Vol. 53 JANUARY, 1919 No. 1

ELECTRICAL ENGINEERING

A Monthly Journal for All Interested in the Practical Application of Electricity
Published at 258 Broadway, New York

ELECTRICAL ENGINEERING in its new form has met with the approval of all of its readers. It has enlarged its scope, as well as improved the arrangement and appearance of its contents. The magazine proposes to discuss all of the problems of vital interest to power plants, industrial plants making use of electrical power, and the public utilities. It will treat of practical affairs, shop practice, and the like, and will present the very latest matters relating to the electrical industry in all of its phases.

In its present issue it gives a complete and authoritative discussion of what the past year has shown in the development of electrical apparatus, a most creditable record when the rigid regulations attending a state of war are taken into account.

Improvements in telephone, telegraph and wireless transmission are described in another paper, and an account is given of the training of great numbers of young women in the electrical industry in this country and Great Britain.

An admirable technical paper deals with overload and reverse power relays, with diagrams illustrating the most approved modern practice. Automatic electric elevator control and commutation are among the other technical matters that are adequately treated.

Electrical Engineering

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MEMBER

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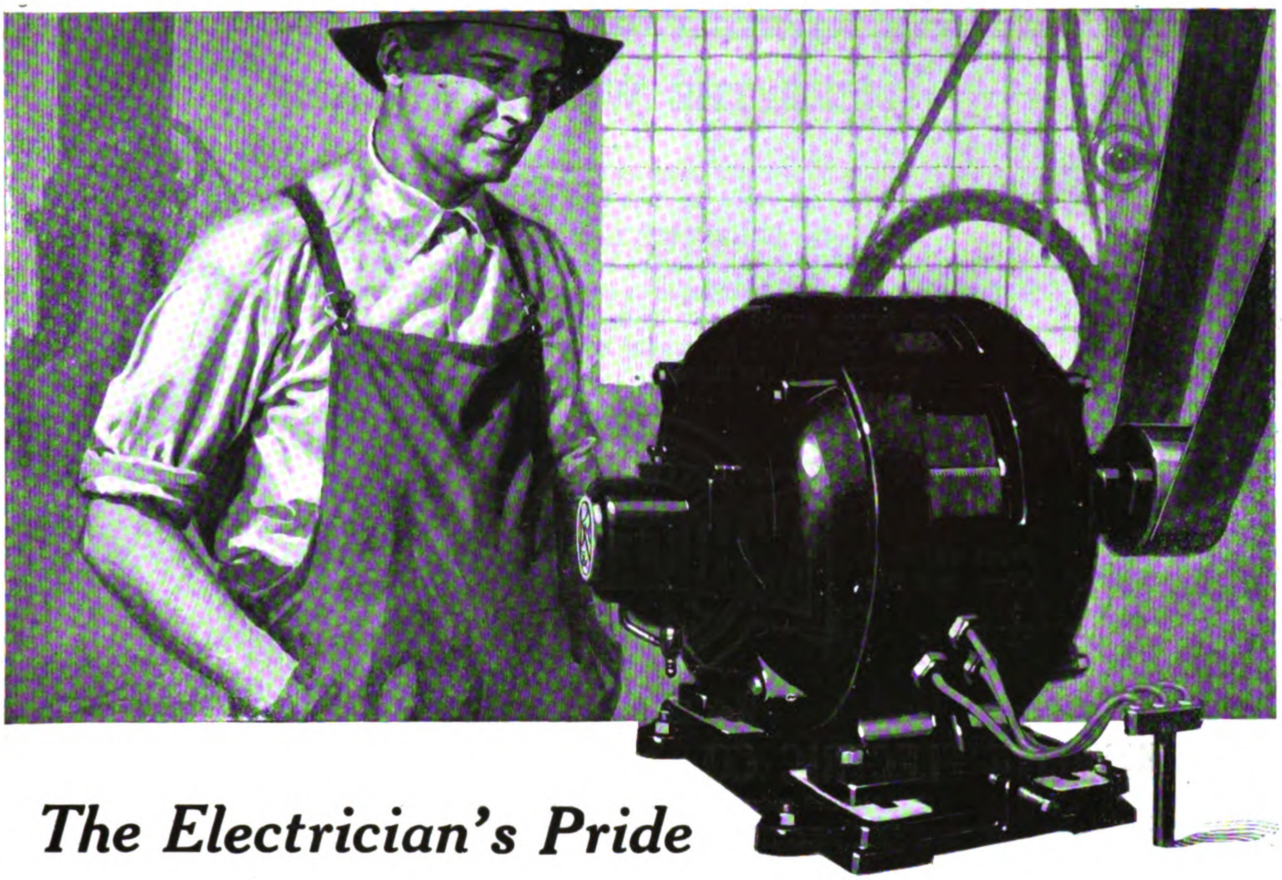

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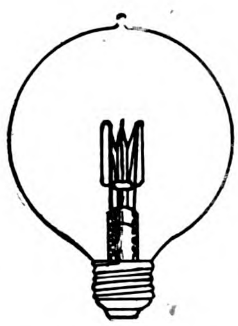

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MAZDA C
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This method of illumination, however, to be most effective requires the use of the right lamps in properly located projectors.

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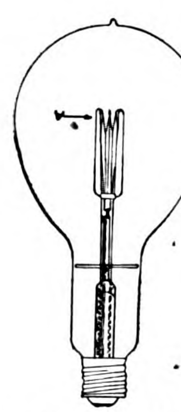
Write for Bulletin No. 3 describing WESTINGHOUSE MAZDA C LAMPS FOR FLOODLIGHTING SERVICE.



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ELECTRICAL ENGINEERING

VOLUME LIII JANUARY, 1919 No. 1

Municipal and Private Electric Lighting

A VERY exhaustive, valuable and interesting study of "The Results of Municipal Electric Lighting in Massachusetts" has been made by Edmond Earle Lincoln, Ph.D., Instructor in Economics and Tutor in the Division of History, Government and Economics, Harvard University. This is published in the series of Hart, Schaffner & Marx Prize Essays, which owe their existence to the enterprise of these Chicago merchants, who seek to encourage the study of economic and commercial subjects by American youth. (Boston: Houghton Mifflin Company. Price $3.00.) At the present time, owing to the operation by the Government of agencies of communication and transportation, there is a very general discussion of government ownership of public utilities. Aside from this war-time measure, electric lighting is the only business which has thus far been generally attempted by public bodies in the United States. As municipal electric lighting is now a well-seasoned business in this country, it affords the most fruitful field for an investigation of the results of public ownership. Mr. Lincoln, who holds a brief for neither side, chose municipal electric lighting in Massachusetts for investigation because of the fact that probably for no other public industry in the United States is it possible to secure even reasonably comparable data over a period of years, and adequate records for the purpose are to be found only in the State of Massachusetts. The first municipal electric lighting plant in the United States began to operate in 1881. Probably due to the fact that many of the smaller towns could not offer sufficient inducements to private capital, the increase in number of publicly owned stations was comparatively rapid. In 1892, as far as it can be ascertained, the entire number was 235, or 16.2 per cent. of all central stations in the country. Ten years later there was an increase of almost 250 per cent., to 815, or 22.6 per cent. of the total; while at the end of twenty years, in 1912, the number stood at 1,562, or 29.9 per cent. of the total, and increase of 565 per cent. for the period. The number of private plants, on the other hand, increased from 1,219 in 1892 to 2,805 in 1902, and 3,659 in 1912, a growth of 130 per cent. for the ten-year period and of only 200 per cent. during twenty years. These figures might prove misleading without some further explanation. On account of the frequent combination and amalgamation of private plants during the past fifteen years or more, the census reports at a given time fail to show the real addition in numbers over a period of years. Also, in some cases, data have been returned as if for a single station when in reality they covered a group of separate plants operated by a single management. While the number of municipal plants was increased by 310 during the period 1907-1912, a growth of about 25 per cent., the increase in the number of company plants between these dates was less than 6 per cent. This difference points to some rather important conclusions. The private plants appear to have been aware of the great advantages usually to be gained from consolidation and large-scale operation in the electric light and power business, and to have acted accordingly. The public plants, on the contrary, have, from the very nature of the case, been unable or unwilling to follow this policy. They have been prevented, no doubt, by local jealousies, by the fact that they are often widely scattered, and perhaps by legal difficulties.

Mr. Lincoln also calls attention to the fact that 170 private plants were transferred to public ownership before 1902; 113 additional transfers were made between 1902 and 1907, and 106 more between the latter date and 1912. On the other hand, while only 13 municipal plants changed to private ownership before 1902, and perhaps as many more were abandoned, there is a record of 38 more cases of this sort between 1902 and 1907; and a still more marked increase of 97 transferred and abandoned stations during the next period of five years.

As the book is a volume of nearly 500 pages, and is a thoroughly conscientious and comprehensive study, backed up in every instance with statistics, it is impossible to summarize it in brief. It may not be unfair to say that Mr. Lincoln concludes from his survey of the figures that public ownership, as compared with private management of the lighting business in Massachusetts, leaves much to be desired. Finally, Mr. Lincoln believes that, under such effective regulation of the electric light and power business as is found in Massachusetts at present, there is no reason whatever why a municipality should invest in an electric plant, certainly not in a generating plant. The book is one that no student of municipal administration can afford to ignore.

Electric Light and Power Stations in Wyoming

The number of commercial and municipal electric light and power stations in the state of Wyoming show a most decided gain since 1907, according to preliminary figures from the forthcoming quinquennial report, given out by the Bureau of the Census, Department of Commerce. This increase is almost wholly confined to the five-year period, 1912 to 1917, for which 23 new establishments were reported, 13 commercial and 10 municipal. All of the 20 establishments shown for 1912 were reported also for 1917. From 1912 to 1917 the total income increased $429,826, or 70.8 per cent., and the output of station 15,852,456 kilowatt hours, or 136.9 per cent. From 1907 to 1912 the corresponding increases were $289,515, or 91.2 per cent., and 6,081,483 kilowatt hours, or 110.6 per cent. Not only the number of employees, but their average annual compensation, have increased from census to census.

Electrical Industries and the Government

A new and powerful federation of American industries was created at the Reconstruction Congress of Industrial War Service Committees at Atlantic City. This association, made up of the nearly 400 War Service Committees that were formed under the direction of the Chamber of Commerce of the United States, was created by the Committees to act in the future as the spokesman for industry before the Government just as the Committees acted separately as the point of contact between industry and the Government during the war period. Speaking as it did, therefore, for the industries of the country, the resolutions that were adopted without a dissenting voice must have great weight. The convention went on record as opposing most unequivocally the government ownership and operation of telegraphs, telephones and cables, and it declared that the Congress of the United States should speedily enact legislation providing for the early return under federal charters to their owners of all railroads now being operated by this Government under federal regulations permitting the elimination of wasteful competition, the pooling of equipment, combinations or consolidations through ownership or otherwise in the operation of terminals, and such other practices as will tend to economies without destroying competition in service.

On two other important questions, the congress declared as follows: "Public utilities have faced difficult problems, which have been accentuated by conditions arising out of war. The development and efficiency of such a utility as local transportation has immediate importance for every community. It is recommended that the Chamber of Commerce of the United States should appoint a committee to investigate and study the question of local transportation as it relates to the control of rates and service, franchises, taxes, the attraction of capital into the business, and such other questions as the committee may find pertinent. Such a committee should report its recommendations to the Board of Directors of the National Chamber, and the Board should deal with them in accordance with the established procedure of the Chamber.

"Industrial activity is dependent upon the available supply of power. A bill which would affect the development of hydro-electric power upon waterways and lands which are subject to Federal jurisdiction is now before a committee of conference between the two Houses of Congress. It is important in the public interest that Federal legislation on this subject should be enacted without further delay. We accordingly urge that the conference committee arrive at an acceptable form of legislation in season for enactment at this session of Congress."

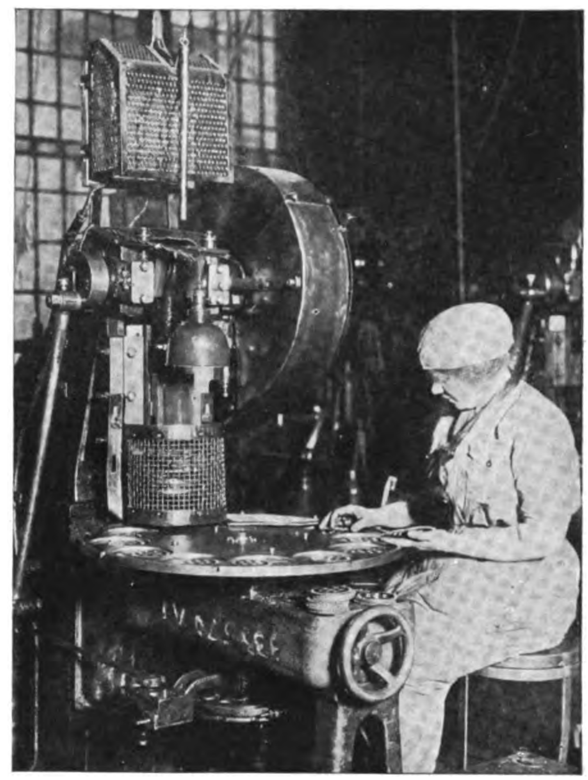
A City Created by Hydroelectric Development

As has been the case in most countries the efforts which industry has made in Norway to help itself and become independent of foreign markets have had great results, writes Commercial Attaché Edwin W. Thompson from Copenhagen. The enormous power in the hundreds of Norwegian waterfalls has been of invaluable importance. One of the main centers of this great industrial revolution is the district around "Sognefjorden," with its 100-mile water basin. None of the Norwegian fjords has such enormous water power as this one, and so, in recent years, one factory after another has been built there. The foremost of these is the enormous plant built by Norsk Aluminum Company, with the Hoyang Falls as source of power. During the past two years a new Norwegian industrial city has been built here, with many factories and good and satisfactory dwellings for the employees. When peace comes this will be an interesting link in the chain of Norway's tourist attractions. When all these plants are running normally they will be Europe's largest aluminum producers.

Women in Electrical Work

THE United States Department of Labor has just issued an interesting bulletin, describing British methods of training workers in war industries. A large number of them were employed in various branches of the electrical industry, and they seem to have more than made good. On the first engagement of women in electrical work, says the report, they were put to the machines in the shops, to general work (including armature work) in the electrical fitting shop, and to cleaning up and repairing a variety of electrical appliances. They worked under the instruction of skilled men, and from the onset their progress was encouraging. In July of 1917 the chief draftsman began a series of popular lectures to women on elementary matters affecting their work. One lecture was on materials; another on the cutting tools of machines, including drills; another on hand tools for metals; another on rules, micrometers, calipers, gauges and screws. The next series dealt with electrical theory. In one lecture an elementary explanation was given of force, work power and electrical energy; in another, the elementary notions of pressure, current and resistance; in a third, the laws of resistance; and others dealt respectively with the electrical circuit and its practical units, electrical power, and the effects of current in a circuit. One lecture then dealt with magnetism and its application to electromagnets; another with the general phenomena and construction of dynamos, and others with the construction and winding of coils and the construction of rheostats. Two lectures dealt with the principles of telephones and their application to various marine types; and the course was concluded by three lectures on electric lighting, dealing respectively with the electric lighting of ships and of shore establishments, and the construction, use, and abuse of electric cables and wires. Two supplementary lectures were given on special types of appliances. The lecturer was of opinion that some of the women did not look favorably on the course, and it is possible that it covered more than some of the hearers could reasonably be expected to assimilate. At the same time, no doubt is felt that the general efficiency of the women is due in part to what was taught them in this way, and, indeed, a considerable and perhaps a sufficient effect may be produced on the practice of shop when knowledge such as was conveyed by these lectures is distributed among the workers, who may be left to influence each other as far as is practically important, with much that they did not pick up individually in the class.

To whatever cause, however, the result may have been due, the progress made by women has been both wide and rapid. Their work in the shops at the present time includes lathe and machine work, engraving, and lacquering; armature and coil winding; making firing circuits, portable electric-light fittings, etc.; repairing and testing motors and secondary batteries, including cleaning and reaciding; repairing, calibrating, and testing electric meters; joinery; coppersmiths' work and zinc lining. They also clean, repair, and test range-finders, and do the whole of the work on bell, hummer, and various types of telephone circuits, working in the proportion of about five women to one electrical fitter as instructor. On the general establishment light and power system they take part in the care and maintenance of the machines, including motor generators and yard lighting, meter reading, the switchboard at the generating station, etc. A large number of them, by their own choice, are working on piecework.



SAFETY GUARDS FOR WOMEN WORKERS
All of the machines in the Westinghouse factories have every possible safety appliance

In the autumn of 1917 it was decided to introduce women on board ship to rewire electric light and power circuits, to do repairs or general installations, etc., work that was originally done by electric fitters and latterly by up-gradeed skilled laborers. Those who were intended to work on board ship were placed in gangs of about 20 women under two capable electrical fitters from the men in the department, and given a room in which parts of imitation bulkheads were fitted up, and the actual cables, lamps, switches, section and distribution boxes, etc., as used on board ship, were put into their hands. In that room they were taught to put up short but complete ship-wiring installation, including almost every particular process originally done by electrical fitters. From four to six weeks is found sufficient to fit them to be taken on board, and about another week, for those who had not worked on shipboard before, was required to give them sufficient local knowledge of ships to be able to master the relative positions of the various decks, compartments, etc. As a rule each gang was accompanied by the fitters who had taught them, and by a chargewoman whose chief duty was to see that they kept steadily to their work.

The work on board ship includes rewiring electric light and power circuits, repairing general installation, etc., and was originally done by men. A number of women are working, by their own wish, on piece-work, and some have earned up to 90 per cent excess of their time rate. They work always in couples. The proportions in which women of various grades are put on to ship work are roughly 65 per cent fully trained and carrying out the work in all its branches; 15 per cent being trained preparatory to being drafted on board; and 20 per cent being entered for training. The whole of the staff of women is under the general charge of two inspectresses, one for those on ship board and one for the land shops and yard. These have no technical functions as electricians, but supervise the moral, physical, and general welfare of the women during working hours, and support the charge hands in keeping the work steadily going.

An Edinburgh firm has recently started training women in blowing electric lamp bulbs. These women have now had had three or four months' experience, and the firm reports favorably on the progress made. Some of them have turned out as many as 400 good bulbs per day. The process consists in "gathering" a sufficient quantity of glass from the pot of molten glass in the furnace; "marvering," or rolling the glass into cylindrical form; blowing the glass out partly, and allowing the bulb to lengthen by the action of gravity; completing the operation in a mold of the proper shape. The opening and shutting of the mold is operated by the blower's feet.

On account of the heat of the furnace in which the glass is made, and the necessary exposure to a very high temperature during gathering, the process has not hitherto been considered suitable for women. Screens, however, have been erected to prevent too much heat radiating to the workers.

In this country an immense number of women have been employed in the various electrical industries, called to it by the labor shortage, and it is unquestioned that many of them will remain after the stress of the war is removed. The general testimony is that the women have made good far beyond the most optimistic expectations. The Westinghouse Electric and Manufacturing Company, alone, employs 5,000 women. They are generally known as overettes, because they wear, for convenience and safety, specially designed feminine overalls. The methods that are followed in fitting the girls for their tasks are interesting. When the new employe leaves the employment office, she is not put at work for three weeks or more. She spends this period in a training school, her wages starting, however, on the hour she enters the works, i. e., she is paid while learning. In this school the fundamental principles and practice of machine operation are taught. Aside from the school's efficiency value to the girl as well as to the company, it has a certain moral or psychological effect. The novice is prepared gradually and thoroughly, so that when she is assigned to a machine, she feels that glow of confidence that moves mountains. It's a great asset, too, for the green employe; for it saves enduring a period of "blues" and discouragement that is often too much for the timid.

The first training course is given in what might be called a "Vestibule School." It saves the employe from learning a productive operation side by side with experienced labor, trusting to chance and friendship, or a sympathetic foreman, for instruction. She is not subject also to ridicule—a deadly poison to the timid. The training that has been given is necessarily short and intensive because of the imperative demand for help. A graduate machine tool maker devotes his entire time to this work, teaching the girls to read blue prints, to use the scale, the micrometer, how to set up machines, shop rules, discipline, the system of wages, and other basic practice. Special instruction is then given on lathes, drill presses, assembling, grinders, shapers, screw machines, milling machines and bench work. No specified time is set for the completion of the course, as occasionally a girl showing unusual aptitude is retained for more highly skilled instruction, and again some girls require more time to learn the simpler operations.

Just recently a class has been organized to train girls in lettering, tracing, mechanical drawing, mathematics and applied arithmetic. This course requires two years' previous training in high school work. Then this has been supplemented by a class for the training of shop clerks, production, time, cost and file clerks and inspectors. They are also paid a day rate while learning.

In addition to the Vestibule School, the Westinghouse Company maintains a so-called "Promotion School." The former school is for new employes, only. However, it is necessary to provide instruction for old employes who desire promotion or a change of occupation. If such is the case, they are placed in this promotion school on part, or even full time for intensive training. This school has the same economic training features as the Vestibule School, minimizing time in learning, and eliminating waste. The best feature of this school is the fact that the girls in the works know that by application and study, direct means are provided for advancement.

Leaving the Vestibule School, the girls enter the shops, capable of assuming considerable responsibility and prepared to operate a machine requiring skill. Perhaps the finest feature of the new work is the moderate physical exertion required. Of course, operations where heavy lifting is required cannot be done by them, but they excel in application and dexterity. Some seem to have a decided bent for mechanics. One girl has mastered ten different operations on a drill press and asked for a chance to learn more. She has also operated balancing machines, assembling ball racers and cones and brush holders. Generally speaking, all the girls excel in assembling operations where application and speed count.

Extra precautions are taken that every belt is guarded and that the most improved safety appliances are used on every machine. The overette costumes themselves are so designed that there is no danger of their clothing getting caught and causing injury.

Lunch rooms and rest rooms are provided, and a regular cafeteria is maintained where a complete meal may be purchased at cost prices. A separate relief department for women has been created, with a trained nurse in attendance. In conjunction with the Westinghouse Electric and Manufacturing Company, the Western Pennsylvania League of Women Workers has organized a large community club at Turtle Creek, a community adjacent to East Pittsburgh, which in addition to its recreational activities has initiated a plan for building dormitories for the girls. The Casino Technical Night School, though planned primarily for the employes of the company, extends admission to all, regardless of occupation, previous education, or present place of employment. The engineering course is open to women. It is designed to give a clear comprehension of the scientific principles upon which the practical work depends. Mathematics, drawing, physics, mechanics, English, chemistry and a knowledge of materials form the basis of the course. The latter part of the course specializes in electricity and steam.

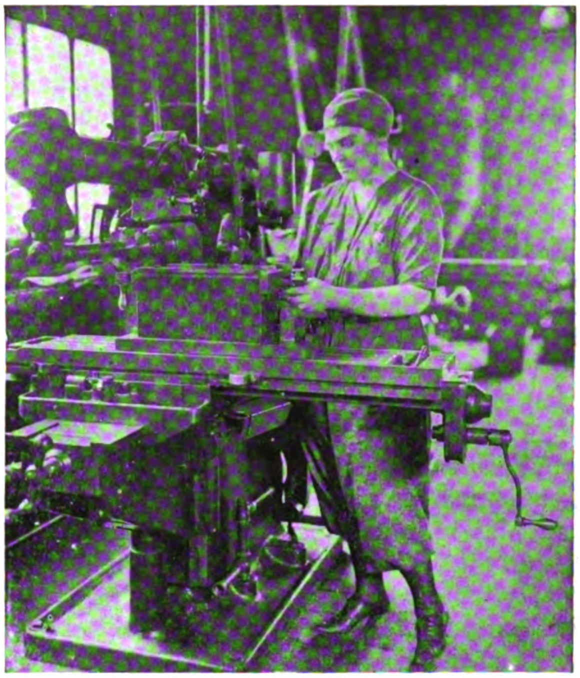
Electric Drive for Future Warships

Electric propulsion for our navy vessels has proved a great success, according to Secretary of the Navy Daniels, and all new capital ships of the American Navy will be equipped with electric propelling machinery. At a meeting of the House Committee on Naval Affairs, Secretary Daniels said that the new electrical engine had been installed and thoroughly tested on the dreadnought New Mexico, and that it was a wonderful success, furnishing American fighting craft with an engine superior to that in any other navy in the world.

It is contended that the new engine is more economical of fuel, develops greater power, is more mobile, and is less easily put out of commission by torpedo explosions than other naval engines. It is approved, the Secretary said, by all the great naval experts and advisers, including the General Board of the Navy.

The Secretary furnished to the committee a formal statement regarding the new engine, as follows:

"I recently paid a visit to the battleship New Mexico, which is the latest dreadnought to join the fleet and the first and only one of any nation to have electrically operated propelling machinery. On this account she has been an object of surpassing interest to the officers of our own navy, and to those of foreign navies as well, and to electrical engineers in general.



Girl Worker in a Westinghouse Factory

"You will remember that when we decided to equip the capital ships of the 1916 program with electric drive it was represented to this committee and to the Navy Department that we were making a great mistake and that we should think twice before embarking on such an unprecedented experiment. I did not regard it as an experiment, for we were in the fortunate position of being the only nation that had had any experience with this system of propulsion, and that experience was of such a satisfactory character that it would have been unpardonable if we had not profited by it to the fullest extent possible.

"The General Board was unanimous in advocating its adoption because of the superior military advantages that its use would secure, and Rear Admiral Griffin, Chief of the Bureau of Steam Engineering, not only saw no objection to it from a technical standpoint, but was strong in his advocacy of it. Added to this, the best advice that I could get outside the Navy Department was so convincing of the efficiency of electric drive that I had no hesitation in giving my approval to its adoption.

"Under the circumstances it was but natural that I should have awaited the trial of the New Mexico with interest to learn how well her machinery had functioned—I never doubted that it would prove a success. The result was satisfactory from every point of view and confirmed the judgment of all who were in any way concerned in its design and adoption. There was not the slightest mishap with any part of it; everything worked to perfection, and the crew was as enthusiastic over the performance of the machinery as is the department, proud in the possession of such an efficient dreadnought.

"The machinery was designed to develop 26,500 horsepower at full speed, which it was expected would give the ship a speed of 21 knots. She actually developed more than 31,000 horsepower, and maintained for four hours a speed of 21¼ knots—and this when running at a displacement 1,000 tons greater than her design called for. If she had been tried at her designed displacement, as is customary with all new ships, she would have made 21.5 knots, without any trouble whatever; and, what is still better, she could have kept up this speed as long as her fuel lasted, for, like all our later dreadnoughts, she is an oil burner, and there would be no reduction in speed due to the necessity of cleaning fires, which must be done in coal-burning ships after a run of four hours at top speed.

"When we entered into contract for the machinery of the New Mexico, we stipulated that, in addition to being capable of developing the maximum power, it should also give an economy at cruising speed very much superior to that obtainable with the turbine installations that we had previously used, and I am happy to say that this stringent requirement also was met. As a matter of fact, the New Mexico will steam at 10 knots on about 25 per cent. less fuel than the best turbine-driven ship that preceded her."

Placing Trained Army Men

America's greatest assets, the brain power and energy of her thoroughly trained young men, are the commodities in which the Professional Division of the United States Employment Service is dealing. Officers and men of the Army and Navy released from active service are being registered with the Division, and placed in touch with those employers who can best make use of their services.

The Professional Division deals only with those men who are well equipped by education and experience in their particular lines of work. The record of each man is carefully investigated before registration is permitted. Many university graduates in mechanical, electrical and civil engineering and in chemistry and other technical men with several years of practical experience have already registered. These men who willingly severed their business relations more than a year ago to give their services to their country are returning to civil life to find changed conditions. Although the industry of the country has great need of their services, neither men nor employers are able, without assistance, to discover each other immediately. To avoid delay in the readjustment processes, not only the labor of the country but also the highly trained directors of industry are being mobilized with the assistance of the Government. The aim is that each man shall fit in that part of our business organization where he can do his best work.

The task of dealing with thoroughly trained men who in many instances can command high salaried positions is requiring the assistance of those technical organizations which have heretofore placed university graduates and experienced men with employers. The Professional Division is seeking to co-operate with all such societies by referring properly qualified men to them, or by obtaining from them data on positions available.

The engineering field appears to present the largest problems of the Professional Division. Thus far, nearly one-half of all the applicants have been qualified for work in various forms of the engineering profession. The temporary lull in general construction work has in part closed one field which, it is believed, will be more available by the time the overseas forces begin a large scale of demobilization.

The Professional Division of the United States Employment Service has its New York Office at 16 East Forty-second Street. Its registrations of experienced men are increasing. Employers seeking such men are asked to inform the Professional Division of the precise nature of the positions which they have available. Only those men who are well qualified to fill such positions are referred to the employer.

Electric Industries of Sweden

One of the leading Swedish newspapers has the following to say concerning the electrical industries of that country: "During the war many Swedish industries have had great difficulties to contend with; for example, the separator industry with regard to shortage of material and restrictions made by the importing countries.

"Our electro industries are expecting better conditions with regard to manufacture and export. The shortage of metals will undoubtedly be improved gradually so that the markets that the war has closed can again be opened. Hopes may be directed toward the other European and transoceanic markets where Swedish manufacturers expect to have good chances on account of extended shipping possibilities and equalizing of exchange rates which, by the high value of the Swedish crown, has given us an advantage especially with regard to the American competition. There seems to be no fear of foreign competition in the matter of hydro-electric work, as the new law makes it easier to exploit water power within the country.

"The chemical industry during the war has rendered the country great services, such as extended manufacture of carbide and new explosives, without which it would have been very difficult to keep the mining industry going. Nitrogen manufacturers may expect strong competition from Germany, but the importance of this competition must not be exaggerated, as our companies have constructed their plants and the necessary electro-power at peace prices, and this is a great point in the competition."

Telephone and Wireless Transmission

WHEN the greater part of the civilized world became engaged in the greatest war of all history, those of philosophic tendency began to discuss the general effect of war upon human nature and activities. It was pointed out that the tremendous conflicts of the past had stimulated the imagination of mankind and had stirred all of the deeper feelings so that they were coincident with periods of unexampled intellectual effort. It is too early, as yet, for us to measure the effect of the war upon literary, poetic and artistic creative effort. But we can already begin to see that the world struggle has done more than several decades of peaceful progress for the development of industrial, applied and pure science. More than one of the great nations was cut off from its accustomed source of supply for the most important of raw materials, and so was forced to find native substitutes. Putting aside all consideration of the development of the strictly war-like arts, the perfecting of aeroplanes, submarines, artillery, explosives, poison gas and the like, who can measure what has been accomplished in chemistry, for instance? The making of dyes and the utilization of new sources for potash, to render ourselves independent of Germany's former monopoly, for instance, is a wonderful chapter of achievement. In no other war in the history of the world has electricity played so important a part. Naturally, then, we shall soon see numberless new applications of electric power, not, perhaps, the direct result of the contest itself, but due somewhat to the stimulation of research and inventive ingenuity by the war.

The entire electrical world was interested in the recent announcement from Washington of the perfecting of a new multiplex telephone and telegraph device, which the engineers of the Bell system believe is the greatest invention since the original discovery of the possibility of electrical transmission of sound. The apparatus has been in successful operation on circuits between Baltimore and Pittsburgh for a sufficient time to demonstrate that it is a complete commercial success. The new device makes it possible to carry on at the same time five different conversations—two one way and three the other, but not all in the same direction—over the one pair of wires of a single telephone circuit. In telegraphy, it makes such a circuit available for forty simultaneous telegraph messages. If desired, the circuit can be made to carry part dots and dashes and part spoken words simultaneously.

Mr. Theodore N. Vail, president of the American Telephone and Telegraph Company, in announcing the new discovery to Postmaster General Burleson, gives some interesting particulars. "With this new system," he says, "four telephone conversations over one pair of wires are simultaneously carried on, in addition to the telephone conversation provided by the ordinary methods. Thus, over a single pair of wires, a total of five telephone conversations are simultaneously operated, each giving service as good as that provided by the circuit working in the ordinary way.

Girls Learning Tape-Winding
A part of the practical training given women workers in the Westinghouse plant

"Heretofore the best telephone methods known to the art provided only one telephone conversation at a time over a single pair of wires. A number of years ago, we developed the 'phantom circuit' arrangement by which three telephone circuits are obtained from two pairs of wires, an important improvement of which we have made extensive use. Now by our new multiplex method, we are enabled to obtain five telephone circuits over one pair of wires—that is, ten simultaneous telephone conversations from the two pairs of wires which formerly could be used for only three simultaneous telephone conversations.

"This represents an increase of more than three-fold in the telephonic capacity of the wires as compared with the best previous state of the art, and a five-fold increase under conditions where the phantom circuit is not employed. In telegraphy, as well as in telephony, sensational results have been attained by the new system. By combining two telegraph wires into a metallic circuit of the type used for telephone working, and by applying our new apparatus and methods to this metallic circuit we have enormously increased the capacity of the wires for telegraph messages. As applied to high speed printer systems, we can do eight times as much as is now done, and as compared with the ordinary duplex telegraph circuit in general use, we can do ten times as much. Thus increased results are attained without in any way impairing the quality of telegraph working.

"Hundreds of the men of our staff have co-operated in the work, and it is impossible to name any one man who is entitled to even the major part of the credit for the result. Without, however, detracting from the credit due to any one of them, there are a few whose contributions to the system have been so distinctive that they should be named here. They are: O. B. Blackwell, G. A. Campbell, H. S. Osborne, J. R. Carson, Lloyd Espenschied, H. A. Affel and John Davidson, Jr., of the engineering department of the American Telephone and Telegraph Company, and E. H. Colpitts, H. D. Arnold, B. W. Kendall, R. A. Heising, H. J. Vennes, E. O. Scriven and H. F. Kortheuer, of the engineering department of the Western Electric Company, the manufacturing division of the Bell system.

"From the earliest days of both the telephone and the telegraph, there have been almost numberless attempts by inventors, scientists and engineers to develop methods for the multiplex transmission of messages. It was while working on the problem of multiplex telegraphy that Dr. Bell had his first conception of the structure of the original telephone. Now the organization which is continuously working to perfect the telephone and to extend its usefulness, has accomplished not only multiplex telephony, but also multiplex telegraphy and has solved the telegraph problem upon which Dr. Bell was working over forty years ago.

"While heretofore no substantial practical results had been obtained notwithstanding the efforts which have been directed to this problem, some proposals made by the earlier workers in this particular field have naturally proved suggestive in the successful solution of the problem. I have in mind particularly a suggestion made by Major General George O. Squier, Chief Signal Officer of the United States Army, about ten years ago and which at the time attracted very general attention. Furtherfore, while working in entirely different fields and with a different objective, Dr. Lee DeForest a number of years ago invented a wireless device known as the audion, which by our improvements and adaptation we have made an important part of our system."

Another announcement of improvement in electric transmission of sound has met with considerable skepticism, and adequate proofs of the actual accomplishment of what is claimed are yet lacking. Some time ago the statement was made that Roy A. Weagant, chief engineer of the American Marconi Wireless Telegraph Company, had succeeded in virtually removing static disturbances, the chief obstacle to the transmission of wireless waves. If this has been accomplished, there will be scarcely any limitations to wireless communication; we may even succeed in getting messages to and from the planet Mars, if that mysterious world is populated by intelligent beings. But in discussing the matter, nearly all of the scientists and electrical experts put great stress upon that very important word, "if."

Nicola Tesla, regarded by many as one of the greatest electrical wizards in the world, has been interviewed as to the claims put forth on behalf of Mr. Weagant.

"Why, I eliminated static effectually nearly twenty years ago," he said. "There is nothing new in this latest claim. If the wireless people applied my old principles, used my old apparatus the way it should be, static would not bother them. Static interference here is very slight compared with what it is in Colorado, as every wireless operator knows. Yet I overcame static completely at my experimental station in that State, erected in 1899."

"Have you been able to illuminate electric lamps by wireless currents?" Mr. Tesla was asked.

"I have given public demonstrations of that simple thing right here in New York City. I have held the globes in my hand. The current has been turned on, and the lamps lit."

"How about the transmission of high-power current?"

"Merely a matter of development. I have stated that it was possible, even easy, to build a power plant which could distribute 10,000 horse-power under a tension of one hundred million volts, which can be handled with safety.

"This energy could be collected all over the globe, preferably in small amounts, ranging from a fraction of one to a few horse-power. It could be used principally for the illumination of homes, as it takes but little power to light dwellings with vacuum tubes operated with high-frequency currents, and in each instance, a terminal, a little above the roof, will be sufficient."

Mr. Tesla said that standard time clocks all over the globe and similar apparatus could be driven and regulated by wireless. He said that when one recognized that this planet, in spite of its great size, was to electric currents nothing more than a small metal ball, it could easily be understood that all sorts of possibilities, of incalculable consequence, were rendered absolutely certain of accomplishment. With static eliminated, he continued, and the establishment of a number of wireless plants throughout the world, the problem of instantaneous world communication was solved. He declared that all that was needed was a cheap and simple device which could be carried in one's pocket, could be set up on sea or on land, and it would record the world's news, or such special messages as were intended for it.

Prof. M. F. Pupin, of Columbia University, himself a radio expert of the highest standing, is skeptical. "Whoever solves the static problem," he said, "would open up such possibilities in wireless telephony and telegraphy that he would be regarded by future generations as one of the world's greatest scientists. Such a discovery would do more to join South America to us in spirit and understanding than anything else could do. Any country newspaper in South America could stick up a tower, twenty feet high, and receive all our news. The same could be done all over the world. We could exchange thought with the whole world. That is civilization."

But Professor Pupin did not believe for a minute that Mr. Weagant had solved the static problem. In the first place, he said, the announcement should have been made in an orthodox scientific fashion at a meeting of scientists. He saw no reason why a demonstration should not be given at once. He said it could be done without disclosing the secret of the discovery, if the Government objected to making it public.

Overload and Reverse Power Relays

By A. E. Hester

THE art of protecting transmission lines by means of relays has advanced very rapidly during the past few years. Though a great many types of relays have been produced, but few have survived the acid test of service on modern power systems. The relay, though one of the most inconspicuous things in a power station, is nevertheless, one of the most important items in its equipment. Figuratively speaking, relays constitute the nervous system of that wonderfully complete body, made up of generating stations, substations and transmission lines. It is the part of the relay to detect and locate anything which tends to prevent any of these members from performing their proper function. When the trouble has been detected, apparatus which will isolate the faulty member from the remainder until the trouble has been remedied, must be set in motion. Thus the relay is called upon to display an almost human intelligence and must function with a speed which is scarcely within the power of man. These requirements have been complied with and it is safe to say that, as the art advances, much improvement will be made.

Many schemes have been used and, strange to say, the first has, up to the present time, given the most satisfactory service. In this scheme of protection an overload relay is used at the generating end of the feeder when applied to radial systems while on systems which include sections of parallel feeders, a reverse power relay is used at the substation end in addition to the overload relay at the generating end. At first overload relays only were necessary as feeders, were not operated in parallel, a spare line being left available in case the first one failed. Then the economy of having all the lines in service all the time was realized and as the demand for continuity of service could not be disregarded it became necessary to develop a reverse power relay for use at the substation end and operate the feeders in parallel.

Various types of both overload and reverse power relays have been developed, but the induction type has proven itself to be the most satisfactory, both because of its accuracy and permanence of celebration and because of the fact that most modern power systems use alternating current for the transmission of power. In discussing induction type overload and reverse power relays we will first consider what each is, its operation and construction and finally how both types are applied to various systems.

An overload relay may be defined as any relay, the contact mechanism of which is operative only when the current in the circuit, to which it furnishes protection, exceeds a pre-determined value. It would be remembered, however, that transmission line relays are rarely even used for overloads in the usual sense of the term but are called upon, usually, to operate on heavy short circuit currents amounting to many times the value of the normal load current.

The induction type overload relay, as the name implies, is merely an induction type ammeter, the movement of which is restrained by a spring. Until the current flowing in the relay windings exceeds a given value, this spring holds the movement at its normal position. Then, except for external influences, for all currents above this critical value the time of operation of the relay is inversely proportional to the amount of current flowing. However, it has been found desirable to have a minimum definite time in which the relay can close and the method of attaining this feature will be described later.

The relay consists, essentially, of an electro-magnet so wound as to produce a rotating field, a metal disc mounted, between the poles of this electro-magnet, on jewel bearings, a permanent magnet for damping the movement of the disc and a pair of contacts actuated by the movement of the disc. These parts are all mounted on a frame, the permanent magnet being placed diametrically opposite to the electromagnet on the disc. The whole is then mounted in a dust and moisture proof case, as shown in Figure 1.

The contact system is very simple, one being placed on the mounting frame and the other being carried by the disc. The current is conducted to the moving contact by the restraining spring, which is heavy enough to carry all ordinary tripping currents. For extremely high currents an internal contaction switch is provided, as will be described later.

The relay windings, as may be seen from Figure 2, are the same as used in the induction type ammeter, consisting of a primary winding, through which the actuating current flows, and a secondary winding, short circuited on itself and supplying the rotating field effect. Tops are brought out at different points on the primary winding and carried to a terminal block so that by inserting a screw in the proper hole in the block any desirable current setting may be attained. Any reasonable number of tops can be supplied, thus giving a larger range of current adjustment. Also in the secondary winding a small one to one ration transformer is inserted. This transformer, or torque compensation as it is termed, is so constructed that its core becomes saturated at a definite value of current and irrespective of the amount of current flowing in the primary winding, the current in the secondary cannot exceed a given value. Thus the torque on the disc is limited to a definite value and this in turn limits the time in which the contacts can close. In this way the minimum, definite time feature is obtained and is usually placed at about two seconds for the maximum travel of the moving contact.

The maximum distance through which the moving contact and disc can travel is limited to 180 degrees. The line setting is obtained by means of a movable lever which limits the disc travel and which can be set at any point in its arc of travel. This lever moves over a scale divided into ten arbitrary divisions and is provided with a stop against which the moving contact support rests. Characteristic curves taken for each point on the time scale are shown in Figure 3, and it will be observed that the time of operation for any load is proportional to the lever setting. A view of the relay showing the time setting arrangement may be seen by referring to Figure 4.

Thus we see that the time and current settings are each independent of the other and that there is a minimum definite time characteristic which precludes any danger of the relay operating on momentary surges and does not allow the time to drop below a minimum definite time on extreme overloads. These settings are very easily made as may be seen by the following example: Suppose we have a case in which we wish the relay to act in one-half second with a load of 500 amperes in the circuit which it protects, the current transformer having a ratio of 100 to 5. This gives us a secondary load of 24 amperes. With the contact screw in the terminal block at the 5-ampere tap 25 amperes would be 500 per cent. load current. Referring to the characteristic curve shown in Figure 3 we see that for one-half second on the 500 percent. line we will have to set the time lever at No. 2 on the time scale. Likewise any given time for any given load may be obtained.

When unusually heavy tripping currents have to be handled the relay is equipped with an internal contactor switch which shunts the tripping current by the relay contacts, thereby relieving them of the duty of carrying the heavy current. As shown in Figure 5 the operating coil in series audits its contacts in parallel with the relay contacts. It remains open until the relay contacts have closed and then it closes and remains closed until the pallet switch on the circuit breaker opens. Oscillograms show that it will close in every case before the tripping current has risen beyond the capacity of the relay contacts. Besides relieving the relay contacts of the duty of carrying the heavy current another advantage is gained in that if the load current falls to normal before the circuit breaker has opened the relay will not have to open the tripping circuit as the contactor switch remains closed until the circuit breaker opens. A view of this switch is shown in Figure 4.

A reverse power relay may be defined as any relay, the contact mechanism of which is operative only upon a reverse in the direction of flow of power in the circuit which it protects. The induction type reverse power relay consists of two elements, a current element exactly similar to the overload relay described above, which closes its contacts at a given time on a given load, and a wattmeter element which discriminates as to direction of power flow. These two elements have their contacts connected in series so that the tripping circuit is closed only upon a simultaneous overload and reversal of power. As may be seen from Figure 6, the winding of the wattmeter element is the same as those of the standard wattmeter. The wattage coil is composed of a great many turns of fine wire, while the current coils consist of a few turns of heavy wire. This, of course, gives the proper phase relations for a rotating field. The current coils are connected in series with the primary winding on the current element and the relay is connected to the circuit through the proper current and voltage transformers. As in the current element, the disc is mounted on jewel bearings between the poles of the wattmeter electromagnet and a permanent electromagnet is provided for damping. The contacts differ, however, in that they are both mounted on the frame and are closed, against the tension of a light spring, by the movement of the disc.

This movement is very small and no time element is provided, since an almost instantaneous action is desirable. Also no current adjustment is provided as this is taken care of on the current element.

In order to obtain a positive closure of the tripping circuit the internal contactor switch described above for the overload relay is included in each relay. As in the case of the overload relay this contactor switch relieves the relay contacts of carrying the heavy tripping current and is made with its contacts sufficiently large to carry very heavy currents. The method of connecting this switch in the tripping current is also shown in Figure 6, and it will be observed that its contacts are in parallel with the relay contacts. Both elements of the relay as well as the contactor switch are mounted in a dust and moisture proof case as shown in Figure 7.

Since this relay is merely an overload relay with a directional element added, it possesses all the desirable features described above for the overload relay. In summing up, these relays have the following advantages:

1. Can be set quickly for any desired value.
2. Are simple in adjustment.
3. Have a large range of adjustment.
4. Have time-selective inverse time element and definite minimum time function.
5. Can be set to operate as a definite time device, instead of an inverse time.
6. Individual time curves drawn on nameplate.
7. Have watthour meter accuracy and permanence of celebration.
8. By properly combining them absolutely selective action in tripping circuit breaker can be obtained.
9. Have rugged construction and are not subject to vibration.
10. When overload is suddenly removed it will not overtravel and make contact.
11. Have high resetting value. That is will reset current only slightly below 100 per cent. load.
12. Require small amount of power to operate.
13. Operate properly on low power factor.
14. Will not trip due to synchronizing and line switching.
15. Operate on low voltage, the reverse power relay selecting as to direction of power on as low as 2 per cent. normal average.
16. The reverse power will not trip the circuit breaker under normal conditions no matter what may be the direction of power flow.

No set rules can be laid down to govern the application of relays. Each and every power system has its own peculiarities, and the choosing and setting of relays must be governed by these. However, if a careful study is made of the system and the conditions existing on each section are thoroughly analyzed no great difficulty should be encountered in securing satisfactory protection on any power distribution system. The accuracy and permanence of calibration of the modern induction type relay insure satisfactory operation if proper application is made.

In laying out a protective scheme on any system a great many factors have to be taken into consideration. The characteristics of the line and each piece of apparatus, generating, switching, transforming and converting, should first be carefully studied as this is what determines the amount of short circuit current available. In determining this short circuit it should always be considered as due to the solid metallic short circuit with minimum generating capacity.

One method of determining the possible short circuit current is to observe the voltage drop between two stations at normal load. Then short circuit current $= \frac{\text{Normal voltage}}{\text{Voltage drop}} \times$ load current. This is only approximate, however, and is very likely to give high results.

Another method is to determine the total impedance, including that of the generator between any point where the short circuit value is desired and the generator. Then short circuit current $= \frac{\text{Star voltage}}{\text{Impedance}}$ This gives the instantaneous short circuit, however, and the sustained value is much less, usually about 2 or 25 times full load current.

Unless a special scheme is used for disconnecting a line on a high resistance ground, as would be necessary

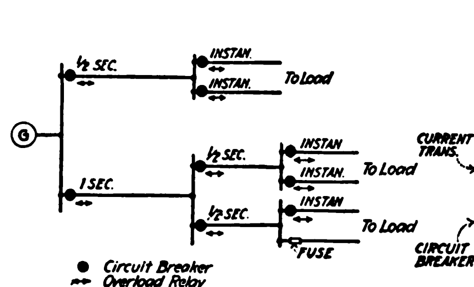


FIG. 1

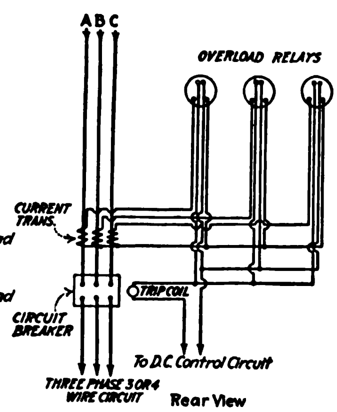


FIG. 2

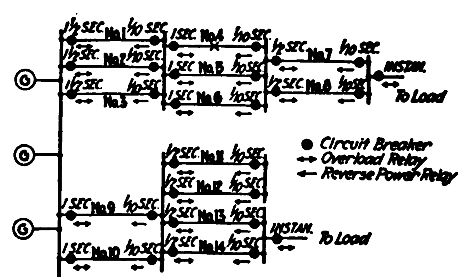


FIG. 3

in the case of a generator having its neutral ground through a comparatively high resistance, modern relays will not clean a high resistance short circuit. This is no disadvantage, however, as a high resistance short circuit will invariably develop into an arc before any damage is done, and since an arc has a very low resistance the effect of a metallic short circuit will be obtained and the relays will operate.

The various connections and combinations used on a system also deserve careful attention when laying out a protective scheme. First the number and location of the power sources should be taken into consideration. The main thing to be considered is whether or not there is more than one source. A layout which would be suitable for a system having one source of power might not be suitable for another having more than one source. Therefore we may discuss systems having one source separately from those having more than one source of supply. It should be borne in mind that we are limiting ourselves to three-phase distribution, as most modern systems are of this nature.

A radial system, an example of which is shown in Figure 8, consists of one or more feeders leaving the generator bus bars—each of which may or may not be, in turn, subdivided into a number of smaller feeders. Protective relays are to be applied to this system in such a way that when trouble occurs on any feeder it is automatically cut off from the remainder of the system, leaving the others in service. This is accomplished by giving the relays a selective action, that is, giving them such current and time settings that due to their operating characteristics they will always disconnect the feeder at the proper point before other relays on the unaffected sections can operate.

On a radial system, such as we are considering, only overload relays are used. They are placed at the out-going of each section, except possibly on the ones most remote from the generating station, which may be protected by instantaneous overload circuit breaker or by fuses.

From the full load current values current settings are made so that the relay will not operate under normal conditions. From the short circuit current values time settings are so chosen from the characteristic curve that each relay will operate in its order, that is, the ones at the greatest distance from the generating station will operate in the shortest time, that time element becoming larger as the generating station is approached. In Figure 8 time settings for our typical radial system are shown, a half-second interval between the time of operation of each relay being chosen to allow for the operation of the circuit breaker.

These overload relays should be connected to the line as shown in Figure 9. Two current transformers may be used on a system having an ungrounded neutral, but there are cases in which the relays will fail to operate, such as the occurrence of a ground on the unprotected phase and an accidental ground in the generator at the same time. Three current transformers will always give complete protection and the insurance is worth the cost of an additional current transformer.

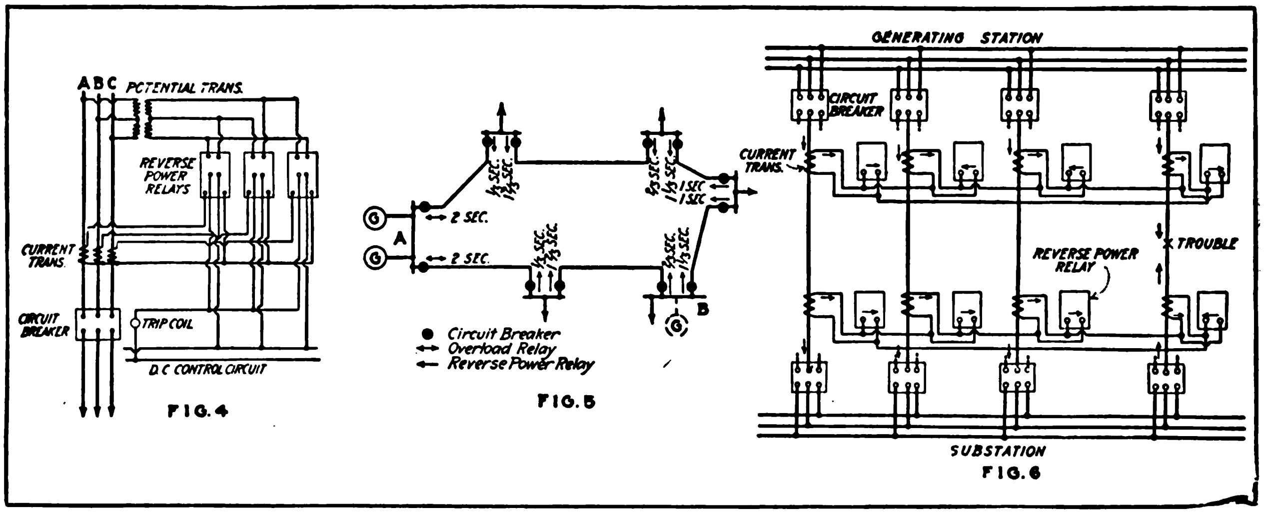


FIG. 4 FIG. 5 FIG. 6

In the parallel feeders system, an example of which is shown in Figure 10, feeders are run in parallel between generating station and substation or between substations. The best method of protecting such a system is to place an overload relay at the outgoing end and a reverse power relay at the incoming end of each feeder. Current settings are obtained in the same way as described for radial systems. The overload relays are given time settings with short intervals between, so as to secure selective action, while the reverse power relays are all given the same short time setting, usually about 1/10 second. In Figure 10, time settings for both overload and reverse power relays on our typical parallel feeder system are shown.

The operation in case of trouble can be seen from the following example: Suppose trouble occurs on line No. 4 at X. Power immediately begins to flow into the trouble from both ends of the line. It is evident that the overload relay on this line will operate before the overload relays on lines No. 5 and No. 6, because it gets approximately twice the current that flows in either No. 5 or No. 6. Also the reverse power relay, in line No. 4 only, will operate because the power flow in this line only is reversed. Whether the overload or reverse power relay on No. 4 operates first will depend upon the point at which the trouble occurs. Thus the defective line is effectually isolated and the others are left in service.

Reverse power relays are connected in the circuit as shown in Figure 11. The current transformers are connected in star and the voltage transformers, of which two are used, are connected in open delta.

It has been found that in order to secure best action with reverse power relays on low power factor, due to unbalanced short circuits, the voltage transformers should be so connected that, at unity factor, the current in the current coils of the relay will lead the voltage by 30 degrees. It has also been found that the most severe condition under which a relay must operate is when two conductors of a three-phase line are short circuited. Numerous lists have shown that, when connected with current 30 degrees in advance of the voltage, reverse power relays operate satisfactorily under this extreme condition. In order to obtain satisfactory results with this connection, however, it is necessary to take into account the direction of phase rotation as shown in Figure 11.

The main difference in the case of the ring system and in the case of two feeders supplying a substation, is that each feeder is made to loop through a substation. Figure 12 shows an example of the ring system and gives time settings for the relays. The operation of the relays is similar to that of straight parallel feeders and when trouble occurs and the defective section is cut out, the system becomes radial until this feeder is put into service again.

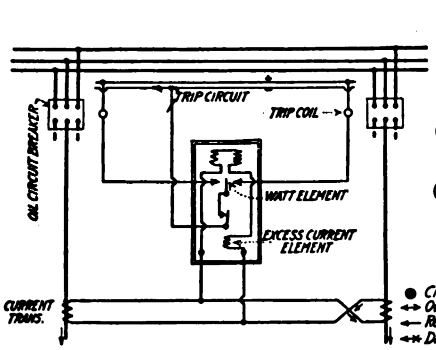


FIG. 7

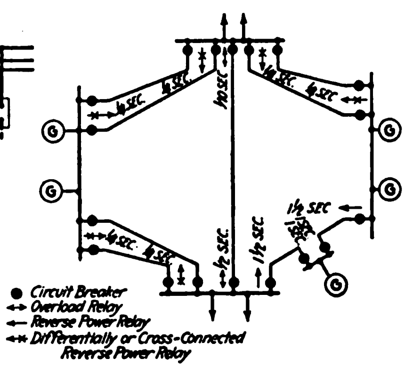


FIG. 8

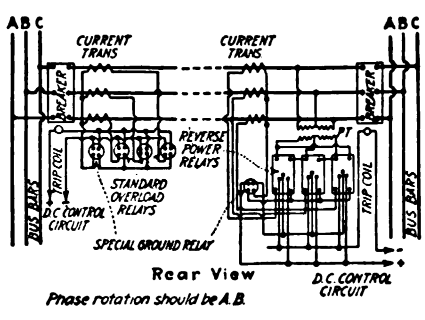


FIG. 9

Systems with More Than One Source

Lines operating in parallel where power is likely to flow in either direction can best be protected by using reverse power relays differentially connected as shown in Figure 13. When the load is balanced it is evident that no current flows through any of the relays. However, when a short circuit occurs, say at X, the relays at both ends of the defective line operate to clear the line, both because the flow of the excess current and because the flow of power is away from the bus bars. This can be seen by referring to the diagram in which the arrows show the direction of flow of the current and power. It will be observed that in every case the flow is in the direction to operate the proper relay. When using this scheme it is necessary to have auxiliary switches on the circuit breaker to short circuit the current transformer on the defective line when it goes out of service. When two lines only are operated in parallel a reverse power relay having double contacts on the voltage element may be used. These contacts operate in such a way that they always open the breaker on the defective line only and leave the other with straight overload protection. This scheme is shown in Figure 14. For simplicity both Figure 13 and Figure 14 are shown for one phase only and in Figure 13 voltage and tripping connections are omitted.

In both these schemes the time and current settings may be made very small but it is usually best to make the current setting somewhat higher than is theoretically necessary in order to take care of any operating difficulties that are liable to occur. No advantage can be gained by setting the relays to operate on smaller currents than those normally obtained during times of short circuit.

The Ring Systems.—If in Figure 12 another generating stations be placed at point B, difficulties would be encountered when it became necessary for this station to carry the entire load. Entire readjustment of the relay would be necessary but with modern induction type relays this can be done in a short time with no great inconvenience.

A great many modern powers are so connected that they form a more or less complicated network. Some sections of these networks can be most satisfactorily protected by the methods described above for parallel feeders having more than one source of power. Other sections to which these cannot be applied must be protected by some other method, using either reverse power or overload relays or a combination of both. No example can be given which will cover all the problems encountered in actual practice. Each case must be studied and the method applied which is best suited to it.

An example of a network is shown in Figure 15 in which reverse power relays are shown connected differentially for protecting some of the sections. For other sections where this cannot be used, reverse power and overload relays are applied as best suits each particular case. Time settings are shown which will give the best selective action. There will be cases in which the circuit breaker on a feeder which is not affected will be opened and in most cases this does not be interrupted. It sometimes happens that, by having other circuit breakers than those on the line actually affected open, the problem of sectionalizing may be somewhat simplified. This is, however, a question which must be decided for each individual application. It is possible, by carefully studying and analyzing the conditions, to secure automatic sectionalizing on any network regardless of its complications.

Protection against high resistance grounds.—It sometimes happens that a system has its neutral grounded through a comparatively high resistance and when a ground occurs conditions may be such that the trouble current is actually less than the full load current. Such a ground cannot be cleared by reverse power and overload relays connected to protect the system against short circuits.

This difficulty may be overcome by using an overload relay, constructed to operate on low currents, connected in the neutral lead of the current transformers as shown in Figure 16. Then under normal conditions no current flows through the neutral lead of the current transformer bank. But as soon as the ground occurs the unbalanced current flows through this lead and the ground relay and the circuit breaker is opened.

When used with overload relays the ground relay contacts so that its operation opens the circuit breaker directly. When used with reverse power relays, however, the ground relay contacts are used to short circuit the contacts of the overload element of the reverse power relays, thus leaving the watt elements to discriminate as to the direction of power flow This is clearly shown in Figure 16.

It should be borne in mind that this scheme can be used only on balanced systems. For unbalanced systems other schemes are used utilizing special relays but since these do not come under the subject of this discussion they will not be mentioned.

Foreign Markets for Electrical Goods

The annual report of the chief of the Bureau of Foreign and Domestic Commerce to the Secretary of Commerce is of particular importance at this time when our foreign trade is growing so rapidly and holds such vast peculiarities for the future. The report contains nearly one hundred pages, and details the activities of consuls and special agents in extending the market for American products. Much of the work has been along the lines covered by this magazine.

R. A. Lundquist has completed his investigation of markets for electrical goods in Australia, New Zealand, China, Chosen and Japan. The elimination of German competition in all these countries has naturally resulted in stimulating imports of American goods, and Mr. Lundquist has pointed out in his reports and by personal interviews with manufacturers the means by which this trade may be retained and extended. Of particular interest is the remarkable development of the Japanese electrical industies during the last four years. Japanese competition with American electrical goods, however, will probably be limited to the cheaper lines. During the year the following monographs by Mr. Lundquist were published: Special Agents Series No. 147, "Electrical Goods in New Zealand" and No. 155, "Electrical Goods in Australia."

The investigation of markets for electrical goods in South America, conducted by Special Agent Philip S. Smith, is nearing completion. The influence of the German electrical industry on South American demands has been very great, owing partly to the fact that in many cases specifications for electrical installations are based on German practice. The supplies of German goods have long been exhausted, however, and it has been very difficult to obtain any samples whatever of such articles. With the restricted imports of other foreign electrical goods and the almost complete lack of local manufactures, the United States manufacturers have had an unusual opportunity to establish themselves in the market. The following monographs by Mr. Smith appeared during the year: Special Agents Series No. 154, "Markets for Electrical Goods in Ecuador and Peru," and No. 167, "Electrical Goods in Bolivia and Chile."

Mr. Rhea's investigation of markets for railway equipment in Australasia, China and Japan was completed during the winter, and his voluminous report on conditions in Japan, China and Chosen will shortly be issued. While primarily a survey of the opportunities for extending the sale of American railway appliances abroad, Mr. Rhea's work in the Far East has been particularly timely and valuable from other points of view. For instance, the high efficiency of the Government-controlled railways of Japan is very instructive in connection with recent developments in this country. The intricate system of railway and other public-utilities concessions in China was necessarily studied in some detail in connection with Mr. Rhea's investigation of possible markets for American manufactures. The general railway situation in China and the general financial and economic conditions in that country are of particular interest at present, in view of the renewed interest in the subject of Chinese loans and the possibility of China's greater participation in the war.

The Year's Electrical Development

The tremendous demands of war have permitted only the essentials to be supplied, leaving time only for such developments as were deemed necessary to help win the war. The great part that electricity and modern power machinery has played in this world holocaust is well emphasized in the following review of developments, based largely on the experiences of the Westinghouse Company. During the past year every effort has been made to utilize existing standards in order to meet the urgent demands of the war for unusual quantities of apparatus on short periods of shipment. As a result, there has been a marked tendency to concentrate on the perfection of details of existing apparatus instead of bringing out new lines. All manufacturers have endeavored to increase their productive capacities in so far as practicable by elimination of special manufacture. However, the government has had important problems to solve, and very gratifying results have been accomplished in conducting the required research and providing special machinery for their purposes.

High reliability and efficiency are essentials to the submarine. While the propulsion of submarines by electric motors is not at all new, the results heretofore accomplished have not been as desired. Distinct contributions have been made to this particular application during the past year in the instance of both motors and control. Motors have been developed, each consisting of two armatures mounted on a single shaft, two fields, and but a single frame. Improved insulation is an important feature. Equipment for controlling these main motors has been developed, this being of the pneumatic type.

Much has been accomplished in a comparatively short length of time in the development of generators and dynamotors for use with wireless telephone systems. The generators have been used on airplanes on the western front. They are of the wind-driven type, and have exceptionally small dimensions and weight. Dynamotors were developed both for the army and for the navy, and several thousand have been supplied. Noise due to vibration is minimized by mounting these machines in flexible cradles. Undamped sending and receiving sets for radio telegraphy were developed for the U. S. Signal Corps, and were used for instructional purposes at the various training camps throughout the country.

The application of electric motors for driving auxiliary apparatus aboard the merchant ships prior to two years ago was very limited. The tendency to electrically drive such machines has rightfully increased during the past year. Special equipment for this exacting service is now being regularly supplied.

The war programme in the steel mills has called for a decided change in the mill schedules, method of rolling and rate of rolling, due to the special variety of steel rolled. One of the advantages of motor drive is latitude permitted in operating conditions by virtue of speed adjustment, through a wide range, adjustment of control to utilize flywheel effect to the best advantage for various load conditions, and ability of the driving units to produce excessive torque to meet the demands of large mills, some of which are operated without the use of the flywheel. It is the development of these detail characteristics of the motor and control equipment to best suit the particular mill that has been a factor in meeting the requirements in such a satisfactory manner with increased tonnage in many cases. A recent report of a reversing type 30-inch Universal Plate Mill—Mark Manufacturing Company—equipped with Westinghouse motor drive, gives a monthly output of 17,393 tons of plate, averaging in thickness less than $\frac{5}{8}$-inch. This is a remarkable record and emphasizes the possibilities offered with electric drive.

The question of electric power supply for large motor drives has received broader consideration during the last few years. Many plants have found it an advantage to analyze their requirements and future improvements from a complete plant standpoint, and thus give each individual mill proposition the benefit of its real relation to the plant proper and thus properly distribute general charges and enables the advantages of the motor drive to be capitalized as a part of the general scheme of improvement. Remarkable possibilities have been shown on this basis, but when the individual mills are analyzed as segregated propositions the summary of the advantages of motor drive do not establish the true over-all plant efficiency.

One of the noteworthy features of recent practice is the selection of large-size turbine units and a more liberal policy to provide for general plant electrification. This tends to improve the efficiency of power production as the water rate of the large-size turbines is materially better than for the size of units formerly selected for mill use. During the past year turbines ranging from 15,000 to 20,000 kw. have been selected for steel mills, as compared with the 5,000 kw. turbine, which is about the average of the units formerly installed.

The Duquesne Works of the Carnegie Steel Company installed a 15,000 kw. Westinghouse turbine this year, and the Mark Manufacturing Company has recently placed a 12,000 kw. Westinghouse turbine unit in operation.

The chemical industry has had a very noteworthy development during the past year, including many large plants for the manufacture of explosives, chlorine gas, and a general line of chemicals, the majority of which were previously imported. The electrification of these plants has been universal, and with but few exceptions central station power has been used, which not only facilitates the building of the plants, but also simplifies the readjustment of industrial matters when the demand for the products of these special plants is greatly reduced.

Some of the more important improvements are as follows: The Hopewell (Va.) plant of the DuPont De Nemours Powder Company, capacity of 1,000,000 pounds smokeless powder per day, and the latest plant which they have installed, located at Nashville, Tenn., and known as the Old Hickory plant, which is of equal capacity, each plant contains about 15,000 h. p. in Westinghouse motors. Nitrate Plant No. 2, Muscle Shoals, Ala., which contains a 60,000 kw. turbine, the largest power unit ever installed by an industrial plant, has already been mentioned.

There has been much activity regarding electrification in the textile industry during the past year, and the prospects for future improvements are very favorable. This, however, will depend largely on the ability of the central stations to furnish power. During the past few years they have been confronted with unusual problems that have limited their extensions and necessitated the postponing of much of their planned developments. With the resumption of normal business conditions, the textile industry will be able to secure additional desired power and thereby improve their plant operations. There has been a decided increase during the past year or so in the use of individual motor drive in this industry, including, particularly, looms and spinning machines.

Previous to 1918 there was a total of 25,000,000 tons capacity of by-product coke ovens, and during 1918 10,000,000 tons of oven capacity, including 2,380 ovens which were placed in operation. Practically all of the plants are entirely electrified, and while there have not been any particularly new lines of apparatus developed, modifications of existing standards have been made by including such features as special impregnation, totally enclosing the frame, and in some cases providing them with special box covers, adding conduit fittings and similar detailed improvements. One of the principal points has been a decided increase in the electrification of gas boosters. This particular requirement calls for an adjustable speed motor, and in the past it has been considered rather dangerous to use direct current apparatus on account of the possibility of sparks igniting the gas that might be in the room. With the rearrangements of the pumps, putting the motors in separate compartments, the electrification becomes a more practical proposition.

It is of interest to note that there have been 1,200 ovens with a capacity of 8,000,000 tons of coke contracted for installation in 1919, and of this number the Westinghouse Company secured the apparatus for 741 ovens, which is approximately 62 per cent. of the total.

During the past year the activity in metal working plants, especially in the manufacture of munitions, guns and shipbuilding, has been very large. Considerable progress has been made, as is shown by the fact that practically all the new plants constructed were erected in the most up-to-date manner. Individual motor drive on the machine tools was used almost exclusively, as also were up-to-date safety-first controllers, the majority being of the magnetic contactor type. Practically all large planers installed were operated by reversing motor drive with automatic control.

In the plant of the New York Shipbuilding Co., South Camden, N. J., there was installed approximately 800 d. c. type SK motors with type C control. In the new 12-inch howitzer plant of the Midvale Steel and Ordnance Co., Philadelphia, Pa., there were furnished approximately 250 d. c. of the same type motors and control. One significant feature of the year's work in regard to motor drive is shown in the fact that when these war plants were being built, none other than motor drive was considered, showing that steam and gas engine drive for such plants are things of the past.

A number of new railroad shops were built, and these were all equipped with modern motor drive, using automatic control both on the machine tools and on the cranes. The same remarks in regard to electric drive in metal working plants apply in these railroad shops. Two of such large shops, practically all the electrical equipment being Westinghouse, are the B. & O. shops at Cumberland, Md., and Glenwood, Penn.

Greater progress was made in the advance of the electric arc welding during the past year than any other time. It had previously been quite generally used in the railroad shops of this country, but during the past year it was used more in manufacturing establishments using iron and steel, and in shipbuilding.

The Welding Committee of the Emergency Fleet Corporation has been doing a large amount of work in promoting electric welding as applied to ships, and although no rivetless ships were built in this country a large one was completed during the past year in England, which was entirely electrically welded, and there is now building a 250-ton ship in which riveting is being replaced by electric welding. Electric welding also made a large advance in the field where formerly gas welding was used, due to the fact that electric welding is cheaper, does the work faster, and is very much less dangerous than gas welding.

Electric drive has made considerable progress in this industry, due to the fact that it is very much cheaper to make ice in electrically driven plants than in steam plants, as plants now equipped with electric motors are making ice for 42 kw.-hr. per ton, and are using Central Station power, on which they obtain very good rates. This does away, of course, with considerable labor, such as firemen, enginemen, etc. Synchronous motors have also been applied during the past year to ammonia compressors very successfully, and it is felt that there will be even more progress made in this industry during the coming year. Future ice plants will be electrically driven rather than by steam.

Activity in the small motor industry has progressed as formerly, with certain restrictions in the commercial field, and has been particularly active in the furnishing of apparatus direct to the government. For domestic service, such as small motor driven washing machines, house pumps, vacuum cleaners and sewing machines, the government has recognized that these are essentials and their manufacture has not been greatly restricted. No manufacturers for any of this class of apparatus, which is distinctly in the labor-saving class, have found any difficulty in selling all they could manufacture, with limited supply of labor and material. Higher wages to skilled and common labor has increased buying power, and therefore the use of these labor-saving devices by persons who, prior to the war, were unable to purchase them. Activities on the part of the manufacturers in view of war conditions have resulted in a considerable simplification of the sizes and types manufactured, and thus a relative decrease in cost of manufacture.

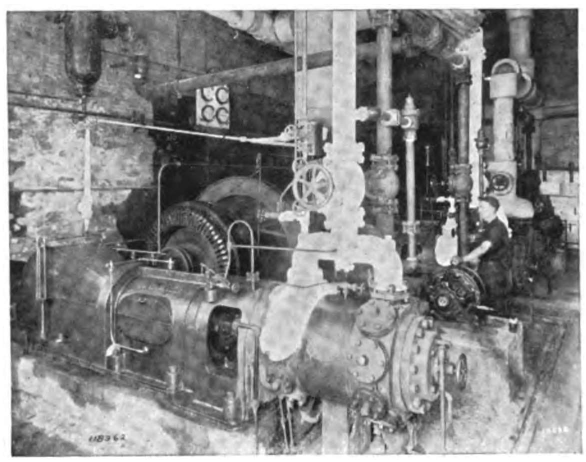
Contrasted with the domestic applications referred to are such applications as motor-driven refrigerators, talking and music machines, pianos, dish washers, etc. These cannot be classed as highly essential, and the domestic refrigerator in particular is a large user of central station current, for it has a high load factor. Consequently, the use of machines in this general class has been very largely eliminated, and many manufacturers have discontinued building them entirely.

In the field of office equipment, there has been a large demand for general use of adding, calculating, blueprinting, duplicating and such machines. Advertising display devices have been largely discontinued and the sale of ventilating equipments reduced.

As would be expected, there has been a good deal of activity in motor-driven apparatus for use in the medical field, such as X-ray and massaging machines, orthopedic devices, vibrators, etc., as well as dental equipment.

Perhaps the greatest activity has been in the use of small motors in machine shops, fabricating plants, shipbuilding plants, etc., with the use of electric drills and grinders. The demand has been enormous, and the use of this apparatus has largely hastened manufacturing processes which have been essential in war work. Electric drills and reamers have been used to a very large extent in shipbuilding plants. Small pedestal grinders employing motors of ½ to 1 h. p. have been used to a very large extent in machine shops.

Obviously, during the past year, there have been few new devices of novel nature employing small motors, developed. All efforts have been toward simplifying and increasing production. In many cases the lack of materials have necessitated substitutions. Some of these may result in permanently altering the class of apparatus manufactured. For instance, manufacturers of sewing machines, as well as decreasing the number of types built, discontinued the use of the cast-iron frame and legs for the sewing machine body. Manufacturers of portable vacuum cleaners agreed to discontinue the sale of hose and special set of tools. The manufacturers of washing machines greatly reduced the number and sizes of types built. It should be noted that there is a continuously increasing demand for small motor-driven machines equipped with low voltage motors (30 volts), for use in connection with farm lighting plants. These are all direct current and have somewhat altered the situation which



Compressor in Brooklyn Ice Plant
Driven by a 350 h.p. direct connect Westinghouse synchronous motor supplied by the central station current

has existed for a number of years of the relative increase in the use of alternating current motors.

A large demand has existed for farm lighting plants and the low voltage storage battery plant appears to be the most popular. One kw. size is largely used, and of course the direct connected plant has now come to stay. The manufacturers of these plants have been considerably limited during the past year in obtaining labor and material, except in so far as these units were supplied for battery charging. With the increasing wealth of the average farmer, the potential demand is increasing, although much educational work is required, as is the case of selling anything to the farming trade.

Early in the year the War Industries Board put a ban on the sale of surface condensers for land use on account of the shortage of non-ferrous tubes. The surface condenser business has, therefore, been practically at a standstill. Orders placed before the restriction went into effect were completed.

Notwithstanding this, there was made during the year another application of 100,000 square feet of condensing surface to a single generating unit similar to the New York Interboro unit. This is for the J. G. White Engineering Corporation, to go in the nitrate plant at Muscle Shoals, Ala. This surface is divided into four 25,000 square feet shells, one to go under each exhaust nozzle of the two-cylinder double flow low pressure elements.

In the jet condenser field there was placed in operation the world's largest jet condenser at Providence, R. I., in the plant of the Narragansett Electric Company. This condenser is of the twin jet type. Also, the world's largest single jet condenser is under construction for the Alabama Power Company. This condenser is capable of handling 13,000,000 pounds of water per hour.

The year has been a notable one in the small turbine field. This has been due to the large amount of standard apparatus which has been manufactured, principally for Government use on land and sea. Because of this demand, there naturally was not very much development along the lines of new devices and products. As an illustration, there were built several hundred small direct connected turbine generator units, of 10 and 15 kw. capacity, for lighting the new merchant marine; a large number of geared turbine units for lighting destroyers, several hundred turbines for driving centrifugal pumps on the merchant marine, and the usual quantity of generating units and auxiliaries for central stations and manufacturing plants working on war material.

The tendency for the past two or three years, and this tendency is growing very rapidly, is to make use of geared turbines for driving small and moderate capacity generators, pumps and blowers. There are many advantages in doing this, and the user has been quick to see the results obtanied. The question of economy is ever important, and in making use of the moderately high speed turbine with a reduction gear for driving relatively slow speed apparatus very much better steam performances may be obtained from the turbine, than where the two pieces of apparatus are direct connected. Generating units of 25 kw. and upwards are of this type, and it is safe to say that during the year 1919 the bulk of small turbines will be of the geared type for all purposes.

Several particularly interesting large turbine installations were made during the year. A 60,000 kw. cross-compound unit is now being installed at Muscle Shoals, Ala., for the Air Nitrates Corporation, which is going to produce nitrates for the War Department. This unit consists of three elements, one high-pressure, non-condensing, exhausting into two low-pressure units. Arrangements are made whereby any element may be run independently of the other two, but this is for use only in the case of an emergency.

There was furnished the Commonwealth Edison Company of Chicago two 30,000 kw. tandem compound turbines. These units consist of two elements coupled in tandem and driving a single generator.

The installation of the Holter plant of the Montana Power Company is one of the largest hydro-electric developments of the West. This plant includes four 12,000-kva. vertical water-wheel type generators, making a total plant capacity of 48,000 kva. The voltage is stepped up through Westinghouse transformers to 100,000-volt transmission lines, and the output distributed among the mining and metallurgical companies in Montana, and the Rocky Mountain electrified division of the Chicago, Milwaukee & St. Paul Railway.

The Eastern Michigan Power Company has placed in operation this year the largest hydro-electric development in Michigan. It is located at Wellston, is called the Junction Development, and the power plant houses three 6,250-kva., vertical, 30-cycle Westinghouse generators. The voltage is stepped up to that of the transmission line, 140,000 volts, which is the highest voltage used in this country with the exception of the one or two systems in Southern California. The largest capacity water-wheel unit yet to be purchased, the 32,500 kva. machine for Niagara Falls, was sold during the year.

The year has been one of output in the case of large transformers. All energies have been devoted to supplying transformers to central stations and industries to enable them to do their share of winning the war. One thing that has contributed to the war programme and that has also been a decided advance in the standardization work on transformers was put through by the National Electric Light Association and the Electric Power Club. Both of these bodies have adopted and published Standardization Rules on Transformers.

Though the principal work of the year has been devoted to output and there have not been built any larger or higher voltage transformers, a number of interesting designs have been completed and the transformers built. There was built for the Alabama Power Company at one time a number of transformers totaling 127,000 kva., which is probably the greatest kva. capacity ever contracted for and built on one contract. These are used in connection with supplying power to the nitrate plants.

There have been in the past year extensive developments in the electro-metallurgical and electro-chemical field. Included in the transformers manufactured is a 7,500-kva., three-phase, water-cooled transformer for supplying two 3,750-kva., 250-volt synchronous converters.

New developments in substation apparatus and equipment have been curtailed to the extent that only those necessary for carrying on war work have been consummated. The greatest difficulty encountered in supplying direct current power for railway purposes has always been in the commutation of the converting apparatus when short circuits, inherent to this class of service, occur. As a result of experience during the last few years, various improvements in the design and application of converting apparatus, together with minor protective features in switching equipment, have overcome many difficulties in 600-volt work. The use of higher voltages, 1,200 to 3,000 volts d. c., for heavier work naturally present conditions more adverse to the successful operation of converting apparatus.

In experimental work that has been in progress for many years with a view towards reducing commutator and collector ring wear there has been a tendency this year towards the adoption of brushes, especially for collector ring use, of a composition of graphite and metal combined, with a larger percentage of graphite than brushes formerly used. These brushes are showing marked improvement in operating results.

The automatic substation switching equipment, while by no means a new development, has undergone many improvements during the last year and has increased in precision and reliability. The indications are that a development of the automatic substation switching has come at a time when it may be an absolute necessity from a labor, if not from an economic, standpoint.

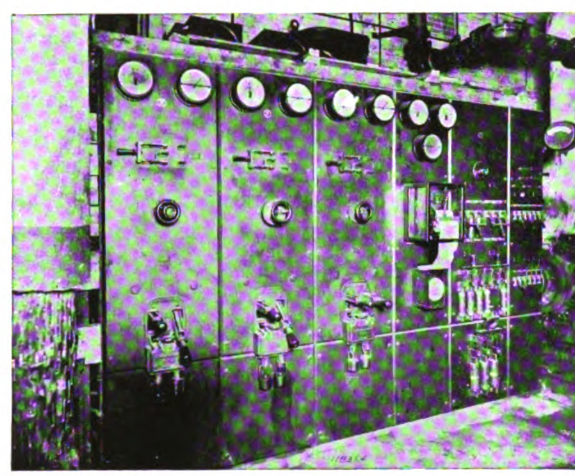
Typical of some of the demands made on account of war work is the case of the switch gear furnished for the nitrate plant at Muscle Shoals, Ala. This included not only the switch gear for the main power house, in which will be installed a 70,000-kva., 12,000-volt turbine and a 40,000-kw. incoming feeder from the Alabama Power Company's 80-mile 110,000-volt transmission line from the Warrior River plant, but also switch gear for the utilization of this power in the manufacture of nitrate. This equipment involves a total of about 210 switchboard panels and 148 oil circuit breakers of various types. A great number of large high conductivity copper fittings were furnished for use with electric furnaces in this plant. Copper required for these fittings totaled something over 100 tons.

Of course, the year has seen a complete utilization of some developments of the last year, including G-2 oil circuit breakers having a rupturing capacity of 1,000,000 arc kva. at 140,000 volts; type CO-2 oil breakers giving extremely high rupturing capacity with minimum space requirements, resulting in marked saving in cost of buildings, circuit-breaker structures, etc., have been developed. Also such minor details as improved oil circuit-breaker controllers, key type meter switches, etc. A constantly increasing number of installations has been made of automatic control for synchronous converters for substations, and this development gives more promise of successful and economical operation.

New switchboard type watthour meters, radio dynamometer type ammeters, motor-operated graphic instruments, transfer, reverse phase and temperature relays, and outdoor voltage transformers represent items that were developed and placed on the market this year.

The motor-operated type of switchboard graphic instruments supersedes the former solenoid operated type. They are furnished with universal motor operation, which feature tends to simplify them, making them more compact and of smaller size. They are more universal on account of being interchangeable on various voltages, and are more satisfactory also for 25 or 60 cycles or direct current, by slight adjustment of the resistor provided with the instrument.

The increasing tendency toward outdoor operation, particularly for the higher voltage service, has influenced the development of outdoor voltage transformers for 20,000 volts and above. This development has been continued so that outdoor voltage transformers can be supplied for a lower voltage.



Switchboard for Ice Plant

It consists of three panels for synchronous-motor-driven compressors, a totalizing panel, and two panels for lights and small motors

In connection with the 3,000-volt d. c. motor generator sets in the substations of the C. M. & St. P. Railway, a flash suppressor has been developed to prevent flashing across the commutator upon the occasion of a short circuit on the d. c. line. A very high speed is necessary in killing or preventing the flash. This is obtained by automatically short circuiting the three collector rings on the d. c. generator of the motor-generator set, upon the occasion of an extreme overload occurring on the d. c. line and thus killing the d. c. voltage and preventing any flashing on the commutator. The three rings are connected to the internal winding of the d. c. generator in a three-phase relation. A quick acting overload on the d. c. side releases a trigger and allows the short circuit contacts to be closed by the pull of a very strong spring. The "short" on the a. c. side automatically operates to open the a. c. breaker through its overload coils. The d. c. breaker also opens from the over-load on its coils. Another circuit operated by the flash suppressor mechanism opens the electrically operated field discharge switch.

The chief progress in the art of street lighting during the past year is to be found in the replacing of a large number of arc lamps throughout the country by Mazda units of various kinds. The high candlepower series Mazda lamp is rapidly taking the place of the arc lamp in street lighting, because of its high efficiency, the superior quality of its light and the absence of flickering and instability. The Luzsolite pendant containing an auto-transformer has made it possible to use the high efficiency 15-and 20-ampere Mazda lamps on the 6.6-ampere distribution circuits regularly used for series street lighting.

The most recent development in the manufacture of pendant units used for this purpose is the substitution of cast iron for copper in the case. The earlier pendant units, and practically all arc lamps, were made with copper cases in the belief that copper was the only metal which would properly withstand the elements. It has been demonstrated that cast iron is better suited for this purpose, being even more durable than copper, and cast iron fixtures have been found to undergo the most severe service without the usual evidences of deterioration.

The high-speed turbine with the floating frame reduction gear, invented by Admiral G. W. Melville and Mr. John H. Macalpine, has proved its reliability not only for use on land but marine service as well. The records of the Westinghouse Electric & Manufacturing Co. show that between November, 1915, and September, 1918, thirty-one ships using this equipment had been put into service, and of these twenty-three have had no trouble with the propulsion machinery; four experienced some trouble due to improper lubrication, two to defective material and one to errors in assembling the apparatus. None of these troubles was vital and all were of a kind that might happen to any machine.

As large turbines are now being built which can deliver to the shaft about 80 per cent. of the energy theoretically available in the steam applied to them, it is evident that further improvements in the turbine itself will not materially raise this efficiency. Hence, in order to improve the performance of the ship's power plant, a matter of great importance in view of the rising cost of fuel, more attention must be paid to the auxiliaries, and the practice of the central station engineer studied more carefully.

Commercial Use of Electricity in Arizona

Preliminary figures from the forthcoming quinquennial report on the central electric light and power stations of the state of Arizona have been given out by Director Sam L. Rogers, of the Bureau of the Census, Department of Commerce. They were prepared under the supervision of Eugene F. Hartley, Chief Statistician for Manufactures.

The statistics relate to the years ending December 31, 1917, 1912 and 1907, and cover both commercial and municipal plants. They do not, however, cover electric plants operated by factories, hotels, etc., which consume the current generated; those operated by the Federal Government and state institutions; nor plants that were idle or in course of construction.

The commercial use of electricity in Arizona shows a remarkable increase at each census for which statistics are presented. There was an increase of 13 in the number of establishments from 1912 to 1917, four of which were municipal, this class of stations being shown for Arizona for the first time at the census of 1917. From 1912 to 1917 the total income increased $968,447, or 82.5 per cent., and the output of stations, 32,771,669 kilowatt hours, or 99.4 per cent. Although the actual increases from 1907 to 1912 were less—$603,336 and 23,567,782 kilowatt hours, respectively—the proportional increases—105.9 per cent. and 250.9 per cent., respectively—were greater.

Electric Power in Rhode Island

There have been substantial gains in the use of electric power in Rhode Island during the past decade, according to the figures given out by the Bureau of the Census, Department of Commerce. The figures for practically all items show substantial gains from census to census. A marked decrease appears in the number of steam engines reported for 1912 as compared with 1907, but this decrease merely shows the use of engines of larger horsepower capacity, since the total horsepower of steam engines was much greater in 1912 than at the preceding census. The decrease in the number of arc street lamps is due to the displacement of such lamps by those classed as "incandescent, etc." which shows an increase of over 50 per cent. for the period 1912 to 1917.

It is significant of the growth in the use of electricity that the actual and proportionate increases, with unimportant exceptions, are greater for the later than for the earlier five-year period. From 1912 to 1917 the gross income increased $2,409,675, or 104.5 per cent., and the output of stations, 99,749,642 kilowatt hours, or 160.6 per cent., as compared with $580,517, or 33.7 per cent. and 26,455,205 kilowatt hours, or 74.2 per cent., from 1907 to 1912.

ELECTRICAL ENGINEERING

With Which is Incorporated the

SOUTHERN ELECTRICIAN and the ELECTRICAL AGE

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Owing to unprecedented price levels and wage standards during the progress of the war it has been necessary for a great majority of public utilities to place in effect higher rate schedules for service. It is only the merest justice to record that this was accomplished in a great majority of cities with the friendly co-operation of the public, which recognized the fact that in the past rates had been reduced when operating expenses were low. The effect of these rate increases enabled the companies to continue good service, maintain credit, perform necessary financing and make the extensions and additions necessary to war production and public welfare. No one doubts that when conditions return to the normal once more, the public utilities will recognize the fact and offer a readjustment of rates.

The awful loss of life, the tremendous destruction of property, the disarrangement of industries and the interruption of production that follow a great war strike such a vital blow at every household that we are inclined to overlook the thousand and one other evils that follow in the train of a great world contest. Rights for the individual that have been secured by centuries of struggle and suffering may have to go by the board in order to secure the greater good, the safety of the community or the nation. As a temporary expedient, President Lincoln could suspend one of the inestimable benefits that came to us from Magna Charta, but it made us no less free. During the present war the Government has assumed various powers that were not contemplated in the building up of our nation. We have acquiesced in this without the slightest demur. But we do not expect that peace conditions will make necessary the continuance of war regulations. In this connection it is interesting to quote the following from a bulletin of the Public Ownership League of America:

"The public ownership movement is not uniformly successful or satisfactory. Public ownership in and of itself is not necessarily a solution. We must have efficient management. We must have democratic control. There are also serious labor problems involved There are many 'failures' of municipal ownership."

A report made to the Chamber of Commerce of the United States by its Committee on Statistics and Standards, headed by A. W. Douglas, of St. Louis, takes a very optimistic view of the general business situation of the country. The report points out that there is a widespread feeling that there must be such readjustments of prices as will bring them to a lower level, assuring stabilization of prices and purchasing and adds: "The general desire is not for radical reductions, but rather for such gradual declines as conditions may warrant. Commingled with this is the knowledge that wages and salaries have much to do with the cost of commodities today and nothing is further from the general thought than that there should be substantial reductions in the income and purchasing power of the many, but rather that a realignment of this nature should assume the form of readjustment in the line of such wages and salaries as are not warranted under the changed situation. There has been no sudden drastic economy, nor financial panic, nor in fact any of those untoward events which in the past we have reckoned as being the natural accompaniment of the end of a period of prosperity. In fact, there is a widespread feeling that the present situation is merely a readjustment and a realignment to something far better in the future when we have surmounted the difficulties that lie directly ahead of us, and thus found a firm foundation for greater business, both domestic and foreign, than we have ever known in the past."

It is pretty generally recognized that the one trait which serves best to distinguish the average Englishman from his fellows is conservatism. That any institution is and has been in existence for a generation or two, is a sufficient justification. The country and the people cling to forms, ceremonials, even grotesque and inconvenient state costumes, simply because they bear the indorsement of time and usage. For nearly five years past Great Britain has enlisted all of its wealth and power in the greatest and most momentous contest in its history. Hundreds of thousands of its young men, in all ranks of society, have given their lives that the Empire and all it stands for might endure. Millions of others, peers and costermongers, delicately reared scholars and brawny laborers, have been thrown together in the intimacy of camp and trench, and have learned to respect one another heartily, all heroes alike. It is a commonplace of criticism that the re-establishment of peace must bring about readjustments, social as well as business and political. The recent parliamentary elections are illuminating, in one way. In no country in the world does political feeling run higher than in Great Britain, and yet the voters have just shown that they can lay aside their political predilections for the time in order to give united and hearty support to those who have borne the burden of carrying on the war.

The country is now tackling the problems of reconstruction and readjustment, and these will be even greater in England than in America, because of the larger part the country took in the war, and the far greater toll taken from its young manhood. One special feature of the reconstruction work in Great Britain is of interest to this magazine—the housing problem. The ownership of the land rests in comparatively few hands. Unless there is a breaking up of the great estates there can never be an "own your own home" campaign in the United Kingdom. The housing of the people depends almost entirely upon the speculative builder. For a number of years past dating before the outbreak of the war, speculative building has been at low ebb, owing to financial conditions in general. The result is that there is now, at the most conservative estimate, a shortage of more than half a million houses. Building must be undertaken at once on the largest scale, and that with government aid in the matter of financing. Royal and local commissions are using every effort to speed up the work and much will have been accomplished before another year goes by.

In the discussion of the building programme in the general and the technical press there is one fact that is very striking. Almost without exception emphasis is laid upon the fact that the British householder, in whatever rank of life he may be, will no longer be content with the style of accommodation afforded him in the past. It is pointed out that even the women have had their awakening, that their work in the munition plants has familiarized them with electric labor-saving appliances, with steam heat, and the hundred and one conveniences that have long had a part in our daily life but are utterly unknown in the ordinary English household. Perhaps it is too much to expect that we of this generation shall see our English cousins discard their dearly cherished open fires, but it is certain that they will make a far more insistent demand than ever before for electric lights, telephones and gas and electric cooking and household appliances. A constantly growing market will surely be opened for our manufacturers in all of these various lines.

Wireless Communication with the President

President Wilson was in constant communication with the United States and France during his entire voyage from the United States to France through the U. S. S. Pennsylvania's powerful radio transmitting and receiving sets. The Annapolis high power transmitting station, transmitting on 16,900 meters, the high power transmitting set at New Brunswick, N. J., transmitting on 13,000 meters, the high power transmitting set at Tuckerton, N. J., on 9,200 meters and the high power transmitting radio station in Lyons, France, on 15,500 meters, were used for communications to and from the President.

The President, on board the U. S. S. George Washington, was convoyed by the U. S. S. Pennsylvania (which is the best equipped ship afloat for signalling purposes in regard to radio communications) and five torpedo boat destroyers. The Pennsylvania's radio equipment consisted of the following apparatus: One 30 kilowatt Federal Arc Transmitter which was used for transmitting messages to the United States and France on 3,600 meters, one 10 kilowatt Lowenstein Spark Transmitter, transmitting on 600 and 952 meters, which was used for intermediate communication with low power coastal stations, one short range radio telephone transmitter, transmitting on 297 meters and one vacuum tube short range transmitting set, transmitting on 450 meters which were used for intercommunication between the U. S. S. Pennsylvania and U. S. S. George Washington.

The Pennsylvania transmitted messages direct to the United States up to a distance of 2,500 miles. Communication with Lyons Station, France, was established long before the Pennsylvania was beyond communication range of the United States.

The Pennsylvania has six receiving booths which were able to receive on eight different tunes simultaneously as follows: One booth guarded Annapolis or New Brunswick tunes 16,900-13,000 meters, one booth guarded Lyons tunes 15,500 meters, one booth guarded Tuckerton's tune 9,200 meters, one booth guarded 4,000 meters (the Standard Arc Calling Tune), one booth guarded 450 meters for the U. S. S. George Washington vacuum tube transmitter tune and one booth guarded 297 meters (the radio telephone tune). One additional operator guarded 600 and 952.

The radio stations at Otter Cliffs, Maine, and Lyons, France, were used to receive messages from the President, transmitted by the U. S. S. Pennsylvania's arc.

The George Washington's radio equipment consisted of the following: one low power spark transmitting set, one 16,900 long wave receiving set, one short wave 600 meter spark receiving set, one short range radio telephone transmitting and receiving set, one vacuum tube 450 meter transmitting and receiving set. The U. S. S. George Washington was able to intercept messages transmitted by the Annapolis or New Brunswick stations and guard 600 meter (commercial calling and emergency tune and the radio telephone and vacuum tunes) simultaneously. Messages for the President transmitted from the United States by the Annapolis, New Brunswick, Tuckerton and the Lyons Station were received by the U. S. S. Pennsylvania and relayed to the George Washington by means of radio telephone and vacuum tubes transmitting sets simultaneously.

had fair sample. I went there in the late fall, and it makes me shiver to think of the cold nights I was called to an almost hopeless job of keeping out anchor ice, but by hard work and plenty of help the plant operated most of the time.

The next jump I made was back in northwest Vermont, where I had charge of a small town plant consisting of one 150 h.p. turbine and two 50 kw. alternators. I was the whole thing and the "Little dog under the wagon," as they have it, staying here seven years. If the river froze over early in the winter and staid frozen I got along very well. The ice covering the water kept it warm and no anchor ice formed, but in open weather, thawing and freezing, night after night, it brought us almost to a standstill. So, after seven winters I was ready to turn it over to some one else.

My next experience was in northeastern York State, near Mechanicsville on the Hudson River, where we had seven 1,000 h.p. generators, each operated by its turbine or all in parallel as occasion might require, gates being controlled by "Lombard" oil pressure governors. I had three months' winter weather on this plant, about two weeks on governors and then as switchboard operator. A number of times during my short stay here we were compelled to drop our entire load on account of anchor ice, and so suddenly did it get us that we had no time to transfer our load to other plants we were tied in with, leaving our gates partly open. The only solution we had lay in being tied in with a 35,000 h.p. hydro plant about 30 miles north on the same stream. This plant, to my knowledge, was never bothered with ice. It had a large storage for water, a deep forebay with turbine intake low down, keeping the water warm and melting the ice before it could reach the wheels. So, if we got time to shift our load they were always in position to handle same. But three months was enough here, 14 hours and two men's work at $60 per month didn't look good to me.

My next and last experience was one winter on 3,000 h.p. plant in the same state and owned by the last named company, or under the name of the Hudson River Power Company. This was about five miles from Amsterdam on a small stream. I started in as general man but finally had charge of the governors. Water here was taken through an open canal about one mile long. As luck would have it, we had plenty of snow and cold weather, freezing over canal so ice gave us little trouble until early spring, when ice and high water made plenty of music. However, it was not so much of a problem to drop the load here, it being in proportion to water we had and we had ample time to shift it. But one winter was enough here. I always was mighty careful about getting too much of a good thing. Now I may feel a little puffed up but I think it would take a pretty good man to tell me anything about anchor ice.

As for a solution of the problem: Anchor ice forms on top of stream and to a certain depth at a certain temperature. If you have a shallow, open stream, the water is full of it. You might combat it to a certain extent by revolving wood screens or moving racks, but the chances are the water at this same temperature will freeze on gates and turbines after leaving screens. Anchor ice will commence to form almost by magic, and leaves the same way on a rise of temperature or on the sun coming up in the morning. To my mind the only real solution is a deep body of water or storage, with your turbine intake at right angles to the current flow and at a good depth below the surface or where the water is warm enough to melt the ice before it can reach the wheels. Satisfactory service may also be had even from shallow stream in steady cold weather where ice forms early and water stays covered for a mile or so from the turbine intake. If you can't meet these last two conditions and must have dependable service, better have steam to fall back on (of course I mean to run an engine with, not to heat the river). Now, I don't know as I have handed out anything new, but Mr. O'Hara has my sympathy and there's one who won't be snooping around after his job.

Kamms, Ohio, Box 55. G. STEVE PARTLOW.

Here and There in the Electrical Field

The Tioga, W. Va., Coal Company, J. N. Berthy, Jr., manager, will install a new electric mining equipment.

The Western Association of Electrical Inspectors will hold its annual meeting in Chicago January 28-30. W. S. Boyd, 175 West Jackson Boulevard, is secretary.

The Springfield, Ill., Gas and Electric Company has filed in the Illinois Supreme Court an appeal case from the Circuit Court of Sangamon County to enjoin the City of Springfield from operating its electric light plant without coming under the jurisdiction of the Illinois Public Utilities Commission. The Circuit Court refused to issue the injuncton.

Judge E. C. Gates has announced that the sale of the property of the Fort Scott, Kans., Gas & Electric Company would be held on January 18. The plant will probably be bought by the second-mortgage bondholders, including the Central National Bank of St. Louis, which holds about $100,000 in bonds, and several St. Louis business men, who have been chief stockholders.

The West Kootenay Power & Light Co., a subsidiary of the Consolidated Mining & Smelting Co., is building a new high-tension transmission system from its power station at Bonnington Falls to Northport and Princeton, B. C., by way of Trail, B. C. The new line is estimated to cost about $1,000,000, and will be used by the Northport Smelting & Refining Co. and the Canada Copper Corporation at each location, respectively. At Northport, the electric energy will be used for smelting operation, while at Princeton, with site known as Copper Mountain, the service will be for mining and concentrating work.

The New Mexico Electrical Association will hold its annual meeting at Albuquerque, N. M., on February 17-19.

How electricity is supplanting the housewife in the matter of bread baking is described in an article in the Minneapolis *Journal*. At least one Minneapolis bakery performs every operation in its bread baking, from mixing the ingredients to wrapping the bread in wax paper, by electricity. The loaves are even distributed to the dealers in electric automobiles.

Favorable water power conditions this year at the Skaguay, Colo., hydroelectric plant of the Arkansas Valley Railway Light & Power Company has enabled the plant to show an output 34½ per cent. in excess of the preceding year.

The farmers in the vicinity of Wegdahl, Minn., are petitioning the Northern States Power Company for electric service, expressing their desire to pay the cost of extensions necessary.

An interesting example of housewifely thrift came up in Denver recently. The Denver Gas & Electric Light Company is carrying on a washing machine campaign, and in the course of reports by representatives one of them spoke of having sold a 1900 Cataract several years ago. Recently he called at the house and found that the woman purchaser had made the machine pay for itself three times. This housewife has a very fine laundry in her basement which she rents out, together with the use of the machine, four days a week at $1.50 a day.

Fort Smith Light & Traction Company is negotiating contract for the electric power requirements of the Frisco shops, amounting to approximately 175 horsepower in motors to cover immediate needs. This will be increased by 125 horsepower in the near future.

The Navy Department has begun the construction of two one-story sub-charging stations at the New London, Conn., Naval Station.

The Seneca River Power Co., of Baldwinsville, N. Y., has filed application with the Public Service Commission, Second District, for permission to acquire the capital stock of the Oswego River Power Transmission Co., Syracuse, and to increase its capital stock to $200,000. The company recently increased its capital to $100,000. The two companies operate distributing systems at Baldwinsville, Phoenix, Van Buren, Lysander and other municipalities, and they declare that the business can be handled better and more economically by one than by two corporations.

The Public Service Commission, Second District, New York, has authorized the issuance of $2,000,000 mortgage bonds by the Niagara Falls Power Co. under a mortgage executed by the Hydraulic Power Co. to the Bankers Trust Co., Buffalo, as trustee. The proceeds of the bonds will be used for extensive additions and improvements.

Pompton Lakes, N. J., will build an addition to its lighting plant.

The War Department will abandon the project for a power plant at Milton, Pa., to cost $100,000.

The annual meeting of the American Institute of Consulting Engineers will be held in New York on January 13 .

The latest census of London, Ont., estimates the population at 67,243, and there is need for street railway extension. The company claims that it has been refused rate increases and that it is unable to finance any improvements.

It is said that negotiations are advancing with respect to a possible amalgamation of the power plants of the Montreal Tramways & Power Company with the Montreal Light, Heat & Power Consolidated, and that sufficient data is on hand to enable the directors to bring the matter to a definite head. The combined capital of these two organizations is in the neighborhood of $100,000,000.

Luchnow, Ont., will vote on a proposition to purchase the electric lighting plant of Walter Stewart & Son.

The Winnipeg Electric Railway Company are adding ten new steel cars to their rolling stock. They are being manufactured by the Ottawa Car Company and are at present in the last stages of construction. The Winnipeg company are also reconstructing their present rolling stock at the rate of ten cars per month, forty cars having already passed through their hands.

For two days Sherbrooke, P. Q., was without a tramway service, the Sherbrooke Railway Company discontinuing its service owing to the council refusing to meet the request of the company for increased fares. The result of the deadlock was a decision of the council to grant a temporary new contract for five months, under which the fares are 5 tickets for a quarter; 6 workmen's tickets for a quarter within restricted hours, and seven tickets for school children for the same amount. On this basis the service was resumed. A new permanent contract will be drawn up and submitted to the taxpayers. The company and the council have been negotiating for a long time as to extension and fares.

In the Miami (Okla.) mine field, the Ann Beaver mines are equipped with all the comforts of a city home. The change rooms, commonly called dog houses, are steam heated and lighted with electricity and modern in every way. A complete telephone system connects all of the offices and dwellings, even the offices 200 feet below the surface.

The West Kootenai Power & Light Company is preparing to construct a new electric transmission line from Grand Forks, B. C., to Princeton by way of Camp McKinney, at an estimated cost of $300,000, and has purchased the copper cable for this purpose.

The city officials of Weatherford, Tex., are planning for the rebuilding of the electric lighting plant recently damaged by fire.

The Magnolia Electric Light & Power Company, of Magnolia, Del., has incorporated with a capital of $10,000 to do a general electric light and power business. John B. Lindal, James Martin and George W. Collins, incorporators.

Work will soon begin on the installation of the new street-lighting system to be furnished Spokane by the Washington Water Power Company under contract. The new lamps, which are of the nitrogen-filled type, will replace the old carbon arcs which have been in use nearly twenty-five years. The new contract is for a period of ten years and calls for 1,410 lamps at $52,170 per year.

The Philadelphia Electric Company has made application to the Public Service Commission for permission to issue bonds for $1,500,000 for proposed extensions and improvements.

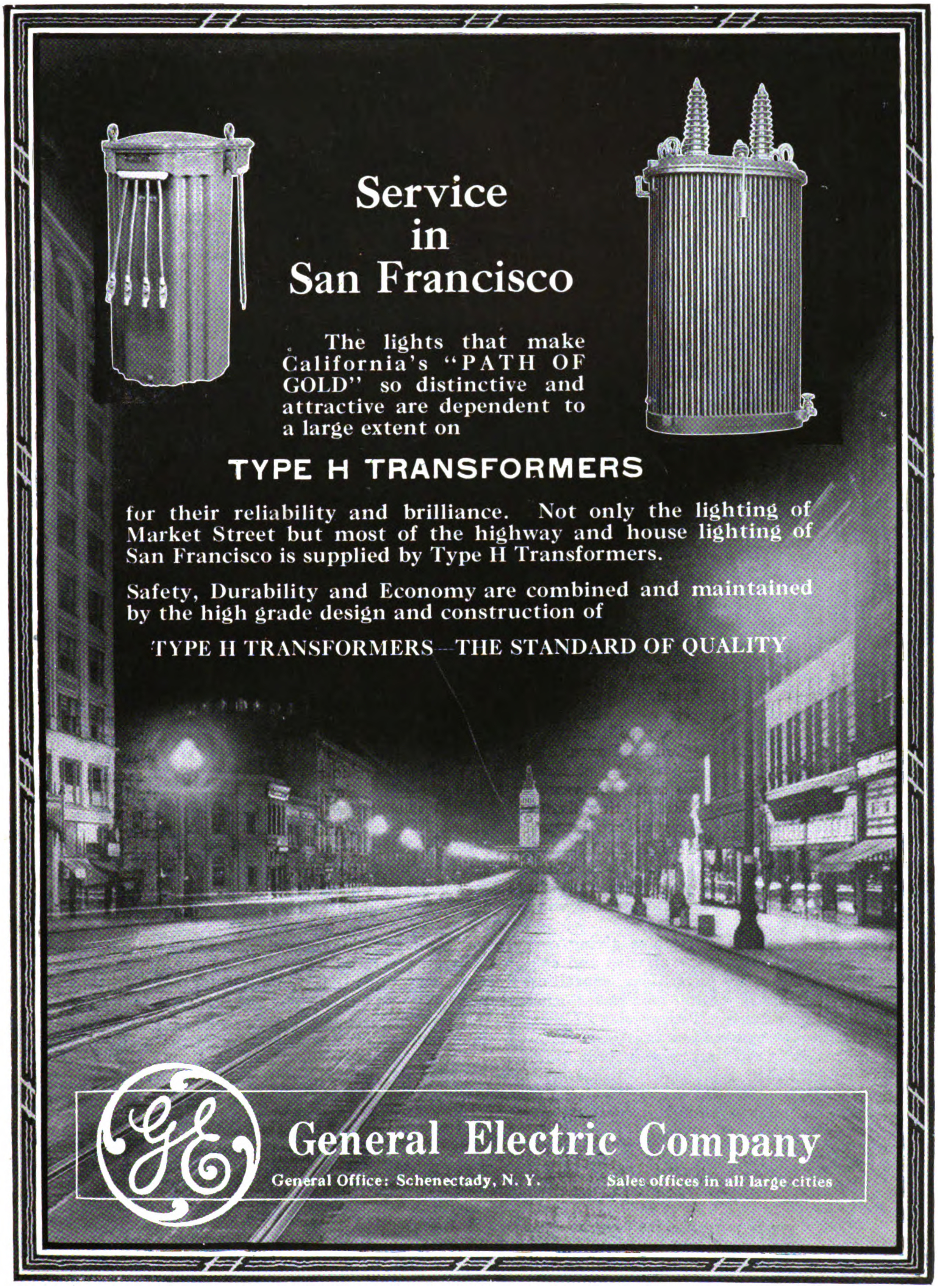
An agreement has been signed by the British Marconi Company and the Chinese Government for a loan of £600,-000, for the construction of wireless plants. The material for these plants are to be furnished by the Marconi company and the price deducted from the loan.

Pipestone, Minn., has voted to issue $100,000 of bonds for the improvements of its city water system. Electric pumping apparatus will replace the steam equipment and energy for operation will be furnished by the Southwestern division of the Northern States Power Company. The city of Montevideo, Minn., is adding a 50 horsepower motor at the water works to supply increased demands. This station is operated electrically with power furnished by the Southwestern division of Northern States Power Company.

The next regular meeting of the Pennsylvania State Association of Electrical Contractors and Dealers will be held in Philadelphia on January 28, with headquarters at the Hotel Adelphia, where open and executive sessions will be held, followed by a dinner, to be addressed by prominent speakers. Representatives of all branches of the electrical industry are invited to attend.

Application will be made to the next session of the Quebec Legislature for the incorporation of the Levis Tramways Company, with power to acquire the property and franchise of the Levis County Railway.

As a means of smoothing out the load curve, staggered hours for closing seem to offer very great promise. A recent investigation made in Boston showed that at least 15,000 kw. in generating capacity would be saved on the system of the Edison Electrical Illuminating Company if 30 industrial establishments would change their working hours by thirty minutes. This statement was made at a recent meeting of the Boston section of the A. I. E. E., by Mr. L. L. Elden, electrical superintendent of the company.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Electrical Engineering

VOLUME XL — FEBRUARY, 1919 — No. 2

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MEMBER

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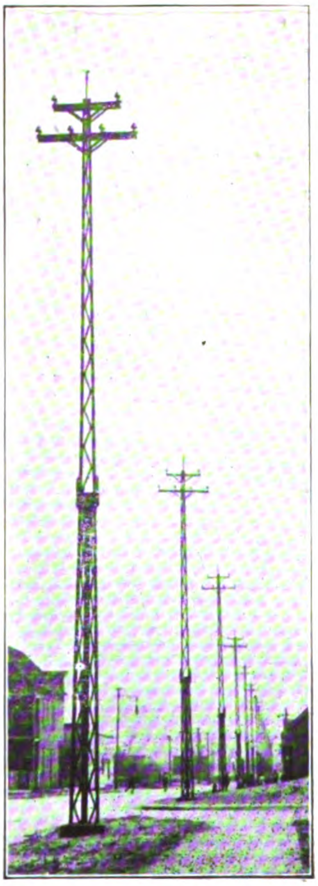

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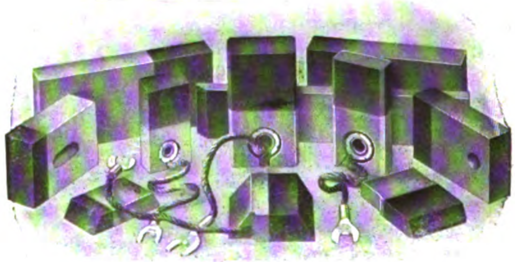

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A box for every purpose and a purpose for every box. Furnished in Sherardized or Black Enameled Finish..
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Complete with insulators. Sherardized Bases. Wires run straight through. No Tie-Wires necessarv
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A Comparison

Sherardizing Steel & Creosoting Wood

The Purchasing Agent for one of the largest Hydro-Electric Power Companies, upon having the Sherardizing Process thoroughly explained to him, remarked:

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For two, three and four wire surface wiring. Lowest installation cost of any metal wiring system.
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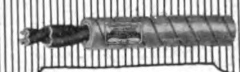

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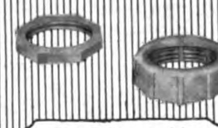

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FIXTURE STUDS
Sherardized Stamped Steel. Hollow Stems. Stronger, and yet lighter, than any other stud on the market.
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ELECTRICAL ENGINEERING

VOLUME LIII FEBRUARY, 1919 No. 2

Electricity in a Southern Textile Mill

NOT only are industrial municipalities awakening to meet new civic problems by making their cities desirable places to live in as well as to work in, but industrial plants themselves throughout the country are beginning to realize the economic value of housing their employees in comfortable and attractive homes. The question of labor turnover which is in some places as high as 60 per cent is largely due to an acquired spirit of restlessness among the men employed in communities with poor homes; where this side of a corporation's interests is men will come, but will also go. Where men cannot bring their families, and take root in new soil; where they say, "that the wages are good but the living is poor," the employer finds dissatisfaction and constant shifting.

The far-sighted company makes the place where the men work, and the place where they live, light, roomy, clean, orderly, and sightly. For instance when one sees a community taking pride in pointing out to the stranger "the attractive backyard," then one feels that that community is there to stay.

The Rex Spinning Company, at Ranlo, N. C., has built cozy homes for their present and prospective employees to live in, and a model plant for them to work in. It is an interesting example of a carefully designed and efficiently operated textile mill.

The village of Ranlo, which consists of the mill, the employees and their families, is situated 18 miles southwest of Charlotte, N. C., and may be reached by the Piedmont & Northern Electric Line. Freight is consigned over the Seaboard Air Line to Mount Holly and thence over the P. & N., or over the Southern to Gastonia and thence over the P. & N. to Ranlo. It has been the consistent aim of the management of this mill, to make it an ideal textile manufacturing community. This policy instituted by its president, Mr. Mayes, has been enthusiastically carried out by the other officers. To-day the mill, from the points of view of operatives' accommodation and uplife, perfection of mechanical equipment, and beauty of its property, make it a model institution.

Ranlo has a population of about 300 people and the mill has at present 120 employees. The mill, in conjunction with other mills in the vicinity and the county, is now erecting a graded school building of the finest and most modern type. It will compare well with modern high school buildings in any of the smaller cities. Until the present, a school has been maintained and operated for the benefit of the children of the operatives, entirely at the expense of the company. The neatly furnished houses, well kept and clean, and the pretty gardens bear testimony to the appreciation of the employees. The company owns twenty five-room and eleven six-room houses, which are rented at unusually reasonable rates. They are substantially built, being equipped with electric lights, bath and sewerage.

The Rex Spinning Company was organized in 1915, began operation on May 1, 1916, and is under the direction of President, J. H. Mayes, Charlotte, N. C.; Vice-President, John Rankin, Lowell, N. C., and Secretary, Wm. Bryce, Charlotte, N. C. The operation of the plant is under the direct supervision of Superintendent C. E. Bean, who makes his home on the property, and therefore possesses more than a passing interest in the community and its welfare.

The mill has 12,000 spindles which will shortly be increased to 20,000 and is engaged in producing yarn from raw cotton at the rate of about 8,000 pounds a week. The raw staple is secured mostly from Mississippi.

The main building is 125 x 400 in area, of an unusually well ventilated and light type of construction, which adds to the comfort of the employees, as well as forming an important factor in production. The building is well supplied with humidifiers and fire extinguishers. The cleanliness, the safety devices for protection of employees and the general spirit of the company seems to have been to make the men and women that work for it contented and happy in their work. But this is not all; the equipment in the mill is of the finest in the market. The shafting in this mill is virtually eliminated, being used only for driving cards and warpers. The drive employed is a two- and four-frame with individual drive on winders, spoolers, and pickers. Westinghouse 25 H. P. motors are used to drive four spinning frames, or twisters, a 10 H. P. Westinghouse motor drives the drawing frames. To drive each two of the speeders 5 H. P. Westinghouse motors are used. All motors except the individual motors are of the ceiling mounted type. Other motors are used to furnish power for the opener and fire pump, and a well equipped machine shop.

Electric power is supplied from the high tension lines of the Southern Power Company, the distributor of electric energy in this district. This eliminates the trouble and additional expense of maintaining a power plant, and enables the operators to devote their time and energy to the production of yarn. The high tension current is stepped down to 550 volts by a bank of transformers located just outside the main building. Water is supplied for the factory and for the town from a deep well by an electric motor-driven pump, the excess going to a reservoir tank from which it flows by gravity into the mains.

Removable Truck Safety First Switchboard Units for Power Plants

For use in electric power plants, the removable truck type safety first switchboard units are eminently fitted. They can be obtained for the control of generator, motor and feeder circuits, and are particularly adapted to plants where electrical distribution to various buildings is made from economically located distribution centers. The construction is such that extensions can be readily made or the units moved to other locations to meet changed or new conditions.

All live parts are enclosed, and the opportunity for an operator to come in contact with the circuit is practically eliminated. A spare removable unit can be used to reduce the time of shut down for inspection or repair. Busbars need not be killed, disconnecting switches need not be opened, leads and small wiring are not disturbed. The design of the units is in accord with the best engineering practice. The oil switches, busses and all live parts are in compartments. This tends to reduce fire hazards and limits disturbances to a single point.

The stationary member of the removable truck switchboard carries current and potential busses with their disconnecting switch studs and barriers between the current studs to prevent accidental contact by any one who enters the compartment. The rear end of the current disconnecting switch studs runs to busses and incoming or outgoing leads; the potential buswires to small contact studs near the top of the compartment. The side walls are provided with hand holes, so that the busbars and buswires can be continued from unit to unit. On the exposed walls of the end units these openings can be closed by removable covers. Access to the rear of a compartment can be had by means of hinged sheet steel doors provided with means for padlocking in closed position.

The removable truck is mounted on wheels. The fore part carries a sheet steel panel on which are mounted the instruments, meters, oil switches or other appliances usually mounted on the ordinary slate switchboard panel. The current transformers are mounted on steel brackets back of the instrument panel. The rear of the truck carries the movable parts of the disconnecting switches, the potential transformers and small wire accessories. To center the truck and to assist in placing it in or removing it from a compartment, rails fastened to the sides of the compartments are furnished. The oil switches, instruments, meters, transformers, and all adjunct parts are removed entirely from the installation by wheeling out the truck.

To remove or replace a switch unit, the oil switch must be open and therefore the load disconnected. This is provided for by an interlock attached to the oil switch operating toggle, which engages cast lugs on the walls of the stationary unit. With the oil switch closed it is impossible to remove or insert the truck. The value of this feature needs no discussion.

The panels are being regularly manufactured in a variety of styles and capacities. These vary in capacity from the smallest up to and including 1,200 amperes—and to operate at voltages up to 15,000. In the larger sizes the housings are usually of re-inforced concrete—and all capacities are designed for use with either solenoid or manually operated oil circuit breakers. These units are made by the General Electric Company.

Electric Equipment for an Italian Plant

Consul B. Harvey Carroll, of Naples, makes an interesting report on one of the largest manufactories of macaroni in his district. This has wholesale offices in Naples and factories at Foggia and Castellamare di Stabia. The plant at Castellamare covers a surface area of 10,000 meters, of which 5,000 meters are occupied by two large 4-story brick buildings, connected at the rear by a covered drying shed. The company is incorporated for 3,000,000 lire (at normal exchange the Italian lira is worth $0.193 U. S. gold) and the plant cost to build about 2,000,000 lire. The company had just had installed new, expensive oil-burning power machinery when the war began. To duplicate the plant would to-day cost at least 5,000,000 lire. This new oil-burning machinery is, however, to be speedily replaced with electric-motor machinery already purchased although not yet installed. Electric power will run the plant at a cost about one-fifth that now paid for oil, but at a price slightly higher than was paid for oil before the war. All new mills of the company will probably use electric engines and motor power.

The Question of Hydro-Electric Development

By D. H. COLCORD

NOW that the Great War is over, the question of developing our Eastern water resources, converting them into electric power for use in our industrial centers is no longer so urgent as the tremendous burden that has been loading the long suffering shoulders of the railroads and coal mines will gradually be lightened until they are able to function normally and as in pre-war times. However, in a normal economic order the value of water power for generating electricity is far from being a dead issue. Even in an industrial section where coal is the natural source of power, water power that is contingent to extensive markets, can and will be developed to supplement steam. And it can be made to reduce the operating cost of central stations enough to make it pay. Again there are a number of instances where our Eastern rivers afford excellent head-sites within easy transmission distance of manufacturing centers, that if developed on a large scale would be practical from a business standpoint to say nothing of their tremendous benefit to the public by affording cheaper light and power.

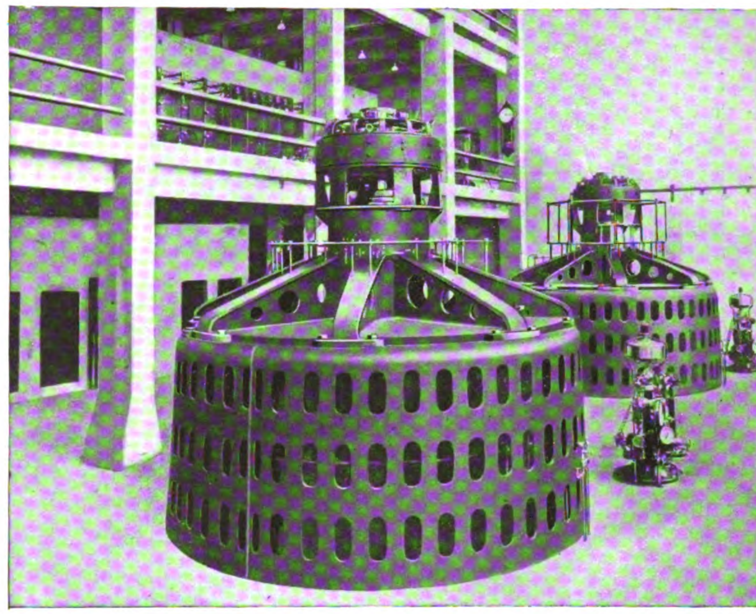
In the United States to-day there are approximately four or five times as much steam as water horsepower in use. The aggregate water horsepower developed is around 60,000,000. The Secretary of Agriculture estimates the water power development in 1916 to be 6,500,000. This means that there is still undeveloped water power in this country equal to twice the present steam capacity in service. Approximately 40,000,000 of the undeveloped water power is in thirteen of the Western States, leaving about 13,500,000 in the East.

It is with the possibilities of developing these 13,500,000 horsepower in Eastern United States that this discussion deals. As 32,500,000 horsepower is generated by steam and as this steam is generally created from coal—a fuel which is sometime going to be exhausted—and as the greater proportion of steam power is used in the East, where there is always a market for power, the question of numerous small developments here, although less romantic than harnessing the tremendous water power potentialities in the Rockies, has certain concrete financial possibilities.

Certain economic and legislative factors have taught the uninitiated investor in hydro-electrics several costly lessons in recent years, and it seems worth while to review these considerations before pointing out water power advantages.

1. Load factors have been overestimated.

2. Drought in summer and ice in winter have prevented the constant source of power counted on to supply the consumer. The initial cost for building impounding dams to overcome this difficulty was so great that although companies might have succeeded in the long run, they could not compete with steam power companies, during their infancy.



POWER PLANT AT ROCHESTER, N. Y.

Two 12500 Kva, 11,000 volt Westinghouse Waterwheel Generators Furnishing Power for Manufacturing Plants

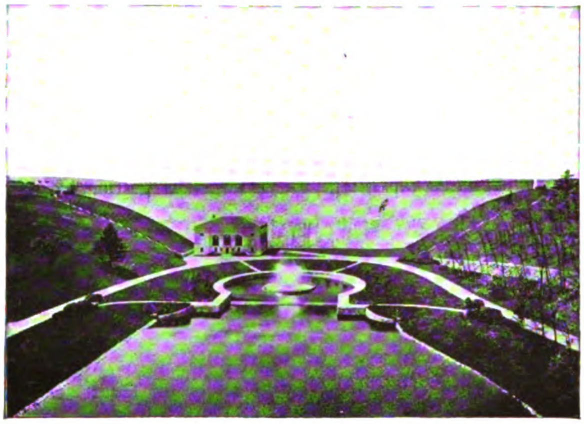
3. The high cost of transmission systems in a mountainous country has been prohibitive in some degree.

4. The cost of installation is high. In 1914, the total cost of installing hydro-electric plants was estimated at $27,000,000, including distribution systems and auxiliary equipment. This gives an average cost per horsepower of $158. A general estimate of the cost complete as given by a prominent engineering company, not including distribution or step-down transformers, has ranged from $75 to $150 per kilowatt installed. If the price of coal increases, in time it will compare favorably. At least the marginal difference in cost will demand increased efficiency in the operation of hydro-electric plants which might make up for this difference. The best steam practice secures at the electric generator less than 20 per cent of the energy stored in coal,

while the efficiency of the water wheel frequently exceeds 90 per cent, which is worth considering.

5. The rapid development of the steam turbine with its increased efficiency has discouraged water power.

6. The distance because of the mountainous nature of the East, from the market, has been a factor.



DAM AND POWER HOUSE AT CLINTON, MASS.
Public water supply being used to develop electrical energy for commercial purposes

7. The high value of land in industrial districts has restricted development.

8. Railroads have followed the streams and in many instances would have to be rebuilt.

9. Many of the streams are of an interstate character involving legislative difficulties.

10. The fact that several projects have been started and abandoned has had a bad moral influence.

11. Long term franchises held by municipal heating and lighting companies made competition impossible.

12. The forestry laws contain inadequate provisions for the leasing of land.

13. There is a scarcity of real good head sites.

14. There is not enough data available on the geological features of stream beds.

15. The recent scarcity and high cost of labor and building material has prevented, since the war, even the completion of development already started.

The report of the Pennsylvania Water Commission of 1916, contains data on hydro-electric projects that have been started and dropped for various reasons and although for one of the Eastern States.

1. These projects were begun at a time when there was a marked scarcity of capital in this country.

2. The companies failed to realize the necessity for a complete engineering survey and improper sites were chosen and then abandoned.

3. Hydrographic conditions were overestimated and in some cases there was not as much water available as counted on.

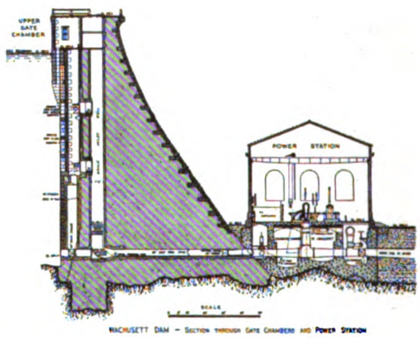
4. Commercial surveys were not thorough in all cases and companies in some cases overestimated their markets for power.

5. In three instances uncertainity in regard to the legal rights possessed by the companies, and subsequent legislation blocked their progress.

6. In several projects, the blame for failure can be laid at the door of financial misfortune.

To attempt to present in so limited a space even a general summary of what has already been accomplished in developing water power facilities in the East would be a task of doubtful value. The wide difference in the capacity of completed plants, some producing as small an amount as 8 horsepower, would indicate little but a brief account of the completed developments in Pennsylvania are indicative of conditions in general.

The grand total of all hydro-electric plants, 61 in number, in Pennsylvania in 1916, including auxiliary powder units, was 172,872 horsepower. These plants vary from 8 horsepower to the capacity of the largest central station at Holtwood. The Holtwood plant is located on the Susquehanna River and is laid out for ten vertical units. Eight units have been installed. Units six, seven and eight are of Westinghouse manufacture of the vertical type and have a normal capacity of 12,000 Kva.



CROSS-SECTION OF POWER HOUSE AT CLINTON, MASS.

each. The dam is half a mile in length and is built of solid concrete with an average height of 55 feet. The power generated at 11,000 volts is stepped up to 70,000 volts through three-phase transformers and is transmitted about 40 miles to the city of Baltimore over aluminum cables suspended from steel towers. The development is owned by the Pennsylvania Water and Power Company. Nineteen of the 61 power plants in Pennsylvania are equipped with Westinghouse generators, the largest number for any single company.

The following table is taken from a report of the New Jersey Water Commission for 1918 and compares the utilization of water power along the Musconetcong River between Hackettstown and

Riegelsville for 1894 and 1918. Excepting the Passaic River, the Musconetcong has the greatest hydro-electric facilities in the state.

Kind of Mill	1894 H. P.	1894 No. of Mills	1918 H. P.	1918 No. of Mills
Paper mills	955	3	1610	3
Grist mills	579	10	368	6
Graphite grinding mills	80	1	290	2
Worsted yarn mills ...	—	1	110	1
Machine knives mills .	75	1	100	1
Saw mills	—	—	40	1
Snuff mills	35	1	——	—
Total	1724	16	2518	14
Total head in feet.....	179		176	

The table shows an increase of 46 per cent in total horsepower in 24 years, although the number of mills decreased by two. It proves that hydro-electric power is successful even within easy hauling distance of the coal mines, and means that a singular outlay on other developed streams would not be a mere venture.

The general advantages desired from a greater development are:

1. The highest use of coal is to create heat to preserve man's life and the term of man's existence may depend on the care of the supply. Fuel is not essentially reproductive. Water power for industry can save the nation millions of tons of coal a year.

2. The East is first and foremost an industrial section and depends primarily on fuel and any effort to conserve it will lengthen out productive life.

3. The electrification of all railroads in the United States is inevitable and provision must be made to supply the electric power. As railroads follow the streams the natural source of power is that which is the most available—the stream itself.

4. Water power makes electric lighting possible wherever it is needed.

5. Where steam power is already used it can well be supplemented by water power.

6. Storage reservoirs used with hydro-electric plants are a protection against floods.

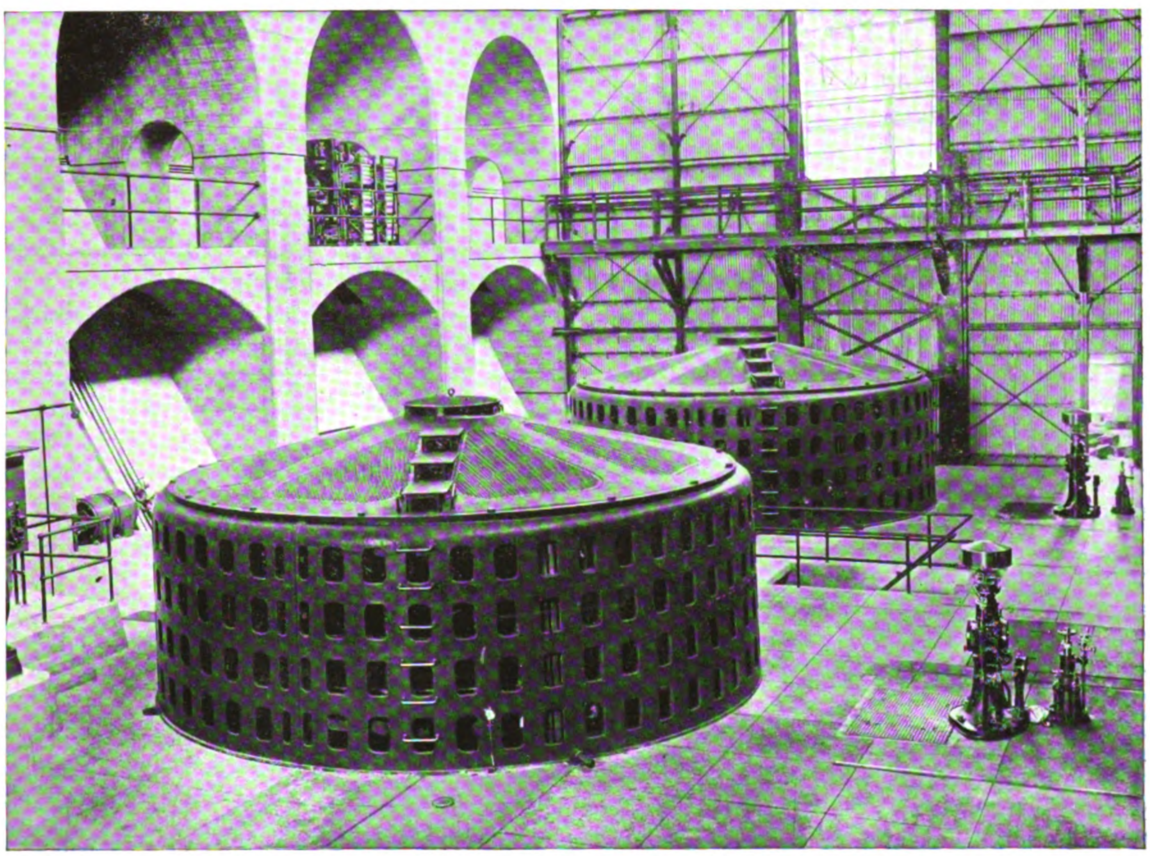
7. During the droughts in summer, the expulsion of water from impounding dams improves sanitary conditions along the stream below.

8. Impounding dams on rivers often improve navigation.

9. The thickly settled districts afford a large market for electric power with reasonable transmission distances.

10. The prevalence of old canals and dam sites make it possible to install a plant at a small cost.

11. There are many limestone streams in the mountainous districts that have a high rate of flow during the dry seasons.



Power Plant at Holtwood, Pa.

Interior of generator station, showing two Westinghouse 12,000 kva., 25 cycle, 11,000-volt vertical water-wheel units

12. Labor that is released with the close of the war, can be used to build the plants.

13. Increased industrial efficiency is effected due to labor saving and waste prevention in distributing power.

From a conservative and absolutely safe standpoint, considering immediate returns on the investment, the correct policy here in the East is to use but water power only to supplement steam and where coal is available at a fair price. But this policy is somewhat pinched and near-sighted from a national, industrial and economic standpoint, because the time is coming when the available coal will be gone. At least a nation like ours can afford to dream of the time when every river that runs from the summits of the Appalachian Mountains to the sea will halt from time to time in its wanton course and convert its energy into power that will electrify the Atlantic Seaboard. There may come a time when the coal that is left will be required for purposes that a central station cannot serve, such as driving the engines on our ocean liners or as fuel for keeping us warm.

Eons ago a shaggy haired fisherman paused in his day's occupation. No fish were caught for several hours. The fisherman's unusually uneventful life had been interrupted with the birth of an idea. For days the idea had been struggling in his thick head and now he was compelled to recognize it. So he paused and thus he reasoned: "If I could cast my lines a few times more each day, in a week I could accumulate a surplus of fish that would allow me a day holiday. I can take this day to build a net which, when ready to use, will catch enough fish in an hour to feed my tribe for a week. The trouble is, I already have a good set of lines and hooks that have cost me time and labor. Must I throw these away, and find new material for a net? Yes, because what little I lose will be made up a hundred fold by my net. It will require sacrifice, labor and new material to create this net; but the net will be capital that will perform my work with increasing returns."

Of course the idea materialized as it has always done. It won because, as Mr. Balfour said, its cubical congealed concrete essence was universal. The idea is simple, it is old, the story is worn threadbare, but like most of the great truths, it is so near that it cannot be seen. For a nation that can raise over $6,000,000,000 in one Liberty Loan Campaign for the prosecution of a just war; for us to cling to an old industrial method because of a lack of capital is absurd.

Right now in Eastern United States, hydro-electric possibilities represents another big idea, still vague, indefinite, but so tremendous, so colossal that it is food, fit only for the brain of some Titan of Industry like George Westinghouse or Thomas Edison. Horsepower that runs into millions is being wasted every year as our rivers run wantonly to the sea.

Why isn't it possible for the Geneso, the Delaware, Susquehanna, the Juniata, Allegheny, Monongahela, Ohio, the Passaic or the Musconetcong Rivers to be harnessed as completely as has the Huron, the Kalamazoo or the Grand Rivers of Michigan? For example, imagine central stations at Lock Haven, Williamsport, Harrisburg, Sunbury, each the size of the complete hydro-electric plant at Manistee, Michigan. They would furnish power for twenty cities and towns, turning the wheels for great silk and paper mills and make it possible to electrify the whole Buffalo-Washington Division of the Pennsylvania Railroad. Multiply in your imagination, this river by hundreds of other streams, and these cities by thousands of other cities, and the vision appears of a vast network of transmission systems extending from Maine to Florida, furnishing every unit of power required from that of preparing the toast for breakfast to that of driving giant locomotives over the Allegheny Mountains. The vision contracts considerably, when you consider that Pittsburgh in 1914 had only 2,320 horsepower derived from water turbines in the Ohio basin.

In Great Britain proposals have been set forth for vast central station power plants, and stock is being taken of all of the water powers of the British Isles. Since the outbreak of the war the Italian government has proceeded with an active water power policy. In 1917 and 1918 there have been concessions granted for 1,024,000 horsepower. Norway has developed 1,120,000 turbine horsepower, and plans to export hydroelectric power to Denmark. Barcelona, in Spain, is replacing steam power by hydro-electricity. In Switzerland 25 per cent of its 2,000,000 available horsepower had been developed. A Canadian company has completed a large portion of an extensive system of reservoir and hydro-electric stations on the Nogurea, Pallaresa and Segre rivers. All of these are indicative of the fact that other people are laying a lasting foundation for power for years to come and it is with them that we must compete for the world's trade.

Applications of Electroplating

Electroplating is an art which has been developed during the last 50 years with only occasional applications of scientific principles. Formerly the industry was much shrouded in mystery, each plater guarding jealously the formulas and methods employed by him. Of recent years, however, there has been a considerable demand from electroplaters and manufacturers for more exact data relating to this industry.

This need and demand for information has been emphasized during the war by the numerous problems that have arisen in connection with the plating of military supplies of the most varied description. Thus, zinc plating has furnished an excellent and, in many cases, the best protection against the corrosion of steel parts, such as airplane and seaplane fittings, fuse parts, hardware on ammunition boxes, etc. Black nickel plating was very extensively used for producing the so-called "government bronze" finish upon brass, hardware and saddlery equipment. Lead plating proved valuable in the lining of gas shells and for bringing up to standard weight shells which were underweight. In connection with these problems a number of investigations were conducted at the Bureau of Standards, whose experts made frequent visits to munitions plants to advise upon the best methods of securing the desired results.

Appropriations have been requested by the Department of Commerce to permit more exhaustive study by the Bureau of Standards of plating problems and their application to various manufacturing industries. Electroplating forms an excellent illustration of a "key industry," *i.e.*, an industry which, while it is not itself of great magnitude, is often of fundamental importance to larger industries. Thus, electroplating is essential to the manufacture of tools, builders' and saddlery hardware, plumbers' supplies, gas and electrical appliances, automobiles, silverware, jewelry, stoves, household utensils, mechanical devices, such as phonographs, cash registers, sewing machines, adding machines, typewriters, cameras, and other optical and scientific instruments, and, in fact, almost every industry in which finished metal articles of any description are produced. Progress in the art of electroplating will bring about corresponding improvements in all such industries.

Pending the appropriation of funds adequate to conduct extended or exhaustive investigations on electroplating, arrangements have been made by the Bureau of Standards to secure, by inquiries addressed to platers, reliable information regarding the kinds and methods of plating now in commercial use. From such a preliminary survey it is hoped to secure much information which can be made immediately available and at the same time to define more clearly the problems most in need of investigation.

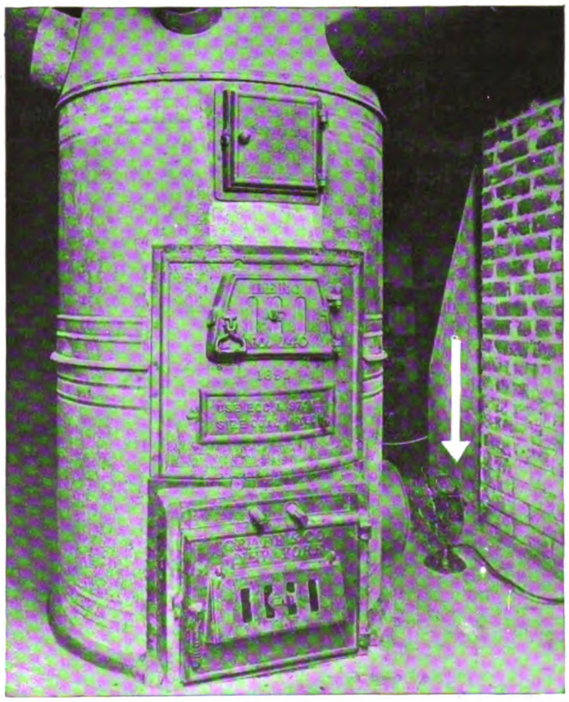
Electric Fans as Heating Aids

THE scarcity and high price of coal makes it imperative that every householder should be as economical of fuel as possible. The fullest service that can be obtainable must be gotten from every heating appliance. The suggestion is made that an electric fan in this connection actually saves money for the user, as it helps to do the job of heating the house, by distributing more of the heat through the house and allowing less of it to slip away up the chimney.

Every householder, whether he is using a hot water, steam, or hot-air system, can save money and coal. In our consideration let us suppose that a closed room is to be heated with a single radiator which receives its heat supply from a hot-water furnace. The effectiveness of that coil depends on two things only: First, the rapidity with which heat is supplied to the coils in the furnace; and second, the speed with which the heat is carried away into the room. Naturally the first object is to get the water as hot as possible in the furnace, and send it back from the radiators to the furnace as quickly and as cool as possible. If it could be sent back at room temperature the system would be working at top efficiency.

Now consider the things that happen while the room is heating. First, the air directly around the coils is heated; second the heater air rises to the ceiling; third, a layer of hot air spreads over the room; fourth, it gives up its heat to ceilings, walls and surrounding air; fifth, it drops to the floor; and sixth, it flows back to the base of the radiator to begin the cycle all over again.

There are only two ways by which the efficiency of a connection system of this sort can be improved. One is by adding more coils to the radiators, and the other is by forcing a current of air past the coils to carry off the heat more rapidly. The first way involves more expense, the latter involves only a small investment in a fan, which can be used summer and winter for many years.



"FEEDING" A HOT AIR FURNACE
Westinghouse electric fan used to supply air to risers that were formerly cold

The principle used in the house heating system is much the same as that of a steam-engine boiler. In the engine the capacity of the boiler depends on the freedom with which the hot gases sweep over the coils and the ability of the boiler to turn the heat into steam. In the heating system the capacity depends on the speed with which the heat can be removed from the coils and circulated in the room.

In the case of a steam heated house, the heating of a room is indicated both by the movement of air and by room temperature taken at the point farthest removed from the radiator. When forced circulation is introduced, the change made in the normal conditions is really surprising.

Some advocates of the electric fan method of distribution claim that the fan should be placed on the floor so that the natural direction of air circulation will be retained, but the movement accelerated. It is also believed that better results can be secured by forcing a downward current to carry the hot air along the floor, and thus use the heat to a better advantage by spreading it across the floor surface than by allowing it to give off the heat near the ceiling.

An electric fan also increased the efficiency of a hot-air furnace. A furnace used to heat a seven-room house had four risers to carry hot air to the various parts of the house. Cold air was taken from the basement. Normally this furnace could not keep more than three risers hot at a time and it seemed that no amount of changing drafts could set things right. A good deal of coal was wasted in trying to keep the house warm until the owner hit on the place of blowing the cold air into the heating jacket with a Westinghouse eight-inch fan. There has not been the slightest difficulty since the new plan was adopted. There is no doubt that the fan system, used with either steam, hot water, or hot-air furnaces, has great possibilities in the way of saving coal.

Licensing of Engineers

Members of the Ohio Engineering Society on the first day of its annual convention in Columbus, voted unanimously in favor of the principle of licensing engineers. It is expected that a bill will be presented to the state legislature at its present session. The action of the Ohio Engineering Society followed an address on "Licensing," by C. E. Drayer, Secretary of the American Association of Engineers.

President Clyde T. Morris of the Association of Ohio Technical Societies announced a plan for the study of the subject of licensing by all engineering organizations of Ohio in order that a generally acceptable bill may be drafted. He has called upon the societies composing the Ohio Association of Technical Societies to name committees on licensing. A conference will be called at Columbus in the near future for discussion and the drafting of the bill.

Mr. Drayer emphasized the necessity of such a law to provide for the safety of our citizens and pointed out that efficiency would be increased, resulting in a very great saving to the public. Licensing would help to dignify the profession by tending to elevate it. Licensing would promote unity of the profession by putting the control of it by law into the hands of engineers.

License laws now in effect in the several states, as well as bills proposed that failed of passage, and bills pending or to be introduced, were reviewed and a comparative statement of them prepared by the Committee on Legislation of the American Association of Engineers was exhibited. In this chart the model law proposed by the American Association of Engineers in 1915 was used as a basis. It was announced that the Legislative Committee of the American Association of Engineers would present a new proposed law in about one month.

The need was recognized of a "grandfathers clause" in any bill in order to avoid an *ex post facto* law and in order not to work hardship upon anyone now in the practice of the profession.

Regarding the question as to licensing, for instance, only civil engineers and surveyors, or all engineers, Mr. Drayer said, "Another moot point is whether all branches of engineering should be included—civil, mechanical, electrical, mining and the score or more of other varieties—or only the civil. It must be borne in mind that the line dividing them in many phases of public work is rather imaginary—for instance, in the construction of municipal waterworks and lighting plant. The tendency is to increase public utilities so that it is fair to assume that more and more of the engineer's work in the future will be in public service.

It might be held in some quarters that the mining engineer need not be licensed if the principle underlying the proposed legislation is to protect the public. The safety of many lives depends on the mining engineer, and likewise the safety of millions of dollars. It has been said by an experienced mining engineer that four out of five mining ventures, in all of which the public invests its good money, would not have been undertaken had they been reported upon by a competent mining engineer.

Higher Rates in Denver Upheld

The Supreme Court of the State of Colorado has declined, by a vote of 5 to 2, to grant the application of the Denver City Attorney, James A. Marsh, for a writ of prohibition to prevent the Denver Gas and Electric Light Company from collecting the higher rates recently authorized by the State Utilities Commission. This decision is not a ruling upon the question of the Utilities Commission's jurisdiction over public utilities in home rule cities. It does, however, allow the Denver Gas and Electric Light Company to maintain the present rates pending final decision.

outstanding factors—the lack of demand for investments other than Government bonds, and the securities of industries which have greatly benefited under war conditions; and the decrease in net earnings of public utilities as a whole brought about by the abnormal costs of labor and materials. The prices of all bonds of companies under Stone & Webster management have reflected general market conditions during the war by a decrease in average price from 96.70 August 1, 1914, to 86.90 December 1, 1918; the price of all preferred stocks from 88.60 August 1, 1914, to 66.20 December 1, 1918. The earnings of all public utility securities under Stone & Webster management have shown an increase of 19.45 per cent in gross earnings for ten months of 1918 as compared with 1917, and an increase of 7.63 per cent in net earnings.

Fuel Saving on Steamships

The high cost of fuel is one of the facts that the ship owner will have to face for some time to come. Of course present abnormal prices will not hold very much longer, but it is doubtful whether fuel will ever again be as cheap as it was before the war, and consequently more thought than ever must be bestowed on fuel conservation. What can be done in this direction? In what ways, not already recognized as good marine practice, can fuel be saved?

As pointed out by Francis Hodgkinson, Chief Engineer of the Westinghouse Electric & Manufacturing Company, in a recent address before the Society of Naval Architects and Marine Engineers, the properly designed steam turbine can now deliver to the shaft up to and over 80 per cent. (depending on the size of the turbine) of the theoretical energy available in the steam expanding between the specified limits. Hence there can be little material improvement in the economy of the prime mover itself and greater consideration than ever must be given to the auxiliaries.

It is not unreasonable for the marine engineer to look to the central station engineer for information concerning fuel economy. The latter is subject to keen competition, and his main problem is to produce reliable energy for the least cost and he has had considerable success in solving this problem. Of course, conditions on land are different from those at sea, and the marine engineer would not for a moment consider installing some of the elaborate equipment that provides the central station engineer with many of his best results, but nevertheless certain features of advanced central station practice can be adopted for marine purposes with a saving of fuel on one hand and without producing unacceptable complication on the other.

Take the matter of feed-water heating systems for example. It is most desirable, from a point of view of fuel economy to have a system that will automatically maintain a predetermined temperature in the feed-water heater at all times, drawing steam from the main turbine for this purpose when necessary and permitting any surplus uncondensed steam from the auxiliary machinery to return to the turbine and develop useful work in the low pressure elements. Heat balance systems of this kind are already available for land purposes, and should find a place in both war and merchant vessels.

High steam pressures are also engaging the attention of central station engineers. Since steam at 600 pounds expanded to 29 inches of vacuum, is theoretically capable of giving 13 per cent. more energy than steam at 200 pounds expanded to the same vacuum, there is, here evidently, an excellent opportunity to economize. Economizers are usually found in good central station plants, but they do not appear to have ever been used at sea. Yet it would seem that their cost would be well warranted in the case of express steamers because on such vessels they can readily produce a net saving of 10 per cent. in the work of the boilers.

Though superheat of as high a degree as is desirable in central stations may not be practical at sea, nevertheless a superheat of 100 degrees F. should present no difficulties with well designed high-speed turbines and its use would save some 4 or 5 per cent. of fuel.

The use of higher vacua will also materially effect fuel economy. The steam consumption of a properly designed turbine is 7 per cent. better with 29 inches vacuum than it is with 28 inches. This higher vacuum is therefore well worth securing, tlthough this can only be done by the use of excellent air removing apparatus and a constant vigilance in the elimination of air leaks.

To sum up, fuel economy will be a matter of price importance in the future and the most efficient steam power plant is one consisting of a high-speed geared turbine supplied with high pressure or superheated steam and using a heat-balance feed-water system, fuel economizers and high vacua.

Hydro-Electric Power in Greece

The Bureau of Industry of the Greek Ministry of National Economy has prepared a report on the post-war needs of Greece in machines and equipment. The Government has created a special department in the Ministry of Communication for the utilization of water powers, but this cannot be furthered, the report says, unless a sufficient number of turbines are imported for the purpose.

According to the latest industrial census, hydraulic horsepower developed thus far amounts to 6,272 horsepower. Flour mills use 1,662 horsepower, oil factories 202 horsepower, chemical producers 1,095 horsepower, cotton, woolen, and thread mills 3,288 horsepower, tanneries 10 horsepower, sawmills 15 horsepower. The whole amount is but one-tenth of the potential hydraulic power of the country. Indeed, it is officially stated that steps are soon to be taken to make Greece's lakes and rivers yield 66,000 horsepower, apportioned as follows:

Lake Ostrovo, the Voda River, with three dams at Vladovo, Vodena and the Divies River	34,000
Axios River	40,000
Aliakmon River	3,000
Moussa Falls	4,000
Verria Falls	2,000
Gorgopotamos River	2,000
Reneos River	3,500
Strymon River (probably)	3,500
Other falls and rivers (to be used by small business in all parts of the country)	10,000

The larger sources of power are to be worked either by the State itself or by companies to which grants are to be made for one of three different periods of time.

The power obtained is to be used chiefly in the production of high-tension electric current for the manufacture of nitrogen fertilizers (calcium cyanamid) and also for supplying light to certain cities. To carry out these plans it will be necessary to import large quanities of dynamos, transformers, transmission systems, and in general, all accessory equipment.

Economy in Electric Cooking

The leading electric journal of Great Britain puts the case for electric cooking in a very convincing way. The *Electric Review*, of London, says: "Statements issued by Messrs. Belling & Co. show that to cook one hundred pounds of meat in a coal range requires one hundred pounds of coal; in a gas range, thirty pounds of coal (in the gas works) ; and in an electric range, twenty-five pounds of coal (in the electricity works). If only half the total amount of roasting and baking done each day were done by electricity, the daily saving would approximate ten thousands tons of coal. With regard to meat saving, they say that every one hundred pounds of raw meat cooked in a coal range weighs eighty-six pounds when done. The same amount cooked by gas weighs seventy pounds, and by electricity ninety pounds when finished. If only half the total weight of meat consumed eaech day were cooked by electricity, the daily saving would be approximately 350 tons of meat.

"The pity of it is that very few people seem to be aware of these astonishing figures, and the vast saving which can actually be effected. Those in the electrical industry do not push electrical cooking forward as they should do, and those outside the industry seem to try to retard it. Why is there not some co-operative movement amongst manufacturers to drive these points home, when it is so obvious to all who are willing to see it that electric cooking effects an enormous saving in coal, labor and many other ways? While the conditions may not be favorable at the moment for such a movement, at any rate preparations should be made to set it going at the earliest opportunity.

"Any device that will add to the safety of the house is commendable. The use of electricity for heating displaces matches and open fires; there is no gas to explode and no flame or flare-up to start fires or to burn the operator. No business man would think for one moment of going back to the old office methods and discarding the use of modern labor-saving devices, such as typewriters, billing machines and adding machines. These devices are considered necessary to the proper and efficient management of one's business. Electricity in domestic service is simply a modern labor-saving device—saving also money, time and worry—and, therefore, should be considered as part of the modern housekeeper's equipment."

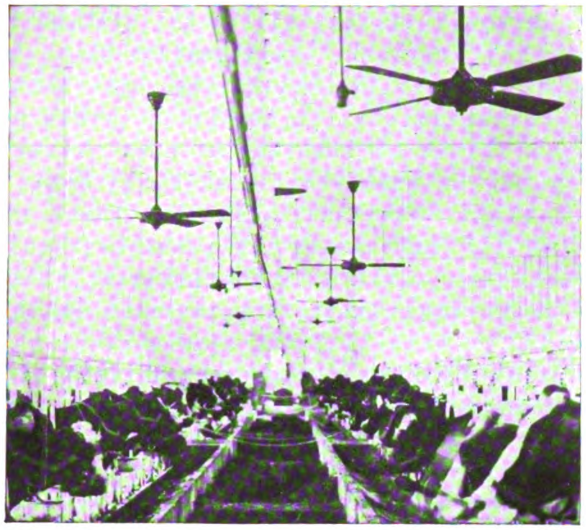
Electricity on the Farm

A FEW years ago economists were greatly alarmed at the shifting of population from the country to the towns and cities. It was easy to understand the reason for the movement but difficult to find a remedy. The prime objections to life on the farm were loneliness, lack of amusement and hard work. One could scarcely blame the young man and woman if the gayety of urban life held attractions for them. That this general movement city-ward has been checked in large measure, few can doubt. It is true that the lure of high wages has drawn many to the factories and munition plants, and that many country boys drafted into the army will seek to establish themselves in the centers of population when they are mustered out. But those who have given study to the subject believe that thousands of the anaemic city-bred, made lusty and vigorous by military training and enamoured of their life in the open air, will scorn desk and counting room, and turn with eager longing to the fields and woods.

Do we ever stop to consider that the greatest single factor in re-establishing country life in favor has been electricity? The tremendous growth of rural telephone service has done much to banish loneliness, especially for the women of the household, who were the greatest sufferers. The telephone has been aided by rural free delivery, which brings the daily or weekly paper to the door, so that the farmer no longer feels that he is out of touch with the world. Moving-pictures have made possible a most attractive form of entertainment even in little hamlets which heretofore could provide very few amusements. Motor cars make these accessible for the farmer and his family, and also give as much social intercourse as may be desired. Electric light, provided either from a central station or by an individual plant of moderate cost, make the home more cheerful, a great asset in itself. Every day electric power is performing more and more tasks on the farm, and lightening the labor of man and beast alike.

In few rural communities has electricity been put to more novel uses than at Briarcliff Dairy Farm, near Atlanta, Ga., owned by Mr. Asa D. Candler, Jr.

Briarcliff Dairy Farm was originally a chicken



A Model Dairy Barn
Double row of Holstein cattle and Westinghouse electric fans

ranch which has been remodeled for dairy purposes. The barn is provided with concrete floors, wooden blocks, electric lights and fans, steel frame stalls, novel drinking fountains, milking machines, concrete feed troughs, electric equipment for the silo and bottling milk. The farm has a colony of 180 full-blooded registered Holstein cattle. They are a fine family and universally conceded to be the best stock for level pasture. Their value is based on their direct proportional response in milk to scientific feeding and careful housing.

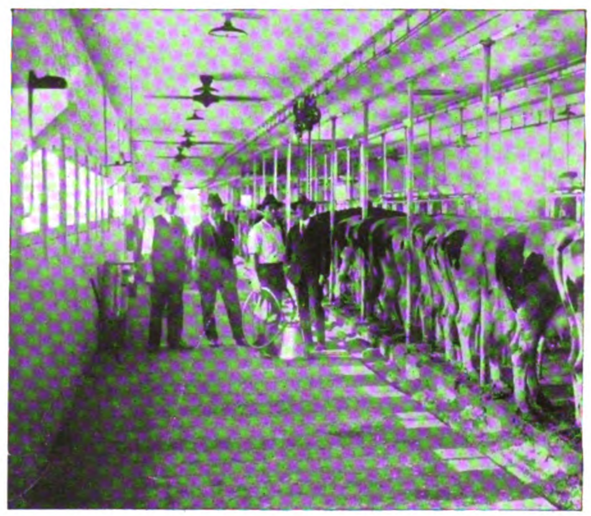
The interior of the barn is absolutely clean and looks it. Some dairy barns are of the bungalow type furnishing numerous catch-alls for everything that's loose. This reminds one of a hospital ward. Fresh air and sunlight are supplied in abundance by the numerous windows on each side equipped for easy adjustment. The floors, walls, and ceiling are concrete and also spell cleanliness. Westinghouse ceiling fans cool the atmosphere in summer and ventilate it in winter. There are also electric lights.

The green corn for ensilage is cut with the aid of a type C. S. 15-H. P. motor, and is blown through a conveyor into the top of a forty-foot silo. Mr. Candler considers green corn ensilage as the next best thing to green grass as a milk producing food.

Each Holstein cow gets its share of sunlight, the windows being so arranged that the sun shines near the cow in the morning and on her just before sunset. Mr. Candler uses the Vacuum Milking Machine. All of the milking is done with these machines, thus preventing any dirt from getting into the milk. The milk flows into an air-tight bucket, is emptied into a larger can and carried to the milk house. Just as soon as the milk arrives at the milk house, it is strained and passed over a cooler until it reaches the proper temperature. From here it passes to a bottle filling machine, where the bottle is automatically filled and sealed. Briarcliff Farm pure cream, pure milk, pure buttermilk and pasteurized milk are served in various hotels in Atlanta and sold to discriminating customers.

Cable Concessions in Uruguay

Consul William Dawson writes from Montevideo that a resolution of September 24, 1918, contained important provisions with referenece to cable concessions in Uruguay. Article 1 of the resolution refuses to grant the petition of the Western Telegraph Company for the extension for thirty years of its concession which expired on July 15, 1917. Article 2 provides for



Briarcliff Dairy Farm
A view in the great cattle barn showing milking machine and fans

the presentation to the Chambers of a bill regulating cable concessions. Article 3 authorizes precariously (con carácter precario) the Central and South American Telegraph Company to extend its telegraph and telephone lines from Buenos Aires to Montevideo.

A statement published in connection with this resolution shows that the Western Telegraph Company has enjoyed an exclusive concession for telegraphic communication with Brazil, Europe, North America, the West Indies, the Guayanas, Venezuela, Colombia, Central America and Africa. In applying for an extension of this concession, the company offered the Government 1 per cent. of the charge per word on all messages to and from Uruguay as well as transit messages, the company to enjoy complete exemption from taxation on its equipment and properties.

The statement further reveals that the Compañia Telegráfica Alemana Sudamericana (a German concern) applied several years ago for the permission to extend its lines from Pernambuco to Montevideo and that this permission was refused because the Western concession was still in force. It appears that the local representatives of the German company has been active in opposing the extension of the Western concession.

With the expiration of the Western concession the Uruguayan Government proposes to establish competition among cable companies and exclusive concessions will not be granted, privileges and monopolies being reserved to the State. It appears that the bill to be presented to the Chambers will provide for the granting of concessions for not over thirty years, the concessionaires to enjoy no privileges or exemptions of any kind. On the other hand, the Government will not subvention companies nor otherwise give preference to one company as compared to another.

It may be recalled, in this connection, that while the Western has enjoyed an exclusive concession as respects the countries and continents noted above, cable communication with Buenos Aires has thus far been maintained by two local lines. These lines belong, respectively, to the Compañia Telegráfica del Rio de la Plata, which is controlled by the Western, and the Compañia Telegráfico-Telefónica del Plata, a subsidiary of the Deutsch-Sudamerikanische Telegraphengesellschaft, the German company (also known as the Compañia Telegráfica Alemana Sudamericana) which has already applied for permission to extend its lines from Pernambuco to Montevideo. The Central and South American Telegraph Company used up to April, 1918, the lines of this German-owned concern for its traffic between Montevideo and Buenos Aires. Since last April, by special agreement, the Compañia Telegráfica del Rio de la Plata (Western subsidiary) has been dispatching and receiving the Montevideo business of the American company, thus eliminating the German lines.

Italy Utilizes Volcanic Power

The present enormous price of coal in Italy, according to the Italian Bureau of Public Information, has resulted in the realization of an idea which at first thought seemed but a dream, but which instead has been developed in a marvelous manner and is assuming quite considerable importance; this is the industrial exploitation of one of the features of vulcanism and that is the natural heat omitted from the soil in those regions more or less volcanic in character.

The first experiments along this line were made some years before the war by Prince Ginori-Conti in Tuscany at Lardorello, near the salt-mines of Volterra, a region extensively covered with volcanic formations, the most wonderful being the so-called "soffioni," which are certain volcanic vents emitting powerful jets of very hot steam containing boric salts and various gases used in the extraction of boracic acid. Instead of limiting the use of these steam-jets, as in the past, to extracting the salts contained in the exalations of these natural vapor-vents, the ejection of the steam is stimulated by boring holes. In this way it is possible to obtain powerful jets at a pressure of two to three atmospheres, according to the locality, and in some exceptional instances as high as five atmospheres, the temperatures varying from 150 to 165 degrees Centigrade. These jets maintain their force and temperature unchanged for many years, and they are not affected even when other openings, not too near each other, are bored in the ground, proving that they do not influence each other reciprocally, so great is the underlying thermic energy below. In 1905, Prince Ginori-Conti applied this natural steam to a 40 H. P. engine, using only a small section of the Nenella fissure, which is the most powerful "soffioni," the steam ejected having a pressure of five atmospheres.

The results obtained during several years of experimentation were satisfactory, so that he continued to make larger and deeper borings, measuring the force of the steam ejected: combined, this force could operate engines of many thousand horsepower.

In 1912 an experiment was made, very wisely on a more modest scale but sufficient to obtain conclusive results, for which a 300 H. P. turbine-alternater was used. Later, because of the enormous increase in the price of coal, the Prince decided to exploit the thermic energy of these soffioni on a much larger scale, but as other substances are omitted with the steam, among them sulphuric acid which corrodes metals, particularly iron and therefore the pipes in which the steam was to be collected, he attempted to use this steam only for heating. Three turbine-alternaters of 3,000 kilowatts each were installed, fed by boilers at low pressure not heated by coal or other combustible fuel, but by the natural steam, superheated to 165 degrees C., issuing from these soffioni and piped and carried to the boilers.

To-day the works at Larderello have a central plant of 16,000 H. P. operating without interruption and distributing current to Florence, Livorno and Grosseto; its capacity is soon to be increased. Here we have a new and original utilization of Italy's natural wealth; current is generated not by the use of "white coal" (water power), but by means of heat energy of volcanic origin. As the natural steam available at Larderello and the surrounding country is, one might say, unlimited and depends upon the number of bore-holes made in the boraciferous soil, the great possibilities for further development are readily seen.

Electricity's Part in "Welcome Home"

THE action of Fuel Administrator Garfield, in removing the embargo on the use of electricity for the purposes of street illumination and advertising assures a more striking welcome to our returning soldier boys. Of course there will be no more gratitude and affection than if our streets were dark, but there will be the keen satisfaction of expressing our feelings by a blaze of light and color and in flashing welcoming messages so that all eyes can read them. Electricity has come to be the generally accepted and employed medium for expressing the sentiments that are in our heart to utter publicly.

Incidentally, too, the flooding of streets and shop windows with light without stint is having a salutory effect upon the spirits of all. Light begets optimism, which in turn is needed to inspire confidence in the unbounded future of our country, as well as to restore men's minds to the normal channels of thought which fathered the past, and will continue the future development of business and industry.

Reports that has been received indicate that the welcome-home spirit is being manifested electrically everywhere, and that many of the signs and devices which are being employed are of a character to insure their permanency for a long time to come. On the front of the Rivoli Theatre in New York City, for instance, there is a cluster of myriad lamps so grouped as to flash out the Allied emblems in all their glorious color, 'atop of which is the American Eagle guarding a shield. On the Union League Club there is a great electric sign which blazes forth this message: "Welcome Home to the Boys from Over There." In fact, look where you will, electricity is on the job of welcoming the boys back to "God's Country."

Some idea of the magnitude to which the plan of welcoming the boys home electrically is being carried can be had from these facts regarding the equipment that is being installed for the New York Times Building, and which consists of over 5,000 10-watt lamps distributed as follows: The entire building will be outlined with 300 two-foot stars, each star containing eleven lamps, alternating red, white and blue on a flasher. On the Forty-third Street side, facing Times Square, will be a cluster of Allied flags, surmounted by a spread eagle holding the American shield. This display utilizes 1,000 lamps and will measure forty feet wide by twenty-four feet high. The flags will have a waving effect, and over this will be an electric sign reading "VICTORY" in six-foot letters. At each of the four entrances of the building will be a pair of crossed American flags waving, these will contain 250 lights each. And on the roof will be four flashlights illuminating the American flag flying from the flag staff.

However, expression of the welcome-home spirit is not restricted to those only who can go in for large and elaborate displays. Individual dealers, many of whom have neither the facilities nor the means to make a big display, have utilized their windows as the basis for their share in the generally expressed welcome. In some of the windows, army and navy signal flags are grouped to spell out appropriate messages of welcome, the whole being lighted by flashers or flood lights. In others, small lamps, operated by flashers, are grouped to spell out such messagess as "Welcome Home," "And You Did Come Back and With Victory," "Welcome to the Victors," "Welcome Home Boys." In others, flags and painted messages are rendered attractive by the judicious use of light.

Participation in the movement is in every sense general; trade and civic organizations, church bodies, societies, patriotic associations, all are doing their "bit." In New Jersey the Governor called a conference of Mayors of the cities in that state to consider plans for celebrations, memorials and rehabilitation, stating in his address that he wished to have devised "a plan for uniform public celebrations in honor of the home-coming soldier and sailor heroes." He further added that it was his idea that every community would want its own local celebration and that the initiative should spring from the individual municipalities, with the State Government co-operating both morally and financially, and that he would recommend to the State Legislature an appropriation for this purpose. The Mayor of Newark emphasized the fact that it was very important to acknowledge in an appropriate way the great service rendered by Uncle Sam's fighting men.

Other states and cities, too, have taken up the question and are formulating definite plans for welcoming their returning citizen-soldiers. In Chicago, for instance, the Commonwealth Edison Company has taken an active part in the movement to arouse and direct the enthusiasm of business interests, as well as to secure the co-operation of clubs, churches, civic and other bodies. Recommendations to cheer up, paint up, brighten up and light up were scattered broadcast. A series of newspaper advertisements were run in the six leading Chicago papers, being continued over a period of six weeks. "Let us," said a newspaper editorial, "show our boys that Chicago welcomes them back home just as heartily as it enthused when they marched away. The Chicago slogan is 'I will'—well, let's put the I WILL spirit back of our welcome." Chicago is doing just that.

The Society for Electrical Development held a meeting of a Special Committee, to formulate ways and means to enable the Electrical Industry to do its share towards making the boys realize that America honored them for their patriotism and was not forgetful of their many sacrifices. Copies of the advertisements used by the Commonwealth Edison Company of Chicago have been sent to all the central stations in the country, together with a letter outlining how they can best get behind the welcome-home movement. Dealers, contractors and manufacturers, too, have been advised of the parts they can best take in making the movement successful. And all business interests that can contribute to the brighten-up phases of the movement have been, or are being, notified of the responsibility resting upon them to participate.

Light-Up Nights Replace Lightless Nights

Signs of the Times for January, 1919, devotes a great deal of attention to electric signs, and includes short article by H. E. Young, sales manager of the Minneapolis General Electric Company, and W. H. Hodge, publicity manager of H. M. Byllesby & Co. In connection with Mr. Young's article the publication reproduces newspaper advertisement entitled "A Timely Opportunity for Minneapolis Merchants," and circular letter addressed to all electric sign customers and prospects concerning the desirability of getting their electric signs into action again. The following paragraphs are quoted from Mr. Young's article:

"The turning on of all signs was especially noticeable after the long period of darkness, and the comment was universal as to the feelings of relief and optimism which this caused after such a long period of dismal and depressing darkness.

"We feel that the stimulating effect of the appearance of signs after this period of darkness has convinced the public in general more than ever of the value of this advertising. The public in general and the advertisers in particular had gotten so used to seeing electric display advertising that they failed to fully appreciate its wonderful value until they were deprived of it and until they were impressed with its advantages by seeing it again in operation."

The following paragraph is quoted from Mr. Hodge's article:

"The above evidence of the commercial and psychological value of electrical advertising and outdoor electric lighting is extremely significant. After nearly two years of retrenchment the demand for greater use of electricity for these purposes is bound to be much greater than anything before known. It is going to take some time to dispel the gloom and sorrow caused by the war in this country, and electricity will be one of the mediums employed for accomplishing this object quickly. I am confident that our business men will realize the manifold value of the liberal electric lighting displays and that the increased use of electric advertising has already begun."

Correct Lighting of School Buildings

THE importance of the proper lighting of school buildings will be understood when it is stated that there are in the United States 20,000,000 school children working at their desks several hours a day. According to statistics, about 10 per cent. of these have defective vision.

In order to improve school lighting as far as possible, the Illuminating Engineering Society has formulated a code of lighting for school buildings, making available the best information extant with regard to this subject.

One of the conditions most productive of eyestrain is the glare of an unshaded lamp. The glare from a bright, reflecting surface will also produce this condition in a greater or lesser degree, depending upon the degree of reflection. To remedy this, all lamps should also be suitably shaded. They should also be so arranged as to secure a good distribution of light on the work, avoiding objectionable shadows and sharp contrasts.

Walls should have a moderate reflection factor; the preferred colors are light gray, light buff, dark cream and light olive green. Ceilings and friezes should have a high reflection factor; the preferred colors are white and light cream. Walls, desk-tops and other woodwork should have a dull finish.

Basements, stairways, store rooms and other parts of the building where required should have switches or controlling apparatus at point of entrance.

Emergency lighting should be provided at main stairways and exits to insure reliable operation when, through accident or other causes, the regular lighting is extinguished.

All parts of the lighting system should be properly maintained to prevent deterioration due to dirt accumulation, burned-out lamps and other causes. To insure proper maintenance, frequent inspection should be made at regular intervals.

A direct lighting system is known as one in which most of the light reaches the work plane directly from the lighting unit, including the accessory, which may be an opaque or glass reflector or a totally enclosing transparent or translucent envelope. Direct lighting systems may be further classified as localized and general or distributing. In the former the units are so placed as to light local work spaces, and in the latter they are well distributed so as to light the whole area more or less uniformly.

A semi-indirect system is known as one in which a portion of the light reaches the work plane directly from the unit and a relatively large portion reaches the work plane indirectly, by reflection from the ceiling and walls. The accessory is usually an inverted diffusing bowl or glass reflector. When this glass has a high transmission factor the lighting effect approaches that of ordinary direct lighting, and when of low transmission the effect approaches that of indirect lighting.

An indirect system is known as one in which all or practically all the light reaches the work plane indirectly after reflection from the ceiling and walls. The accessory is usually an opaque or slightly translucent inverted bowl or shade containing a reflecting medium.

All three of these systems of lighting are in successful use in schools. There has been a growing preference for semi-indirect and indirect lighting, especially since the introduction of modern lamps of great brilliancy. Local lighting by lamps placed close to the work is unsatisfactory except for special cases such as the lighting of blackboards, maps, charts, etc.

Except in very rare instances bare light sources should not be exposed to view. They should always be adequately shaded. Even when shaded by translucent media, such as dense glassware, the lighting units should be placed well out of the ordinary range of vision; in other words, it is recommended that lighting units be of low brightness, even if they are located high in the field of view.

Glossy surfaces of paper, woodwork, desk tops, walls and blackboards are likely to cause eyestrain because of specular or mirror-like reflection of images of light sources, especially when artificial light is used. Matte or dull-finished surfaces are recommended. It is to be noted that a high reflection factor does not necessarily imply a polished or glazed surface.

The chief factors which must be considered in arriving at the size and number of lamps to be used in a given room are: (1) the floor area, (2) the total luminous flux emitted per lamp, and (3) coefficient of utilization of the particular system considered. The first should be measured in square feet. The second may be obtained from a data book supplied by the manufacturers of lamps. The third involves many factors such as the relative dimensions of the room, the reflection factor of the surroundings, the number of light units and their mounting height, and the system of lighting. By coefficient of utilization is meant the proportion of the total light flux emitted by the lamps which is effective on the work plane.

Suitable switching and controlling arrangements should be made to permit of lighting one or more lamps independently as conditions may require.

The teacher's desk may be illuminated by one of the overhead lighting units, or if necessary by a desk lamp.

With the usual lighting equipments the distance between the units should not exceed one and one-half times the height of the apparent source of illumination above the working level.

Blackboards should be of minimum size practicable and should not be placed between windows. Their position should be carefully determined so as to eliminate the glare due to specular reflection of images of either artificial or natural light sources directly into the eyes of occupants of the room.

Glare due to specular reflection from blackboards may be reduced or eliminated by lighting them by means of properly placed and well-shaded local artificial light sources.

Electrifying Italy's Railways

Great savings in the use of coal, according to the Italian Bureau of Public Information, have been effected in Italy in the past few years through the electrization of railroads and harnessing the water power of the country to generate electricity. The percentage of railroads electrified in Italy from 1900-1915 is greater than in any other European country, and the economies resulting have been gratifying.

Electric traction of railroads began in Italy in 1900 with installations on the Varesina Line, which runs through Milan, Gallarate, Varese and Ponteceresio, and on the Valtellinese Line which runs from Lecco to Chiavenna. Railways which runs on mountainous routes and carry heavy trains have been installed with different systems. The principal mountain routes electrified are the Moncenisio Line, the Ceva-Port Savona Line, the old line of Giovi and the new supplementary Giovi line. These cover some of the most difficult territories traversed by any of the railroads in Europe.

The Moncenisio Line is the longest of the mountain railways. It is 8.5 miles long, travels at an altitude of more than 1,000 yards above sea level and is continuously on the ascent. It has a nominal carrying capacity of 640,000,000 tons per mile, and actually carries 240,000,000 tons. The Ceva-Port Savona Line is a series of steep inclines and declines. The Giovi Line has the most rapid descent of any railroad in Europe and the supplementary Giovi Line carries the heaviest traffic in Italy.

The perfect systems installed on these mountain routes has made possible the increase in the carrying capacity and the speed of the railways. There is at present under consideration the electrification of 1,250 miles more of railways.

Haiti and Dominican Telephone Connection

The telephone systems of Haiti and the Dominican Republic have recently been connected, writes Consul Arthur McLean, from Puerto Plata, Dominican Republic. It is now possible to communicate between the principal towns of the two Republics. Telephone messages are written out in this country the same as telegrams in the United States. They are then transmitted by the telephone operator. There is no exchange telephone service between the various towns of this Republic. The rates to Haiti are 20 cents a word from the southern section, and 25 cents from the northern provinces of the Dominican Republic. The address and signature are charged for additional.

Growth of Electric Service in Various States

PRELIMINARY figures of the report on the central electric light and power stations of a number of the states have been given out by Director Sam. L. Rogers, of the Bureau of the Census, Department of Commerce. They were prepared under the supervision of Eugene F. Hartley, Chief Statistician for Manufacturers.

The statistics relate to the years ending December 31, 1917, 1912, and 1907, and cover both commercial and municipal plants. They do not, however, cover electric plants operated by factories, hotels, etc., which generate current for their own consumption; those operated by the Federal Government and state institutions; and those that were idle or in course of construction.

The number of establishments in Delaware, District of Columbia and Maryland, reporting increased from 56 in 1912 to 63 in 1917, a gain of seven, four of which were commercial and three municipal. During the same five-year period the income increased $3,803,905, or 70.6 per cent, as compared with an increase of $2,040,675, or 61 per cent, from 1907 to 1912. Steam power in 1917 formed 97.9 per cent of the total for all classes of power, and a noticeable feature of these statistics is the steady increase in the capacity of the steam engines and turbines used. The average horsepower per unit increased from 565 in 1907 to 997 in 1912 and to 2,702 in 1917. The increase in the output of stations from 1912 to 1917, amounting to 208,404,896 kilowatt hours, is significant of the growth in the business of the electric stations.

The figures for New Hampshire show substantial gains for each of the two five-year periods for which statistics are presented, although the increases are somewhat greater for the 1907-1912 period. From 1912 to 1917 there was an increase of $941,666, or 40.4 per cent, in the total income, compared with a gain of $905,918, or 63.7 per cent, from 1907 to 1912. The total horsepower, which increased 80 per cent from 1907 to 1912, shows a gain of only 10.8 per cent from 1912 to 1917. The kilowatt capacity of the dynamos shows corresponding increases, 81 per cent and 13.5 per cent, respectively. From 1912 to 1917 the output of stations increased 33,862,253 kilowatt hours, or 26.7 per cent compared with a gain of 71,335,049 kilowatt hours, or 129.1 per cent, from 1907 to 1912. There was a great decrease in the use of arc lamps for street lighting, together with a decided increase in the incandescents, etc.

Substantial increases in Virginia are shown from census to census in all details except the number of arc street lamps. This decrease in arc street lamps, however, is in harmony with the general practice in street lighting, and in Virginia the loss is more than made up by the large increase in incandescents, etc. From 1912 to 1917 the income increased $1,612,064, or 200.2 per cent as compared with an increase of $414,394 or 106.1 per cent from 1907 to 1912. The expenses show similar increases, that for the five-year period 1912 to 1917 being 267.4 per cent and that from 1907 to 1912, 116.8 per cent. A similar proportionate increase appears for the output of stations; from 1912 to 1917 this increase amounted to 78,856,074 kilowatt hours, or 274.5 per cent compared with an increase of 18,516,324 kilowatt hours, or 181.4 per cent from 1907 to 1912.

The figures for Nevada show general increases at each succeeding census. As a rule, however, the gains are greater for the later five-year period. From 1907 to 1912 the number of establishments decreased from 9 to 8, but from 1912 to 1917 it increased to 14. The income and expenses increased during both five-year periods, and it is noticeable that the percentage of increase in expenses was greater than that for income; from 1912 to 1917 the income increased $319,987, or 51.7 per cent and the expenses $234,104, or 54.7 per cent; from 1907 to 1912 the increase in income amounted to $246,834, or 66.3 per cent and in expenses to $182,964, or 74.6 per cent. From 1907 to 1912 there was an increase in each of the three classes of power shown, but from 1912 to 1917 the horsepower of steam units and of internal-combustion engines decreased, while that of water wheels increased 2,575 horsepower, or 20.5 per cent. From 1912 to 1917 the output of stations increased 8,876,406 kilowatt hours, or 19.7 per cent, compared with an increase of 15,348,042 kilowatt hours, or 51.8 per cent from 1907 to 1912. In common with other states, Nevada shows decreased use of arc lamps for street-lighting purposes.

The figures presented for Utah show a remarkable growth in the central electric light and power stations, more pronounced during the later five-year period, from 1912 to 1917. The total number of companies reporting increased fourteen from 1907 to 1912, and only two from 1912 to 1917. The number of stations, however, has but little significance because of the tendency to combine in a single system two or more plants that previously reported as independent stations. From 1912 to 1917 the income increased $3,895,542, or 251.4 per cent., compared with an increase of $844,024, or 132.9 per cent., from 1907 to 1912. The expenses increased correspondingly, 233 per cent. and 161.4 per cent., respectively. From 1912 to 1917 the output of stations shows a gain of 380,360,478 kilowatt hours, or 439 per cent., compared with an increase of 24,961,997 kilowatt hours, or 40.5 per cent., from 1907 to 1912. The total horsepower increased 274 per cent. and 68.5 per cent. during the respective five-year periods. Unlilke most of the states for which such figures are presented, Utah shows a large increase from 1912 to 1917 in the number of arc street lamps, the gain in incandescents being comparatively insignificant.

The figures presented for New Mexico show substantial gains for each five-year period. From 1912 to 1917 the income increased $396,312, or 79.6 per cent., compared with a gain of $205,213, or 70.1 per cent., from 1907 to 1912. From 1912 to 1917 also the actual increase in expenses, $395,059, or 87.9 per cent., was greater than from 1907 to 1912, when the gain was $222,579, or 98.1 per cent. From 1912 to 1917 the output of stations increased 8,216,944 kilowatt hours, or 91 per cent., compared with a gain of 4,413,475 kilowatt hours, or 95.6 per cent., from 1907 to 1912. The actual increase in dynamo capacity was greater from 1912 to 1917 than for the prior five-year period, but the percentage of increase was less for the later than for the earlier period. In harmony with the showing for street lamps in most of the states, the use of arc lamps for street lighting shows a decided decrease from 1912 to 1917.

The total number of establishments reported from Mississippi increased at a nearly uniform rate between 1907 and 1917, from 68 in the earlier year to 97 in the later. The figures for most of the remaining items show greater increases, both actually and proportionally, from 1907 to 1912 than for the following five-year period. For example, the increase in the total income from 1912 to 1917 amounted to $134,610, or 11.5 per cent., as against $481,087, or 70.1 per cent., for the preceding five years; the increase in the total expenses during the later period was $169,291, or 19.3 per cent., as against $358,510, or 69 per cent., for the earlier; the increase in the total horsepower between 1912 and 1917 was only 2,791, or 9.2 per cent., as compared with 14,975, or 96.5 per cent., between 1907 and 1912; and the increase in the output of stations from 1912 to 1917 amounted to only 2,573,918 kilowatt hours, or 9.2 per cent., whereas during the earlier period it was 12,219,559 kilowatt hours, or 77.8 per cent. As in the cases of most other states, the number of arc lamps used for street lighting decreased materially from 1912 to 1917, the rate of decline being 53.2 per cent.

Electrical Combinations in Connecticut

There were fewer commercial and municipal electric light and power stations in the state of Connecticut in 1917 than in 1912, according to figures just given out by the Bureau of the Census, Department of Commerce. As a matter of fact, however, seven plants were added during the five-year period and none reported for 1912 were omitted for 1917. The decrease is due to combinations that have taken place whereby a number of separate plants reported for 1912 have been included under a single ownership for 1917. The actual increases are generally greater for the later five-year period, while the relative increases, as a rule, favor the period from 1907 to 1912. The income from 1912 to 1917 increased $5,373,712, or 100.5 per cent, and the output of stations, 214,890,942 kilowatt hours, or 164.5 per cent. From 1907 to 1912 the corresponding increases were $2,878,009, or 116.5 per cent., and 63,265,969 kilowatt hours, or 93.9 per cent.

To Build Electric Locomotives at Essington

Discussing the prospects for the year 1919 at the Essington, or South Philadelphia, Works of the Westinghouse Electric & Manufacturing Company, Mr. R. B. Mildon, assistant to the vice-president, made the following statement: "We share the general opinion in the industrial field that business will slow down somewhat owing to the readjustment of the industries from a war to a peace basis; but by spring this phase should be over and then for the next few years we should have a period of prosperity.

"As far as the Westinghouse Works at Essington is concerned, we have enough orders on hand to keep us busy for the next year without considering new business which is now beginning to develop.

"We are at present making nothing here but ship propulsion machinery, but our plans contemplate bringing here all of our turbine and electric generator construction work that is now being handled at East Pittsburg. Before we can accommodate this additional business, however, we shall have to build several new buildings, including an office building, a shop for making turbine blades, and an electric generator shop. Unless we are mistaken in our expectations, however, this new construction work should begin this spring.

"Looking a little further ahead into the future, it is probable that we shall in time erect a building for the construction of electric locomotives. The electric railroad situation is unquestionably very favorable and a large amount of electrification will be undertaken in the next ten years. We co-operate with the Baldwin Locomotive Works in the manufacture of electric locomotives and our location here, so close to the Baldwin plant, makes this the proper place to do our part of the work.

"In other words, we plan to build at Essington all of our large and important apparatus, and as the demand for this class of apparatus is certain to increase rapidly from year to year, we expect to see our plant expand in the near future to many times its present size."

Medical Service in Public Utility Company

The Division of Industrial Hygiene and Medicine of the Department of Labor gives the following report of the service that has been established in a public utility company in Illinois: "Periodical inspections, which include all employes of the company with the exception of laborers and temporary help, are conducted by the company physician. * * * A visiting nurse service is also maintained to insure proper care and medical attention of sick employes. The nurse is sent to the home of any absent employe on the request of the head of department in which he works to give such help or suggestions as the case may warrant. The physical inspection and medical examination of employes, the visiting nurse service and the company's welfare work in general are conducted under the supervision of the employment bureau. The care exercised in safeguarding the health of employes since this system was established several years ago has been productive of excellent results and has materially increased the efficiency of the working force."

Cumberland Has Right to Raise Fares

Under the laws of Maryland the Cumberland & Westernport Electric Railway Company filed a new tariff of rates which were 2⅓ cents a mile. The franchise agreement provided a rate of 1⅔ cents a mile, and taking this as a basis two individuals filed protests against the Commission approving these rates. The matter was referred to W. Cabell Bruce, general counsel, who, in a recent opinion, holds that the Cumberland & Westernport Electric Railway Company had the legal power to take the action it did.

The opinion is as follows: "I have received your communication of the 20th instant asking me whether the Cumberland & Westernport Electric Railway Company has the legal power to file tariff schedules with commission fixing rates in excess of those prescribed by the franchise agreement entered into between itself or some of its corporate predecessors, and the County Commissioners of Allegheny County, all of these agreements having been executed prior to the Public Service Commission law on April 5, 1910. In my judgment the Cumberland & Westernport Electric Railway Company has the legal power to do so. Contracts, even as individuals, when entered into are necessarily subject to the control of the police power of the state whenever a contract relates to matters which are, or may be, subject to the exercise of such power."

This particular point has been raised in many instances in which traction companies or other public utilities sought increases in rates, and this decision is of particular interest in consequence. Also because the opinion holds that a state commission can raise as well as lower rates.

Minnesota's Telephone Systems

Minnesota has 250,610 miles of telephone wires, according to James W. Howatt, supervisor of telephones, in his annual report to the Minnesota Railroad and Warehouse Commission. There are 1,719 known telephone companies in the state, ranging from the Arthur Freese Telephone Company, of Lyon county, with one subscriber and three-fourths of a mile of wire strung on fence posts, up to a $24,000,000 corporation. The total investment in telephone properties reaches the huge sum of $45,671,957.

The total number of telephones in use is 395,789, which on the population basis of 2,432,000 gives one telephone for every six inhabitants. There are 99,439 telephones on rural or farm lines. The number of farms is given as 156,137, and hence 64 per cent. of the farms in Minnesota are supplied with telephone service, or, in other words, 64 out of every 100 farms are connected with the extensive telephone web of Minnesota.

Lead and Zinc in 1918

The domestic mine output of lead and zinc decreased in 1918, according to C. E. Siebenthal in a statement just issued by the U. S. Geological Survey, Department of the Interior. The lead and the recoverable zinc of ores mined was approximately 563,000 tons and 627,000 tons, as compared with 651,156 tons and 711,192 tons in 1917. The refined lead output of smelters and refineries was 645,000 tons, against 612,214 tons in 1917, and the antimonial lead output was 22,000 tons, as against 18,647 tons. The lead available in the United States is 540,000 tons, against 515,258 tons in 1917. The output of spelter from domestic and foreign ore was 525,600 tons, compared with 669,573 tons in 1917. Spelter from foreign ore decreased to 23,300 from 84,976 tons in 1917. The apparent domestic consumption of spelter was 440,000 tons, compared with 413,984 tons in 1917. The consumption figures of both lead and zinc include the metal shipped abroad for use of the American Expeditionary Forces. The average price of lead at New York was 7.6 cents a pound and of spelter at St. Louis 8 cents a pound.

England Needs Half a Million Houses

The providing of housing for the thousands who are arriving in London daily is a problem which is causing much anxiety to the authorities. One of the daily papers discusses conditions in the city under the heading "One Million Persons Too Many in London." The creation of Government departments and bureaus for war work has brought thousands of people into London. There are approximately 130,000 people employed in clerical work relating to the war, and 900 buildings have been taken over by the Government in which to house them. These buildings, in the main, have been large hotels, which has caused added congestion to the hotels not affected. In a good many instances these war workers have brought their families with them, causing quite a demand for small flats and houses and resulting in congestion and insanitation.

The housing of the transient or floating population, made up of soldiers and sailors on leave, is one of the chief factors which is causing concern. Transportation facilities are inadequate, especially in the tubes and busses. This has been due to the shortage of rolling stock and labor, but the situation is being relieved as rapidly as possible and new trains are being added. The gasoline restrictions heretofore in effect have caused the bus companies to curtail their service, but no wthat this restriction has been relaxed a better schedule is being maintained.

It is estimated that 100,000 new houses are needed in London alone. During the war 1,500 houses have been condemned as insanitary and should not have been used, but under the circumstances they had to be occupied. The London County Council has 106 acres on which houses are to be built at once, which can accommodate 17,000 persons. It is proposed to spend £3,500,000 ($17,032,750) on this program. Other councils in Greater London have made application to erect houses on 60,000 acres. The Local Government Board has a scheme for erecting 300,000 houses, but the procuring of the material required is a great problem. Six thousand million bricks, 94,000,000 cubic feet of timber, 2,500,000 windows, and 3,000,000 doors are needed for these houses. British industries at present can not furnish all these materials, and the Government will have to import considerable quantities.

Apart from present overcrowding, if London's population continues to grow at the rate it did before the war, 145,000 houses to accommodate 720,000 persons must be built by 1928, in addition to those for people to be rehoused from cleared slums and those now living in overcrowded houses. At least 500,000 houses are needed in this country, involving the expenditure of some £200,000,000 (roughly $1,000,000,000).

Governor Coolidge Urges Building at Once

Governor Calvin Coolidge, of Massachusetts, has issued an inspiring message to the people of his state, arguing that the return to normal business life will not be accomplished by worrying over what may happen, but can only be accomplished by doing the tasks at hand. He says:

"Instead of being the sport of chance, Massachusetts ought to be the master of destiny. Instead of waiting, we should act. Government has released raw materials, labor and transportation. There is plenty of money, which makes a demand for merchandise. There ought to be no lack of a disposition to act, no lack of enterprise.

"The question is where to begin. A committee working with our board of labor and industries suggests the revival of building. This industry has been at a standstill for the past two years. It is in its nature basic. A contract for any kind of building at once makes the opportunity for other contracts for steel, cement, bricks, lumber, plumbing, steam heating, electrical equipment, and all other materials required in construction. This would mean the employment of large numbers of people in various factories manufacturing these materials.

"In this the various agencies of government ought to take the lead. It is therefore urged that all the departments in the commonwealth, counties, cities and towns should start the foundations, at least, for school houses, hospitals, libraries, police and fire department headquarters, bridges and other public buildings. There are many of these operations partially completed, and many others for which plans have been drawn and money appropriated. If public construction begins, private construction will soon follow as the increase in population requires more housing facilities. There is also much construction work on the railroads of New England, which the roads themselves and the national government should be urged to begin at once.

"The material resources of the community must be used for the benefit of the people of the community. Such use is the only thing that gives them value, and the only warrant for their existence. Unless this is done by private enterprise, it will have to be done through the taxing power and otherwise, for the purpose of relieving the suffering caused by unemployment. Every facility is at hand for an era of great prosperity. What is needed is the courage to act. In the exhibition of that courage the government agencies must take the lead."

Cities Service Company Buys Colorado Plant

The Cities Service Company has purchased control of the Western Light and Power Company of northern Colorado from Westinghouse, Church, Kerr & Co. Directors of Cities Service Company have ratified the negotiations and new directors have already taken charge of the company.

The power plant of the Western Light and Power Co. is located at a coal mine near Lafayette, and is equipped with automatic stokers and other machinery to save labor in handling its coal supply. The company furnishes light and power current for Boulder, Longmont, Loveland, Greeley, Fort Collins, Milliken, Fort Lupton, Brighton and other northern Colorado towns. The main offices are at Boulder.

Equipment improvements to cost $1,250,000 are being planned by the Doherty interests and a reorganization of the Colorado Company is probable.

Wireless Station in South Pacific

A wireless station has been established at Avarua, the principal town and port of Rarotonga, that now practically connects up a chain of wireless stations between the Fiji Islands, Tahiti, and Rarotonga with New Zealand, writes Consul General Alfred A. Winslow from Auckland. This was made possible by the fruit export trade of Rarotonga agreeing to pay a duty of 2 cents a case on fruit exported from that island of the Cook Group, this tax amounting to about $3,407 a year. This is quite an important matter for the South Pacific Islands, and will bring this part of the world in much closer touch with the outside, and should be of interest and value to the shipping interests at home.

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The following appeared recently in a Minot, North Dakota, publicataion: "Some time ago the city of Drake bought the local electric light plant and ran it as a municipal proposition. This proving unsatisfactory, the original owner was induced to buy back the plant and give the city the old-time good service." As we showed in the review of the recent volume by Prof. Edmond Earle Lincoln, of Harvard University, the experience of Massachusetts in the municipal operation of the electric light and power plants has not been very satisfactory. Mr. Lincoln's conclusions are: "Whatever the sequel may be, this modest study, as well as most careful and unbiased investigations, points to the conclusion that as a rule only the simplest and the 'well-seasoned' enterprises are at all suitable for public operation; and even these are in grave danger of becoming less efficient than they would be in private hands. Though political expediency or social necessity may sometimes momentarily outweigh all economic considerations, it still seems inherent in the nature of things that private industry must continue to show the way."

ITALY, whose population as a whole was without coal for heating and in large part without gas for cooking, for many months of the war period, was the worst sufferer from fuel shortage among the allied nations, according to the report of the commission sent to Europe by United States Fuel Administrator H. A. Garfield. Representatives of the Italian government, the commission reports, urge an annual national supply of 12,000,000 tons to meet actual requirements, drawing attention to the fact that "while the people may suffer privation without protest in war time," with the coming of peace a refusal to supply fuel "may give rise to serious disturbances." The whole of this quantity would of necessity be imported since Italy's only domestic fuel is a very poor grade of lignite. Before the war Great Britain shipped annually to Italy some 8,000,000 tons a year, but under present conditions it is doubted whether it can approximate to anything like these figures. The exports from the United States dwindled from nearly two million tons in 1915 to but 9,700 tons for the first nine months of 1918, due to prohibitive freight rates and shortage of ships. A month or two ago we printed a map in these columns showing the elaborate system of central stations and electric trunk lines in Northern Italy. In view of the very unpromising condition of the fuel situation, the country must make the most determined effort to develop its hydro-electric resources.

THE cessation of the war naturally left the United States Government in possession of a vast amount of supplies of various kinds for which it has no use. The disposition of these without a disastrous effect upon the general market is a problem that needs careful attention. Meetings of the director of sales and the representatives of the various industries affected have been held in order to decide upon some method of disposition that would not seriously disarrange the industries affected. It was agreed that the Government, in the case of machine tools, for instance, the manufacturers of these tools will be given an opportunity to purchase them at a price and on terms of settlement which will be satisfactory to all parties concerned. In case it is impossible for the manufacturers to purchase his product outright, an effort will be made to arrange for the marketing of the product by the manufacturers in an equitable manner, securing for the Government and the manufacturer alike the best possible terms. In case both these methods of disposition fail, the material will be offered for sale to the general public in a manner prescribed by law. The Government also has on hand a great amount of building material, and this will be disposed of in such a manner as to produce the least possible disturbance to the general market.

THE American Association of Engineers is giving its attention to a discussion of the question of licensing engineers, believing that it is important that an early solution of this most vital problem should be secured. The committee on legislation, of which Mr. L. K. Sherman, of Washington, D. C., is chairman, has just submitted a preliminary report on licensing. This discusses at length the existing license laws, and statutes that have been proposed in various states. As to the scope of license laws, the report says: "No existing license law includes all of the branches of engineering. Some states include surveying, others civil engineering. Illinois includes structural engineering. Other states license the practice of hydraulic and irrigation work and mining engineering. Electrical and mechanical engineering are not licensed to our knowledge, but almost invariably the operator of a steam or is being used extensively in the Government training classes for junior engineers on steam engineering work.

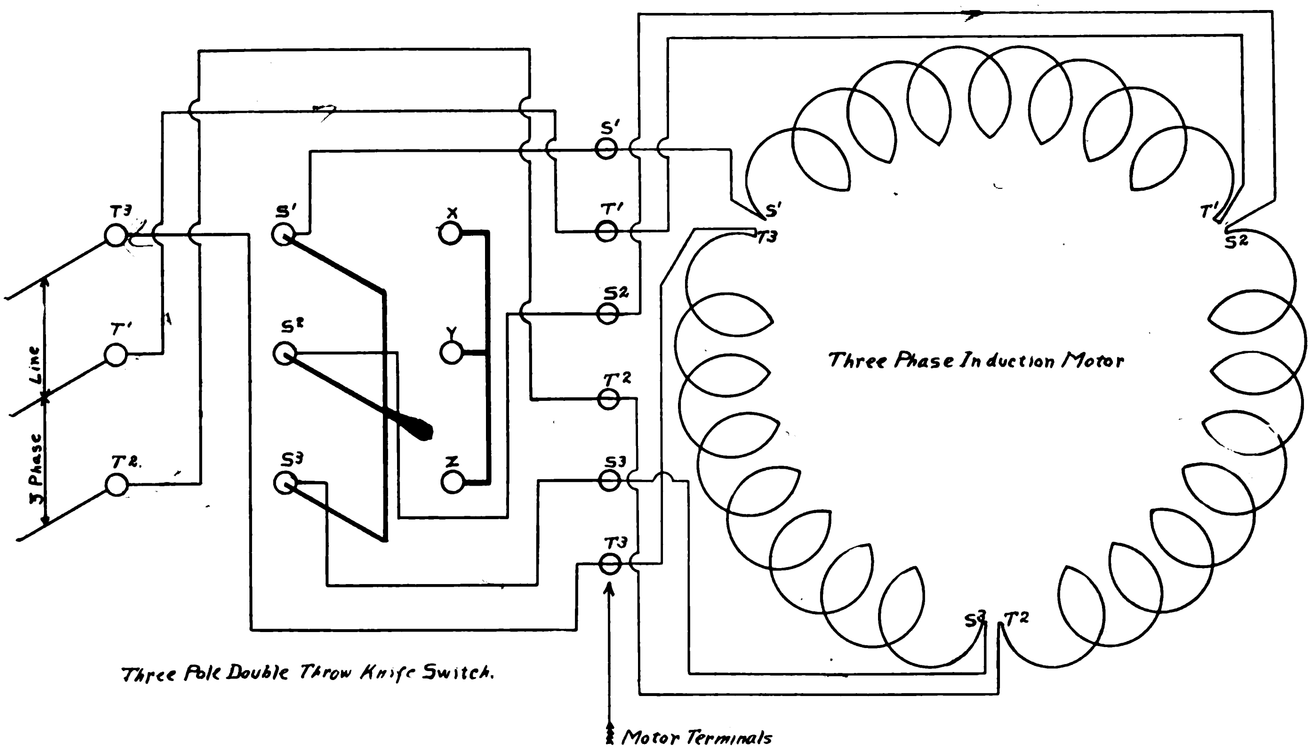
Three Pole Double Throw Switch

A correspondent asks for a diagram showing the connections for starting a three phase induction motor as a Y connected machine and when started to run it as a delta connected machine. The following diagram shows how this can be accomplished by using a three pole double throw knife switch, which is operated as follows:

The terminals of each phase or winding are brought out as follows:

S1 is the beginning of phase one (1).
S2 is the beginning of phase two (2).
S3 is the beginning of phase three (3).
T1 is the ending of phase one (1).
T2 is the ending of phase two (2).
T3 is the ending of phase three (3).

Terminals S1, S2 and S3 are connected to the blades of the switch, and the terminals T1, T2 and T3, also the three line wires, are connected to the jaws on the running side of the switch; the jaws on the starting side of the switch are bridged together.



Three Pole Double Throw Knife Switch.

By closing the switch so that the blades (to which terminals S1, S2 and S3 are connected) are in contact with jaws X, Y and Z the motor will start as a Y connected machine; when the motor has been started by throwing the switch to the other side so that the blades are in contact with the jaws to which the terminals T1, T2 and T3 are connected, the machine will then run delta connected.

Personal Notes

H. E. North, formerly with the Minneapolis General Electric Company, has been appointed manager of the Contract Department of the Oklahoma Gas & Electric Company, Oklahoma City, Okla.

Lieut.-Col. H. W. Byllesby was tendered a dinner last month by the officers and forty male employees of H. M. Byllesby & Co., at the University Club, New York, in honor of his return from service with the American Expeditionary Force abroad. Col. Byllesby related his experiences in the service, and declared that the second and harder phase of the war is now before us.

D. J. Young, of the San Diego Consolidated Gas & Electric Company, San Diego, California, has been appointed Vice-President and General Manager of the Tacoma Gas & Fuel Company, Tacoma, Wash., Olympia Gas Company, Olympia, Wash., and the Puget Sound Gas Company, Everett, Wash.

C. M. Brewer, manager of the Richmond division of the Western States Gas & Electric Company, has been appointed Vice-President and General Manager of the Mountain States Power Company, operating in Montana, Idaho, Washington and Oregon.

N. I. Garrison, manager of the El Reno, Okla., division of the Oklahoma Gas & Electric Company, has been appointed district chairman of the Public Utilities Association for the district around El Reno, embracing twelve counties.

Major William J. Hammer, one of the best known consulting electrical engineers, with offices at No. 55 Liberty Street, New York, has been appointed by the War Department a member of the General Staff Corps, and has removed to Washington. For some time past Major Hammer has been serving on the War Plans Divisions of the the War Department, but his appointment to the General Staff came as a complete surprise to him.

Mr. W. H. Finley, president of the American Association of Engineers, will address an open meeting of New York engineers at the Machinery Club, 30 Church Street, on Monday evening, February 10, at 8 P. M., on "Engineering Organization and Its Relation to Public Service." The meeting will be preceeded by a dinner at 6.30 P. M., and is under the auspices of the New York Chapter of the American Association of Engineers.

C. A. Hall has been promoted from assistant general manager to general manager of the Eastern Pennsylvania Railways Company and the Eastern Pennsylvania Light, Heat & Power Company, of Pottsville, Pa., by the J. G. White Management Corporation, New York, N. Y., the operating managers of the Pottsville properties. Mr. Hall succeeds L.

S. Cairns, deceased. In June, 1918, Mr. Hall entered the service of the two Eastern Pennsylvania Companies as manager of the electric light and power department and shortly thereafter was advanced to the position of assistant general manager. After leaving school in 1904, Mr. Hall entered the employ of the Consolidated Light Company, Huntington, W. Va. In 1907 he joined the organization of the Ohio Valley Electric Railway Company, Huntington, W. Va. He became superintendent of the Canonsburg Electric Light, Heat & Power Company, Canonsburg, Pa., in 1909, and following the purchase of this utility in 1911 by the West Penn Power Company of Pittsburgh, Pa., he was appointed local manager of that company in charge of the Canonsburg territory. Under Mr. Hall's management this property was entirely rebuilt and many improvements to the service made. He is a member of the National Electric Light Association and the American Institute of Electrical Engineers.

Elevator Manufacturers' Convention

The Elevator Manufacturers' of the United States held their semi-annual convention at the William Penn Hotel, Pittsburgh, recently. Among the subjects discussed were cost systems, co-operative service, elevator regulations, service stations, and the prospects of the industry. Among the features of the occasion were a banquet, a theatre party, and a trip to the works of the Westinghouse Electrical & Manufacturing Company.

The following officers were selected for the coming year: President, I. N. Haughton, Haughton Elevator Co., Toledo; Vice-President, O. P. Cummings, A. B. See Electric Elevator Co., New York; Secretary, Frank A. Hecht, Jr., Kerstner & Hecht Co., Chicago; Treasurer, J. H. DeVere, Ohio Elevator Co., Columbus.

Convention of the Indiana Engineers

The Thirty-ninth Convention and Annual Meeting of the Indiana Engineering Society, was held at the Claypool Hotel, Indianapolis, January 23-25. The first session, on Thursday afternoon, was devoted to a discussion of highway construction and maintenance, and kindred topics. The Thrusday evening session was devoted to the economic welfare of the engineer, and was held jointly with the American Association of Engineers. At the Friday and Saturday sessions, the local section of the American Society of Mechanical, Civil and Electrical Engineers participated. Friday afternoon Mr. Charles Brossman, of Indianapolis, Consulting Engineer on Public Utility Plants, U. S. Fuel Administration of Indiana, read a paper on "Lessons from the Fuel Administration and Public Utility Plants," the discussion being led by Mr. C. P. Baldwin, of Detroit. Mr. H. O. Gorman, chief engineer of the Indiana Public Service Commission, Indianapolis, presented a paper on "Public Utilities in the War Period." At the Saturday morning session three interesting papers read were the following: "The Year's Progress in Electrical Engineering in the Allied Fields," and "Electrical Pumps in Municipal Water Work," by Prof. D. D. Ewing, Purdue University, Lafayette, and "Some Recent Technical Developments in Telephony," by Prof. R. V. Achatz, Purdue University, Lafayette.

St. Louis Engineers in Annual Meeting

The St. Louis Chapter of the American Association of Engineers was installed at a banquet at the Planters' Hotel on the evening of January 18th, with about one hundred and fifty members enrolled. H. W. Clausen, vice-president of the American Association, presented the charter and spoke on "Social and Business Problems of the Engineer"; C. E. Drayer, national secretary, on "What A. A. E. is Doing"; Professor E. J. McCaustland, of the University of Missouri, on the need of the engineer to study his economic condition and to take steps to improve it. Mr. Baxter Brown, President of the Engineers' Club of St. Louis, extended the greetings of the local club and invited the St. Louis Chapter of the American Association to co-operate with the local club, particularly in its efforts along civic lines. A communication was read addressed to the local Chamber of Commerce from the Engineers Club of St. Louis urging upon the Chamber the appointment of an engineering committee and that reports on civic questions involving engineering practice be not made without obtaining engineering advice.

Election of permanent officers for the new chapter resulted as follows: Lef Winship, president; F. L. Flynt, first vice-president; C. G. Harrington, second vice-president; R. B. Kerr, secretary; George Grimm, Jr., assistant secretary; C. P. Calvert, treasurer.

Directors: J. F. Peters, W. E. Playter, E. F. Collins, Prof. E. J. McCaustland, University of Missouri; L. T. Maenner, H. L. Hopper.

Legal Decisions in Electrical Fields

Constitutional Law Impairing Street Railway Franchise—Revocation. The grant by a county board of a right to locate, construct, maintain, and operate an interurban electric railway along a state highway, without specifying any limit of time, is held in Northern Ohio Traction & L. Co. v. Ohio *ex rel.* Pontius, 245 U. S. 574, 62 L. ed. 481, 38 Sup. Ct. Rep. 196, L.R.A.1918E, 865,—unless there are controlling provisions in the state Constitution or statutes, or a prior adjudication by its courts to the contrary,—to constitute, when accepted, a perpetual franchise, protected by U. S. Const. art 1, sec. 10, against revocation by subsequent resolution of such board.

Evidence—Derailment of Car Presumption of Negligence. The derailment of an interurban electric car to the injury of a passenger who is free from contributory negligence is held to raise a presumption of negligence on the part of the carrier, in the Iowa case of Lewis v. Cedar Rapids & I. C. R. & L. Co. 167 N. W. 588, L.R.A.198E, 826.

Master and Servant—Liability for Act of Servant Lent to Another. An express company which lends by the day a team, wagon, and driver to an electric company engaged in constructing an electric line is held not liable in Pullman v. Express & Standard Cab Co. 259 Pa. 393, 103 Atl. 218, for injury to an employee of the electric company by the negligence of the driver in passing out a tool from the wagon, where the electric company directs the activities of the driver while the team is in its service.

The question as to who is responsible for the act of the driver of a hired vehicle is treated in the note accompanying the foregoing case in L.R.A.1918E, 118.

Negligence—Electricity—Pole in School Yard—Liability. Those responsible for maintaining within a school yard a pole carrying electric wires are held not liable in the Maryland case of Grube v. Baltimore Atl. 948, annotated in L.R.A.1918E, 1036, for injury to a bright boy ten or eleven years old, who, knowing that climbing the pole was not permitted, reached the climbing spikes from a fence and ascended the pole until he came in contact with a wire, which burned him and caused him to fall, to his injury.

Street Railway—Joint Use of Tracks—Act of License—Liability. A street railway company which makes an agreement with another company, under the authority granted by Ohio Rev. Stat. Sec. 3443-17, for the joint use of its tracks, is held liable for injuries caused by the actionable negligence of its licensee thereon, in Quigley v. Toledo, R. & L. Co. 89 Ohio St. 68, 105 N. E. 85, annotated in L.R.A.1918E, 249.

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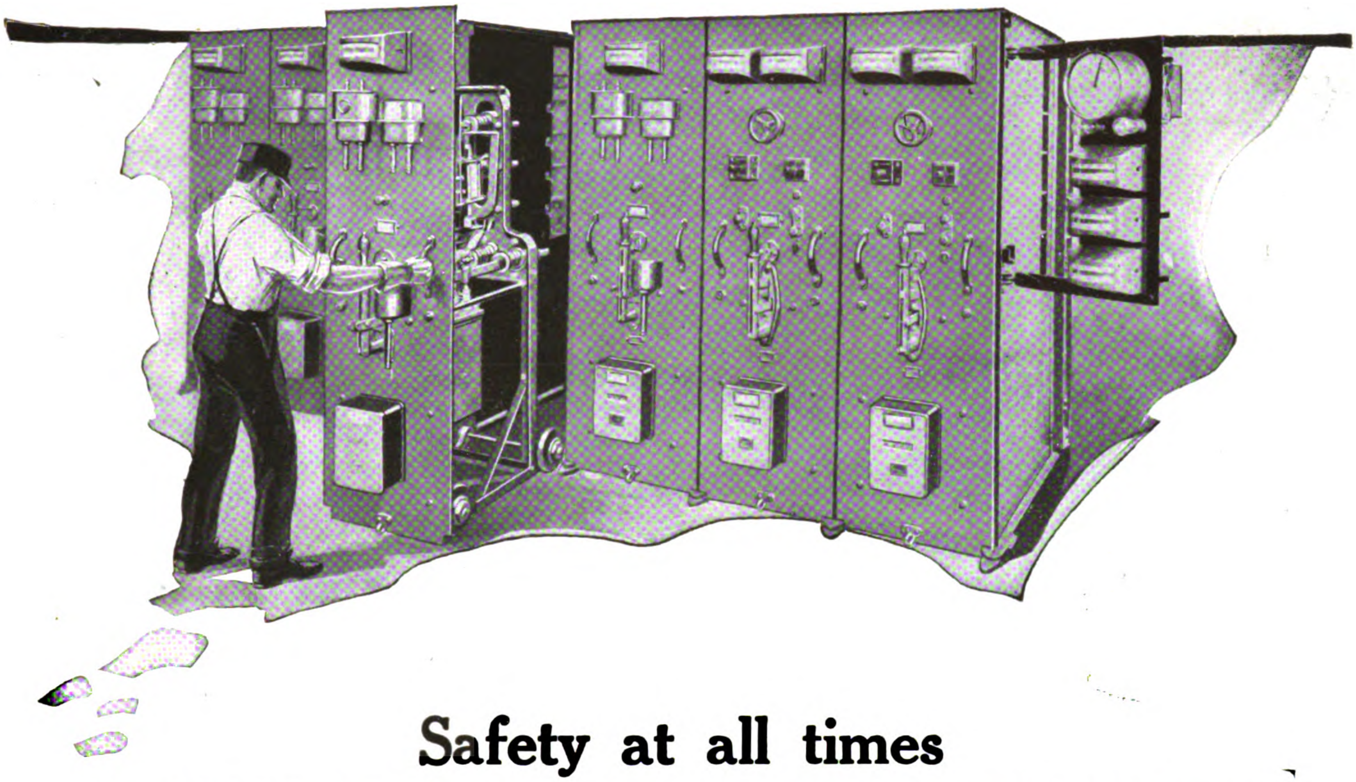

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Electrical Engineering

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MEMBER ABC

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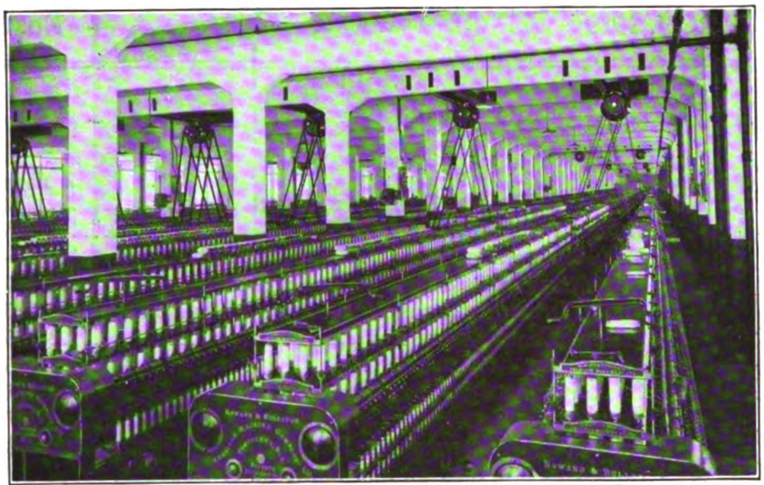

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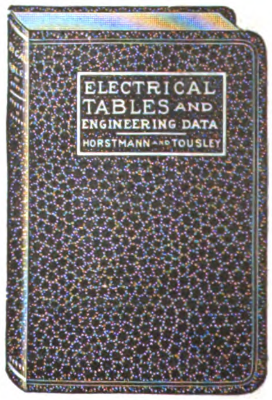

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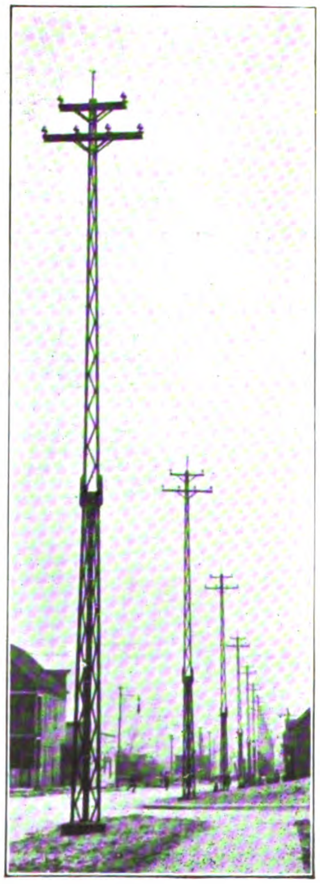

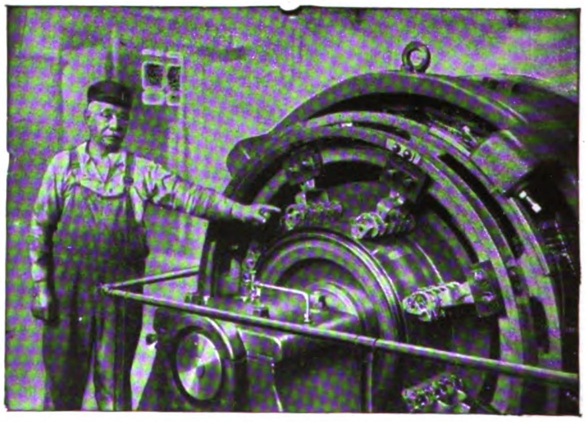

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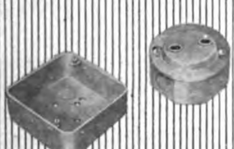

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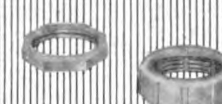

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ELECTRICAL ENGINEERING

VOLUME LIII MARCH, 1919 No. 3

Quarrying and Working Stone by Electricity

BELGIUM was the first country that made any general application of electric power to the quarrying and working of stone. Some years ago, before the country was invaded and its industries ruined, there were immense quarries and stone-dressing plants in which there were model equipments, all of the machinery, even the gang saws, having their individual motor drives. In the United States the substitution of electric for steam power is steadily increasing in stone plants. It offers many advantages in works of this nature which must, of necessity, be widely scattered. The invention of the electric-air channeler has made it possible to take the electric power even into the quarry pits. Most lines of business can be established in the most convenient location, taking into consideration the availability of labor and power and transportation facilities. It goes without the saying, however, that a quarry must be opened and operated where the deposit of stone is found. and this is often in a most inaccessible location. The cutting plant must often be close at hand. While the quarry may be so situated as to make the obtaining of fuel costly, electric power from central stations may be readily available. Or there may be a water power close at hand that can be developed. For many years the Vermont Marble Company, perhaps the greatest marble producing concern in the world under a single management, operated its enormous plants by steam power. These were far from the coal mines, and fuel was costly. In addition to this, there was a magnificent water power close to the principal quarries and mills. A few years ago one of the most complete hydroelectric powers in the country was developed, and this has solved the problem of convenient and economical operation.

In Great Britain, the stone industry is singularly unprogressive. The quarries and cutting plants have adopted few of the most improved methods of getting out and working stone, such as channellers and carborundum machines. On the contrary, they depend to an almost unbelievable extent upon hand labor. An anomaly is found in the fact that the slate industry in Great Britain is far more progressive than the stone industry, while in this country it drags far behind. The leading Welsh slate quarries began the electrification of their plants some years ago, and although the industry has undergone a period of unexampled depression, it is, from the standpoint of power and equipment, in a far more favorable position than the American slate industry.

Few of the British manufacturers have specialized in electrical appliances from stone quarrying and working. In this country almost every variety of stone machinery is designed either for electric or steam drive. We have electric-air channelers, electric hoists, and all saws, planers, copers, air-compressors, rubbing beds and polishers can be had with electric drives. As a further means of economy wherever electric power is available, there have lately been perfected electrically driven shovels or draglines for use in stripping overburden preliminary to quarry operations. These are also employed in mining coal, excavating, dredging, reloading coal and coke, making railroad cuts, and similar work.

The advantages arising by the use of the electrically driven shovel and dragline are as follows: lower operating cost, when fuels are scarce, expensive and hard to transport; a fewer number of operators are required; fuel is not an essential; there is no water to supply or freeze; no boiler, or boiler-troubles, no smoke, no sparks, no objectionable noises and more material can be handled.

A complete line of shovel and dragline equipment which meets the especially severe service encounterd in such work, has been resigned by the Westinghouse Company. Simplicity is another feature of the apparatus tending to give it reliability in operation without skilled and frequent attention. Both alternating and direct-current equipments can be furnished. In general, the location of the shovels make alternating-current equipment preferable because alternating current can be transformed more economically, and by using the alternating-current motors the necessity of converting alternating current to direct current is eliminated, resulting in simpler equipment.

The motors are of the wound-rotor type, capable of exerting powerful effort at the instant needed in the cycle of operation. Each motor is mounted on a massive frame with a strong shaft and amply large, well supported bearings of the oil-ring type. The rotating part is of small diameter and consequently has a low flywheel effect, which permits rapid starts, stops and reversals. The motors have few wearing parts and require little attention except for an occasional oiling. The controllers are simple and compact and are designed and arranged that the operator can, by manipulating his master switches, cause the shovel to respond to his very wish and with facility. By means of the protective features of the controllers, the shovel or dragline can be operated at its maximum rate of operation without injury to attendants or equipment and without loss of time. On account of the ease and simplicity of control and the savings in power cost, by the use of these motor-driven shovels and dragline equipment, not only can more material be handled, but more material at a lower cost per cubic yard.

Another newly designed form of electrically operated stone-handling plant is a skip hoist, which consists of a bucket running on inclined or vertical tracks, and hoisted by means of a steel cable attached to an electrically driven drum. The bucket consists merely of a rectangular steel box open at the top and fitted with guide rollers and hoist bale. The bucket is started by a rope attached to the motor controller, or, if preferred, a push button control, such as is used for "inching" with electrically driven printing machinery, can be installed. Automatic control is fitted to the bucket so that it discharges on reaching a given position and returns to the pit. It is possible also to synchronize the movements of the bucket with a filling device, so that as soon as a desired amount of material is loaded the bucket automatically starts. This hoist can be used with a small electric car to move the material a short distance to the loading hopper, or it can be used with a drag line bucket. It is claimed that a 35 cubic feet trolley hopper car on a 130 foot haul, traveling at a speed of 400 feet per minute, can make a round trip in two minutes, including filling and dumping, assuming that the material will flow by gravity into the car. This equals 40 tons per hour for the extreme, or 20 tons per hour for the average haul. A skip consisting of two buckets, one going up whilst the other is coming down, can make a trip in 90 seconds, including filling and dumping. If the buckets are 35 cubic feet capacity each, it would give 28 tons per hour at 50 cubic feet per ton and a 50 foot lift. The 20 cubic feet single bucket skips, on a 50 foot lift at 40 feet per minute, can handle 8 tons per hour, and this size of hoist only requires a 6 horsepower motor. Only one attendant is required to fill the hopper and start the hoist, and where a continuously operating excavator is used, and automatic filling adopted, one man is sufficient to handle even the largest plant.

Mention has been made above of the electrical equipment of the Vermont Marble Company in its quarries at Proctor and West Rutland. This method of operation has been found greatly superior to the use of steam power. In the Vermont quarries there are used in all about 100 electric channellers, including about two dozen of the old double-lever type, which are driven by direct-current motors, whereas the electric air machines are uniformly equipped with 12 horsepower induction motors. These motors have phase-wound rotors and external resistance connected through slip-rings, and are specially adapted for conditions requiring frequent starting under load with a relatively low starting current. In addition to the channelling process, the bottom of the block of marble is perforated by means of gadder drills, the holes being usually driven either along or parallel to the "rift" or natural cleavage lines, thereby rendering it possible to loosen the block by means of levers or wedges. There are 70 electric air drills for this work, operating on the same principle as the electric air channellers, but the drill proper and the motor-driven air compressors are separate portable units connected only by flexible air tubing. The load conditions are not severe, and the compressor is direct geared to a two-speed 5.5 horsepower induction motor. While most of the quarries are open workings, some extend for a considerable distance underground. In the West Rutland Quarry electric lighting is required, and an electric locomotive is used to haul the blocks of marble from the underground working face to the base of a slope hoist, which in turn lifts them to the surface. This engine is operated on 230 volts, direct-current, supplied through a motor generator set to a guarded feeder wire running along one side of the track, about 78 inches from the ground. The ventilating fan in this quarry is also electrically driven, as are also the pumps for lifting the water which accumulates. The hoisting ing motors for the derricks are rated at from 25 to 165 horsepower. More than 20,000 blocks are handled annually, the largest weighing about 55 tons. When the blocks have been hoisted to the surface they are deposited on flat cars and hauled either directly to the mills or to yards, where they are stored for future use.

The blocks are removed from the flat cars by means of electrically operated cranes and transferred to the mills. Direct current motors are used for the storage yard cranes, which are in some cases equipped with five motors, viz., one bridge motor of 35 horsepower, two hoist motors each 30 horsepower, and two trolley motors each 7½ horsepower. The crane has a bridge span of 160 feet and a capacity of 50 tons.

When the blocks of marble are transferred to the mill for sawing, they are delivered to the gang saws by a specially designed trolley-type locomotive crane, which travels on tracks running lengthwise through the mill building between two rows of gangs. The overhead yard crane removes the blocks from the flat cars in the yard and deposits them on a short heavy car, which is in turn placed on the tracks of the small transfer car, which is then moved into the mill by the crane, and the car carrying the blocks is finally run off on to the sawing beds. This crane is equipped with travel, hoist and turning motor, and has also a motor operated winch for pulling the block-carrying cars on to the transfer car after the sawing operation is completed. There are more than 300 electrically operated gang saws in service. In some instance a 6 foot diamond circular saw is employed in cutting and trimming marble slabs. It is provided with two motors, one of 25 horsepower for rotating the saw, and another 3 horsepower unit driving the feeding mechanism. There is also an electric carborundum machine in use for cutting grooves in pieces of marble. The bedplate has a slow reciprocating travel similar to that of a planer, and the adjustable grinding elements are carborundum wheels of various sizes and shapes. As with the saws, it is independently driven, a 20 horsepower induction motor driving both tools and bedplate. About 65 electrically operated rubbing beds are at work in the different shops. The older of these installations consist of groups of five or six machines driven through counter-shafting by 50 horsepower motors. The individual drive system, with its inherent economy, is now largely used for this purpose. In the more recent additions to the shop machinery it is usual to provide a 25 horsepower motor, belt-connected to each pair of rubbing beds. The squirrel-cage type of induction motor was adopted for this work and for practically all finishing shop drives. There are several hundred pneumatic hand tools used in the shops, and the air is supplied to them at from 50 to 60 pounds pressure by motor-driven air compressors. Overhead electric travelling cranes of the usual types are found in both shops and yards.

The flexibility of motor drive is well illustrated in this large installation. It has been clearly proved that the efficiency of the electric system is unaffected by temperature changes, which must always be considered with steam or air lines, and the laying of additional wire or cable to supply current to new machinery or to meet changes of location of any existing machine can be safely, easily and rapidly accomplished without interfering in any way with the operation of the remainder of the quarry equipment. It is found that with individual motor drive the energy consumption of each machine is limited to its period of actual operation, and the generating equipment need only be designed for the average maximum demand of the entire system. With steam or air, however, the boilers or compressors at each quarry would have to maintain full pressure throughout the working day, even at periods of low loads on the machinery or during changing or adjusting tools on individual machines. The conditions in a quarry are not by any means ideal for the operation of motors, due to the difficulty of completely protecting them from moisture, dust, mechanical injury or vibration strains; but the Vermont marble quarries show that enforced stoppage of work due to motor troubles, even of individual units, is exceedingly rare, and that the repair expenses for well-designed open type modern motors, in constant use over long periods, is confined largely to the occasional re-winding of the smaller pump and drill motors. For the larger units it is practically negligible. In this quarry system there are now in service a total of about 570 motors, ranging in capacity from 2 horsepower to 250 horsepower, with an aggregate rating of approximately 14,000 horsepower. Direct-current units are in many cases applied to hoists, cranes and locomotives, and constitute about 25 per cent of the total motor equipment. The remainder are polyphase induction motors, operating at 220, 400, or 2,300 volts on three-phase 60-cycle circuits.

Modern Lighting Awakens French Village

Lieut. Robert Montgomery, of the 140th Infantry, now Town Major of Boncourt, France, formerly commercial manager of the Louisville Gas & Electric Company, writes:

"To-day a French woman came into my office and said 'Monsieur, I would like to have electric lights installed in my house 'tout de suite, s'il vous plait!'

"For a moment I had to pinch myself for I wondered if I was still in a French village or back in the office of the Louisville Gas & Electric Co.

"When I came to this village I noticed a transmission line passed the place so I soon acquired sufficient material to wire my office and my room, after securing permission from the proper authorities. There are 60 officers, 2,000 men and 400 horses billeted in the village and our signal platoon had soon strung wire into the rooms of all the officers, the quarters of the men and some of the stables, so now all of the American forces in the village are provided with Mazda lamps.

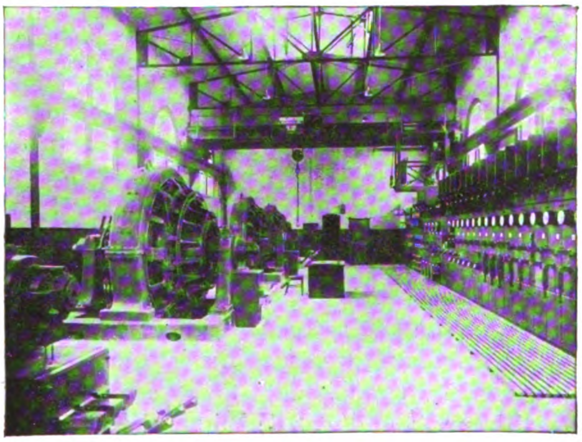
"The old ladies here and there have brought their knitting near the lights in the quarters of our troops, and found they could count the stitches as easily as were the sun shining—folks don't go to bed so early now. The three 40-watt lamps, one at each intersection of the streets, enable one to get about at night without bumping into a jackass or the town pump. There is a big contrast between their 'petrol' and our electric lights.

"Now the old ladies are all coming to see the 'American Major de Zone' concerning the wiring of their homes—and for once I have to turn away electric business as only our temporary lighting can be served from the line.

Railway Converter Substations

By C. E. Lloyd

DIRECT current railway substations are essentially very similar, since they all perform the same general functions, that is, supply power to propel cars and at the same time provide for safety, convenience of operation and economy. Necessarily, various substations differ widely in arrangement in details to best meet various local conditions. Naturally, it is the aim of each and every operating engineer to produce the substation most nearly approaching the ideal for his conditions at a minimum initial cost, to which end the operating engineer and manufacturer must co-operate closely, which will materially reduce the necessity of building special apparatus and incidentally reduce the price of standard apparatus.



Rear View of Westinghouse Substation Switchboard

The rotary converter is generally applicable and preferable to other classes of converting apparatus for railway service, requiring 600 and 1200 volts D. C. This statement is made unreservedly, since the converter has proven its reliability from an operating standpoint while its efficiency, including transformers, is from five to eight per cent better than that of a similar motor generator without transformers. In cases where a motor generator requires transformers, a greater efficiency advantage is obtained from the converter outfit. The railway substation, at least for interurban work, operates at comparatively poor load factor and in consequence a further advantage is gained with the converter outfit, since a greater saving in efficiency maintains at the lighter loads. Practically the only conditions which may preclude the use of the converter are two in number, as follows:

First: Where alternating current feeder line conditions are very poor, having for instance, excessive ohmic drop, severe surges, wide frequency fluctuations, etc., on which synchronous apparatus would probably prove unstable, the induction motor generator is the proper application. Today, this application is rarely met, since a system to be consistently efficient, must afford alternating current lines with comparatively little loss and be comparatively free from frequency variations, surges, etc. The choice in converting apparatus, therefore, usually narrows down to synchronous motor generators, or rotary converters.

Second: Where the line power factor is very poor it may be desirable to raise it with the converting apparatus, operating partially as a condenser. As the rotary converter is purely a unity power factor machine, a separate condenser is required to produce the same results as a synchronous motor generator, having its motor designed to operate partially as a condenser. Where the first cost and efficiency of the motor converter with separate condenser are equal to or better than the first cost and efficiency of a generator, the former is preferable.

The type of transformers selected depends almost entirely upon local requirements. The oil-insulated, self-cooled transformer is most universally used, especially in the smaller sizes, on account of its simplicity, due to its not requiring any additional apparatus for cooling purposes. If water is to be had in sufficient quantity at little or no expense, it may become desirable to use the oil-insulated, water-cooled transformer, except in the smaller sizes, where this type of transformer is more expensive than the self-cooled. In some localities, fire insurance rates are considerably reduced where transformers do not require oil. In cases of this kind, assuming moderate voltages, not to exceed 33,000 volts, the air-blast transformer is used. This type of transformer may also be applicable and desirable in large sizes, from a cost standpoint, even though there is nothing to be gained by lower insurance rates. It is, however, a safe rule to use oil-insulated, self-cooled transformers unless some marked advantage is to be gained, such as lower first cost or reduced insurance rates, by the use of one of the other types.

The phase selected may be dictated by local conditions. However, since the stationery transformer is possibly even more reliable than the rotary converter, there is little to be gained by the use of single phase in preference to three-phase transformers unless the first cost is equal or less. Roughly, in the self-cooled type, there will be a saving in the three-phase transformer in voltages below 33,000 for converters up to 1,000 kw. capacity. Above this size, single phase are practically no more expensive than three-phase transformers and are therefore, recommended. In the oil-insulated, water-cooled and air-blast, the three-phase transformer is always less expensive.

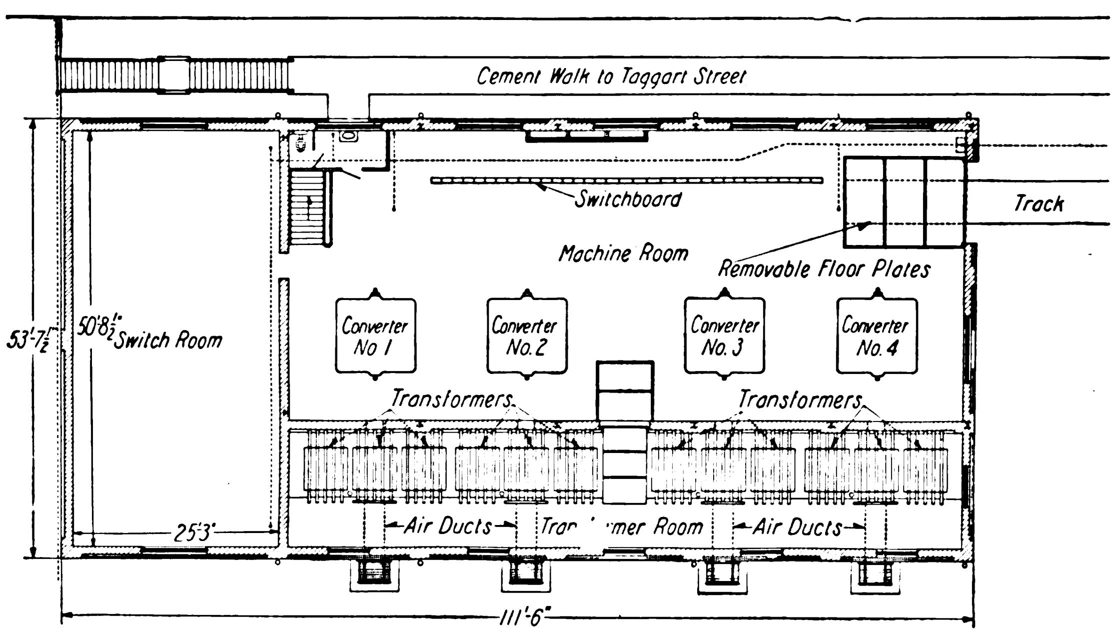
Reactance, either inherent or external to their transformers, is required by compound railway converters for compounding purposes. Transformers with inherent reactance are recommended in preference to those with normal reactance and external reactance coils, primarily due to lower initial cost.

Upon the selection of switching equipment very often depends the success or partial failure of a substation. The switching equipment must be selected with a due regard for maximum simplicity, convenience and reliability. While essentially standard switching equipment is applicable in practically every case, there are very often local conditions which warrant and require additional protective apparatus for the best results. There is no universal rule to follow in the selection of switching equipment. It can only be selected by competent engineers after careful study of individual local conditions.

A. C. circuit breakers must be selected not only of sufficient ampere capacity, but must be capable of rupturing the maximum capacity available under short-circuit conditions. The liability of short-circuit trouble between the high-tension breaker and the low-tension side of the converter is very remote; in fact, so remote that protection for such an occurrence is not recommended. Consequently, the impedence in the converter transformer should be taken into consideration in figuring the current under short-circuit conditions. Assuming, therefore, the standard converter transformer having 15 per cent inherent reactance, the maximum line current that can be taken by a converter operating from this transformer, under short-circuit conditions, will be approximately seven times normal. Therefore, a breaker capable of rupturing seven times normal three-phase line current is recommended for the standard transformer and rotary converter outfit.

D. C. circuit breakers and switches are rated on the basis of the maximum current they will carry for one hour or more, not to exceed temperatures approved by the Underwriters. Since standard converters are rated on the basis of 150 per cent load for two hours the rating of the circuit breakers and switches should correspond to this value. The calibration range of the D. C. breakers should be considered, as it is good practice to set the machine breaker, where automatic, comparatively high, with the feeder breakers set as low as practicable.

A. C. and D. C. meters should be carefully selected to meet the particular application requirements. D.C. ammeter scale equal to the momentary swing capacity of the converter is recommended. It may, however, be desirable to shorten this scale in some cases, in order to obtain better readings on average loads.



Plan of Taggart Street Substation, Pittsburgh Railways Company

Protective devices as follows are recommended for all installations if the best results are to be obtained.

1—A. C. machine breaker with low-voltage release and pallet switch attachment.

2—D. C. machine breaker with low-voltage attachment.

3—Reverse current relay.

4—Reactive factor meter.

5—D. C. feeder breakers.

6—D. C. feeder resistance.

Adjustment of protective devices is recommended as follows:

1 (a) The alternating current machine breaker should be automatic. At least in sizes of 1,000 kw. and below, this breaker should entirely protect the converter from excessive swing loads, and in consequence, should be equipped with an instantaneous

trip. In general, this will require a high setting, it being satisfactory to work at any value within the guaranteed swing capacity of the machine. In sizes larger than mentioned above, applications may require definite time or inverse time limit trip, which may be entirely satisfactory.

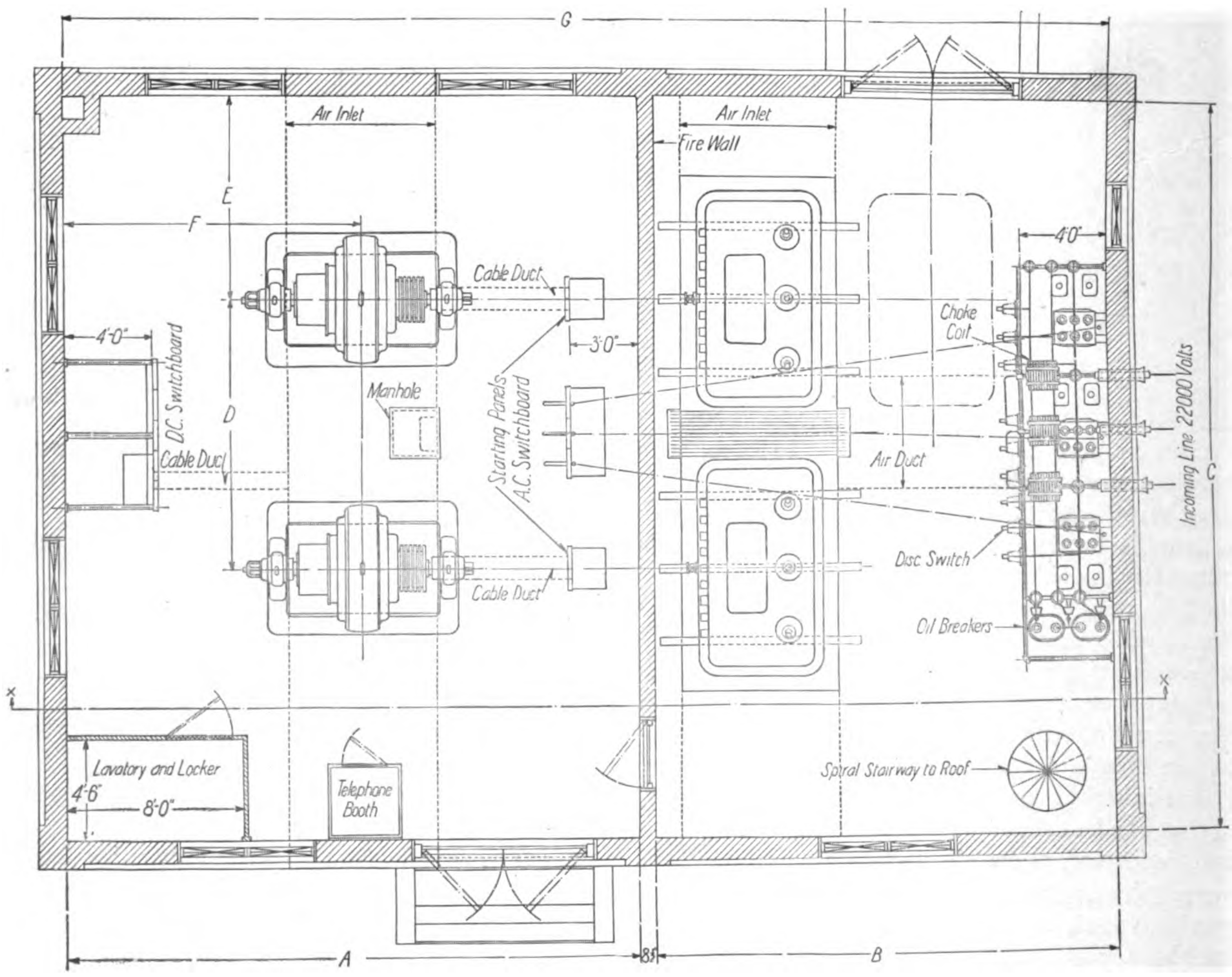
(b) The pallet switch should connect the alternating current and direct current breakers electrically in a manner to cause the direct current breaker to open upon opening the alternating current breaker. The speed limit switch is connected in series with the pallet switch, which also opens the direct current breaker upon operating.

(c) The low-voltage release should be adjusted to operate at as high a voltage as is practicable for the application. It is essential, especially for commutating pole converters, to disconnect them from the line when the alternating current voltage drops an appreciable amount, since the restoration of the normal voltage presents conditions similar to switching the converter from the starting to the running position in starting with its brushes on the commutator, under which condition a flash invariably results.

2. The D. C. machine breaker, at least in sizes of 1,000 kw. and below, should be arranged to insure its remaining closed until opened by the alternating current breaker or speed limit switch. In these cases it is usually the best practice to make the direct current breaker non-automatic and protect from severe overloads by proper alternating current breaker and direct current feeder breaker settings. With the larger railway machines, applications may require automatic direct current machine breakers, which may be entirely satisfactory.

3. The reverse current relay should in general be connected to trip the alternating current breaker, which will in turn open the direct current breaker. With the large machines, applications may warrant tripping the direct current breaker only upon reversal of current, providing it will not be caused by failure of the alternating current source of supply.

4. The reactive factor meter is essential for obtaining proper converter power factor. This is particularly essential, since at normal and overloads, converters must be operated at close to unity power factor. As an illustration, the heating on the tap coals of converters, which are, of course, the limiting parts, is increased by approximately 50 per cent at 97.5 per cent power factor.



PLAN OF SUBSTATION FOR SMALL UNITS

5. The direct current feeder breakers should be automatic instantaneous trip, except where the feeder breaker is equivalent to the direct current machine breaker and the machine is protected from excessive swing load by the alternating current machine breaker. Invariably, synchronous converters will satisfactorily commutate very large momentary currents, providing the direct current machine breaker does not open, while they will flash at no greater currents if the direct current machine breaker opens. It is obvious, therefore, that the low instantaneous overload setting of feeder breakers, where available, thereby obtaining selective action between the feeder and the machine breaker, is productive of good results. This is due to the cushioning effect of the feeders in circuit and prevents the entire load being thrown off the machine instantaneously.

6. Proper direct current feeder resistance is a most important point where short circuits are liable to occur. In this connection it should be remembered that in a case of severe short circuits, the current increases so rapidly compared with the speed at which the breaker opens, that the current values go far beyond the breaker setting. In the case of a short circuit immediately outside the substation, where the feeders are tapped at this point, the current may easily reach five to ten times the normal rated current, assuming the ordinary type of carbon circuit breaker is in use; and this current value will be practically independent of the circuit breaker setting. With circuits subject to frequent and severe shorts, such as in many installations, it is desirable to connect the feeders from the substation to the trolley at some distance, in order to have some resistance between the converter and point of short circuit, even should the short occur directly at the point of feeder trolley connection.

The relation of direct current trolley feeder taps to the source of power, or conversion, is of greater significance than is generally recognized. However, after careful consideration, the benefits to be derived from placing these taps at reasonable distances from the apparatus are readily appreciated, as the reasons are both simple and logical.

It is common knowledge that a rotary converter or direct current generator will "buck" or flash over, if "dead short-circuited" across its positive and negative terminals. Now consider the positive feeders as a continuation of the positive terminal, and the negative return as a continuation of the negative terminal. It is evident that a short circuit near the substation on these feeders (or extended terminals) will cause the converters or generators to flash-over. Now follow the feeders (or extended terminals) a mile, and short circuit them. The chances are, unless the feeders are large, the machines will not flash over.

There has been no change made in the converter, generator or switching devices in either of the above cases, but notwithstanding this, the results have been inconsistent. The answer is simple. In the last case there was no flash-over, the feeders (or extended terminals) having supplied enough reactance and resistance to limit the current required by the short circuit to within the capacity of the machines.

No type of converting apparatus is free from flash-overs, providing the provocation is sufficiently great. There are, of course, other reasons for flash-overs besides "close-in" taps, but at least 75 per cent and perhaps 90 per cent of the flashing nuisance is traceable to this cause. In consequence, producers of electrical railway power owe it to themselves, as well as to the manufacturers of their apparatus, to protect their machines in this simple, inexpensive and fundamental way, in addition to the use of the protective features mentioned above.

The question naturally suggests itself, What rule should be followed in fixing the tap distance from the machines? Unfortunately no general or universal rule or formula has been advanced. So many variables enter into the solution of the problem, that it will prove quicker and more definite to solve each case by removing the "close in" taps until the resistance of the circuit becomes great enough to cushion and protect the machines. The principal variables which enter into the solution of tap distances are as follows:

1. Capacity, or energy, behind the rotary converter.—It is obvious that for a given size of converter, the greater the capacity at the source of generation, the greater will be the damage resulting to the converter in case of trouble, and the nearer the converter and the alternating current capacities agree, the less serious will be the damage resulting from trouble.

2. Capacity of converting apparatus.—The larger the converting apparatus, the less sensitive it is to D. C. line troubles, since, for instance, feeder short circuits are a smaller proportion of its capacity, and therefore the machines are less subject to flash-overs from this cause, at least.

3. Voltage of system.—The lower the voltage of a given system, the nearer the taps may be placed to the machines. In general, on a given system, tap distances for 1200-volt service should be at least twice those of 600-volt service.

4. Size of feeders.—The larger the feeders, the greater the tap distances should be from the machines.

5. Disposition of feeders.—When possible, the distribution of feeders should be such that each will carry a reasonable proportion of the station output; that is, where several feeders originate in one station, no excessive proportion of the station output should be handled over any single feeder. Any trouble on such a feeder reacts on the entire substation and is frequently responsible for flash-overs.

6. Size of rails.—The heavier the rails, obviously, the greater should be the tap distances.

7. Bonding.—Broken bonds and poor ground connections have been known to result in flash-overs.

Such cases, however, are not frequent. Obviously, the bonding has a direct bearing on proper tap distances.

8. Sizes of cars.—It is evident that with a given substation unit, the heavier the car equipment and the larger the motor rating, the greater will be the "drag" on the substation equipment and the more destructive the effects in case of motor troubles. The rating of the car equipment has therefore a bearing on the proper tap distances, especially when the substation units are relatively small, as compared to the motor ratings.

From the foregoing, it will be seen that to evolve a formula to cover such a diversity of conditions would prove itself a problem, and the results, until proven, could not be accepted as much more reliable than a guess. In general, experience has shown that on 600-volt systems the first tap should not be nearer the machine than 2500 feet, and on 1200-volt systems, 5000 feet. Should flashing persist, these distances should be increased until the flashing stops. The line losses due to these tap distances are of little consequence when compared to the loss on account of flash-overs, including the time and expense involved in cleaning up the damaged apparatus. Furthermore, the car equipment is benefited by being worked at a more uniform voltage.

Bonuses for Fire-Room Efficiency

If a fireman is to become an expert in coal economy, it must be worth his while to learn, and worth while for someone higher up to teach him. Rewards for coal-saving are paid by the Charles Pfizer Company, of Brooklyn, according to an ingenious scheme applied by F. S. Jones, works engineer. For the watch engineers, a bonus of 10 per cent of their pay is given, conditioned on the maintenance of an evaporation rate of 8.4 lbs. of water from and at 212 degrees F per pound of coal. This requires that their responsibility for the cleanliness of boiler surfaces, inside and out, shall be taken quite seriously, and that each man should see that the fireman on his watch should maintain his fires in proper condition. The firemans' bonus in turn depends on their maintaining an average CO_2 per cent of 11.6, as shown by analysis of gas drawn continuously during each watch. Coal passers, too, receive a bonus if they keep the firing floor in good order and lose no time. In all cases, a man who cannot or will not earn his bonus regularly is not retained.

The Pfizer plant manufactures chemicals, and hence uses electric power and steam at high and at low pressures. Its boiler plant consists of two 380 horsepower boilers, equipped with Westinghouse underfed stokers and forced draft blower, and eight 150 horsepower hand-fired boilers, of which but two are kept on the line as a stand by when cleaning fires. The new stoker-equipped boilers are served by a coal-conveyor, which later will be extended to serve two additional boilers. Ashes are removed by a dump-bucket run under the boilers on a car whenever the stoker ash-dumps are opened. It is lifted and dumped into a motor truck by an electric hoist. Feed water is taken from deep wells on the premises. Steam at 80 lbs. is used for cooking, and for power in high-speed reciprocating engines. Exhaust steam at 4 lbs. is used for heating and drying. Bituminous run-of-mine coal is burned.

Hydroelectric Power in France

The best estimates place the hydroelectric resources of France at 5,000,000 primary horsepower, and from 4,000,000 to 5,000,000 secondary; the first of these being available the year round, and the second available for six months of the year, writes Consul Tracy Law, from Paris. Of this total, only 750,000 horsepower had been developed in 1913. During the war, on the initiative of the Government, 415,000 additional horsepower was developed rapidly, and at present other projects are under way from which 125,000 horsepower should be realized in 1919, and 225,000 horsepower by 1921. This would carry the total waterpower development to some 1,600,000 horsepower.

At present the steam power employed in France for all purposes is 11,000,000 horsepower, from which it will be seen that ultimately the pressing question of fuel may find its solution in the development of hydroelectric force. The utilization of waterpower is being strongly agitated.

Sicilian Electrical Company Enlarges

A company formed to produce and distribute electricity from water power in the eastern provinces of Sicily has been so successful even during wartimes that it recently decided to enlarge so as to include in its scope the entire Island of Sicily, according to the last bulletin issued by the Italian Bureau of Public Information. The "Societa Elettrica della Sicilia Orientale" was established in 1907, and by 1917 its capital was $3,000,000 and its income $1,000,000. Despite the decrease in industrial development, due to the war, the company was able to declare a dividend of 5 per cent in 1914-15-16, and in 1917 a dividend of 6 per cent. The enlarged scope of the company has necessitated an immediate increase in capital to $6,-400,000, and by 1919 the company expects to have a capital of $8,000,000.

Mica from Guatemala

Trade Commissioner W. M. Strachan reports that a good grade of mica has been located in the Department of Quiche. Three or four tons have been shipped to the United States in an experimental way. The workings at present are all at the surface. The mica contains a very low percentage of iron and splits into large sheets.

Central Light and Power Plants

PRELIMINARY figures of the forthcoming quinquennial report on the central electric light and power stations of various states have been given out by Director Sam L. Rogers, of the Bureau of the Census, Department of Commerce. They were prepared under the supervision of Eugene F. Hartley, Chief Statistician for Manufactures. The statistics relate to the years ending December 31, 1917, 1912, and 1907, and cover both commercial and municipal plants. They do not, however, cover electric plants operated by factories, hotels, etc., which generate current for their own consumption; those operated by the Federal Government and state institutions; and those that were idle or in course of construction.

The report shows a pronounced growth in the amount of business done by the electric light and power stations in New Jersey. Their total income in 1917 was $23,480,320, representing an increase of 114.5 per cent since 1912, as compared with an increase of 83.9 per cent during the period 1907-1912. The income from electric service alone in 1917 was $20,188,244, an increase of 90.7 per cent for the later five-year period, as against 79.1 per cent for the earlier. The total output of the stations was 781,230,790 kilowatt hours, an increase of 103.5 per cent between 1912 and 1917, as against 173.2 per cent for the preceding five years. The total expenses, including salaries and wages, amounted to $18,760,138, an increase of 100.7 per cent for the period 1912-1917, as compared with 103.3 per cent for the preceding five years. The relative increase in the amount of current generated was greater at each of the five-year periods than the increase in the income for electric service or in that for the total expenses. The stations employed 5,065 persons, to whom were paid salaries and wages aggregating $4,821,852. The rates of increase in the number of persons employed were 69.5 per cent for the period 1912-1917 and 69.9 per cent for the preceding five years, but the rates of increase in salaries and wages were considerably greater—94.5 per cent and 80.9 per cent for the later and earlier periods, respectively. The total primary horsepower, 96 per cent of which was derived from steam engines, was 367,743 in 1917, an increase of 53.5 per cent during the period 1912-1917, as against 155.9 per cent for the preceding five years. The kilowatt capacity of the dynamos was 249,521, an increase of 39 per cent between 1912 and 1917, compared with 154.3 per cent between 1907 and 1912. The horsepower of the stationary motors served was 262,858, an increase of 209.2 per cent over 1912, as against 208 per cent for the preceding five years. As in the cases of most of the States, the number of arc lamps used for street lighting shows a decrease, while a pronounced increase appears in incandescent lamps.

The figures for Oregon are fairly comparable for 1912 and 1917. The decreases shown for the period 1907-1912 are due mainly to the fact that certain establishments reported as central electric light and power stations for 1907 were later taken over by electric railways and were therefore reported with them for 1912 and 1917. From 1912 to 1917 the total income increased by $1,154,594, or 81.2 per cent; the expenses, by $1,070,431, or 88.8 per cent; the horsepower, by 22,691, or 49.3 per cent; the kilowatt capacity of the dynamos, by 15,501, or 47.8 per cent; and the output of stations, by 49,097,631 kilowatt hours, or 83.5 per cent. As in the cases of practically all the states, the use of arc lamps for street lighting shows a pronounced decrease.

The actual increases shown for Nebraska from 1912 to 1917 are in excess of the large increases for the prior five-year period. The remarkable addition of 76 plants from 1907 to 1912 was exceeded in the later period, when 154 new stations were added, 85 commercial and 69 municipal. The actual gain, however, was only 123, because of combinations in single reports of a number of plants reported separately in 1912. The total income in 1917 was $4,860,874, an increase of 73.4 per cent over $2,802,614 in 1912. In 1917 the expenses were $3,911,923, compared with $2,239,542 in 1912, the relative increases being 74.7 per cent from 1912 to 1917 and 93.4 for the preceding five-year period. In 1917 there was a total of 112,103 horsepower, compared with 52,168 in 1912, the proportionate gains being 114.9 per cent from 1912 to 1917 and 73.8 per cent from 1907 to 1912. Steam formed 79.5 per cent in 1917 and 81.4 per cent in 1912 of the total power reported. The dynamos show an increase in capacity from 34,586 kilowatts in 1912 to 78,227 kilowatts in 1917, or 126.2 per cent. The output of stations increased from 56,299,682 kilowatt hours in 1912 to 129,531,131 kilowatt hours in 1917, or 130.1 per cent, compared with 76.2 per cent from 1907 to 1912. The number of arc street lamps decreased from 2,451 in 1912 to only 178 in 1917. On the other hand, the number of incandescents, etc., increased from 12,149 to 27,752, or 128.4 per cent.

The figures presented for Florida show that the increases from 1907 to 1912 have continued during the later five-year period. There was a remarkable increase of 40 in the number of new establishments in the state since 1912, 28 commercial and 12 municipal, although, by reason of the combinations in single reports of a number of plants that reported separately in 1912, there was a net gain of only 32 in number of stations from 1912 to 1917. The total income in 1917 was $2,376,908, almost wholly for electric service, representing a gain of 74.6 per cent since 1912, while the total expenses were $1,684,599, an increase of 60 per cent. The corresponding increases from 1907 to 1912 were 108.1 and 119 per cent, respectively. In 1917 the total horsepower, of which 86.7 per cent was steam, was 58,195, a gain of 72 per cent since 1912. During the same period the kilowatt capacity of the dynamos increased from 23,619 to 37,812, or 60.1 per cent. The output of stations in 1917 was 50,887,992 kilowatt hours, compared with 25,895,751 in 1912, and the relative gains for the two five-year periods were 96.5 per cent and 120.1 per cent, respectively. From 1912 to 1917 there was a slight increase (3 per cent) in the number of arc street lamps, compared with 165.6 per cent for the incandescent and other varieties.

The figures presented for Kentucky show increases in practically all items from census to census. The increase of 36 in the total number of establishments shown for the later five-year period is not truly representative, since 23 establishments that reported separately in 1912 were included in combined reports in 1917, while 60 new plants have been added since 1912. In 1917 the total income, almost wholly for electric service, was $4,436,445, compared with $2,754,115 in 1912, an increase of 61.1 per cent; from 1907 to 1912 the percentage of increase was 65.8. The total expenses in 1917 were $3,531,547, an increase of 57.3 per cent since 1912; the increase from 1907 to 1912 was 74.3 per cent. The total horsepower, nearly all steam, increased from 41,984 in 1907 to 87,767 in 1912 and to 98,752 in 1917, the rates of increase being 94.8 per cent and 20.8 per cent, respectively The increase in the kilowatt capacity of the dynamos kept pace with that in horsepower. In 1917 the capacity of the dynamos was 69,442 kilowatts; in 1912, 54,062; and in 1907, 29,140; the increase amounting to 28.4 per cent and 85.5 per cent for the later and the earlier five-year periods, respectively. The output of the stations in 1917 was 122,630,433 kilowatt hours, compared with 75,593,179 in 1912, an increase of 62.2 per cent. The number of arc street lamps decreased from 7,332 in 1912 to 6,757 in 1917, or 7.8 per cent, while the incandescent street lamps increased from 5,278 to 10,890, or 106.3 per cent.

The figures for Tennessee show that the actual increases, although large from 1907 to 1912, were much greater for the later five-year period; so also were the proportionate increases in most particulars. From 1907 to 1912 the number of stations increased from 78 to 90, while in 1917 there were 106 plants. Thirty-one new plants have been added since 1912, but a number of those that reported separately in 1912 were merged into combinations before 1917. The income in 1917, practically all for electric service, was $4,937,285, an increase of 101.7 per cent over $2,448,218 in 1912. In 1917 the total expenses were $4,436,698, compared with $1,753,875, the relative increases for the five-year periods 1912-1917 and 1907-1912 being 153 per cent and 98.7 per cent, respectively. The total horsepower was 201,912 in 1917, compared with 68,994 in 1912, or an increase of 192.7 per cent. In 1917, waterpower formed 65.2 per cent of the total, compared with 40.2 per cent in 1912, having increased from 1,240 horsepower in 1907 to 27,750 in 1912 and to 131,652 in 1917. The dynamo capacity of the stations increased from 49,640 kilowatts in 1912 to 145,335 in 1917, or 192.8 per cent. The output of stations in 1917 was 564,914,272 kilowatt hours, and in 1912, 75,544,893 kilowatt hours, an increase of 647.8 per cent, compared with a gain of 116.8 per cent from 1907 to 1912. The number of arc street lamps decreased from 3,938 in 1912 to 2,861 in 1917, or 27.4 per cent, while the incandescents, etc., increased from 6,732 to 15,099, or 124.3 per cent.

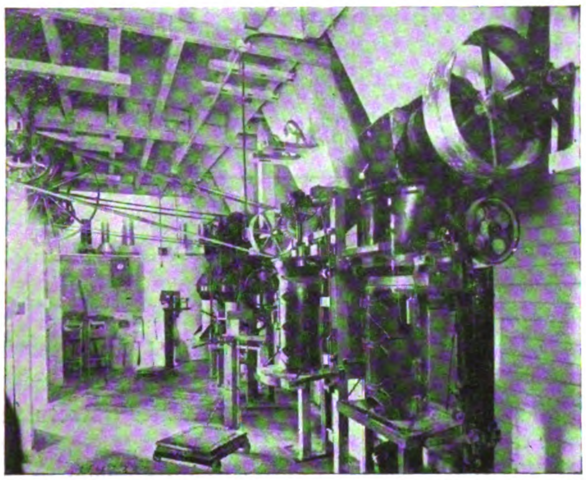
Large increases are shown in substantially all items in Oklahoma for both five-year periods covered by the table, but the increases from 1912 to 1917 are in most cases proportionally less than those for the preceding five years. The number of stations increased from 130 in 1912 to 201 in 1917. The actual number of new establishments added since 1912 was 83, of which 43 were commercial and 40 municipal; but, as the result of a number of combinations in the commercial systems and of various other changes, an increase of only 71 establishments, 43 of which are municipal, is shown by the figures. In 1917 the total income, 97.8 per cent of which was for electric service, amounted to $4,306,782, the percentages of increase being 82.6 and 113.1 for the periods 1912-17 and 1907-12, respectively. The total expenses in 1917 were $3,541,443, the percentages of increase for the later and earlier five-year periods being 87.5 and 84.1, respectively. The total horsepower in 1917 was 80,997, an increase of 50.2 per cent as compared with 1912, and during the preceding five years the rate of increase was 138.4 per cent. Although steam supplied the greater part of the horsepower in 1917, the figures show a very great proportional gain in the power derived from internal-combustion engines—from 200 horsepower in 1907 to 5,966 in 1912 and to 12,860 in 1917. The total dynamo capacity, 57,783 kilowatts in 1917, shows an increase of 50.9 per cent as compared with 1912, the rate of increase during the preceding five-year period being 147.1 per cent. The output of current generated in 1917 was 100,737,632 kilowatt hours, representing an increase of 106.3 per cent over 1912, as against 95.4 per cent for the period 1907-12. The number of arc street lamps decreased from 3,303 in 1912 to 1,925 in 1917, or by 41.7 per cent, while the incandescent lamps increased in number from 8,334 to 13,763, or by 65.1 per cent.

Western States Company Shows Large Increase

During the year 1918 the Stockton, Cal., division of the Western States Gas & Electric Company added 1,090 electric consumers to its lines. There was an increase of 7,063 horsepower in connected load, of which 5,339 horsepower represents the increased load in motors.

Electric Power in a Flour Mill

THE Pasco Flour Mill Company, organized in 1916, at Pasco, Wash., attribute their great success, which has come in a comparatively short time, to the fact that its officers have been closely identified with the flour milling and grain business of the Pacific Northwest for the past thirty years, and to the wisdom of locating the mill at Pasco. It is in the heart of the best milling wheat-producing district of Washington and Oregon, with unexcelled transportation facilities. Wheat of the proper varieties and grades can be secured readily to make the various grades of flour demanded by the different sections of the entire country. The soft white wheat for making flour so much demanded in the southeastern and southern states, and the strong variety for the Pacific Coast and California territory, can be secured at all times on account of the splendid location of the Plant. The location is also favorable for the distribution of the mill's products to all markets.



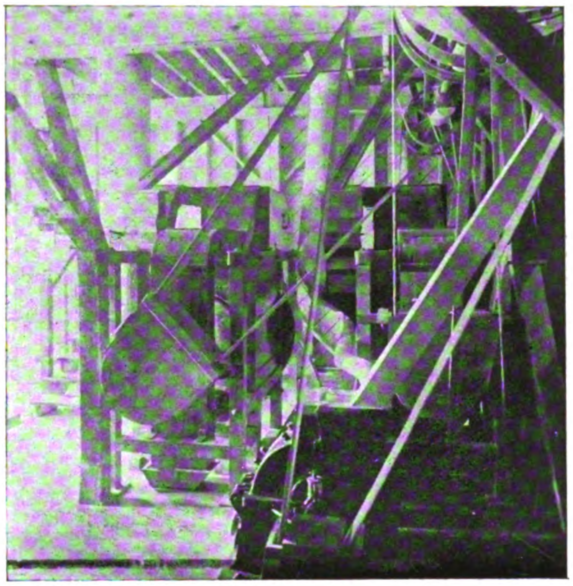
FLOUR AND WHEAT PACKERS
Electrically operated devices in a Pacific Coast flour mill recently completed

Soon after the organization of the Pasco Company, plans for the plant were submitted, and actual construction was immediately begun. The plans anticipated a two-unit flour mill with ample warehouse and elevator facilities for a 1,000-barrel plant. At the beginning it was planned to install only one unit at a time, and to operate only the first unit until increased business called for additional capacity; but the first season being an exceptional one, the second unit was begun soon after the completion of the first, so that by February 1, 1917, the entire capacity of the mill was in full operation, day and night. All motors are equipped with the latest safety appliances to insure absolute safety in operation and eliminate all hazards from fire. Eight Westinghouse motors, ranging in size from 2 h.p. to 100 h.p., drive the machinery for the entire mill. The wiring for both power and light is in metal conduits.

The rolls, sifters and purifiers of the first unit are of the Barnard and Leas Manufacturing Company, of Moline, Ill.; the second unit being equipped by Nordyke & Marmon, of Indianapolis, Ind. The cleaning machinery consists of two Printz & Rau separators and two Monitor scourers, manufactured by the Huntley Manufacturing Company, of Silver Creek, N. Y., and the latest improved Wolf Dawson wheat washer, manufactured by the Wolf Company, of Chambersburg, Pa.

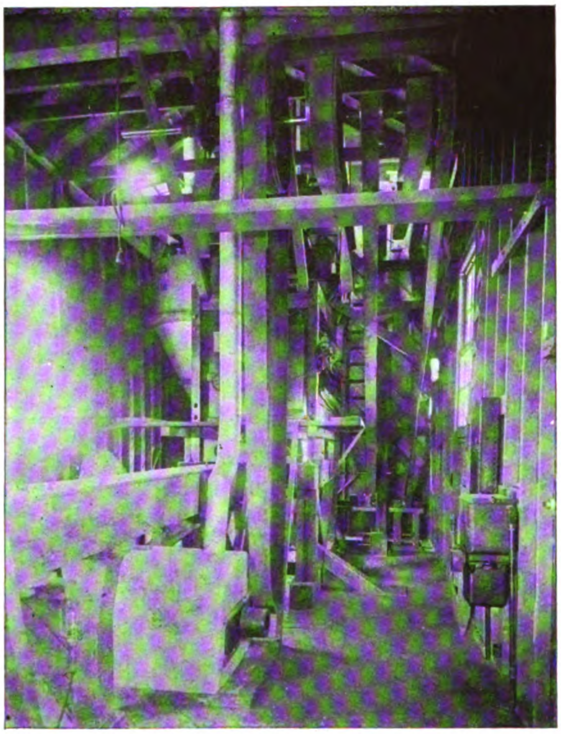
In the so-called wheat end of the mill, five stands of elevators with a capacity of 175 bushels, a Printz & Rau separator, one 16 ft. 9 in. conveyor, two Monitor scourers with a capacity of 200 bushels, one Williams grinder, one Wolf Dawson scourer with a capacity of 175 bushels and one 9 in. dampening conveyor and blender are operated by a 40-h.p. slip-ring CW Westinghouse motor.

The wheat received for milling is handled directly from the cars to the elevators, while the transfer of wheat and flour to the warehouse is accomplished by electrically driven portable elevators. An unusual scheme is used to move cars on the switch, back and forth to different loading and unloading doors in the warehouse. A counter-shaft extension from the main shaft in the mill has a steel drum attached to the end that projects to the platform. Attached to this drum is a 1¼-in. rope which is hooked to the car intended for moving. The direction of the pull from the drum is made by changing the wind of the rope on the drum.



SEPARATORS, ELEVATORS AND CONVEYORS
Operated by a 15 hp. CS type Westinghouse motor, in the Pasco mill

This scheme has increased the unloading capacity from four cars to six cars per day. One 40-h.p., 440-volt, 3-phase, 60-cycle, 1,700-r.p.m. Westinghouse type CS motor, with complete starter, overload, and no voltage release, drives the main shaft. Connected to this shaft is a three-ton-per-hour steam barley roll with a cleaner and three elevators. From the same drum described above, a power scoop is operated in unloading cars of bulk wheat into the bulk elevator hopper, unloading 1,200 bushels per hour. Two men using the scoop do the work of six scooping by hand, and the cars are thoroughly emptied. It is also planned to use the same motor to drive the belt conveyor from the warehouse to the bulk elevator hopper, and thus save the labor and



Scourers and Grinders in a Flour Mill
Part of the equipment of the Pasco plant operated by a 40 hp. Westinghouse motor

expense of trucking sacks of wheat there for storage. This will save two cutters (men who open the sacks and pour the wheat into the hopper) and four truckers.

The wheat is conveyed from the elevator to the mill to be converted (by the various machines) into flour by one 36 ft. 9 in. conveyor, operated by a 3-h.p. type CS Westinghouse motor 1,155 r.p.m. The plant is steam-heated from a 60-h.p. high-pressure boiler, which also furnishes heat for the office and warehouse.

When the company began to operate, all the piling of loaded wheat sacks or even empties was done by man power, using a block and tackle. The same method was also used to unload wheat from the cars to the warehouse. Since then they have installed a piling machine which piles any size sacks of flour from 24 to 140 pounds. This machine is of steel construction and can pile as high as 16 feet. Four men (one man on the pile and three truckers) can pile 800 barrels or 140 jutes in four hours with this piling machine. By the old operation it would take six men approximately ten hours to do the same work. This machine is operated by 1/3-h.p. type Westinghouse motor, speed 440 volts, 60 cycle, 3 phase, 1,130 r.p.m.

A reference is made to one more example to show how thoroughly the Pasco Mill is equipped with modern, up-to-date machinery. A McCahey Sure Count Truck Counter, manufactured by the J. J. Ross Milling Company, is installed in the floor of the warehouse entrance and is used to count the sacked wheat and flour coming into and going out of the warehouse. The truck on entering or leaving the warehouse runs over this counter, pressing a rod which is connected to an indicator, thus registering the load. This saves time and insures accuracy.

The Pasco Flour Mills Company has a very wide market for their product, and at present they are shipping to all parts of the United States. The field covers the Atlantic coast including Boston, New York, Philadelphia, Atlanta and Savannah; the Gulf of Mexico, New Orleans and Galveston. In the west they ship to Southern California and Northern Washington.

Hydroelectric Plant at Shawinigan Falls

A project is on foot in Quebec for a new railroad to run from St. Felicien to the Ungava region, reaching a number of large lakes near Hudson Bay. This district is rich in minerals and timber. In reporting on the plan, Consul E. Verne Richardson, of Quebec, says that there are many important water powers that may be developed. He recalls that the largest privately owned hydroelectric installation in all Canada is, according to official reports, in the Quebec consular district, not 100 miles from Quebec city, at Shawinigan Falls. This plant carries a load of 205,000 horsepower, supplies 76 distribution systems and serves triangular area with a base of 140 miles and a depth of 75 miles. The head of water at Grande Mere, Shawinigan, is 83 feet. This single instance of hydroelectric enterprise is mentioned as showing what may be done along the streams of the Ungava district, where the elevation is, at many points, from 1,000 to 2,000 feet above sea level, and where there are undoubtedly natural falls readily susceptible of conversion to industrial uses. That a great height of fall is not essential to economic success is proved at Cedars, Quebec, where one of the largest power plants in the Dominion is operating with a water head of but 30 feet.

Municipal Plant Forced to Raise Rates

The United States Reclamation Service, which has been supplying electricity to Williston, N. D., has submitted a new contract for acceptance by the city, 25 per cent higher than the rates paid heretofore. The city must either pay the increased rates or do without electricity.

Static Interference and the Wireless

ROY A. WEAGANT, Chief Engineer of the Marconi Wireless Telegraph Company of America, presented a technical paper describing his discovery of a new law of Nature and inventions relating to the elimination of static interferences in wireless communication before a special joint meeting of the Institute of Radio Engineers and the New York Electrical Society. The meeting was held March 5 in the large auditorium of the Engineering Societies Building, 29 West Thirty-ninth Street, New York. Among those present were many well-known experts in the art of radio communication and others prominent in the development of electrical communication.

Mr. Weagant's paper was entitled "Reception Through Strays and Interference." It was a highly scientific treatment of the subject, covering in detail methods and electrical circuits invented by him and employed by the Marconi Company at its various long-distance wireless plants located in the United States.

Reviewing the conditions which prevailed in wireless communication prior to his inventions, Mr. Weagant said: "Since the birth of wireless telegraphy serious difficulty in reception has existed, due to natural electrical disturbances. These disturbances commonly called 'static,' 'atmospherics' or 'strays,' produced in the receiving telephones cracking noises, which often drowned out the incoming wireless signals.

"As the distance over which wireless telegraphy was worked increased, it became necessary to use longer wave lengths. This increased the troubles resulting from static so that in the case of more important long-distance circuits, such as those operating between Europe and the United States, static caused such great interruptions to the service that the continuity of communication compared unfavorably with that of cable working.

"An idea of the magnitude of the problem that existed," he explained, "may be gathered from the fact that during the summer months, the energy collected from static at wireless receiving stations was often more than a thousand times as great as that of a normal wireless signals received at the same station."

Describing the natural phenomena surrounding static disturbances, Mr. Weagant said: "It was found that static disturbances were most severe in summer and less troublesome in winter; also that they displayed a daily variation in intensity, being at minimum between sunrise and noon and increasing very rapidly to a maximum about sunset; from then on remaining practically constant until shortly before sunrise, when the intensity fell off very sharply to a minimum again."

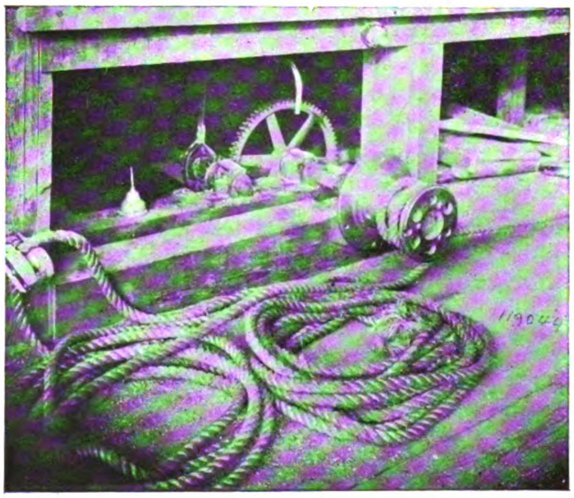
He noted that accumulated experience had shown these static disturbances to be more severe in locations near or in the Tropics than in the Temporate or Frigid Zones; also that at any given location they vary from day to day, somewhat in accordance with the variation of temperature, being greater on warm days and less on cold days.

Mr. Weagant called attention to the vast amount of study that had been given by many leading scientists and experts to the nature and origin of these static disturbances and also referred to the innumerable attempts made to secure methods of reducing or eliminating their deadening effects at wireless receiving stations. Of his own investigations, he said: "So far as I am aware, no success of a major order was obtained with any of these attempted methods prior to my inventions and work in this field."

That portion of Mr. Weagant's paper which dealt with his discovery of a new law of Nature secured the closest attention of the scientists present. Stripped of its technical phraseology, this discovery may be described as follows:

Since the inception of the wireless art, "static" has persisted in dominating the wireless signals, forcing itself upon the radio receiving instruments with such strength that frequently the signal was completely submerged and only the static could be heard. All prior attempts to minimize the crashes of static had likewise minimized the buzz of the telegraph signal, thus producing the same net result on the human ear and offering no advance in the perfection of communication. For years, investigators in this field had considered the characteristics of the signal wave and the static wave to be the same. But Mr. Weagant held an opposite view, believing that a difference existed between the signal and static waves. He realized that once the difference could be determined and defined, engineering methods of taking advantage of this difference could be devised. The discovery of this difference was the gigantic problem.

Unremitting study, investigation and experimenting



DEVICE FOR MOVING CARS ON A SWITCH
Drum attached to counter shaft extension electrically driven, in the Pasco plant

led Weagant to the solution, which followed his discovery that static waves, instead of moving horizontally in space as do the wireless signal waves, actually move in a vertical direction, from a source either overhead or underfoot. With the determination that the static waves propagate at right angles to the direction of wireless signal waves, he had found the much looked for point of difference; the new electrical principle; the discovery of a new law of Nature.

The next step required devising means for taking advantage of the discovery. To overcome the static interference, Weagant invented a new type of antenna or aerial wire, for the reception of electromagnetic waves which, at one stroke, did away with the need for the huge steel masts or towers formerly used at all wireless stations. The Weagant type of antenna is placed but a few feet above the ground and consists of two rectangular loops of wire, separated, but in alignment with each other.

The static waves originating overhead and moving earthward, reach both loops simultaneously, while the signal waves, traveling horizontally from a given direction, set into vibration, first, the loop nearest the direction from which the message is coming; and then actuates the second loop. In other words, the static waves arrive at both aerials at the same instant, while the signal waves arrive at the two aerials at different times.

This method of operation sets up in both loops static currents which are in phase or in step with each other, while the signal currents set up are out of phase. By a proper arrangement of electrical circuits in the receiving instruments, located between the two aerial loops, the in-phase static currents are balanced out, or cancelled; while the out-of-phase signal currents combine and remain in the circuits operating the wireless receivers which record the incoming messages.

In summary of his paper, Mr. Weagant said: "Continued use has established beyond question that the performance of my system is not occasional or accidental but is reliable and consistent. With the new system of reception, trans-Atlantic radio telegraphy can now be carried on free from interruptions caused by 'static' of any kind whatsoever, excepting only local lightning. Since the cables are also interrupted by local lightning, it follows that continuity of communication equal to that of cable operation is now possible by radio telegraphy. Wireless has the further advantages of cheapness and greater speed of operations."

Referring to the future of wireless telephone, Mr. Weagant stated: "The great barrier in the way of practical and successful radio telephony has also been removed for 'static' has interfered with wireless telephony to a much greater extent than with radio telegraphy."

Describing the appearance of his new receiving system, Mr. Weagant said: "It is pleasing to be able to state that arrangements have been perfected which are of such small dimensions that the entire equipment, including aerials, can be readily mounted on this lecture platform and receive radio messages from across the ocean."

Commenting upon Mr. Weagant's paper, Mr. David Sarnoff, commercial manager of the Marconi Wireless Company of America, writes as follows:

"Some time ago I asked Mr. Weagant to tell me, if he could, the particular thought or idea responsible for his faith in the ultimate solution of the static problem. I asked the question specifically because of the apparent disbelief of so many others that a real solution of this vexatious problem could be obtained.

"In answer to my question, Mr. Weagant stated that he had always considered Nature reasonable and logical; it followed, therefore, that it would not, on the one hand, bestow upon mankind a boon, such as electrical communication through space; and, on the other hand, place in its way a deadly barrier, such as static has been, without offering means of nullifying it and obtaining the full advantages that space communication offers to the world. It was this implicit faith in the justice of Mother Nature which spurred Mr. Weagant on in his determination to master the disturbing elements. The task has, perhaps, helped to add a few gray hairs to his otherwise young head. He told you himself how he reached his goal, and I merely wish to call attention to the original inspiration and conviction characteristic of the man.

"In my judgment, the elimination of static interference marks the most important practical advance in the radio art since Marconi's original invention. International radio telegraph communication, a child of the past, will now grow rapidly to sturdy manhood. Radio telephony over long distances and across the oceans—impracticable heretofore—is now in full view, and commercial wireless telephone service between the United States and Europe may confidently be expected.

"Think what this means! Electric signaling, now more than three score years old, has not provided means for talking to our friends across the great oceans. Whatever we had to say, others said for us by telegraph code. And now, for the first time in the history of electrical science, the spoken word may be uttered by us in our own language and heard by the desired ears across the oceans. Gentlemen, I predict that transoceanic radio telephony will in time revolutionize international, business, diplomatic and social intercourse in the same way that the Bell telephone revolutionized our daily affairs on this continent.

"Mr. Weagant made reference in his paper to the possibility of conducting long-distance wireless communication with less power at the transmitter than is now generally employed. This, it seems to me, should logically follow as one of the results of his great invention, and one is now justified in expecting that, before long, communication across the Atlantic may be carried on successfully with transmitters of, say roughly, fifty kilowatts, or perhaps less, and receivers of the compact type described by Mr. Weagant.

"Nothing brings nations and peoples closer together than reliable, rapid and cheap communication, and wireless now promises to be the International Courier fulfilling these three vital requirements. The present high cable rates between widely separated countries has limited the amount of news or press matter exchanged between the United States and such countries as, for example, China, Japan and Australia. The mail service is, of course, too slow to record important events.

"With the elimination of static interference and the possibility of reduced power at the transmitters, it is conceivable to me, and no doubt to many others, that two or three long-distance transmitting stations, located in the most important and suitable parts of the world, could be devoted to the exclusive transmission of daily news or press matter, broadcasted to all the countries, where, with the use of the proper receiving system, the broadcast messages could be received by all and published in the press of the world.

"Cable companies and the interests they represent have long made use of their favorite argument that communication by wireless is not secret, whereas by cables it is. Of course, I need not tell practical men that no system of communication is really secret; but the very fact that several transmitting stations can simultaneously communicate with the entire world, gives to wireless an advantage that the cables never had and never can possess."

Instructions for Electric Welding

The British Board of Trade has now published for official use an instruction to surveyors of vessels on the subject of making repairs to the boilers of passenger steamers by the electric or oxyacetylene processes. The instructions are given below:

The repairing of the boilers of passenger steamers by the above processes has been tentatively in operation for a considerable period and, in view of the experience gained, the surveyors are informed that, provided the work is carried out to their satisfaction by experienced workmen, these processes may be employed, within limits, for repairing cracks in furnaces, combustion chambers and end plates of boilers, and in the same parts for reinforcing the landing edges of leaky riveted seams which have become reduced by repeated chipping and calking.

In some old furnaces which have been repaired by the above processes it has been found that, after a few months' working, cracks have again developed at parts adjacent to those welded; probably owing to the original material of the furnace having become fatigued and worn out by long and severe usage. In dealing with old furnaces therefore, this fact should be taken into consideration.

It has also been brought to the notice of the board of trade that a shell plate of a cylindrical marine boiler cracked recently through a solid part where some surface welding had been done by the electrical process two years ago. The welding had extended for a length of about 12 inches along the outside calking edge of one of the middle circumferential seams at the bottom of the boiler, the leaky edge of the seam and the adjoining shell plate having been covered (soldered) by metal deposited by this process in the usual way. The shell plate was 1 5/32 inches thick and the crack, which followed the line of surface welding, extended in a circumferential direction for a distance of 2 feet 9 inches, the welded part being situated midway along the crack.

For the present it is not proposed to prohibit, within limits, the reinforcement of the circumferential seams of boiler shells if the end plates are well stayed but no welding should be done to these parts by any process which may cause local heating over an appreciable area of the plate, such as the oxyacetylene, oxyhydrogen, or other similar methods.

In no circumstance should any part of a boiler of a passenger vessel be welded if wholly in tension under working conditions, such as a stay or the shell plate at a longitudinal seam, the failure of which by cracking at the welded part might lead to disastrous results.

In any case in which the proposed repairs to the boilers of passenger vessels by either of the above processes are of an uncommon or unusually extensive character, the particulars should be submitted for the board's consideration and approval.

After repairs by welding have been completed, the parts at or adjacent to the welds should in all cases be well hammer tested; and, unless the welding is of a trifling character, a hydraulic test of not less than one and a half times the working pressure should be applied to the boiler after the hammer testing has been effected.

Saving Electricity in Amsterdam

The non-arrival of British and German coal in the Netherlands has made an acute shortage of fuel, and measures to reduce consumption have been adopted. The city of Amsterdam put into force on January 6 the following regulations, with a view to saving electricity: Cafes, restaurants, shops, and stores will be allowed to use only half as much electricity as they have been allowed since October 30 last. Private residences will have to reduce the use of electricity to 65 per cent of the amount used in November, 1918. All factories, etc., will also have to reduce their consumption of electricity to 65 per cent; furthermore, they may not use any electricity whatever for industrial purposes between 4 P. M. and 10 P. M. This restriction in hours does not apply to factories engaged in the preparation or manufacture of foodstuffs; such factories may recommence the use of electricity at 6 P. M., and the amount of electricity which they may use will be determined by the State Coal Bureau.

Electrical Goods in China

THOSE who have never been to China are likely to think of this nation of ancient civilization as it was presented to them in their school geography. They have not comprehended a change in other parts of the world similar to that in our own. As a matter of fact, however, there has been a gradual development in that country due to more intimate contact with foreign civilization, to better transportation facilities, and to a slowly increasing earning power.

In the sale of electrical goods, prime movers; machinery, propellers (as boilers, turbines, etc.), the pre-war years showed the imports from the United Kingdom to represent 65 per cent of the total, while the direct imports classified under "electrical materials and fittings" showed that less than 8 per cent came from the United States.

The people of China have shown a progressive tendency and with its great population and increasing purchasing power, an increase of a very small percentage of the people will make a large aggregate. As an instance, it is shown that one per cent of the population aggregates three times the population of New Zealand alone. Not only do the numerous wealthy merchants and officials appreciate modern conveniences and comforts, but as one passes along the streets where electricity is available he is struck by the number of small shops that have electric lighting. Not only this, but they appear over rather than under lighted, showing they are liberal consumers. The strong present market lies in the furnishing of apparatus and materials for new stations. This market is being developed faster than one would expect.

While a fair volume of electrical trade is possible now, the great volume of trade with China will come with the greater development of the country; this will increase purchasing power, which will result in a more extended use of electrical service. Combined with earning power, education will also result better living and everything that goes to make up higher standard of living.

Those who wish to meet success in entering this market must bear in mind that first of all they must arrange for proper representation; that, secondly, they must have goods adapted to the needs of the Chinese under existing standards; and that they will find it a great advantage if their representatives in China are able to extend moderate terms of credit to native companies that may buy central station apparatus and materials. American goods have a good name and the United States as a nation stands well with the Chinese. If American electrical manufacturers are willing to cultivate the market in a broadminded, thorough manner, China affords an export market almost as rich in its potentialities as all of South America. It is relatively a small market to-day, but, and this may be advantage, a great one to-morrow.

This information, together with an interesting description of the climate and living conditions; language and educational facilities; postal and transportation facilities, agriculture, mining and timber resources; manufacturing industries and a complete account of the electrical industry is given in a bound illustrated monograph, comprising over one hundred pages, issued by the Bureau of Foreign and Domestic Commerce under the title "Electrical Goods in China, Japan, and Vladivostok," written by R. A. Lundquist, Trade Commissioner of the Bureau, who was sent to those countries by the Government for the purposes of making a thorough investigation at first hand.

From this account we learn the two main amusements of the Chinese appear to be their theatres and teahouses. Attending a Chinese theatre in a large port one hot evening, the writer was struck by the good ventilation, in spite of the fact that both men and women were smoking. The electric lighting also was ample and was disposed so as to have little unfavorable effect on the eyes. Electric fans of both ceilings and walls were in operation. Of interest to engineers is the fact that at Canton a store termed "universal providers" not only has all the usual appurtenances of an American department store, but has recently added a foundry department and a machine shop which is a step ahead of their American contemporaries.

It is impossible in a review of this kind to give a comprehensive analysis of the Chinese market for electrical goods and those interested are therefore directed to Mr. Lundquist's report. It may be said in passing, however, that a complete analysis is given of central station development factors, practice and management of generators, switchboard and switch gear; transmission and distribution equipment; underground cable, bare and weatherproof wire-poles and towers; crossarms, insulators and pins-line hardware; transformers; street lighting fixtures; motors and controlling apparatus; electric-railway equipment; meters and testing instruments; lamps; batteries; electrical vehicles; farm-lighting plants; telephone and telegraph equipment; wiring supplies and lighting fixtures; fans and other domestic and office appliances and other electrical equipment.

It is but possible to make reference in a general way to a few of these. We learn that while a great amount of bare wire is used, the tendency seems to be towards the use of weatherproof rather than uncovered wire for distribution lines and in the past most of this has apparently come from Germany or England. No triple-braid weatherproof wire so far seen comes up to good American wire in quality, and prices are not materially lower than those that could be made by manufacturers in the United States. Insulators are of porcelain, generally white in color, and are usually bought complete, with pin and washer. In the past

Germany, England, and the United States have sold in this market.

Prior to the war the chief competitors in the field for transformers were one of the American companies, a German, and two of the large English companies. American transformers used in China have a very good reputation, only one complaint being made. This was in regard to small-size, three-phase units, of which the general criticism was made that they were not so satisfactory as the best British transformers of the same type. In the past street-lighting fittings have come from England, Germany and the United States, but in future Japan will be a competitor.

The gradual electrical development in China is bringing an immense market for motors. The business will not be in large units as a rule, but rather the reverse, since a great deal of the demand will be for low-horsepower motors for work that has hitherto been done by hand, horses, or by mules, such as small rice or bean-oil mills and machine shops. The development of railroads will bring a large market for motors, since electric drive will be employed in all new railway machine and repair shops, and mining on a large scale will also create a broad field for the sale of electrical power apparatus of all kinds. In addition there will be more cotton mills, silk filatures, cement mills, cold-storage plants, etc., which will mean increased demand for electrical motors. From this development will come the market for larger type motors, but the volume of business during the next few years will likely be in the smaller capacities, motors of 2 to 25 horsepower.

In the past England, Germany, and the United States, with Japan a growing factor, have supplied most of the motors used in China. In direct-current lines, American motors are generally high in price, the British and Germans competing with each other closely in normal times. In alternating current motors the American manufacturers compete well, quality considered, and in single-phase lines they show not only better operating characteristics, but lower prices as well.

In Shanghai, American single-phase motors have not been strongly represented in the past apparently, but if properly pushed there are several makes that can do considerable business there. American single-phase motors are the best in the market, the only strong competition noted coming from England. The British competition can readily be met when American motors are locally represented, and well-known American designs are being sold to British central stations, owing to their marked superiority and better price. This is one of the few instance where higher-quality American apparatus sells at a lower price than its inferior foreign competitor. While American manufacturers will not be likely to do much business in direct-current motors, of which there is not a great amount anyhow, they should sell a considerable number of alternating-current motors in spite of a somewhat higher price.

The market for electric elevators is small, though growing, and is confined to a few of the largest cities. The Chinese are good builders and like to have elevators in buildings where there is any need for them.

At present China presents only a limited market for portable instruments, but in this line American manufacturers may do a little better, since quality is more of a factor in this type of instruments than in panel meters. One field for portable instruments, and switchboard types as well, that American manufacturers can cultivate is the market afforded by the development of the technical school in China. By furnishing instruments to these schools at a small margin of profit at the start not only is there an opportunity to secure such business in the future at better prices, but the student will become accustomed to good instruments and will not be satisfied to use inferior meters when he completes his course and takes a position with a power company.

The meter business is growing rapidly, as new plants are being installed. In 1916 they were imported in the amount of over $40,000. The market is largely for alternating-current types. The American alternating-current meter can compete with foreign makes. Prior to the war one American manufacturer only seemed to be at all active, but since then two or three others have arranged representation and have sold a fair number of meters. Foreign meters do not have the quality of American meters. Not only are they less accurate over a period of time, but they seem to deteriorate more quickly under the climatic conditions.

American exports of batteries have been of fair volume the amount being (for China and Hongkong) in 1918 $34,419. In the dry-cell line American manufacturers are in a better position and there is a good market, the majority of the telephone systems being of the magneto type. The climate is such that cells do not dry out as in some countries and the normal life is longer. There should be an opportunity for American manufacturers to do a fair amount of battery business in connection with the sale of electric vehicles.

Only one item in general domestic and office appliances is selling to any extent in China; that is the electric fan, which is universally used on account of the hot, humid summer weather and which is one of the most important of American electrical exports to that country. In 1918 those exported amounted to $173,520, the American trade having trebled when the war removed European competition. At present a half dozen good American fans are on the market. Fans not only are given severe usage in China, as they are often operated continuously for a whole day or more, but the humidity causes insulation leaks and breakdowns. It was said by one dealer that a certain American fan was the only one than can be run continuously without difficulty, that Japanese fans get hot quickly and also show leakage. In ceiling fans Americans have an excellent hold on the market.

While there will be a small but increasing demand in China for the best in all lines of electrical goods, coming from the wealthy Chinese as well as from foreigners living in the country, importers state China, generally speaking, wants apparatus and similar large equipment to be the best, but that in minor devices, supplies, and accessories the cheapest will be favored.

Merchants' Association Opposes Public Ownership

The Merchants' Association of New York has reaffirmed its opposition to government ownership and operation of public utilities and has declared emphatically in favor of private ownership under government regulation. The following is quoted from the report of a special committee:

"While we are not unmindful of the defects that not frequently characterize the operation by corporations of public utilities, we do not believe that those defects can be cured by substituting another method which in every respect of efficiency is much below the standards that generally prevail under private management. In so far as the evils which are popularly assumed to exist in private management are found to exist in fact, other remedies than the substitution of methods abounding in greater evils should be found.

"We believe that the public can best be served by utilizing the efficiency, enterprise and energy of private corporations for the continued operation of public utilities, under such public control as shall protect the public in its right to efficient service and fair rates; and at the same time assure to private capital invested in public utilities a fair return upon such capital.

"We do not find any change of conditions resulting from the war which warrant or require the previous position of the Association, in opposition to government ownership and operation, to be modified."

National Electric System for Spain

A royal order published in Spain December 31, 1918, provides that as soon as possible a permanent Spanish electric commission shall be formed under the direction of the Ministry of Public Works, writes Consul-General C. B. Hurst, from Barcelona. This commission shall report on the following points:

1. The possibility and practicability of the construction by the State, directly or indirectly, of a national system for the distribution of electric current.
2. The maximum extension possible of such a system.
3. The approximate cost of such a system calculated on a basis of relatively normal prices, or with copper at between 70 and 80 pounds sterling per ton.
4. The possibility of the State supplying the capital to be thus employed, or of guaranteeing its interest, taking tolls on the current transmitted, and how much this toll should be, or any other means of financing the system deemed preferable.
5. The possibility of a uniform tension and the means to secure it.
6. The basis on which a law should be drawn up in connection with the foregoing.

The director general of Spanish commerce, industry, and labor states that it is of transcendental importance to Spanish industry that it avail itself of the electric energy that the country is capable of producing. A great deal has been done to this end, but there are still many problems to be solved in connection therewith. Water power is distributed throughout Spain, but only companies with great capital can confront the expense of producing sufficient current to electrify railways. While there is water power in some parts of Spain supplying force a hundred miles or more, there are again tracts where no such power exists. Climatic conditions vary largely, as does the flow of water in the rivers. For example, the proportion of water in the Guadalquivir in winter as compared with summer is 1 to 1,000, and on the other hand there are rivers on the slopes of the Pyrenees which are dry in the winter and fullest in August when the snows are melting.

Coal production has been brought to a prosperous condition during the war, but the problem of its transportation remains unsettled.

Although general electrification is difficult, the undertaking in Spain is regarded to be well within the realm of possibility.

New York Jovian League Dissolved

Members of the organization known as the New York Jovian League operating under a charter from the national organization, the Jovian Order, with headquarters at St. Louis, met at the Hotel McAlpin the past month and unanimously voted to divorce themselves from the national order and to become from this time on the New York Electrical League. The New York Jovian League was composed of men interested in electrical industries in general and the new organization, as its name indicates, will have the same class of membership and will be devoted to the same purposes and principles. Hereafter it will not be necessary for members to become affiliated with the Jovian Order in order to become a member of the New York Electrical League.

The officers, committees, etc., of the old organization by a unanimous vote become the officers, committees, etc., of the new organization. Plans are being formulated for the organization of a permanent body to be known as the Electrical Board of Trade of the City of New York. The New York Electrical League membership will form the nucleus of the Electrical Board of Trade.

Increase in Electric Railways

THE forthcoming quinquennial report on the electric railways of the various states shows the remarkable growth of this service, according to preliminary figures given out by Director Sam L. Rogers, of the Bureau of the Census, Department of Commerce. They were prepared under the supervision of Eugene F. Hartley, chief statistician for manufactures. The statistics relate to the years ending December 31, 1917, 1912, and 1907. The totals include electric light plants operated in connection with electric railways and not separable therefrom, but do not include mixed steam and electric railroads nor railways under construction.

The figures for Mississippi show substantial gains in the industry during the decade 1907-1917, but the growth was chiefly confined to the first half of the period, the railway revenues in 1917 being slightly less than in 1912 and the operating expenses materially greater. There were 11 companies in 1917, as compared with 12 in 1912 and 8 in 1907. The track mileage increased from 86.40 in 1907 to 117.14 in 1912 and to 122.79 in 1917, exclusive of 4 miles not operated. The number of persons employed was 627 in 1917, as compared with 507 in 1912, an increase of 23.7 per cent; and there was paid in salaries and wages $392,600 in 1917, as compared with $302,509 in 1912, an increase of 29.8 per cent.

The revenue passengers carried numbered 10,730,801 in 1917, as compared with 10,883,077 in 1912, a decrease of 1.4 per cent, though the number in 1917 is an increase of 18.1 per cent over 1907. The income from all sources was $1,225,712 in 1917, as compared with $910.390 in 1912, or an increase of 34.6 per cent, but the increase was entirely due to growth in the light and power business of the railway companies. The revenues from auxiliary operations increased from $273,217 in 1912 to $583,515 in 1917, an increase of 113.6 per cent, while the revenues from railway operations were $617,527 in 1917 as compared with $626,307 in 1912, a decrease of 1.4 per cent.

The operating expenses were $890,006 in 1917, as compared with $651,866 in 1912, or an increase of 36.5 per cent; and deductions from income, comprising taxes, interest, and fixed charges, amounted to $455,148 in 1917, as compared with $296,833 in 1912, or an increase of 53.3 per cent. As a result there was a deficit in 1917 of $119,442, as compared with a deficit of $38,309 in 1912 and a net surplus of $123,914 in 1907.

The power consumption was 23,301,621 kilowatt hours in 1917, of which 20,022,367 was generated and 3,279,254 purchased, as compared with 13,650,069 kilowatt hours in 1912, of which 9,954,975 was generated and 3,695,094 was purchased.

The figures for Arizona and New Mexico show general increases at each successive census. The number of companies has not changed, Arizona having 4 and New Mexico 2, but they operated 57.49 miles of line in 1917 ,as compared with 54.19 in 1912 and 37.82 in 1907. The number of passengers carried increased from 3,135,459 in 1907 to 5,802,885 in 1912 and to 9,488,467 in 1917.

The income of the roads from all sources increased from $225,630 in 1907 to $360,288 in 1912 and to $613,333 in 1917; and the operating expenses from $160,335 in 1907 to $292,987 in 1912 and to $456,542 in 1917, the increases for the period 1907-1917 being 172 per cent in gross income and 185 per cent in operating expenses. Deductions from gross income, comprising taxes, interest, and fixed charges, amounted to $123,947 in 1917, as compared with $94,551 in 1912, resulting'in a net income in 1917 of $32,844, as compared with a net deficit of $27,250 in 1912.

The power consumption was 5,537,348 kilowatt hours in 1917, of which 1,526,960 was generated by the companies and 4,010,388 was purchased, as compared with 3,435,207 kilowatt hours in 1912, comprising 685,400 generated and 2,749,807 purchased.

Colorado showed marked losses in the industry for 1917 as compared with 1912, although there were pronounced gains during the period 1907 to 1912. The number of operating companies was 15 in 1917, as compared with 16 in 1912 and 11 in 1907. There were 499.87 miles of single track operated in 1917, as compared with 467.97 miles in 1912 and 317.37 miles in 1907, but the number of revenue passengers carried in 1917, 84,623,896, was 2.3 per cent less than in 1912 (86,597,205), though 15.2 per cent greater than in 1907 (73,458,468).

The income from all sources decreased from $6,630,480 in 1912 to $5,826,512 in 1917, the decline amounting to 12.1 per cent, though as compared with 1907, when this income was $4,483,254, there is shown an increase of 30 per cent for the ten-year period. The decrease in income for 1917 as compared with 1912 applies to income from railway operations and to non-operating income. On the other hand, there was an increase in operating expenses from $3,264,753 in 1912 to $3,404,817 in 1917, or of 4.3 per cent, and in deductions from income, comprising taxes, interest, and fixed charges, from $2,106,967 in 1912 to $2,211,329 in 1917, or of 5 per cent. As a result the net income, which was $1,110,809 in 1907 and $1,258,760 in 1912, was but $210,366 in 1917, making a decrease of 83.3 per cent as compared with 1912 and of 81.1 per cent as compared with 1907.

The power consumption waws 111,508,542 kilowatt hours in 1917, of which 98,227,472 was generated by the companies and 13,281,070 was purchased, as compared with 106,373,451 kilowatt hours in 1912, comprising 97,915,436 generated and 8,458,015 purchased.

The figures as presented for Vermont show that during the decade 1907-1917 and the five-year period 1912-1917 there were substantial gains in number of passengers carried and in revenues from railway operations, but the marked increase in operating expenses for 1917 as compared with 1912 has resulted in a decrease in net income. The companies credited to the state—9 in 1917 and 1912 and 10 in 1907—operated 107.95 miles of track in 1917, 102.85 miles in 1912,. and 124.31 miles in 1907, the figures for 1907 include track operated by outside companies in the later years. The mileage of single track in the state was 125.47 in 1917, in comparison with 120.83 in 1912 and 113.38 in 1907, an increase of 10.7 per cent for the decade. The number of revenue passengers carried increased from 7,103,082 in 1907 to 8,135,725 in 1912 and to 8,738,378 in 1917, the rate of increase for the decade being 23 per cent.

The income from all sources increased from $454,-252 in 1907 to $631,241 in 1912 and to $875,058 in 1917, the rate of increase being 92.6 per cent for the decade and 38.6 per cent for the five-year period 1912-1917. The operating expenses, however, increased from $313,845 in 1907 to $345,268 in 1912 and to $599,446 in 1917, or at the rate of 91 per cent for the decade and 73.6 per cent for the last five-year period. Deductions from gross income, comprising taxes, interest, and fixed charges, amounted to $239,724 in 1917, as compared with $169,912 in 1912 and $117,601 in 1907. As a result the net income which was $22,-806 in 1907 and $116,061 in 1912, decreased to $35,-888 in 1917.

The electric power consumption amounted to 21,-754,488 kilowatt hours in 1917, of which 11,601,930 was generated and 10,152,558 purchased, as compared with 8,989,344 kilowatt hours in 1912, comprising 6,867,675 generated and 2,121,669 purchased. These figures show an increase of 142 per cent in electric power consumption for 1917 as compared with 1912.

The figures as presented for the states of Idaho and Wyoming show small gains in trackage, equipment, and income for the semi-decade 1912-1917, but they are far below the gains made during the period 1907-1912. The operating companies in these two states numbered 6 in 1917, 5 in 1912, and 2 in 1907. There were 127.7 miles of single track in 1917 (Idaho 104.65 and Wyoming 23.05), as compared with 111.84 miles in 1912 (Idaho 88.93 and Wyoming 22.91) and 44.24 miles in 1907, the latter being all in Idaho. The number of persons employed was 204 in 1917 and 224 in 1912, and there was paid in salaries and wages $186,209 in 1917 and $195,630 in 1912.

The revenue passengers carried in 1917 numbered 4,736,414, with a passenger revenue of $423,940, as compared with 5,568,781 revenue passengers in 1912 with a passenger revenue of $450,913, showing decreases of 14.9 per cent in number of revenue passengers and 6 per cent in passenger revenue.

The total income was $524,182 in 1917, as compared with $519,153 in 1912, an increase of but 1 per cent. Operating expenses increased from $368,697 in 1912 to $375,858 in 1917, or by 1.9 per cent, while deductions from income, comprising taxes, interest, and fixed charges, which amounted to $154,302 in 1912, were $132,786 in 1917, a reduction of 13.9 per cent. As a result the roads show a net income of $15,538 in 1917, whereas in 1912 there was a deficit of $3,846. The companies all operated with purchased power, the consumption of electric current amounting to 6,587,-229 kilowatt hours in 1917 and 6,144,296 kilowatt hours in 1912.

The Mica Industry of India

The annual report of the Chief Inspector of Mines in India says that the mica output for 1917 was practically stationary, being 35,896 hundredweight, as compared with 35,978 hundredweight in 1916. This was the result of an increase of nearly 10,000 hundredweight in the Bihar and Orissa field being balanced by an equal decrease in the Madras field. In the first-named field conditions in the earlier part of the year were much the same as in 1916, with prices ruling firm and supplies considerably short of the demand, particularly for the better qualities, though stained mica was in considerable request. In the latter half of the year an increasing demand for the smaller sizes, chiefly from America, for wireless-telegraphy apparatus resulted in an abnormal rise in their value. The work in this field is now being carried on with greater energy and improved methods. New roads are under construction, and in other ways the local government has assisted the mine owners to improve conditions generally. In the Madras field, in spite of the encouraging features of the market, there was a marked decrease in the output. A considerable number of new plots were prospected, but very few turned out well.

Hydroelectric Development in England

In the electrical field in Great Britain, the past year was occupied with meeting immediate needs for power rather than in embarking upon new developments, writes Commercial Attaché Philip B. Kennedy. These, however, are destined for attention in the near future, when effort must be focused on the problem of cheap electrical power as an essential to increased industrial output. Both at home and abroad hydroelectric developments have been freely discussed as a preliminary to something being done when normal conditions are restored. Authorization is already being sought for large developments of Scottish water power, and estimates of the available power from the Highlands place the figure between 375,000 and 650,000 horse-power. In any case, water power is not to be overlooked in the program of reconstruction. Interest, however, will first center upon the scheme for the large increase in electrical-power production at the much-talked-of super-power stations.

Small Investors Important Factors in Building

Economists investigating present financial conditions for the Department of Labor agree with Mr. Walter Stabler, Comptroller of the Metropolitan Life, in the conclusion that more than ever before in financial history the small investor in the United States is to be an important factor in financing business and building. Mr. Stabler is quoted to the effect that large mortgage lenders are not plentiful in the market and borrowers must look to small investors, whose participations may be pooled under the trusteeship plan.

Mr. Stabler's statement, advertised by the Title & Guaranty Trust Company, of New York City, was limited to the New York district, but investigations made by the Department of Labor, through its Division of Public Works and Construction Development, suggest the conditions to which Mr. Stabler directed attention is pretty general the country over.

Replies to a comprehensive questionnaire, recently distributed to a selected list of representative institutions throughout the country, indicate an absolute decrease during 1918 of funds available for investment in real estate mortgages and indicate also a relative decrease since 1914 of funds so invested compared with the total resources of the institutions considered.

It is essential, in the opinion of the Department of Labor, to devise ways and means of availing of the small investors' capital and for that reason the American Bankers' Association's plan, advocating the adoption of amortization schedules for real estate loans, together with the Building and Loan Associations' agitation for a federal system of "Home Loan Banks," have challenged the sympathetic interest of the Labor Department.

Just how to gather the comparatively small amounts of capital held by the small investors, and marshal them in amounts necessary to financing extensive building projects, is a problem which must be met by local initiative where the problem arises. The Division of Public Works and Construction Development points out that the small investors were the balance of power necessary to the success of the government's war finance program, and they may now be made the balance of power in the reconstruction work of the nation.

The home builder—he who builds for his immediate use rather than for rental purposes—appears to be getting under way with his building plans. This especially is noted in the central west. The home building program will be facilitated and augmented if small investment money is made available for building loans. In one or two communities this is being attempted by private organizations, brought together for this sole purpose. In other and more numerous cases the regular banks are giving thought to the problem. The building and loan interests already have formulated a plan under which a system of Federal Home Loan Banks would enable them to rediscount their first real estate mortgages, and make available for further loans more than a billion dollars of their assets.

While the Department of Labor is endeavoring to cooperate with state and municipal authorities in getting under way road building and public improvements, and with private interests in their more extensive building operations, it is convinced that home building, for the use of the builder rather than for rental, must be looked to as an important factor in providing better employment for labor during the transition from war to peace production, and for the stimulation of business. For this reason the Department of Labor is making a determined drive for a nation-wide "Own Your Home" campaign.

Foreign Trade Convention

The Sixth National Foreign Trade Convention will be held in the Congress Hall, Chicago, on April 24, 25 and 26, 1919. James A. Farrell, chairman of the National Foreign Trade Council, who issued the call for the convention, and will call the meeting to order, says: "Now, as never before, the United States must rely upon foreign trade to make certain the full employment of labor and to provide investment for capital; to stabilize industry and prevent disturbance of domestic conditions; to insure the permanent retention and operation of our new merchant vessels under the American flag; to maintain prosperity among American producers and to forestall any retrogression from the high standards that have been achieved."

This year the convention has assembled a large amount of valuable technical information, which is available to all delegates who wish to use it. This information will be furnished by the volunteer trade advisors of some of the most experienced business houses and by the representatives of the Government trade agencies. A number of prominent business men of long experience in every branch of foreign trade have offered their services as volunteer advisors. The information they can give is based on personal experience, and as such is doubly valuable. In addition, the Department of State will co-operate by assigning to the convention some members of the Consular Service, who will just have returned from Europe, Latin America and the Far East. The Department of Commerce will send a number of its experts from the Bureau of Foreign and Domestic Commerce. The Shipping Board will be represented. The Pan-American Union will be present to give information on Latin-American relations. These men are thoroughly familiar with their respective fields and can supply a great fund of valuable information if called upon.

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VOL. LIII MARCH, 1919 No. 3

THE business interests of the country are complaining of the loss of trade and the delays resulting from the censorship of foreign cables and mail. The Merchants' Association of New York is using every effort to obtain an abatement of the restrictions, especially to neutral countries such as South America and the Far East, where the enforcement of censorship regulations seems unnecessary now that the war is over. While some of the Federal officials express sympathy with these efforts, so far they have been without result. Permission to use codes in commercial messages is also being sought. It is pointed out that the employment of codes would greatly relieve the pressure upon the cables, thus facilitating the sending of messages, and that it would reduce materially the expense of doing business abroad.

THE fight against the continued Government operations of public utilities is going steadily on. The sentiment throughout the country among business men in crystalizing against a policy that could be justified only by the emergencies of a great war. Senator Joseph I. France, of Maryland, in a letter to the Merchants' Association, says: "I feel it will be better for the country if the wire systems are returned as promptly as possible to the people. I have always feared the effects upon our Government of a policy of Government ownership until there has been developed among our people more of the community and co-operative spirit. These fears have been justified by my observation of the effect of Government ownership and operation during the last few months. I find that many of the progressives who formerly favored Government ownership have awakened to the realization that bureaucracy may become oppressive and that more power lodged with the Government by its assumption of non-governmental functions means less power reserved to the people for the protection of their rights and the preservation of their liberties. Viewing the subject from the standpoint of the common welfare, I feel obliged to advocate the earliest possible abandonment of the Government ownership policy and the prompt return of the wire systems to the people." During the war one could patriotically make allowances for the many sins of omission and commission of the Post Office Department, but conditions have improved very slightly since the coming of peace. America certainly does not want its unsurpassed cable, telegraph and telephone systems brought down to the level of the post office administration.

AN experiment that will be watched with a great deal of interest is the opening by the U. S. Employment Service, Department of Labor, of a practical demonstrating office in New York, the first of its kind in the country. Skilled mechanics and their helpers only are registered for placement, the function of the office being to determine the fitness of applicants for the positions they seek, for reference to opportunities for employment may depend upon other elements than trade ability such as education, age, experience, physique and the like, and the technical interview is relied upon only to determine the degree of trade ability and skill actually possessed, which enables the Service to refer only suitable applicants to the employer and from which the latter may make his selections. If government officials can conduct such an enterprise as this without becoming the slave to red tape and bureaucratic methods, the business world will be more hopeful about the many other enterprises which the Government is endeavoring to manage.

IN discussing conditions confronting the country, Secretary Wilson, of the Department of Labor, says: "The present period of readjustment is the critical time. If we can pass through it safely, we have before us from eight to ten years of industrial activity equal to any wave of prosperity we ever have had. But if there is any serious unemployment, there will be a period of industrial unrest which may lead us to a repetition of the French or the Russian revolution." Secretary Lane, of the Department of the Interior, refers to this prediction and declares that he can do much to stem the tide of industrial unrest if Congress will appropriate the sum he asks in order to enable him to establish soldier-settlements in every state in the union. This scheme would enable him to offer jobs to 100,000 of the returning fighting men and provide farm homes for 25,000 of these men. Without any attempt to belittle Secretary Lane's plan, it would seem to the ordinary business man that the best way to obviate industrial unrest would be to improve general business conditions and thus do away with unemployment in the natural and logical way. A conference of governors and mayors was called at Washington for a discussion of business and labor problems growing out of the ending of the war. But this is not a matter to be settled by politicians or state and city officials. It is the concern, mainly, of those who direct great industries. And yet business was not directly represented. In order to find out the views and attitude of business, the journal *Industry* sent out a questionnaire to the most important corporations and manufacturing firms in twenty-six states, all of them large employers of labor. The answers that were returned attribute the growing unemployment to various causes. Labor itself was blamed for decreased production and prohibitive costs, enforced by strikes for shorter hours and higher wages. But many of the manufacturers were frank in putting much of the trouble up to the Government itself, which, it is charged, has had no fixed policy, has inclined toward paternalism in many fields, and has coquetted with price fixing and Government regulation. The paper says editorially that there is a hesitancy throughout the country which is due, in part at least, to suspicion of the Government's efficiency in handling the economic and financial problems which have followed the war. This suspicion is based on the fact that this Government has done practically nothing since the armistice was signed to stabilize conditions; while, on the other hand, there has been a persistent campaign to concentrate in the hands of the Government a power of interference which inevitably disturbs business throughout the country.

Public Opinion on Government Control

The interim report of the Public Policy Committee of the National Electric Light Association has the following to say on public ownership:

"Public opinion will be divided as to the influence of war experiences upon the question of public ownership of utilities. The former advocates of public ownership will try to see in the extension of public control exercised during the war a trend which is likely to continue. On the other hand, the general public will be likely to judge the merits of the question by its opinions as to economic and service results achieved under direct government control in comparison with the results of previous operations under corporate management.

"Government control of the railroad systems of the country during the war has been universally recognized as a wise procedure, because of the necessity of subordinating the individual interests of the various railroads to the all-important idea of securing the maximum of transportation service throughout the country for the movement of troops and essential commodities. The serious curtailment of the usual passenger and freight service coincident with the greatly increased charges for both classes of service, has been accepted by the public as necessary to the quickest possible success of the war program.

"Now that hostilities have ceased, the railroad administration will be judged by other standards than those of war necessities, and already the editorial columns of prominent papers are extremely critical of the operating and financial results of government control. In the opinion of your committee, there is nothing in the experience of the Government thus far to justify or encourage permanent public operation of the railroads either from the standpoint of economics or of service, and while doubtless the ardent advocates of public ownership will seek to capitalize recent experiences of the Government in favor of their theories, it is indisputable that those who travel on the railroads and those using them regularly for shipping are anxious for the termination of direct government operation as soon as may be practicable."

Popular vs. Government Ownership

Carl D. Jackson, Chairman of the Wisconsin Railroad Commission says: "The actual ownership of most public utilities is by the people themselves. The first liens on most public utilities are very often owned by Trust companies, banks, and largely by insurance companies thoroughout the United States. Nearly every man carries an insurance policy. The average citizen has a bank account, yet not one citizen out of a hundred realizes that in one form or another his actual savings and insurance and his wife's and children's welfare depend upon the solvency and continued operation of public utilities. There is probably not one man in fifty whom we meet on the street who does not own a part of a public utility, whether he knows it or not. So the question relating to public utilities are not confined to the consumers on one side and the public utilities as such on the other, but the whole question is one involving financially nine-tenths of the entire population. Furthermore, public utilities should not only be solvent in themselves, but there should still remain a reasonable incentive to reasonable development along the lines to be demanded by future generations. Nothing should take place in this country to discourage individual and collective efforts along progressive lines."

Colonel H. M. Byllesby, in a telegram to the Oklahoma Utilities Association in convention at Oklahoma City, said:

"The trend of events in the utility situation is one which should command our most earnest, thoughtful and active attention. It seems to me that only two courses are open to the utility business; first, that the laws be so adjusted as to enable these companies to make such a fair return upon their investment as will enable them to find capital continuously for the further extension of their enterprises which the growth of the community served and the improvements in the art render increasingly necessary. These laws and regulations at the hands of Commissions or other properly authorized bodies should encourage in every proper way the spirit of enterprise and provide some profitable return beyond the mere bare interest on the cost of the properties in order to bring to bear the very best inventive and enterprising capacities of all those engaged in this business.

"If the laws and regulations cannot provide for this situation then the only alternative it seems to me is that the various communities should take over the properties at a fair and suitable compensation to the owners, as I am confident that at bottom no real American wishes to rob anyone or to take possession of any property without making due, proper and fair payment therefore. This latter course is one which I sincerely trust will not be adopted as it involves all the evils which years of experience have shown always attach to governmental operation of enterprises of this nature.

"The very best results to the community, to those who pay for the service rendered, will be found as always in private ownership, where this ownership, while being regulated along proper lines, is still allowed full scope for the exercise of ingenuity and enterprise; and in order to do this they must be allowed, as I have previously stated, not only a standard return for the capital invested in other enterprises of a similar nature, but in addition to this some fair, reasonable allowance to compensate for the exercise of painstaking, continuous industry, ingenuity and enterprise."

Italian Specifications for Electrical Machinery

The Italian Gazetta *Ufficialle* for December 12, 1918, publishes a decree announcing that the standards of the Italian Electrotechnical Association for 1916 (Norme per l'ordinazione e il collauda delle machine elettriche, edite dall' Associazione Elettrotecnica Italiana nel 1916) will be followed in the specifications of electrical machinery for the Government. The regulations are printed in detail and include conventional signs, terms, and definitions and instructions for bidding on Government work.

Government Telegraph Rates Raised

The Ceylon telegraph lines are owned by the Government, and the rate has now been increased from a unit charge of 25 rupee cents to 40 cents for 10 words, including the address, writes Consul Walter A. Leonard, from Colombo. This means an increase of 60 per cent on the minimum charge, but the rate for additional words remains the same, viz. 5 rupee cents for each additional 2 words or less.

Organization Conference of Railroad Engineers

Questions of immediate concern to all railroad engineers will be discussed at a conference in the Gold Room of the Congress Hotel, Chicago, March 17, beginning at 2 P. M. and extending through the afternoon and evening. The conference will be held under the auspices of the Railroad Committee of the American Association of Engineers, of which Mr. W. H. Finley is president and chairman of the Railroad Committee. Some of the subjects on the program are: The need of an association including all railroad engineers to look after their economic welfare; Methods of organization; Aplication to order 27 and supplements of the U. S. Railroad Administration, especially with reference to overtime and classification of engineers; Rates of pay.

The session will be held on the Monday of the week of the annual convention of the American Railway Engineering Association in order that those planning to attend the A. R. E. A. convention can come a day earlier and attend the organization conference. The conference is thoroughly democratic in character. Every railroad engineer is invited, whether a member of any engineering organization or not, and whether mechanical, civil, electrical or in any special field. Detail of program will be announced later.

The Railroad Committee of the American Association of Engineers announces the employment of an Assistant Secretary to give attention to the railroad field. A sub-committee will be appointed to study wages paid technical engineers on the railroads and elsewhere. A tentative report will be represented at the March 17 conference.

Exhibition Committee Plans

The Exhibition Committee of the National Electric Light Association held a meeting at the headquarters in New York on February 15th, under the chairmanship of Mr. J. W. Perry. It was formally decided to approve the proposition to hold the next annual convention at Atlantic City, the week of May 19th, and to resume all the proposed plans and activities that had been so carefully worked out in 1917, with additional features of interest to the operating member companies. These will be given in full for publication as soon as possible. In the meantime the committee desires to announce to the Class D exhibiting members that all reservations made in 1917 as to exhibition space will be given priority and be carried out by the Exhibition Committee, which is communicating immediately with all the pledged and prospective exhibitors, upon whom it is impressing the fact that this is the reconstruction convention after the great war, the most notable and historic in the life of the N. E. L. A. Mr. H. G. McConnaughy, secretary of the Exhibition Committee, can be addressed on all such matters at the association offices, and it is suggested that all exhibitors get in touch with him at once.

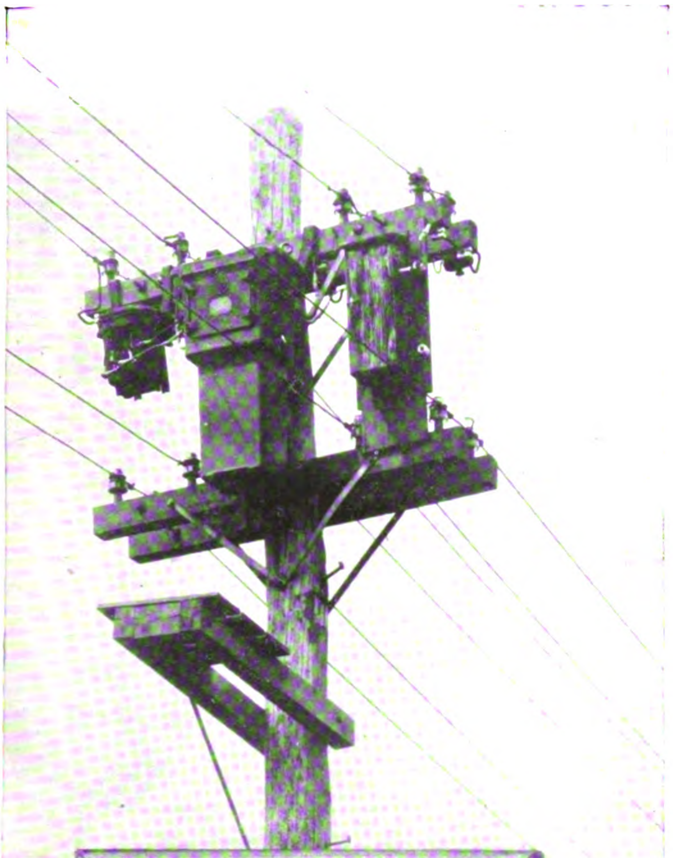
Obituary Notes

E. H. Jacobs, construction engineer and superintendent of all distribution lines of the Western States Gas & Electric Company at Stockton, Cal., died of pneumonia recently, after having been ill with influenza for about ten days. Mr. Jacobs has been connected with the Western States Company for ten years, and for the last seven years had been located at Stockton.

A. O. Dicker, Illinois manager for the Luminous Unit Company and St. Louis Brass Company, died at his home in Oak Park, Ill., the past month, at the age of 30 years. He had taken a prominent part in illuminating engineering in Chicago.

Will Join the Westinghouse Forces

William A. Sumner, Rockville, Conn., recently discharged from the Army, with the rank of second lieutenant, has entered the employ of the Westinghouse Electric & Manufacturing Company, East Pittsburgh, where he will specialize on electrical machine designing.



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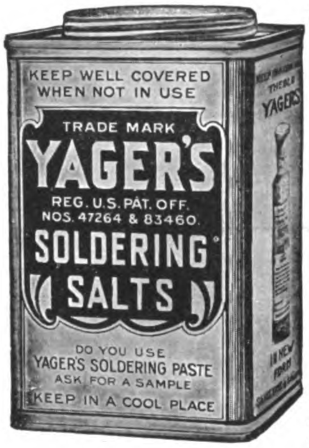

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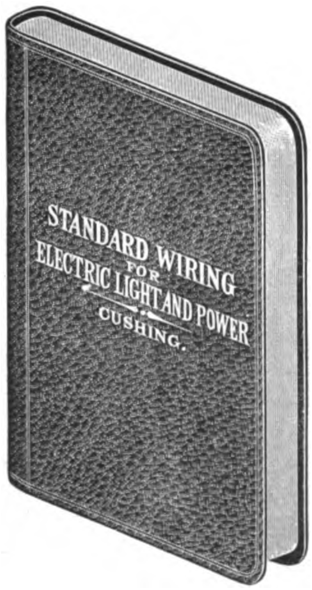

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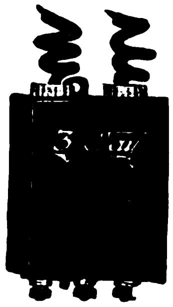

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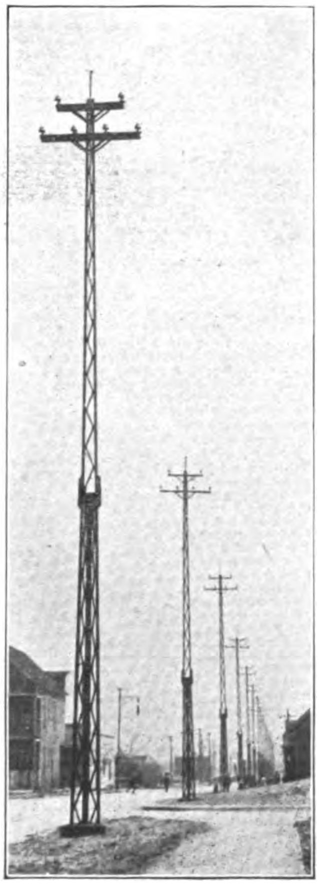

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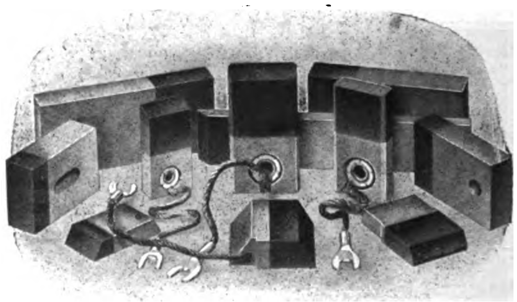

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ELECTRICAL ENGINEERING

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Perfecting the Submarine Detector

THE United States Navy Department, after nearly two years of the closest censorship, has given approval to the publication of certain data relating to the development in the United States during the war of submarine detecting devices, which were used to signal advantage by this country and the Allies in prosecuting and bringing to a successful conclusion the campaign against the German U-boat. The apparatus may be termed the composite work of the General Electric Company, Submarine Signal Company, Western Electric Company, the National Research Council, assisted and advised by many eminent scientists, engineers and research men, chief among whom were Drs. W. R. Whitney, Irving Langmuir and W. D. Coolidge, Prof. R. A. Milikan, Prof. Max Mason, etc.

Realizing that the prompt solution of the submarine problem was the key to a successful termination of hostilities, Secretary Daniels, immediately upon our entrance into the conflict, appointed a special board to devise ways and means to overcome it. At the suggestion of Dr. Whitney, director of General Electric Company's research laboratories, a group of scientists was formed at Nahant, Mass., under Dr. Irving Langmuir, where the results of extensive research activity were put to practical tests under actual conditions as nearly as possible approaching those in European waters. Another group under Prof. Milikan, head of the Physics Department of the University of Chicago, was organized at New London, Conn., where and the work of both bodies was later co-ordinated.

Out of the efforts of these two groups and the work carried on in Schenectady, assisted by Allied commissions of scientific men, there grew the American Submarine Detector—a development of the old principles of sound wave transmission in water in an altogether new and startling manner. The apparatus, finally perfected and put to immediate use, was first designed to hang overhead from naval craft amidship below the water line and it depended for its direction getting qualities on the peculiar and heretofore little understood faculty of the human ear to detect the direction of sound by the shifting of that sound from one ear to the other.

Owing to the interference of sounds made by the listening ship's own motors, it was found more practical to stop the engines when about to take observations and this added greatly to the effective range of the instrument. To overcome this obstacle, another device was developed which could be trailed off the stern a hundred or so feet away where the engine noises of the ship were out of range and the sound was then brought into the operator in the ship's hold. A third adaptation of the listening principle was an instrument which protruded through the hull and was a stationery part of the vessel's equipment. A somewhat circular device was constructed for use on submarines, but all of them were used to advantage.

While demonstrating the device to the British Admiralty, our American engineers were asked to study the question of fitting submarine detection units to airplanes, balloons and dirigibles. After some experimentation, followed by more practical tests and conferences with the Lancashire Group of scientists at Harwich, apparatus was developed which met these needs and many aircraft were equipped with sound detectors which rendered it possible for them to follow the course of the enemy after they had seen her submerge, a valuable faculty which such craft did not possess until the introduction of the American detector.

Permission has not yet been obtained to enter into a detailed description of the devices invented during this period. The Government, having spent large sums of money on the apparatus, desires the intricacies of its manufacture still kept secret, while other matters involving several American concerns, makes discretion the better part of valor in attempting to tell the inner secrets of its development. However, when the devices had proved themselves eminently satisfactory after exhaustive experimentation here, the Navy Department organized a special Service Party under Captain R. H. Leigh of the Bureau of Steam Engineering to demonstrate the detectors to the British Admiralty. Shortly after the arrival of this party abroad, the

American submarine detectors were universally adopted by all the Allied navies. It was found to be much superior in many ways than any of previous development, and came to be considered one of the most effective offensive weapons ever used against the submarine.

To sum up, the results achieved by these American listening devices, it is only necessary to recount a few pertinent points to illustrate the device's practicability. Under ideal conditions with extraneous noises reduced to a minimum or entirely eliminated, the device was effective at a range of from 15 to 25 miles. Trained operators could clearly and invariably distinguish between the sounds made by approaching surface craft and under-water vessels (submarines). Under average circumstances, the device was good for a range of between 3 and 8 miles. Within five miles the engine characteristics of different vessels was clearly marked even to the point of identifying by name certain (unseen) vessels after they had been observed previously for more than one time. (This test was substantiated by a series of night time experiments at the entrance to Boston harbor in September and October, 1917.)

It was found practical to tell when a submarine changed from her oil engines to electrical drive which was necessary every time she submerged. The direction of sound could usually be computed within a very few degrees of its actual location and a good judgment of the distance could generally be made. This was proved to the satisfaction of all concerned following a number of practical tests off Cape Cod, Mass., in the late summer of 1917, in waters adjacent to Boston and in Long Island Sound.

While in fairness to all of the sound-detecting devices developed during the war period, it must be said that the American device was inferior in certain respects when it came to the application of these devices under actual battle conditions and in heavy sea and weather they stood up remarkably well. This factor was of especial value during operations in the English Channel and the North Sea, which has been termed the roughest body of water for its size in the world.

The addition of these listening devices to submarines added the heretofore lacking sense of hearing to all the underwater craft and made them at once a much more effective weapon of offense. An Allied submarine on one occasion chased a German U-boat for four hours, while both craft were submerged, without once losing sound contact with the enemy.

The engagement occurred one early morning in the English Channel. A small squadron of sub-chasers discovered an enemy craft moving slowly up the channel submerged. Forming for the attack they rushed over the spot where the listeners indicated the U-boat to be, dropped a pattern of depth bombs and then withdrew to take observations. Feverish activity and the sound of hammers ringing against the ship's side was heard. The submarine engines would then start up and stop, start and stop again. Further attacks were delivered and more noise came to the listeners from the hold of the submarine. Evidently the first depth charge had taken good effect and the enemy's crew was making a last desperate effort to reach the surface. Then there was a dead silence broken at last by twenty-five sharp reports like revolver shots. The crew, giving up in despair, had committed suicide. The loss of this submarine was later substantiated by the British Intelligence Department.

When Captain Leigh and his party went abroad in November, 1917, he requested the Admiralty to loan him two high-speed chasers in which operations could be begun in English waters, but was finally obliged to accept three trawlers of 9 to 10 knots speed, because of the then scarcity of higher speed craft. Equipping these vessels with all of the anti-submarine detecting apparatus they went out in the English Channel on New Year's Day, 1918. Shortly afterwards a wireless message was picked up from an airship giving the position of a submarine which had just been seen to submerge. The channel had been laid out in numbered squares to facilitate the immediate location of enemy craft and the little squadron steamed over, got their devices out and picked up the submarine course. When believing themselves about over the enemy, depth bombs were discharged and later a trawling instrument was used which indicated that the submarine had been destroyed. Great quantities of oil rising to the surface also substantiated the success of the attack.

Remaining in English and French waters for several months, where the American devices proved of great value and were highly complimented both by Admiral Sims and British naval officers, another squadron was equipped and sent into the Mediterranean and Adriatic where at this time submarine activity was at its height. Because of the deeper water and less interference from surface traffic, listening conditions were unusually good. A barrage line of boats was organized across Otranto Straits between the main land and the Island of Corfu to effectively put a stop to the enemy's free entrance to the Mediterranean.

Three of the chasers patrolling in formation abreast one dark night heard a sub approaching. The bearings obtained by the two beam vessels pointed directly toward the center boat. The middle boat now heard the submarine approaching from a position dead astern. The enemy came nearer and nearer and finally passed right under the sub-chaser so close to the surface that those on board felt a wave of water along the keel of their ship. When the German had passed on and out in front, the attack was made in unison, a pattern of depth bombs was "let go" and the little fleet halted for further observations. Pretty soon the whirl of the submarine's electric motors was heard evidently in an effort to reach the surface. When came a crunching noise not unlike the popping in of a blown-up paper bag. It was apparent that the submarine had been damaged, put out of control and sunk and that she had collapsed from the tremendous water pressure at these depths.

Many incidents of this kind occurred during the subsequent operations in foreign waters and several submarines were accounted for through the direct aid of the American listening devices. In fact, naval experts who were closely in touch with submarine detection development during the war period, state with conviction that if the conflict had continued through another summer, the submarine would literally have been driven from the ocean, the promise of a condition due in a large measure to the perfection of submarine detecting apparatus.

It has also been stated that the noticeable change in naval tactics—from defensive to offensive—which marked this country's entrance into the war was largely caused by the application of American principles to the pursuit and attack of the U-boat, something made possible by the practical use to which it was found the American submarine detector could be pupt.

Electric Railways in Porto Rico and Hawaii

Preliminary figures of the forthcoming quinquennial report on the electric railways of Porto Rico and Hawaii have been given out by Director Sam. L. Rogers, of the Bureau of Census, Department of Commerce. They were prepared under the supervision of Eugene F. Hartley, Chief Statistician for Manufactures. The statistics, which relate to the years ending December 31, 1917 and 1907, show substantial gains in the electric railway industry in both Porto Rico and Hawaii for the ten-year period covered.

There were three operating companies in Porto Rico in both 1917 and 1907. The mileage of track totaled 22 in 1917, as against 18 in 1907. The number of revenue passengers carried was 6,724,051 in 1917, or 32.2 per cent more than in 1907. The revenue car mileage amounted to 1,378,322, an increase of 67.4 per cent. for the decade. The electric power consumed amounted to 7,445,563 kilowatt hours, of which 2,390,601 was generated by the companies, and 5,054,962 was purchased.

There was only one operating company in Hawaii in 1917, as in 1907, with 32 miles of track in the later year, as compared with 26 in the earlier. The number of revenue passengers carried was 14,378,092 in 1917, or 95.4 per cent more than in 1907. The revenue car mileage amounted to 2,039,235, an increase of 29.4 per cent for the decade. The electric power consumed—all generated by the operating company—amounted to 4,734,000 kilowatt hours, an increase of 104.1 per cent, as compared with 1907.

In order not to disclose the operations of individual companies, the financial statistics for Porto Rico and Hawaii were combined in 1917, as in 1907. The comparative statistics for the two districts combined are as follows.

The companies employed 582 persons in 1917, an increase of 46.6 per cent, as compared with 1907. The salaries and wages paid to these employees aggregated $472,356, an increase of 93.6 per cent for the decade. The income from all sources was $1,186,418, of which sum $1,167,714 represented operating revenues. The rate of increase in the total income for the period 1907-1917 was 57.4 per cent. The operating expenses aggregated $684,054, an increase of 63.5 per cent. over 1907; and the deductions from income, comprising taxes, interest, and fixed charges, amounted to $139,876, a decrease of 24.1 per cent as compared with 1907. The net income was thus $362,488, as compared with $151,025 in 1907, the rate of increase being 140 per cent.

The Electric Light and Power Industry

According to a report about to be issued by Director Sam. L. Rogers, of the Bureau of the Census, Department of Commerce, the electric light and power stations in the United States during the year 1917 generated more than 25 billion kilowatt hours of electric energy, producing an income of more than a half billion dollars, and gave employment to more than 100,000 persons, whose salaries and wages aggregated nearly $100,000,000. The output in 1917 was more than double that for 1912, and more than quadruple the output for 1907.

This report, which was prepared under the supervision of Eugene F. Hartley, Chief Statistician for Manufactures, covers both commercial and municipal plants, but does not cover electric plants operated by factories, hotels, etc., which generate current for their own consumption; plants operated by the Federal government and state institutions; nor plants that were idle or in course of construction.

The figures show great strides in the industry during both of the five-year periods 1907-12 and 1912-17. The output of electric energy by the light and power stations increased at a considerably greater rate, and their expenses at a slightly greater rate, than their income; and the rate of increase in the number of persons employed was much smaller, particularly during the later five-year period, than that in the amount of business done.

The total number of establishments increased from 5,221 in 1912 to 6,541 in 1917, the latter comprising 4,224 commercial, and 2,317 municipal, establishments. The increase indicated by these figures is somewhat misleading, since 2,295 new establishments came into existence between 1912 and 1917, but as a result of combinations in the commercial systems and various other changes, the net increase was only 1,320, comprising 565 commercial and 755 municipal stations.

The total income of the stations in 1917, of which 95.3 per cent represented electric service, amounted to $526,886,408, an increase of 74.3 per cent, as compared with 1912 and of 200 per cent as compared with 1907. The total expenses were $427,136,136,049, or 82.1 per cent more than in 1912 and 218.3 per cent more than in 1907. The employees of the light and power stations numbered 105,546, an increase of 33 per cent over 1912, and of 121.6 per cent over 1907; and their salaries and wages aggregated $95,239,954, an increase of 55.7 per cent, as compared with 1912 and of 168.9 per cent over 1907.

The total primary power in 1917 amounted to 12,857,998 horsepower, an increase of 70.8 per cent, as compared with 1912 and of 213.7 per cent over 1907. Of this power nearly two-thirds—8,389,389 horsepower—was derived from steam; almost one-third—4,251,423 horsepower—from water; and the remainder—217,186 horsepower, or less than 2 per cent—from internal-combustion engines. The corresponding proportions for 1912 and 1907 differed but slightly from those just stated. The average horsepower per steam engine shows a very great increase—from 334 in 1907 to 631 in 1912 and to 1,124 in 1917. The average horsepower of the water wheels also shows a marked increase from census to census, but in the case of the internal-combustion engines there has been a decline.

The total dynamo capacity, 9,001,872 kilowatts in 1917, represents an increase of 74.3 per cent as compared with 1912 and 232.2 per cent over 1907, these rates of increase being slightly greater than the corresponding ones for total primary power. The output of electrical energy aggregated 25,438,611,417 kilowatt hours, an increase of 119.9 per cent for the period 1912-17 and of 333.9 per cent for the decade. Of the 6,541 establishments reported for 1917, those which purchased all their electric energy from other establishments numbered 1,422, as against 507 in 1912 and 227 in 1907.

The horsepower of stationary motors served amounted to 9,216,323 in 1917, or 123.1 per cent more than in 1912 and 458.9 per cent more than in 1907. The figures indicate that the arc lamp for street lighting is being fast superseded by the incandescent of various types. The former class of lamps decreased in number from 348,643 in 1912 to 256,838 in 1917, the reduction amounting to more than one-fourth, while during the same period the number of incandescent lamps more than doubled, increasing from 681,957 to 1,389,382.

A Big Turbine-Generator Equipment

By J. P. Rigsby

THE 45,000 K. W. Turbo-Generator unit recently put into operation in the power station of the Narragansett Electric Light Company at Providence, R. I., is of the now well-known Westinghouse cross-compound double unit type, consisting of a high and low pressure turbine, each connected through a flexible coupling to its own generator, having a capacity of 22,500 kw. and mounted on separate bedplates supported on foundations lying parallel to each other. The generators are arranged to feed separately or together to the main bus.

This type of turbine is very successfully exemplified by the three 30,000 kw. units installed a few years ago in the Seventy-fourth Street Station of the Interborough Rapid Transit Company, New York. Steam enters the high-pressure turbine through suitable governor-controlled valves, passes through this single flow element, and out through an exhaust on the top, and is conducted by means of a receiver pipe overhead to the middle of the double flow low-pressure turbine alongside, where it divides, flowing in opposite directions through low-pressure blading, then down through the exhaust chambers into two Westinghouse Leblanc jet condensers of the latest type.

The energy given up by the steam at full load is equally divided between the high and low-pressure turbines, the generators dividing the load in half; at lower loads a greater proportion is carried by the high-pressure element. The unit was designed to operate with a steam pressure at the throttle of 200 pounds with 100 deg. superheat and a vacuum of 29 inches in the exhaust, while the generators have a capacity of 23,750 kva., 11,000 volts, 3 phase, 60 cycles at 0.95 factor, the high-pressure elements having a speed of 1,800 r. p. m., and the low-pressure 1,200 r. p. m. There are four bearings to each unit, a flexible pin type coupling being used to cónnect the turbine and generator.

The high pressure turbine is of the single-flow reaction type throughout, of a very simple, rugged construction, designed for efficiency and dependability, all parts coming in contact with high-pressure steam being made of cast steel, while the exhaust chamber and other parts not subjected to high temperature or stresses are of cast iron. The pressure in the high-pressure cylinder varies from a maximum of about 200 lbs. at the inlet to atmospheric pressure in the receiver pipe at full load.

With reaction type machine, high-pressure steam is admitted, of course, direct to the cylinder casing instead of into nozzle chambers, as is the case with an impulse type. This presents the problem of perfecting a horizontal joint on a cylinder of considerable diameter that will be tight, and stay tight, against 200 to 300 lbs. steam pressure, or any tendency to open, due to distortions from the high temperature.

The high-pressure end, or steel part of the cylinder, is composed of two steel castings, 5 ft. 10 in. inside diameter and 1¾ in. thick, while at the joint thickness gradually increases until it merges into a flange eight inches wide, tapering to the outer edge. These bolts, or studs, as they really are, 2¼ in. in diameter, are tapped alternately into upper and lower flanges registering with suitable bosses on the companion flange.

This method permits of a closer spacing of bolts, removing less metal, and produces a stronger flange than by any other means. No gasket is used, the joint being scraped to a surface.

The four rings containing the blades are not an integral part of the main cylinder, but are made of separate castings joined in the middle, resulting in simplicity of construction, freedom from strains, and the absence of those difficulties inherent in a complicated steel casting, besides being a distinct aid in manufacturing, as the machine work is not all done on one piece, but can be divided among different machines, and finally assembled when each piece is completed. These rings are clamped in place, again saving expensive work on the main castings.

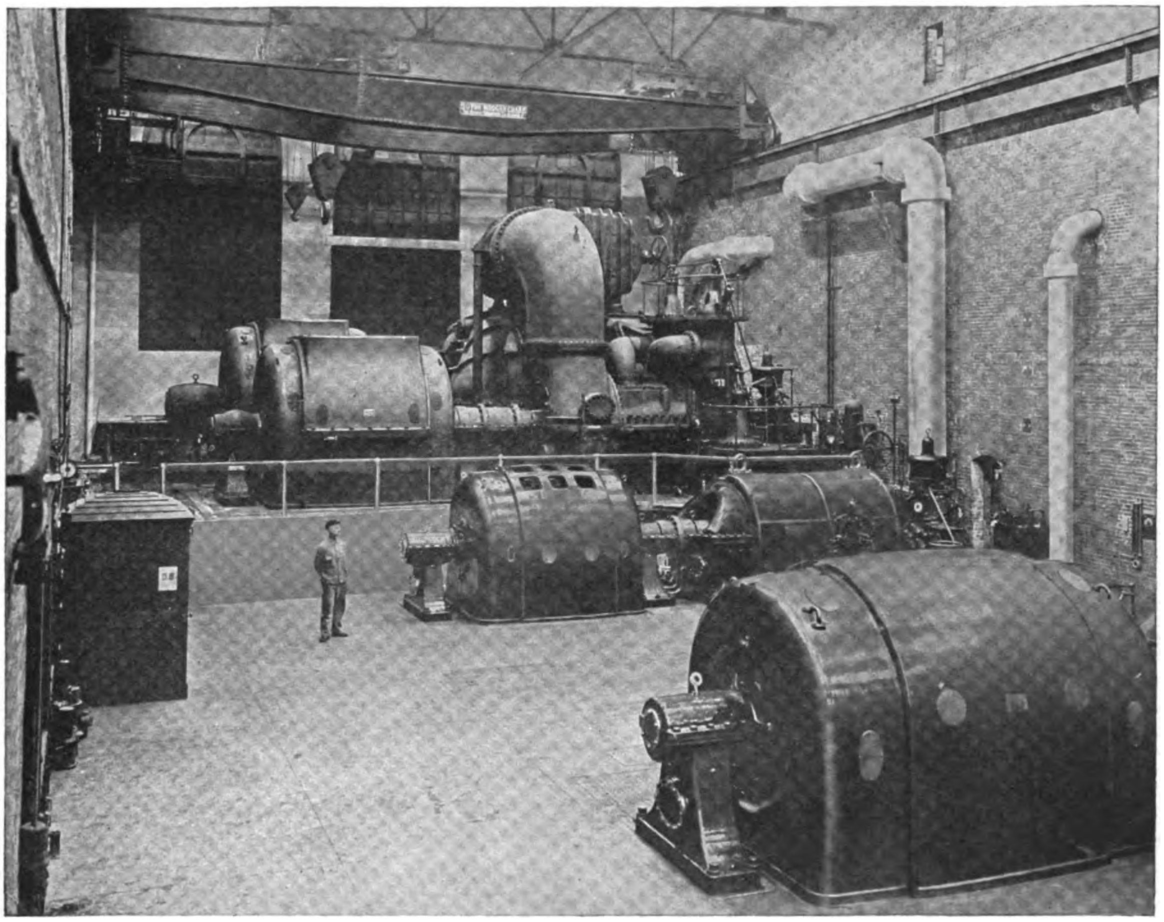
The high-pressure cylinder is supported on three points, as usual, one under the governor, or thrust end, and one on each side of the exhaust, near the center line, thus insuring against distortions, or a possibility of misalignment, due to differential expansions between the turbine and generator supports from unequal temperatures.

The high-pressure spindle consists of a hollow steel drum about three feet in diameter, carrying most of the blading, there being two blade rings of larger diameter on the one end, and corresponding dummy rings, or balance pistons, on the other. The spindle ends are pressed into the drum and are secured with tee-headed shrink links, which are themselves held in place by the blade and dummy rings. The stresses in the spindle parts are quite low, these parts being made from ordinary carbon steel. However, strict care is taken in making the castings in order to insure homogeneity, the precautions necessary to secure this uniformity having been learned by long experience.

There are 24 rows of blades in the high-pressure turbine, ranging in size from 1 in. blades, 4 in. long, to 1¼ in. blades, 9½ in. long. These blades are unusually strong and rugged, and they insure the highest efficiency and durability. The maximum mean blade speed is 470 feet per second.

The steam passes out through an exhaust at the top of the cylinder into a 66-inch receiver pipe leading over to the low-pressure turbine. A similar exhaust is provided directly below, which connects through an automatic relief valve to the atmosphere. A gate valve is placed in the receiver pipe, in case it is necessary to operate either turbine alone, the high-pressure turbine running non-condensing, under control of its own governor, or the low-pressure turbine, on steam admitted through a 14-inch throttle from the high-pressure line, it being connected in step electrically with some other unit in the system.

Steam is supplied to the unit through a 24-inch



A 45,000 K. W Turbo-Generator Unit for a Providence Lighting Company header, every care being taken to provide adequate flexibility to the line. A standard Westinghouse type throttle valve with the regular automatic stop features controls the admission. The throttle valve steam strainer and primary steam chest, which are located adjacent to the bedplate alongside the turbine, are spring-supported, so as not to impose a dead load on the cylinder.

The low-pressure element is of the straight, double-flow reaction type. The steam entering at the top through the above-mentioned receiver pipe, passes around the spindle in an annular chamber of ample proportions, and enters the low-pressure blading, there being eight rows in each end, ranging from ¾-inch blades 6 in. long, to 1¼-in. blades 18 in. long. The low-pressure cylinder rests on four supports applied near the center line on each side of the exhaust chambers. It is free to expand axially sliding on these supports, the turbine being anchored to the inboard generator pedestal. A system of radial and axial stays in the exhaust chamber produces extreme rigidity, minimizing the possibility of distortion or sympathetic vibrations.

The low-pressure spindle is composed of a central hollow drum, rigidly secured to the spindle ends. Upon each of these ends are mounted two discs carrying the low-pressure blades, the maximum mean velocity of which is only 515 feet per second, which precludes the necessity of using other than a reasonably good grade of cast steel in the blade rings. However, owing to the double-flow feature, ample blade area is provided to make the best use of a high vacuum and still maintain a conservative blade length in the last rows. Phosphor bronze blades are used throughout, except the last three rows in the low-pressure, which are forged steel. The low-pressure cylinder is entirely of cast iron, composed of a center section and two end sections, bolted and spigoted together, and all split horizontally. The three upper pieces are handled as one, the vertical points never being disturbed.

The high-pressure steam admission is controlled much the same as on all other Westinghouse machines, by means of a powerful, though sensitive, governor, which operates the plunger of an oil relay attached to a floating lever, this relay controlling the admission of oil to an operating cylinder mounted on the side of the first, or primary valve. This cylinder, by means of levers, controls the primary, secondary and tertiary admission valves. The primary valve, located on the side, admits steam to the bottom of the high-pressure cylinder, while the secondary and tertiary valves, being located on the top symmetrically about the center line, admit steam to the second, or third stage, as the case may be. Loads of 30,000, 40,000 and 50,000 kw. respectively, can actually be carried on these valves.

Both turbines are equipped with double Kingsbury thrust bearings capable of taking the load in either direction, though when running under load the thrust is toward the generator. The shafts are sealed with the usual well-known water gland with the addition of an annular steam chamber for the admission of steam so that a vacuum can be established before starting up. Each turbine is provided with an oil pump sufficient for its own needs, though both feed into the same oiling system. They are double plunger pumps, running at 165 strokes a minutes, with a common suction, but separate discharge.

The high-pressure oil necessary to operate the steam inlet valves is taken from one side of the pump on the high-pressure turbine, pressure being maintained by a spring-loaded relief valve. The total amount of oil used is approximately 175 gallons a minute. The bearing oil pressure is from five to eight pounds.

This unit, although it does consist of two separate elements, is started the same as any other machine. Field excitation is supplied to the generators, the throttle on the high-pressure element is opened, and slowly brought up to speed, the low-pressure generator operating as a motor, and coming to speed in step with the other. The two machines as a unit can then be synchronized, and placed on the line, remaining in step and properly dividing their load.

The condenser equipment for the above turbine consists of the largest condensing apparatus in the world. The condenser unit is composed of two separate and distinct low-level jet condensers, which can be operated together, or separately, if necessary. If the temperature of the injection water is low enough to warrant it, the operation of only one condenser is necessary to maintain a workable vacuum. These condensers are connected to form a single condensing apparatus by means of an exhaust connection, ample in area to permit operating either condenser alone, when necessary.

The same water level is maintained in each condenser by the use of a water equalizing connection between one pump body and the other. This is an absolutely necessary feature, and it is provided in order to maintain a constant submergence over the center line of each pump, to provide sufficient head to force water into the runner under vacuum. This water-equalizing connection is so constructed that no surges occur between the condensers, it being made in the form of a toe, the bottom of which forms a reservoir. A baffle running almost to the bottom prevents surging. An air equalizing connection is provided to maintain the same air pressure in each condenser. If both are in operation, the valve may be either open or closed, but it has been found by trial that if one condenser only is in operation, the valve must be open in order to have the same air pressure in each.

The condensers are equipped with geared turbine-driven pumps, running at 500 r. p. m. instead of 700 r. p. m., which latter is standard. This was found necessary, owing to the limited headroom in the basements. These pumps are able to operate with a submergence of 50 in. above the center line of the pump shaft, while 72 in. is necessary with a 700 r. p. m. pump. This resulted in a saving in headroom of 22 in. Considering capacity, this unit requires less floor space than any other condenser unit now in operation.

In starting up this condenser it is necessary to use a priming pump. The main turbine is operated non-condensing, or with a slight vacuum, until sufficient vacuum is obtained for the condenser to lift its own water. The operating company has found it convenient in winter time, when the temperature of the injection water is very low, to operate only one condenser of the twin outfit, and still maintain the vacuum desired, thereby cutting the cost of operation in half. In cutting the condensers out, it is only necessary to close the discharge and injection valves to the condenser not in operation and to operate the other independently.

As a matter of interest, it may be well to note that the above concern uses nothing but jet condensers. Its experience has been that while boiler feed water is expensive, nevertheless, surface condensers do not stand up under the extremely bad water conditions existing at Providence, and it is necessary to employ jet condensers. The twin condensers used with the above 45,000 kw. turbine require 18,000,000 lbs. of condensing water per hour, 9,000,000 lbs. in each condenser. In addition to this 15 per cent. more is required for the operation of air pumps.

Use of Electric Furnace Products

Important steps were taken to promote the use of various electric furnace products, at a meeting called by Mr. Acheson Smith, Vice-President and General Manager of the Acheson Graphite Company, held at Niagara Falls on Friday and Saturday, March 21 and 22. Mr. Smith called the meeting to order and made a general statement of the importance of getting before the consumers of electric furnace products, and the public generally, the many great advantages of the use of electric furnaces, and the uniformly high grade products which are made by them. He asserted that it was his belief that all interested in the matter could join together on a common basis to extend the use of electric furnaces and their quality products. A special emphasis was laid on electric steel, the tonnage of which during the past four years has shown a remarkable increase not only in the United States but throughout the world. This has been brought about for two important reasons, (1) the higher quality which can be made by use of the electric furnace, (2) and the lower cost of operation shown in most cases as compared with the previous method of manufacture.

The meeting passed resolutions inviting all manufacturers of electric furnaces, electrical apparatus, electric furnace supplies and accessories, public utility corporations, designers and inventors of electric furnace equipment, and the users of electric furnaces to become members and to join in making an aggressive and thorough campaign to disseminate to Engineers and to the public accurate data as to the quality of electric furnace products of all kinds.

A splendid start was made in an organized way to carry out these plans. The meeting was attended by representatives of a large number of companies representing manufacturers of electric furnace equipment, accessories, utilities, supplies, designers and inventors, and manufacturers of electric steel. Among those present were the following: Mr. L. S. Thurston, Mr. C. A. Winder, Mr. G. Campbell and Mr. J. A. Seede, of the General Electric Company; Mr. C. J. Schluederberg, Mr. J. L. McK. Yardley, Mr. C. B. Gibson, and Mr. R. P. Chase, of the Westinghouse Electric & Manufacturing Company; Mr. F. J. Ryan, of the American Metallurgical Corp., Philadelphia; Mr. F. T. Snyder and Mr. F. von Schlegell, of the Industrial Electric Furnace Co., Chicago; Mr. C. A. Vom Baur, of the T. W. Price Engineering Co., New York; Mr. C. H. Booth, of the Booth-Hall Co., Chicago; Mr. H. A. DeFries, of Hamilton & Hansell, New York; Mr. R. J. Paulson, of the Ludlum Electric Furnace Co., New York; Mr. W. E. Moore, of the Pittsburgh Electric Furnace Co., Pittsburgh; Mr. F. A. Fitzgerald, of the Fitzgerald Laboratories, Niagara Falls; Mr. F. J. Tone, of the Carborundum Co., Niagara Falls; Mr. Acheson Smith, Mr. E. G. Acheson, Jr., Mr. W. H. Arison, Mr. H. P. Martin, Mr. S. L. Walworth, Mr. A. M. Williamson, Mr. P. D. Steuber, Mr. J. F. Callahan, Mr. E. B. Drake, Mr. L. C. Judson, and Mr. A. B. Oatman, of Niagara Falls.

The organization formed is to be called the Electric Furnace Association. A permanent organization was created, as follows:

President—Mr. Acheson Smith, of the Acheson Graphite Co., Niagara Falls.

First Vice-President — Mr. C. H. Booth, of the Booth-Hall Company, Chicago.

Second Vice-President—Mr. W. E. Moore, of the Pittsburgh Electric Furnace Co., Pittsburgh.

Secretary—Mr. C. G. Schluederberg, of the Westinghouse Electric Mfg. Co., Pittsburgh.

Treasurer—Mr. F. J. Ryan, of the American Metallurgical Corp., Philadelphia.

Directors—The Officers and Mr. C. A. Winder, of the General Electric Co., Schenectady, and Mr. F. J. Tone, of the Carborundum Co., Niagara Falls.

Important committees were created to begin work without further delay. These are as follows:

Publicity—Mr. C. H. Booth, Chairman; Mr. C. A. Winder, Mr. C. G. Schluederberg, Mr. A. B. Oatman.

Data—Mr. W. E. Moore, Chairman; Mr. J. A. Seede, Mr. A. M. Williamson, Mr. F. J. Ryan, Mr. F. A. Fitzgerald, and Mr. C. A. Vom Baur.

Fields—Mr. F. T. Snyder, Chairman; Mr. F. J. Tone, Mr. H. A. DeFries, Mr. S. L. Walworth.

The President was authorized to get in touch with all companies and persons who should be interested in joining the organization, and was requested to arrange an early meeting when completed publicity plans could be presented and thoroughly discussed. In the meantime, the different committees were instructed to make every effort to rapidly perfect reports which could serve as a basis for constructive work.

It is quite likely that the next meeting will be held in New York City the early part of April, at the same time as the Spring meeting of the American Electro-Chemical Society.

Meeting of the Electrical League

Mr. Arthur E. Reinke, European Engineer of the Western Electric Co., Inc., was the principal speaker at the New Electric League luncheon held at the Hotel McAlpin "Winter Garden," on March 27. Mr. Reinke said that "the term Bolshevism is used very loosely and, as a rule, is confused with anarchism. Bolshevism, pure and simple, is radical socialism carried through to its local conclusion by brute force against any opposition. Everyone is asking how Russia can survive and this to me is easy to understand. The country is agricultural, factory industry is little developed. The people will simply return to the agricultural life. They will raise what they need, they will know how to weave cloth, make sheepskin coats and felt boots. The structure of the country will cause Russia to break up into one-half million self-sustaining agricultural communities. Many of the city workers will return to their relatives on the farm. The lack of national instinct will avoid counter-revolutionary efforts, with its attendant bloodshed. The change in Russian affairs will be slow in coming, it may take years, but when it comes the revival of Russia will be startling. The people want order. It is bred in the bones of the Slavs. Lenine and Trotsky are not a pair of crooks or scoundrels, but clear-headed, sincere, enthusiastic radical socialists, whose power in Europe has steadily grown and who have started a campaign for Bolshevizing Europe. It is as clear-sighted leaders of a movement that we must look at that so that we can wake up and fight this menace."

M. H. Roughton, Australian Commissioner on Investigation of Exports and Imports, spoke briefly on existing business relations between Australia and America. He made an earnest appeal for the affection of Americans for Australians and said he hoped that eventually there would be a better understanding bteween the peoples of the two countries. David A. L'Esprance, Major 369th N. Y. Colored Regiment, who was awarded the Croix de Guerre for meritorious service in France, also spoke briefly. Mr. J. M. Wakeman, President, presided.

Electricity and the Housing Problem

"There's more than one bite to a snake" and there are many results of the war that, despite their individual and even local application, are regarded as vital issues. Not the least important of these is the housing problem. Because of the Government restrictions placed on building materials during the war, there have been practically no dwellings erected in the past two years. The consequent situation is startling. The average number of buildings erected yearly before this country entered the war was between 300,000 and 350,000. Building contractors base their calculations for the next twelve months on the erection of not less than 700,000 new homes, just double the number of former years. The Government, somewhat more optimistic, or pessimistic, according to the point of view, sets the estimate at 1,000,000. According to officials in real estate circles and in the metropolitan public utilities who are in a position to know, there are, in the city of New York alone, 30,000 families searching almost hopelessly for homes. And New York reflects the situation in other large cities.

With these conditions existent and the Government restrictions on all building materials lifted it was believed my many that there would be a surplus of labor, hence one bugaboo of the building question would be dispelled. It was furthermore believed that with restrictions off the prices of building materials would decline.

On the contrary, it is a fact that labor wage is almost certain to remain at its old scale—if it does not climb still further. In fact, in the New York papers of March 20 appeared the notice of an increase of one dollar per day to all classes of labor in the building trades. This was the decision of Supreme Court Justice P. Henry Dugro, umpire, selected by the Building Trades Association and the United Brotherhood of Carpenters and Joiners to consider their dispute over wages.

Uncle Sam says the best time to build is now. The prevailing conditions of labor and material costs should be taken advantage of, because it is certain that prices, in the main, will be at even a higher level.

In addition to the proposed construction of new houses, thousands of homes, more than the annual average number are slated for remodelling, re-decorating and other renovating. In most of the larger cities the shortage of suitable houses had driven Mr. Average American to become a home owner, and realty companies report many sales transactions and many more pending the final breaking of winter.

Some of the great cement manufacturers, whose ears, figuratively speaking, are always close to the ground, report an increasing number of calls for estimates of building construction, which is a most hopeful condition.

The Society for Electrical Development of New York City has inaugurated a national campaign, scheduled for April 1st to May 15th, called "Electrify Your Home," which is destined to stimulate trade activities. This dovetails into several other spirited national movements to hasten prosperity by the Government and various trades and mercantile associations in which the publishers of the country are actively co-operating.

Electric Drive for U. S. S. "New Mexico"

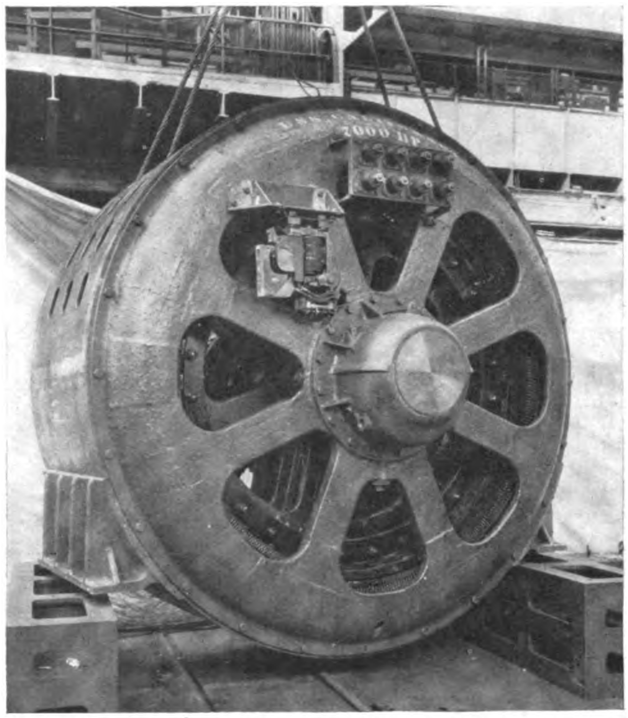
SOME years ago experts in the building and equipment of ships became convinced that one of the most important fields for improvement was in the application of the electric drive to the propulsion of vessels. Electrical science had brought to a high degree of perfection turbine generators that gave great efficiency and high speed, with minimum size and weight. As long ago as 1912 the United States collier *Jupiter* was equipped with two electric motors, directly connected to the propeller shafts. This vessel was a twin-screw boat of 20,000 tons displacement, having a speed of 14.5 knots. So favorable were the results obtained after exhaustive tests that no one doubted that electric-driven battleships would be a feature in our future navy.

The *New Mexico,* a 32,000-ton ship and one of the most powerful battleships afloat, was chosen by the officials of the United States Navy as the first of the electrically driven fighters. This vessel was to have a great cruising radius, and a maximum speed of 21 knots. In the April number of the "General Electric Review," advance sheets of which have kindly been placed at our disposal, a full account is given of this interesting installation. Mr. A. D. Badgley, of the General Electric Induction Motor Engineering Department, says that it was evident that for the most economical operation a changeable-pole motor giving a speed ratio of 2:3 was desirable on each shaft, the four motors at full speed taking power from two generators and when cruising from one generator. By changing the poles on the motor, the proper speeds of the screw are obtained with a maximum speed of the generator thus giving low steam consumption on the turbine in both cases.

Previous to the time of designing the motors for the *New Mexico,* a 2:1 speed ratio had been extensively used with single windings in stator and rotor. All other ratios of speed had been secured by using two windings in the stator, one for each speed, rather than a single winding with a large number of stator leads, which would cause too great a complication of the control. The double winding has the disadvantage of requiring a larger motor, as only half of the copper is in active use at either speed.

Since the motors and generators of the *New Mexico* were to be especially built to operate together, more liberty in design was allowed. A new type of winding was designed, the coils of which were so grouped that a change in the connection at the motor terminals would give a balanced quarter-phase distribution for either 24 or 36 poles. This gives a simpler control than if the motor were wound three-phase. In addition, since the four motors receive power from two generators at full speed and one generator at cruising speed, the best combined operation is obtained with a decreased voltage on the 36-pole combination. This also works out best for a quarter-phase winding; by connecting the generators in square connection for high speed and parallel connection for low speed, the correct ratio of operating voltage is obtained. By this scheme of connection, eight terminals were brought out of the motor though only four-line leads were required.

The torque requirements derived from actual experiments on the *Jupiter,* supplemented by tank trials, showed that a resistance inserted in the rotor winding would be required only for a few seconds at a time, that is, during starting or upon reversal in order to obtain quick possession of the screw and bring it up to speed. With this in mind, a double-squirrel-cage type of motor was adopted thus eliminating the rheostat. The outer high-resistance low-reactance winding takes the place of the rheostat when starting and reversing. The inner low-resistance higher-reactance winding is



FACTORY VIEW OF ONE OF THE "CALIFORNIA" MOTORS
This motor is similar in appearance to those of the "New Mexico," except that the frame of the latter is somewhat longer and the contractor on the shield end is not used

the running winding when the motor is up to speed. The inductive action between these two cages is such that when the frequency in the rotor is high, as at starting or reversing, the current is choked back in the low-resistance winding thus forcing a large percentage of the current through the high-resistance and producing adequate torque. As the motor speeds up, the rotor frequency drops off and the inductive effect on the inner winding decreases, allowing the current to increase with a corresponding decrease in the outer winding until at slip frequency practically all of the current passes through the low-resistance cage. By this construction, the torque advantage of a high-resistance rotor is obtained with the low slip and high efficiency of the low-resistance type of rotor when at full speed.

The specified requirements for driving the *New Mexico* propellers called for 26,500 h. p. at 161 revolutions per minute, corresponding to 21 knots ship speed, and 8,350 h. p. at 112 revolutions per minute for cruising at 15 knots.

The motors were wound to operate with either 24 or 36 poles with an output of 6,700 h. p. at 4,000 volts on the 24-pole connection and 2,050 h. p. at 2,800 volts on the 36-pole connection with an overload capacity of 8,375 h. p. at 173 r. p. m.

At speeds from 8 to 15 knots, the four motors are operated on the 36-pole connection from one generator with its winding connected in parallel, the switching being so arranged that either generator can be used. The variation of speed is obtained by steam control on the turbine-generator.

From 15 to 17 knots, the motors are thrown over to the 24-pole connection still using one generator only. Above 17 knots, two generators are used connected in two squares. The two motors and generator on the starboard side and the two motors and generator on the port side are connected together and each set operated as separate units.

For reversing, the 36-pole connection only is used. If the motor is running on the 36-pole connection one phase is reversed. If operating on 24-pole, the connections are changed over to 36 poles and reversed.

During the trial run a test of this reversal was made with the boat running at a speed of 21.25 knots. At this speed the motors were reversed and the screw was brought up to full-speed astern on the 36-pole connection (two-thirds of the forward speed) in 20 seconds; 12 seconds of this time being used in switching.

Mr. C. S. Raymond, in the same magazine, describes the turbine-generators. There are two main turbine-generator units, each generator designed to develop 10,500 kw. at 78 per cent. power-factor, and 13,500 kv-a. at full speed of the ship, and to carry a 25 per cent. overload (16,850 kv-a. at 78 per cent. power-factor) for four hours. The rotors have two poles and a maximum rotative speed of 2,100 r. p. m., which corresponds to a frequency of 35 cycles. The stators are wound two-phase with leads brought out from the beginnings and endings of each phase to an 8-pole, double-throw, disconnecting switch placed in the main circuit between the generators and the motors. By manipulating this switch two generator connections are available: first, diametrical, two-circuit, low-voltage (3,000 volts); and, second, square, one-circuit, high-voltage (4,240 volts). With a constant flux, the voltage will vary directly or inversely as the $\sqrt{2}$ depending on the connection involved. Suitable interlocks have been installed, making it impossible to operate the two generators in parallel.

All speeds of the ship up to 17 knots inclusive are obtained by the use of one generator having the low-voltage connections, the generator furnishing power for driving the four motors. Above 17 knots, two generators having the high-voltage connection are used, each generator furnishing power for driving two motors. The main turbine-generators are used only for propelling the ship, and are in no way connected to the lighting or other auxiliary power circuits. Therefore, it is possible under the varying conditions of load to adjust the voltage and current to obtain good efficiency.

The induction motors, direct connected to the ship's propeller shafts, are two-speed motor with connections for 24 and 36 poles. The speed reduction between the generators and the motors when using the 24-pole motor connection is 12 to 1, and with the 36-pole connection, 18 to 1. Hence, the extreme range of generator r. p. m. for the specified operating speeds of the ship, 10 to 21 knots, is approximately 1,440 r. p. m. to 2,100 r. p. m. In order to calculate the generator efficiency with accuracy, the windage loss must be carefully determined at various speeds for this is the largest single loss. Tests were made at the factory to determine the windage of the rotor. The windage loss varies approximately as the cube of the speed.

The *New Mexico* generators are conservatively designed. Compared with the maximum rated machines for land practice, the relative armature reaction is considerably lower and the densities in the magnetic section are slightly higher. Sufficient excitation current is applied to the generator fields to insure keeping the motors and generators in step. In other words, the generators are not working at the peak of the kilowatt curve, but at a safe distance down where there is sufficient margin in power to take care of the rudder swings and heavy seas. Based on the maximum power-factor of the motors, 79 per cent., the generators have a margin in power of 24 per cent. with the excitation given.

Another very important feature in regard to the generator design is the condition of over excitation required for starting and reversing the motors. The turbine-generators have a fixed mechanical rotation, but the motors may be run in a clockwise or counter-clockwise direction by changing the phase rotation by suitable switching. A very important feature inherent with electrical propulsion is that full power is always available for either direction of propeller rotation. From actual reversal tests, at maximum speed of the ship, the observed excess excitation current required for reversal was approximately 60 per cent. above that for the steady running condition. The line current increased to approximately three times the steady running value. That these high values of current are not injurious to the generator is due to the extremely short time required for reversal and the large heat storage capacity in the generator. The observed time for reversal from maximum speed ahead to full reversing speed astern, with the motors in the 36-pole or low-speed connection, was approximately 20 seconds. To pull the motors into step in the reversed direction of rotation required holding the over excitation on the generator fields approximately eight seconds, the balance of reversal time being consumed in the release of the interlocks and in the switching operation.

Mr. Eskil Berg says that the contract for the electric propelling equipment of the U. S. S. *New Mexico* included the following machinery:

Two main turbine-generator units, complete with throttle and governing valves.

Four main propelling motors.

Switches, panels, instruments, controllers, cables, insulators, etc., complete.

Two main motor-driven circulating pumps.

Two main motor-driven air pumps.

Two main motor-driven hot-well pumps.

Four motor-driven lubricating oil pumps.

Two motor-driven oil coolers and tanks.

Motor-driven blowers for ventilating the main motors.

Spare parts for the above apparatus.

The total weight of the apparatus and material above mentioned, complete in all respects with spare parts, was guaranteed not to exceed 700 tons. In case this weight was exceeded, a penalty of $500 per ton was to be imposed; and if it was exceeded by 5 per cent. or more, an additional penalty of $10,000 was to be deducted from the contract price. The actual weight of all the apparatus furnished, with spare parts, was 590 tons.

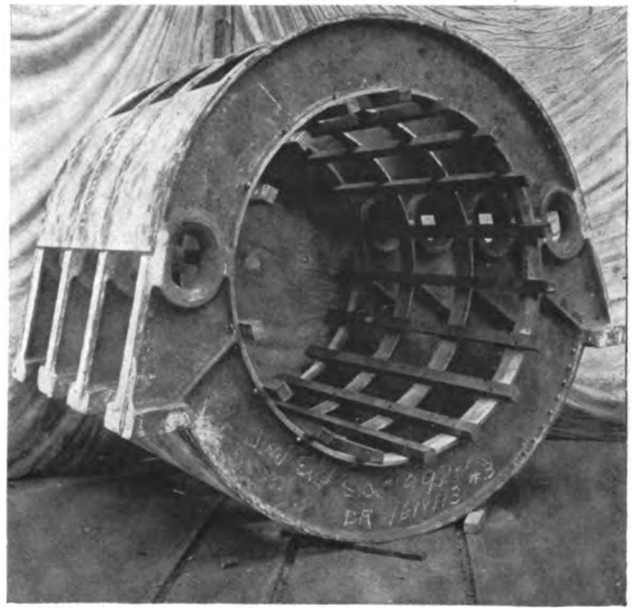
The steam consumption guarantees were all based upon 250-lb. gauge steam pressure at the throttle and dry saturated steam, with the following corrections: Should superheat be used, the guaranteed steam consumption will be reduced at the rate of one per cent. for each 13 deg. F. of superheat observed at the turbine. Should the steam contain moisture, the guaranteed steam consumption will be increased at the rate of 2¼ per cent. for each per cent. of moisture present in the steam at the turbine. The steam consumption guarantees as made to the Government cover the total amount of steam used both by the main generating units and the auxiliaries mentioned above, and were as follows:

Steam pressure 250 lb. at throttle, dry steam.

10 knots, 15.38 lb. per shaft h. p.-hr.
15 knots, 11.57 lb. per shaft h. p.-hr.
19 knots, 11.32 lb. per shaft h. p.-hr.
21 knots, 11.53 lb. per shaft h. p.-hr.

Very heavy penalties were attached to these guarantees in case they were not met; namely, $25,000 per lb. for 10 and 15 knots and $20,000 per lb. for 19 and 21 knots.

The contract price for the *New Mexico* equipment, including all auxiliaries and apparatus mentioned in the beginning of this article, was $431,000.



THE SECTIONALIZED I-BEAM TYPE OF GENERATOR FRAME
This construction, embodying light weight without sacrifice of strength and rigidity, is used in the "New Mexico" Generators

New Electrical Plant for Nottingham

Arrangements have been made by the municipal authorities of the city of Nottingham for the construction of an additional electrical plant at a cost of $379,000, writes Consul C. M. Hitch. The electricity department in a recent report to the Nottingham City Council stated that, owing to the removal of the lighting restrictions and to the fact that many inquiries are being made for power and light, it is absolutely necessary that an additional plant should be installed to meet the public demands.

It was the intention of the city to erect a modern power station on the Trent River, and with that object in view an electrical engineer was instructed to report early in 1915. Before definite action was taken upon the report, however, the Government placed restrictions on capital expenditure and new schemes, and no further action could then be taken. Recently the Coal Conservation Committee of the Ministry of Reconstruction and the Committee on Electrical Supply appointed by the British Board of Trade have presented reports, with the result that the whole question of electric power supply for the country is under consideration by the Government, and it is expected that some definite action will shortly be taken.

In anticipation of the Government scheme, certain action has been taken by the city council of Nottingham and by the local authorities in the surrounding district, and experts have been engaged to report upon the question of an ample and cheap supply of electricity for this area. Pending the decision of the Government and the settlement of the course to be taken locally, it is deemed essential that some provision should be made to meet the demands which may be expected during the coming year. The electricity committee has therefore, after careful consideration of a report prepared by the city electrical engineer, decided to extend the turbine bay at St. Ann's power station and install at 3,000-kilowatt alternator, with the necessary auxiliary plant, transformers, switch gear, and rotary converters, and also extend the underground mains from time to time as the necessity arises.

An estimate of the capital required for the above purposes placed the sum required for extension of plant at $279,000, and that needed for extension of mains at $100,000. The city engineer estimates that the annual saving of coal at the present prices will amount to $60,000, but that the extension agreed upon will only meet the demands for the coming year.

When Our Natural Gas is Gone

A news item published recently in a Philadelphia paper stated that the Pennsylvania Fuel Commission will have finished their duties as soon as the question of the serious natural gas shortage in three northern tier counties has been settled. The situation in this particular quarter calls to mind numerous others that we have been reading of. The time is not far distant when our supply of natural gas will be entirely gone. How are we to supplement its service for heating, lighting, cooking and power uses? With the establishment of central stations, the nation-wide spread of electrical transmission systems, and the development of our waterpower, electricity is undoubtedly going to become the dominant factor. Industrial plants, farmers and householders as well, have already stepped forward, economically, by the use of electric motors. Electric lighting is, in fact, today more common than gas lighting. Is the housewife now using gas for cooking, going to change over to a coal range, or is she considering the good points in favor of electric cooking? The advantages of an electric range are worth reviewing:

1. They require no kindling or coal handling.
2. There is no early rising to start fires.
3. There are no ashes to carry out and no consequent sweeping from such a cause.
4. Not a cent's worth more heat is required than is actually needed.
5. There are no stove pipes.
6. It is not necessary to cook during the hot months in the summer in an overheated kitchen.
7. The price of electric current will drop, as the supply of current increases due to a relief from the extra demand during the war.

The fact that modern school systems are equipping their domestic science departments with electric cooking appliances is a strong indication that the young women of today who are being taught to cook by electricity, and thus appreciating its value, will demand it in their future homes. At any rate, in several sections of this country where there has been an absolute dependence on natural gas, which is now becoming exhausted, the question of coal or electricity is a forced issue and worth serious consideration.

Extension of Big British Electric Plant

The Borough of Rotherham, with a population of 62,500, is only 6 miles distant from Sheffield, with which it is joined by street railway connections, as well as by two lines of railroads, writes Consul John M. Savage, from Sheffield. It is largely engaged in the steel industry, and several important works are situated there. In order to meet manufacturing requirements the first electric super-power station has been erected by the Rotherham Corporation and will be available for distributing its output early in 1919. The war undoubtedly influenced the extensions, and the municipality in its enterprise has the support of the Government. The new works are an extension of the former electrical department inaugurated by the corporation in 1891.

The first two turbo-alternators will have a capacity of 12,500 kilowatts each, or 16,800 horsepower per set. By midsummer next a 30,000 kilowatt set, representing 40,200 horsepower, will be completed. With the existing generating machinery of the power station, the capacity will then be brought to 70,500 kilowatts. This figure, it is believed, constitutes a record for any municipality in England. There are special advantages in respect of railway and water connection, and an abundance of fuel is within easy reach. The arrangements are such that it is computed that fuel can be brought from the pithead to the overhead bunkers in the boiler house at about 14 cents per ton.

The installation includes 12 of the largest water-tube boilers, each equipped with special coal-feed arrangements, and a suction ash plant. With the class of coal now being used, it is computed that the consumption per unit delivered on consumer's premises will be less than 2 pounds per kilowatt, or to 1½ pounds per horsepower. An achievement of this sort is considered remarkable.

The Rotherham Electricity Department has during the past year greatly extended its sphere of influence by taking over the electrical area of the Mexborough (6 miles) and Swinton (5 miles) Tramways Co. The necessity for the new developments was in a measure due to some 15,000 horsepower being required for a new rolling mill plant. At present there are applications from existing works for between 40,000 and 50,000 kilowatts. As to cost, the old and new works total approximately $5,000,000, and sanction has been obtained for the expenditure of a further $4,000,000. Cheap power for industry is the primary object and there is every probability that the enterprise of the Rotherham Corporation will be profitable.

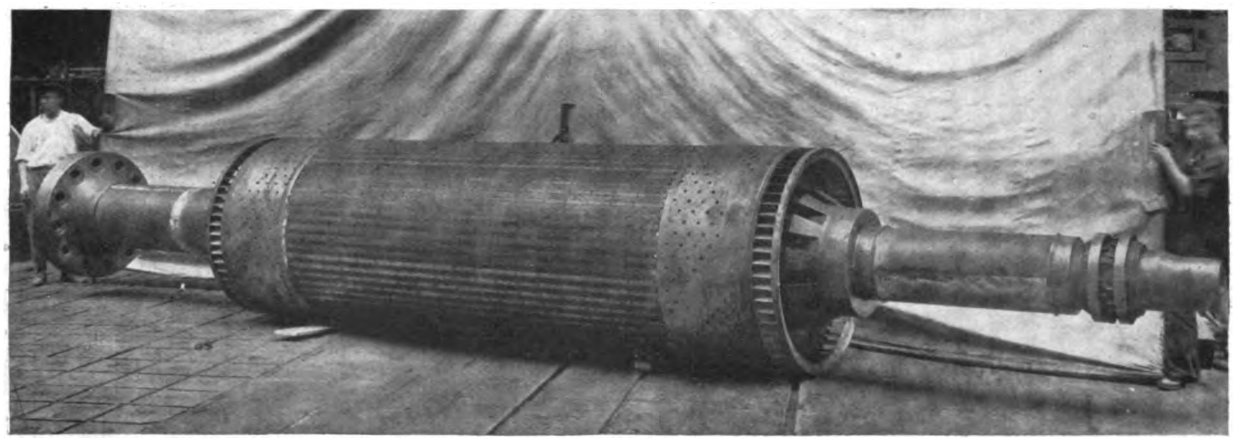
Advantages of Electric Drive

ANY type of propelling machinery, to be acceptable for a capital ship, must be entirely satisfactory in the following particulars:

(1) Reliability.
(2) Weight and space occupied.
(3) Economy.
(4) Flexibility of installation.

Needless to say, the most important of these is reliability; and no machinery should be considered at all which has not proved itself satisfactory in this respect. The performance of the *Jupiter* during the past five years has thoroughly proved the reliability of electric machinery on board ship. For demonstrating this quality, the *Jupiter* was a good type of ship to select, as a collier ordinarily does a great deal more cruising than a capital ship, writes Commander S. M. Robinson, Bureau of Steam Engineering, Navy Department, in the "General Electric Review." During the past five years the *Jupiter* has been held up only once on account of trouble with her electric equipment, and in this case the delay was for only two or three hours and the repairs were effected by the ship's force with the facilities available on board ship. The trials of the *New Mexico,* just completed, indicate that she should duplicate the performance of the *Jupiter* in this respect. In fact, there are inherent reasons why electric propelling equipment is more reliable than other types of machinery. As direct-connected or geared turbines are usually arranged, it is seldom the case that damage to one turbine does not affect more than one shaft; with electric machinery, each shaft can be absolutely isolated from the others by merely opening a disconnecting switch to the motor on that shaft. Furthermore, in case of damage to a turbine with straight steam drive, the ship is left to drag one or more propellers while driving with the others; with electric drive, the failure of one turbine will still allow the ship to be propelled by all four screws in perfectly normal manner. The latter will be seen to be no small advantage when it is considered that the effect of one dragging screw may be as high as 15 per cent. of the total effective horsepower required to drive the ship, and to this may be added the fact that the maneuvering qualities of the ship are not nearly so good when it becomes necessary to drag one screw. It sometimes happens that the damage to a turbine is such that the shaft cannot be allowed to revolve; in this case, it becomes necessary to limit the speed of the ship as the "jacking gear," or other locking device, is not sufficiently strong to hold the shaft at high speeds of the ship. There is still another advantage of electric propulsion that is brought out very strongly when the ship is maneuvering in shallow or muddy water, such as obtains in harbors and their entrances; the ordinary ship uses all of her main engines and therefore all of her main condensers and auxiliaries all the time, but an electrically driven ship need use only one turbine, condenser and set of auxiliaries and the other can be kept as a standby. If the steamdriven ship runs into mud, she will probably plug up all her condensers at the same time, or even if she only plugs one she will temporarily be deprived of the use of one or more shafts and this may be fatal for maneuvering in restricted waters. As an actual experience the *New Mexico* while entering New York Harbor had to shift main generators twice owing to the plugging of her condenser with mud, and these shifts were made so quickly that they did not affect the operation of the ship at all. There is one other point that adds to the reliability of electric drive, and that is that the direction of rotation of the steam turbine is never changed; reversal of direction of rotation is the most severe of all conditions imposed upon any form of steam machinery, and its entire elimination in electric drive adds very much to the reliability of the latter.

When comparing different types of propulsion in regard to the other three points given at the beginning



Rotor Development for High-Speed Turbine Generators
This type of construction is used in the propulsion generators that are a part of the electric drive equipment of the U. S. S. "New Mexico".

of this article, it is difficult to say that anyone of the three is of more importance than the others, inasmuch as the machinery must be satisfactory in all three respects; it is only where two types of machinery are nearly equally satisfactory in some of these respects that they can be directly compared in regard to the remaining points. For example, no type of machinery could be considered which was vastly heavier or occupied twice the space of other types of machinery, no matter how economical it might be, and, vice versa, the economy must be reasonably good or any question of weight saving could not be considered. Therefore, the electric drive will first be compared with other types of machinery in these two respects before proceeding to a consideration of its relative advantage as to installation. It is difficult to arrive at exact comparisons with other types of machinery in regard to weight as, so far, we have built no capital ship with geared turbines arranged on four shafts and therefore are unable to get a direct comparison of the two types of machinery; but, from the data at hand, it is not believed that there is any very great or important difference between the electric drive and general turbines in regard to weight, although it seems to be fairly certain that the geared turbine has a slight advantage in this respect. In regard to the question of floor space occupied, it is not believed there is any great difference, and what difference there is is probably in favor of the electric drive. It is at least safe to say that so far as weight and space occupied are concerned, the difference is not great enough to be of much importance.

As to the relative economy of electric and geared drives, we are able to make a little more definite statement than in the case of the weight comparisons. It seems fairly certain that in the case of large horsepower installations with large speed reductions, such as are found on battleships and battle cruisers, the geared turbine will have a slight advantage at full power, but at the lower speeds of the ship the electric drive will have a very material advantage over the geared installation. Just how great this advantage will be will depend to some extent upon the arrangement of the machinery. For example, on a battle cruiser developing enormous horsepower at full speed, and where it would be necessary to use all of this transmission gearing at the cruising speeds of the ship, the saving by the use of electric drive would be very much greater than in the case of a battleship where the percentage of reduction of power would not be so great. In connection with the subject of economy, it is interesting to compare the trial results of the *Pennsylvania* and the *New Mexico*. The *Pennsylvania* is fitted with direct-connected turbines and small geared cruising turbines which can be run up to speeds slightly above 15 knots. The trial results of the two vessels show that in total fuel consumption the *New Mexico* saves more than 20 per cent. over the *Pennsylvania* at speeds from 19 knots to full power. At a speed of about 15 knots, which is about the limit of the geared cruising turbine and also of the low-speed connection of the electric drive, there is a very much greater saving, it being something in the neighborhood of 30 per cent. At ten knots, the fuel saving is apparently very small, although at both 10 and 15 knots the trial results were not directly comparable on account of the different conditions under which the trials of the two ships were run. Ships fitted with small geared cruising turbines, however, showed remarkable good economy at very low speeds of the ship, such as 10 knots.

It therefore appears that electric drive, generally speaking, is quite satisfactory in regards to points (1), (2) and (3), and compares very favorably with other types of propulsion in these respects. It may, therefore, be compared directly with other types of machinery in regard to point (4), the "Flexibility of installation." The tendency in building modern capital ships is to provide for more and more torpedo protection and it becomes necessary to crowd the machinery away from the sides of the ship as much as possible. This arrangement is also desirable from the point of protection against gunfire for a similar reason. In this respect, electric drive has an enormous advantage over any other type of machinery in which the prime mover is mechanically connected to the propelling shaft. The main turbine-generators may be placed in any part of the ship that is most desirable; they may be placed in compartments forward of each other and they may be raised up enough to place the main condenser underneath them—in fact, there is practically no limit, other than the head room, as to the position of the main turbine-generator in the ship. This gives an enormous advantage to electric drive over all other types of machinery and enables the Naval Constructor to give far more adequate protection to the ship and machinery against damage by torpedo and gunfire. Those parts of the machinery—the main motors—which it is necessary to connect mechanically to the shafts, are comparatively small and take up only a small space so that they can be placed in small isolated compartments which will not menace the ship in case of flooding; since no main auxiliaries are required for the motors, the flooding of a motor room will not entail any loss in that respect. Also the motors may be placed very much farther aft than can steam-driven turbines and therefore the length of the main shafting can be very materially reduced. This constitutes a big advantage; both on account of less liability to derangement of the shafting itself, due to injury to the ship, and also of less danger to the ship itself because of the shafting not having to pierce a number of watertight bulkheads. These advantages of installation constitute the real and main reason for the adoption of electric drive for capital ships and any other advantages are minor compared with them. Utilizing these advantages to the fullest extent makes it possible to build capital ships which are far superior to any others fitted with any other form of machinery. In addition to advantages from the point of view of protection, there are also the advantages from an engineering standpoint. The shorter lengths of shafting make it easier to keep the shafts in line; the grouping of boilers around the machinery makes short and direct steam pipes with a consequent reduction in weight and complication and a smaller drop in steam pressure. The same may be said of practically all the other piping systems of the ship, such as feed lines, oil lines, exhaust lines, etc.

"Electrify Your Home" Campaign

Harry A. Wheeler, President of the United States Chamber of Commerce, in a letter to J. M. Wakeman, General Manager of the Society for Electrical Development, has manifested his approval of the Society's nation-wide house-wiring campaign. The greater use of electric service, Mr. Wheeler agrees, is a benefit to the community and should be fostered everywhere.

It is Mr. Wheeler's opinion that the nation is on the road to great prosperity, but that the driving must be done carefully. People and industries, he says, need time to readjust themselves, and a too rapid or forced stimulation will be dangerous. The electrical campaign, however, he feels is a necessary one for public and private good, and should be backed throughout the country.

Mr. Wheeler's letter reads in part: "Obviously I must approve the nation-wide campaign of your Society for urging greater use of electric service, not from the standpoint of stimulation which it might supply to your business and others related, but rather because the greater use of electric service improves the standards and convenience of living, and as such is to be encouraged everywhere.

"Prosperity is just around the corner, but if we try to make the turn too quickly we may suffer a spill. An effort to stimulate public work whether necessary or not, just for the sake of starting things, is economically unsound and will bring about serious reaction. A legitimate campaign to do whatever is necessary in private or public work at the present time is a campaign of common sense."

Electricity in Oxygen-Making

The commercial importance of oxygen in medicine and to aid in the generation of heat is well known. When it is made from water by electrolysis, double its volume of hydrogen is given off. Within the past few years this hydrogen has found a large market for the hydrogenating of vegetable oils, converting them into stearine. This is hard at ordinary temperatures, and is used as the basis for margarine, cooking fats, etc.

An interesting plant for the manufacture of oxygen and hydrogen is that of the Bettendorf Oxygen-Hydrogen Company, near Davenport, Iowa. It contains 100 I. O. C. type electrolytic cells and 200 Levin type cells. An electrolyte of caustic potash is used. Water is supplied to replace that broken up, so that the level of the liquid remains constant. An asbestos barrier is placed between the electrodes so that the two gases cannot mix. It is very important for the safety of the plant and of users of gas that it should be practically pure, since even a small percentage of one gas in the other will form an explosive mixture, causing a flame to "flash back" from a torch to the storage tank and a serious explosion. Hence the manufacturer maintains a purity standard above 99 per cent. for each gas.

Electrical power is purchased at 440 volts, 3-phase alternating current and converted to direct current at 125 volts by means of four motor-generator sets, of which three are of Westinghouse make. Current is passed through a suitable number of cells in a series to give the proper current. The gas is collected by a piping system and taken to outdoor steel gas holders. From here oxygen is delivered by a pump driven by a Westinghouse 15 h. p. motor to the adjoining factory of the Bettendorf Steel Car Company, and hydrogen to the hydrogenating plant of Wilson & Company. Surplus gases are compressed into steel cylinders for shipment, the compressors being each driven by 10 h. p. Westinghouse motors.

Ventilating System in Rural School

The "district school," where so many famous men learned the "three R's" needed no ventilating system, the cracks round the windows and between the weatherboards let in plenty of air—more than the big stove could keep warm. But the modern consolidated school, serving a whole township, must have the best of heating and ventilating equipment, including, of course, forced draft. The Orange Township School, in Blackhawk County, Iowa, six miles south of Waterloo, has two low-pressure boilers, a temperature control system and a ventilating system through which a 24-inch fan, driven by a Westinghouse 5 h. p. single-phase motor, forces air to every room. The building has now 230 pupils, and serves 38 square miles of rich farming country. Electricity for power and lighting is secured from a transmission line passing the door. The pupils are hauled free of charge in 12 busses furnished by the school board. J. C. Ralston, of Waterloo, was architect for the building.

High Voltage Generators for Radio Communication

For use in continuous-wave radio work the Westinghouse Electric and Manufacturing Company has manufactured a number of types of small direct-current machines, which have been used by the Signal Corps for communication in France and by the Navy. One of these is a two-commutator generator, giving direct current at 27 volts, 2.5 amp., to light the filaments of three-element vacuum tubes, and at 280 volts, 80 milli-amp., for the output circuit of vacuum tubes used to generate continuous high-frequency oscillations. This generator is mounted on the landing-gear of an airplane, so that the back-wash of the propeller drives the generator by means of a small two-blade wooden fan. Thus the generator runs whenever the plane is in motion, and also when it is on the ground with the engine running. Constant voltage with variable speed is secured by an ingenious arrangement of differential fields controlled by a two-element vacuum tube mounted in the streamline housing at the rear of the machine. This generator furnishes power for sending and receiving radio-telephone messages between airplanes and between airplanes and the ground.

For use at ground stations, a Westinghouse dynamotor was developed to operate from batteries. It has an input of 10 volts, 9.3 amp., and output of 80 milli-amp. at 350 volts or 166 milli-amp. at 300 volts. Originally it was mounted on a light metal framework with a panel carrying a voltmeter, fuses and terminals, but recently a metal carrying case has been designed, which has a top-plate mounting a switch, fuses, and terminals, to which leads are permanently attached. When not in use, these are folded inside the lid. A rubber gasket makes the box watertight when closed. This dynamotor is used with continuous-wave sets for both telegraph and telephone communication.

A similar dynamotor was furnished to the Navy for use on submarine chasers, the voltages being 27.5 and 300. These machines were mounted in pairs, one serving as a spare, in a spring cradle. This was done to minimize noise, which might be heard by the sensitive listening devices of an enemy submarine in the immediate vicinity.

Water-power Resources of Norway

NORWAY and Sweden are said to possess the most abundant water power of any European countries. The power available for development in Norway is estimated to be about 15,000,000 horsepower and in Sweden more than 6,000,000 horsepower.

The development and utilization of this water power on a large scale started about 10 or 15 years ago, and by this time it is estimated that 1,300,000 horsepower is developed in Norway and 950,000 horsepower in Sweden. This is of interest to note at this this time when special attention is being given by the United States, England, France, and Germany to utilizing the maximum amount of hydraulic power obtainable.

Large developments are in progress in all parts of Norway and also in Sweden, and even the tarnsmittal of power from Norway to Denmark has been considered. (*See Commerce Reports* for June 12 and July 9, 1918.) Denmark is practically without any possibility of hydraulic power development; the only place where power can be developed is at Gudenaaen, where the total possible development is not more than 800 horsepower, and only 200 horsepower has already been developed. Exportation to Denmark will take place through a submarine cable from southern Norway direct to the northern part of Jutland or to the southeastern part of Sweden, whence in turn power will be transmitted to Denmark.

The scarcity of fuel in recent years has made the people aware of the advisability of developing hydro-electro power for light, for electrifying railroads, for power for all sorts of industries, and even for heating. The production of carbide in the electrochemical industry has been of great help in overcoming the difficulties in the fuel situation.

The total water power available in the eastern part of the country is estimated to be about 2,500,000 horsepower. Some of the greater sources are the waterfalls in Glommen, 350,000 horsepower; waterfalls in Drammenselv and Hallingdal, 225,000 horsepower; Norefaldene, 200,000 horsepower; and other falls in Numedal, 125,000 horsepower.

The total water power available in southern Norway is also estimated at 2,500,000 horsepower. Some of the larger waterfalls are Rjukan, 290,000 horsepower; Toke, 240,000 horsepower; other waterfalls in Telemarken, 400,000 horsepower; waterfalls in Arendal district, 120,000 horsepower; and waterfalls in Saetesdal, 200,000 horsepower.

Western Norway is considered the district where the water power is most favorably located for development and for use in the electrochemical and electrometallurgical industry. It is estimated that about 5,000,000 horsepower is available in this part of the country. This amount of power is distributed thus: Waterfalls at Ryfylke, 550,000 horsepower; Tyssefaldene, 190,000 horsepower; Kinso, 120,000 horsepower; other waterfalls in Sondhordland and Hardanger, 900,000 horsepower; waterfalls in Bergen and Voss district, 475,000 horsepower; Aurlandsvasdraget, 250,000 horsepower; other waterfalls in Sogn, 500,000 horsepower; Aura, 190,000 horsepower; and other waterfalls in Romsdal and neighboring districts, 250,000 horsepower.

It is assumed that also northern Norway possesses water power amounting to about 5,000,000 horsepower, although the investigation of this part of the country has not been as thorough as that of other parts of the country. A number of waterfalls in this district is owned by the State. These are Glomfjord, 125,000 horsepower; waterfalls in Rosaaen, 230,000 horsepower; waterfalls in Bjerkelven, 45,000 horsepower; and other waterfalls belonging to the State in northern Norway, 190,000 horsepower.

In the past few years the Norwegian State has bought a great number of waterfalls in all parts of the country and is now owner of more than 1,500,000 horsepower. A great part of this power has been bought with the intention of electrifying the State's railways, from 200,000 to 300,000 horsepower being reserved for this purpose. The State's largest sources of power are the waterfalls in Hallingdalselv, 75,000 horsepower; Norefaldene, 200,000 horsepower; Toke, 240,000 horsepower; Kvina, 55,000 horsepower; Ulla, 150,000 horsepower; Rauma, 70,000 horsepower, and those in northern Norway mentioned above. Only a very small part of the State's water power has been developed. The first large development to be finished will be the Glomfjord plant, recently purchased by the State, where 50,000 horsepower will soon be available for use. Of the 1,300,000 horsepower already developed in Norway, 1,100,000 horsepower is in private ownership and 200,000 horsepower belongs to different communities.

The saltpeter industry is carried out in the Telemarken district of southern Norway. More than 300,000 horsepower is being used in the plants at Notodden and Rjukan for making nitric acid, Norwegian saltpeter, and other nitrates and nitrites. The company Norsk Hydroelektrisk Kvaelstofkompani (Norsk Hydro) is also the owner of several waterfalls in other parts of the country.

The manufacture of calcium carbide is the oldest electrochemic industry of the country, and there are now many large plants making this product, which has became highly important to all industrial life in recent years, particularly to the steel industry. A large plant in operation at Hafslund, near Sarpsborg, is making more than 30,000 tons of carbide a year. Another plant is located at Notodden and a third at Kragero, all in the southeastern part of Norway.

The largest carbide factory at present operating in the country is the Odda plant of the Alby United Carbide Factories (Ltd.), which in 1915 produced at least 60,000 tons. Of this production about 20,000 tons were used for manufacturing cynamide at the North Western Cyanamide Co.'s plant, which is also located in Odda. Another carbide factory closely connected with the Odda factory is located at Meraker, near Trondhjem. This is a comparatively small plant, with a production of only a few thousand tons a year. The total production of calcium carbide in Norway in 1915 was more than 100,000 tons, but it is probably not that high now.

Several large plants for manufacturing calcium carbide and other electrochemical products are now under construction at different places in the country. At Saude, in the district of Stavanger, an American company has a concession to use 84,000 horsepower, and a large plant for utilizing this power is now being built. Another company has just finished the construction of a plant in Aalvik, in Hardanger, and has started operations with a load of 34,000 horsepower. A plant at Hoyangen, in Sogn, has recently finished its power development and has started operations.

There are several ferrosilicon plants in Norway; these are located at Sarpsborg, Notodden, Arendal, Tyssedal, and Meraker. The production is now about 30,000 tons per year. Other metallurgical plants for production of ferroalloys, aluminum, zinc, and similar products are located at Sannesund, Porsgrund, Atendal, Kristianssand, Flekkefjord, Stavanger, Florli, Haugesund, Tysse, Vadheim, Stagfjord, and Trondhjem. Large plants are being built at Kvina, Bremanger, Aura, in Sundalen, and Glomfjord.

Norway possesses more water power in proportion to its population than probably any other country. It is also interesting to note that the developed horsepower per capita is larger than in any other country. The population of Norway is 2,500,000 and the developed power is about 1,300,000 horsepower, which gives more than 0.5 horsepower for every person in the country. The corresponding figure for Sweden is 0.17.

One-Man Electric Cars

Pine Bluff, a thriving city of 30,000 inhabitants, situated in the richest cotton and rice-growing section of the State of Arkansas, can boast of an up-to-date and efficient street railway system. The Pine Bluff Company have had in operation for more than a year one-man cars with decided success. During the entire period of operation these cars have not had one failure or caused one detention in service. These cars, four in number, were rebuilt and changed from two-man to one-man type. The seating arrangement consists of cross seats for twenty-eight passengers and with this number of one-man cars a regular city schedule under ten minutes headway is maintained over a three-mile city line. The original equipment, consisting of heavy obsolete motors, was replaced with double Westinghouse No. 506-C-2 motors, employing the original type K-10 control with only slight alteration in the car wiring. With these modern lightweight motors and equipped for one-man operation, the car weighs complete 18,500 pounds.

Electrical Industries of Japan

In respect of funds invested, the electrical industry in Japan has a lead on several even of the greatest industries, says a report issued by the Department of

Communications on January 7, 1919, on the achievement of the industry last year. The investment increased by as much as 64,515,000 yen ($32,160,727) during the last twelvemonth.

The electrical industry has been given a developing incentive by the boom in fuels and the wonderful industrial expansion of Japan occasioned by the great world war, says the official report. At the end of last year the use of electrical power was thought to be economizing petroleum to the amount of 3,700,000 koku (176,319,800 gallons) and coal to the extent of 4,000,000 tons.

In light and power plants 368,482,823 yen ($183,688,687) had been invested by the end of 1918, 43,717,969 yen ($21,793,408) in electric tramways, and 332,997,483 yen ($165,998,245) in plants both for suppyling power and light and operating tramways. The total amount of capital invested amounted to 745,198,275 yen ($371,480,340), this figure being a gain of 64,515,000 yen ($32,160,727) over the close of 1917. The investment in this comparatively new line is, says the official report, bigger than that in mining, which stood at 240,000,000 yen ($119,640,000) at the end of last year. It even threatens to rival the investment in railways, which is 1,100,000,000 yen ($548,350,000).

Steam Railroad Electrification

By Calvert Townley

ELECTRICITY fills every requirement of railroad service, but as it involves a large investment, electrification has proceeded slowly. Electrification has also been retarded because the problem has been largely considered one of replacing the steam locomotive by the electric locomotive, whereas in reality the problem is much broader. It really offers a fundamentally different method of train propulsion because the limitations of the steam locomotive disappear and the strictly limited motive power is replaced by one that is practically unlimited, thereby opening up many possibilities in the methods of railroad operation. While there are a number of different systems of electric traction all of the systems have many features in common and the possibility of unlimited power is a characteristic of them all. A brief review is given of electrified sections of railways showing the advantages which have been realized in both the freight and passenger service. Existing electrifications have been operated for a sufficient length of time so that operating statistics are now available, and any proposed undertaking may, therefore, be predicated on established facts. While electrification will greatly increase track capacity, there is a large railroad mileage which already has more than sufficient capacity, in which case electrification would not be justified. On the other hand, there are so many cases where its advantages are clear and conclusive that when the railroads are able to finance their required electrification it will test the capacity of the electric factories of the country to serve them.

Electricity now performs every railroad service previously rendered exclusively by steam locomotives and in every case does it better than it was done before. But in order to use electricity a large investment in equipment and installation must be made and electrification has proceeded slowly because railroad executives were not convinced that the advantages to be gained are always worth the cost.

The progress of electrification has also been impeded, first, before the war by the difficulty in financing, due to conditions other than the merits of electrification, and second, since the war began, because every one has been too busy to consider any work that could be deferred and because the government's taking over the railroads has created an unsettled situation not conducive to the investment of new capital for future returns. Now, however, there seems to be ground for hoping that these bars to progress will be removed in the not distant future so that electrification can be again studied on its merits; therefore, our consideration of the subject is timely.

In reviewing the past twenty years' history of this question, I cannot escape the conclusion that we electrical men, and not our steam road colleagues, are responsible for the slow progress made. We have not known enough about either the science or the art of railroading. Our belief in and our zeal for our own profession has led us, albeit with entire honesty of purpose, to make more or less extravagant claims as to what we could do and to underestimate the cost of doing it. The inevitable reaction of mind which followed an accurate determination of facts, of course, disturbed confidence in our judgment. But if at times we have injured the cause of electrification by claiming too much, strange as it may sound, we have injured it a great deal more by not claiming enough. Electrical engineers not having always been railroad men, have been unable to study railroad problems as they should have been studied, that is to say with only real and not with any arbitrary limitations before them. It has been natural for the electrical man to ask the railroad man for a statement of the conditions he was expected to meet. It was equally natural for the railroad man to prescribe the conditions upon which his steam service was predicated. Under these circumstances the problem became largely one of replacing one sort of locomotive with another, and of balancing hoped-for economies in operation and maintenance on the one hand, against fixed charges for the additional investment required, on the other. Right there comes the mistake. A perfectly natural, but yet a fundamental mistake, for which no individual or class should be censured, but for which the unusual development of the art is responsible. We cannot blame railroad men for not being electrical engineers nor electrical engineers because they are not railroad men, but the progress of electrification has to lag until both should be able to see, each with the eyes of both. It is only by combining the railroad man's knowledge of the fundamental requirements of his service with the electrical man's skill in applying electricity to perform that service that all the possibilities of any specific problem may be developed.

The electrification of a railroad is not simply the substitution of one kind of locomotive for another. It is far more than that. It is the adoption of a fundamentally different method of train propulsion. It is conservative to say that, within the bounds of ordinary practice, electricity can furnish every train with all the pulling power that can be used. The limitations of the steam locomotive in this respect disappear and ruling grades rule no longer. A strictly motive power is replaced by one that is practically unlimited.

There are a number of so-called "systems" of electric traction and heavy emphasis has been laid by the advocates of each upon its points of difference from every other. So much has been said about these differences and so little about the points of similarity as to create an entirely misleading impression. It is a fact that there are more kinds and types of steam locomotives in use many times over than there are electric systems. It is a fact that except for the storage battery locomotive, which has but a limited field of application, all electric systems have many more common features than differences. It is a fact that they agree on fundamentals and differ in detail only. Their costs may not be the same, their efficiencies may vary, but they all do their work and do it successfully and well. The possibility of unlimited electric power is a characteristic not of any one system but of all. It is due to basic differences between steam and electric equipment. A steam locomotive is a complete independent unit which not only generates but also utilizes its power. The electric locomotive generates no power at all. It is only a translating device receiving energy from an outside and a remote source. The electric power house always having much greater capacity than any one locomotive, can supply ample power for the heaviest train on the steepest grade. The steam locomotive which carries its own power house with it is limited to the capacity of its one boiler. By the multiple unit principle as many electric locomotives as may be needed can be coupled together and operated in synchronism by one crew from any cab. Any required tractive effort can thus be exerted without slipping the wheels, without imposing undue strains on the rails or bridges and without increasing the number of engine crews.

The business of a railroad is to transport freight and passengers. I put freight first because on the average it produces 73 per cent of the revenue. Unlimited motive power permits longer trains and higher schedule speeds. On the Elkhorn grade of the Norfolk & Western the schedule speed was doubled. It cuts the operating cost by hauling more cars with the same or a smaller crew. The Norfolk & Western uses two electrics to do the work of three Mallets. These new opportunities at one fell swoop banish many of the railroad's time honored traditions. The traffic possibilities must be studied from a new angle and advantage taken of every facility. It is a new thought to realize that train length is limited not by motive power but by the yard tracks and length of sidings, or that all the trailing tonnage that the draw bars will stand can be hauled. Nor are these new limits fundamental. Sidings can be extended, draw bars can be made stronger, if it pays to do it. In a word electrification opens up tremendous possibilities of increasing the freight capacity of a road and without it being necessary to build additional tracks.

While not as important as freight, passenger traffic likewise comes in for its share in the widened horizon and the vanishing tradition. Unlimited power, of course, is available, but the absence of combustion is another basic advantage. Smoke and cinders disappear. Tunnel operation loses its terrors. Unobscured signals permit normal speeds with undiminished safety. Projects like the Pennsylvania terminal in New York, depending entirely on submarine tunnel operation and previously impracticable, become immediately possible. Railroads owning valuable realty in cities can erect buildings thereon, where before smoky locomotives made any structure above the ground level impracticable. The aerial rights are now valuable. Multiple unit operation has in fact made suburban traffic. The rapid acceleration made possible by electric traction has directed attention to the equal value of rapid retardation and has quickened the study of braking acordingly; also of modified coach design to bring about the more efficient loading and discharge of passengers. These combined possibilities secure increased schedule speeds and attract patronage. The people not only get over the line in a shorter time, but as a corollary more people get over it in the same time. Again it is seen, therefore, that in passenger as in freight traffic the ability to do something that could not be done before rather than to do the same thing at a lower cost is the most valuable attribute of electrification, and again we find a greatly augmented capacity without the need of additional tracks.

It is not my purpose to make an exhaustive comparison of the relative advantages of steam and electric operation. That has been done often and well by others. What I have said about the expanding opportunities for electrified service is by way of illustration to emphasize my plea that the question should always be viewed in its broader aspect and not hampered and restricted within any narrower limitations than properly belong to it.

I am going to assume, then, the broadest possible treatment and to suppose that every electrification project is to have its pros and cons most fully examined. The real and vital question then is, "How far will this lead us?" "To what extent may we expect complete electrification of all our roads?" Parts of a number of them have already been equipped. Many of these are numbered among our prominent roads, successful corporations which have had the advice of the most highly skilled executives and engineers, and which are progressive. The service performed on the electrified sections comprised practically every kind of railroad transportation. The Bluefield division of the Norfolk & Western Railroad in West Virginia is an example of an important coal road operating through the mountains. The Chicago, Milwaukee & St. Paul 440-mile main line, through Idaho and Montana, demonstrates what can be done by a trans-continental carrier on a large scale with through traffic, both freight and passenger. The New York, New Haven & Hartford Railroad 73-mile stretch between New York and New Haven shows how through freight and a heavy passenger traffic can be taken care of on the most congested four-track section of an important eastern carrier and what is possible for complicated freight yard operation, while the New York Central and the Pennsylvania out of New York City are splendid examples of our greatest modern passenger terminal electrifications. There are, of course, many other electrifications, but even if there were not, those named are of a character to command the respect and attention of the railroad world. Now, every one of these projects has been successful. Every one has justified itself. Nearly every one in its present scope represents an extension of the zone initially electrified, the most convincing evidence possible as to what views the operating companies hold regarding these several projects. Railroad officials are generally glad to give others the benefit of their experience, so it is reasonably safe to say that operating statistics are available covering long enough periods so that the results to be expected from any proposed undertakings may be predicated on established facts and not upon theories. In the light of present day knowledge, therefore, what answer can we make to the question "Should all railroads be electrified?"

Taken together in 1910 there were in the United States 240,000 miles of railroad main line regardless of the number of tracks. Of this mileage approximately 1,250 or one-half of one per cent has been electrified or is today in process. The remaining 99½ per cent comprises, of course, roads performing every variety of service. They range from the back country branch line built by some over enthusiastic promoter and now perhaps, operated as part of a large system, only because operation cannot be avoided and regularly contributing its annual deficit, up to the most important through arteries of travel upon which the commerce and industry of the nation depend. Every sort of community is served; every kind of railroading has its place in this vast aggregation of effort, and the variables in the problem are so multitudinous and their nature often so profound as to well daunt the courage of one who seeks to formulate them for incorporation in a general statement. Fortunately or unfortunately, depending on the point of view, it has been my lot to have to deal with this electrification problem from both sides. At one period from the standpoint of an intimate affiliation with the development and manufacture of electric apparatus and at another from that of one charged with official responsibility on the railroad's behalf. I am a thorough believer in the virtues of electrification and an enthusiast about the wonders which it can accomplish, but I also have a keen appreciation of the almost infinite variations in the railroad problem and a very wholesome respect for the dollar. I do not believe that all railroads will ever be electrified. I am not sanguine even that all the tracks of any one really big system will be so equipped in our time. It is a question of economics, and the results will not justify the expenditures even when considered with such broad vision as that which guided the Pennsylvania in spending millions to put their passenger terminal in New York City without the prospect of a direct return. Electrification will increase the track capacity. But there are thousands of miles of railroad that have sufficient capacity now, frequently several times over, and where the wildest stretch of imagination fails to picture a future need of this kind. Electrification works wonders in suburban and interurban passenger service. I have ridden for hours across the western prairies without seeing a single town, much less a city where these advantages would count. Electrification effects marked economies in fuel, in maintenance, in labor and otherwise through a long list; but electrification calls for a heavy investment and unless these economies bulk large enough, the interest on such investment will wipe them out and turn the enterprise into a losing venture. I do not believe the cause of electrification is helped by undue optimism on the part of its advocates. Rather should there be an enlightened partisanship, enthusiastic where enthusiasm is justified but tinged with the sober conservatism of the man who has to put his own dollars to work.

Mr. Townley says that electrification is now firmly entrenched and successful, and is recognized as an effective agency with great possibilities.

Pre-War and Present Prices

REDUCTIONS in steel prices, as announced by the Industrial Board of the Department of Commerce, are held to be no more important to the general business situation, especially in the building and construction industries, than are the Board's statements that present wage levels should not be disturbed and pre-war prices are out of the question.

Since January there have been received in the Department of Labor thousands of letters from architects, building contractors, prospective investors in buildings, and from State and municipal authorities in which it was represented that uncertainty as to prices and wages, rather than the present high level of prices and wages, were the stubborn obstacles to be eliminated before a general revival of building and construction work would be had.

Recently the Information and Education Service, in the Department of Labor, has been putting out the results of investigations by trained economists, in the price and wage fields. The conclusion has been, and in this conclusion so eminent an authority as Prof. Irving Fisher of Yale University has concurred, that the popular expectation of a re-establishment of pre-war prices is not justified. It was asserted that wages had not advanced in proportion to living costs, and that while minor price changes might be expected in some fields, to use the language of Prof. Fisher, "we are on a permanently higher price level and the sooner business men of the country take this view and adjust themselves to it, the sooner will they save themselves and the nation from the misfortune which will come if we persist in our present false hope."

Since the steel industry is one which most profited from the demands of the war, it probably can afford to make a greater reduction in present prices than may be expected in other industries. Building and construction authorities are not, therefore, disposed to believe that subsequent price negotions by the Industrial Board of the Department of Commerce will develop reductions proportionately as marked as those announced for steel. They assert that the Board's statement, "in view of the higher costs developed throughout the world as a result of the war, a return to anything like pre-war prices is regarded as out of the question," is a sound conclusion and timely corroboration of the statements made by the Department of Labor in its campaign to stimulate building and construction work.

Two departments of the Government—the Department of Labor and the Department of Commerce—working independently, have arrived at the same conviction, namely, that the country is on a new price level and to delay business projects in the hope that pre-war prices again are to prevail is to jeopardize the business structure of the country, delay the return of prosperity, and in the end discover, as Prof. Fisher puts it, "to talk reverently of 1913-14 prices is to speak a dead language today."

Investigation of contracts on building and construction projects, let in February, 1919, made by the Department of Labor, produced convincing evidence that a majority of the contractors and builders in the country have come to understand the situation. When the contracts let in February of 1913 and 1914 are revised to the basis of present construction prices and these figures are compared with the contracts let in February, 1919, the comparison shows that February, 1919, was better than 90 per cent of normal. Now that the Industrial Board of the Department of Commerce adds its testimony on the futility of delaying business in the hope of availing of pre-war prices a reasonable expectation is that building and construction work will show a further approximation of normal.

Through all the economic studies recently issued by the Information and Education Service of the Department of Labor has been such evidence as clearly indicated the imprudence of any policy contemplating radical changes in existing wage scales. In the recent conference of Governors and Mayors in Washington it was clearly the consensus of opinion that readjustment should not and could not mean an immediate pressing down of wages. This because wages have not gone up in the same proportion as living costs and, further, because it is generally believed prudent to do everything possible to maintain the higher living standards which have been evolved during the war.

Notwithstanding these developments, there are many in industry who have been urging wage reductions. There has been enough of this agitation to create an uneasiness in the ranks of labor, and uncertainty as to the future labor conditions in the minds of prospective builders and contractors. For this reason the precedent established by the Industrial Board of the Department of Commerce in the steel case should have a very beneficial effect. On the wage matter, in the statement announcing the new prices on steel, the Board says:

"It is fully understood and expected that the present wage rates or agreements will not be interfered with, the approved prices having this in view."

All economists and practical business men agree currency conditions are an important factor in present prices. This can not be admitted without admitting also that present currency conditions are an important factor in present wages. Money is just as cheap when it buys labor as when it buys steel, and those who talk of pre-war wage scales under present currency conditions ignore entirely the fact that we do not have pre-war dollars and we will not have them for many years to come.

ELECTRICAL ENGINEERING

With Which is Incorporated the

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DURING the past few weeks the Bureau of Foreign and Domestic Commerce, which is the agency of the United States Government for promoting trade between this and other countries, has sent more than thirty commercial representatives, with others to be sent from time to time, to investigate foreign trade opportunities and obtain the latest, most complete information for American business men and manufacturers. The changed position of the United States in the business world demonstrates most conclusively the vast importance of foreign trade and the possibility of its expansion. This country is now a creditor instead of a debtor Nation. During the past year the United States did an export business of about $6,150,000,000, as against an import business of $3,031,000,000. The month of January, 1919, showed the largest exports of any single month in American history, and every effort should be put forth to sustain and develop this great commerce with the buyers overseas.

THE Treasury Department, through its newly created Division on Savings, has issued a call to retail men throughout the nation to aid in the 1919 campaign for the continued sale of War Savings and Thrift Stamps and the promotion of the idea of national and personal thrift as a happy permanent American characteristic, by establishing War Savings Societies in all retail establishments. Information reaching the national War Savings headquarters at Washington indicates that the retail trade has responded to the Government's call in a most gratifying way, and already many large retail associations, some of which have as many as 2,000 and 3,000 branches scattered throughout the country, have set about establishing these savings societies in each of their branches. Retail men are asked to align themselves with the Government in its campaign on the grounds that public thrift is of untold value as a stabilizer of business. Thrift, it is pointed out, is a much broader matter than one of mere saving. It is shown to the business man as care and prudence in the management of one's business affairs and as the foundation upon which is based every successful and enduring enterprise. Here is the doctrine which the Government, through the hundreds of War Savings workers, is preaching to the business man: A nation the citizens of which measure up to the standard of making the most of one's resources, tangible and intangible, is a stable, dependable nation. Hence the 1919 thrift campaign. It is shown that in the present period of flux and change, of unrest and intrigue and revolution, America can only perform her duty to her people and the people of the world if she holds steady, and she can only hold steady through industry and the foresight of her citizenry. Waste, it is pointed out, is the enemy of good business. Why, it is asked, should the farmer leave the plow to rust away outside the barn all winter? Why should the housewife overheat the house and the factory worker throw good material on the scrap heap? Because of these things, statistics show that there are in America today 1,250,000 people who are dependent upon charity, because in their earning days they cultivated habits of waste rather than of thrift. The merchants of America, it is further shown, must carry much of the burden of support of these wasteful dependents on their shoulders. Education in thrift will make the present generation of workers reduce this burden. Because the retail merchant has for years been carrying on an education in values, the present campaign of the Government parallels and extends certain lessons already promulgated.

The Payment of Engineers

AT the Railroad Confeernce held in Chicago last month, Mr. J. L. Jacobs, a consulting industrial engineer, read a paper on "Principles and Procedure in Classification and Standardization of Salaries of Railroad Professional Engineering Positions." After telling of the activities of the American Association of Engineers along this line, Mr. Jacobs said:

"Inequalities in salary rates for positions having similar duties and responsibilities. interpretation and readjustment of salaries and working conditions without definite and sound bases; lack of standards of duties, responsibilities and qualification requirements; multiplicity of misleading and unnecessary titles; inequitable and unsystematic practices concerning selection, assignment, promotion and other employment conditions—all these have a demoralizing and stagnating effect on employes, employers, and the community.

"This constructive program contemplates not only the elimination of inequities and inequalities in the compensations and opportunities of employment but has for its objects the formation of sound and definite bases for the determination and regulation of salaries and employment conditions; the development of practical standards of service, duties and qualification requirements; the establishment of clear and uniform understanding of the obligations and advantages of employments; the introduction of definite procedures governing selection, advancement, promotion and retirement on the basis of merit and seniority; and detailed fact bases and organization necessary for effective administration of all matters of employment."

Among the essential points in any programme to carry out this plan, Mr. Jacobs gives definite wage differentials for different positions based on special work and qualification requirements, location and other special employment conditions, and classification of positions into functional classes, all positions being played into classes according to general character of duties and into grades according to responsibility and difficulty of work.

At the same conference, Mr. Halbert P. Gillette, the well-known writer and editor, presented a paper on "Shall Engineers Be Paid Overtime?" Among other things, Mr. Gillette said: "Between the extremes of purely muscular and purely mental work, there is a great intermediate class of work that calls for both muscular and mental activity, such, for example, as ordinary drafting or operating an instrument like a transit. The men who do this intermediate class of work frequently aspire to advance to a higher grade wherein nearly all their work will be mental and of a designing or supervisory character. Yet so long as they hold positions of a semi-mental, semi-muscular nature, is it just to require them to be oblivious to the length of the working day in the hope that eventually they will be rewarded by advancement to the supervisory class? I doubt it. It seems to me that there has been altogether too much feeding of young engineers on hopes of future incomes from higher positions. There has been too much appeal to their professional aspirations while asking them to accept less than skilled mechanics' pay.

"A man able to run a steam shovel, a locomotive or a lathe efficiently—a skilled mechanic—is really in about the same class as a good leveler or a transitman, so far as purely manipulative skill is concerned, but in a lower class so far as mental training is concerned. Hence for wage purposes, it would surely be reasonable for instrument men in surveying parties to receive at least as favorable wage considerations as skilled mechanics receive. I am, therefore, inclined to believe that technical engineers in subordinate positions should be paid overtime wherever practicable."

The question of the payment of engineers of standing and reputation takes care of itself. No claim is ever made that such service is underpaid. But the matter is far different with those holding subordinate positions. Unionized labor has fixed a standard to wages and hours that has never before been equalled. It is time that something should be done for those who have no organization back of them, and who may be young and struggling to establish themselves.

The convention of the National Electric Light Association at Atlantic City in May will be a "Victory" celebration in every sense of the term. During the war the entire electrical industry of the country gave full support and co-operation to the Government by every means in its power. All that it was enabled to accomplish will never be fully recorded, although it is gratefully acknowledged. Now that the contest is over, the industry will organize and direct its best energies towards meeting the problems of peace. An elaborate and interesting program is being prepared for the May convention and the indications are that the attendance will reach record-breaking proportions. Plans for the exhibition are virtually completed, and it is certain that there will be a display of electrical devices that has rarely, if ever, been equalled.

Electric Plant for a Stone Quarry

The Blue Mountain Stone Company, R. J. Funkhouser, vice-president and general manager, First National Bank Building, Hagerstown, Md., has just started the construction of a grinding mill for reducing into granules for roofing purposes a green stone commonly known as basic rock for copper deposits. The quarry is located on Jack's Mountain, one of the South Mountains, a part of the Blue Ridge system. The mill and quarry property are at Charmian, Pa. The new mill will be three stories in height, 35 by 155 feet. The company will use electric motor drives, with current from the power company at Hagerstown. Part of the machinery will be in groups, with shaft connections, and part with individual drives.

Orders have been placed for two 100 h. p. motors, one 40 h. p., one 30 h. p., one 15 h. p. and one 5 h. p. motor. These are of Allis-Chalmers make, purchased through the Standard Electric Elevator Company, of Baltimore. The crushing machinery consists of one No. 6K Gates gyratory crushers, from the Allis-Chalmers Company, followed by one 24 by 13 Farrel jaw crusher, from the Farrel Foundry and Machine Company, one set of 36 by 16 Superior crushing rolls, three sets of 36 by 16 Sturdevant rolls and steel elevators and conveyors, also Sturdevant equipment. The air compressors and drills are from the Sullivan Machinery Company, Chicago. The air compressor and hoist are in a detached building, 30 by 30 feet. Both are motor driven, 40 h. p., on the conveyor and 30 h. p. on the hoist. The transmission line for the power is 5½ miles in length, from the company's property to the power company's line connection near Waynesboro, Pa.

The company is opening new quarries. Construction work on the mills has already been started and a spur track has been completed into the quarries from the Western Maryland Railroad. It is hoped that the work can be completed and production begun by May 15.

British Electric Companies Amalgamate

According to reports received by the Bureau of Commerce, arrangements have been completed for the amalgamation of certain electrical plants. Dick, Kerr & Co. announced at their annual meeting that the English Electric Co. had acquired the shares of the Conventry Ordnance Works and the Phoenix Dynamo Manufacturing Co. and had made them a similar offer to exchange their shares for an equal number of English Electric shares. The English Electric Co. has a capital of £5,000,000 ($24,332,500), of which only about £2,000,000 ($9,733,000) had been issued at the time of amalgamating with Dick, Kerr & Co., which latter firm has been given the right to subscribe at par for one £1 ordinary share in the English Electric Co. for every three shares, ordinary or preferred, that it has exchanged. The English Electric Co. will now be one of the three principal electrical manufacturing concerns in the United Kingdom and its board of directors, which includes several representative railway men, contemplates a considerable expansion of its activities.

It is considered that the future success of electrical companies will depend on their capacity to undertake large schemes, such as the electrification of railways, the construction of large power stations, and the development of hydroelectric installation. For this reason the present amalgamation will play a very important part in the future of the English electrical industry.

Personal

Mr. John Henry Schafer, president of the Schafer Construction Material Company of New York, on April 1, sent out an announcement of the fortieth anniversary of his entrance into the business of pole line hardware, and thanking his business friends for their patronage and consideration.

R. E. Brown, manager of the Northern States Power Company, Mankato, Minn., division, has been elected vice-president of the Minnesota Electric Association for the ensuing year.

H. A. Joslin, manager of the Dallas, Ore., division of the Mountain States Power Company, has been re-elected vice-president of the Dallas Chamber of Commerce.

Mr. Calvert Townley, assistant to the president of the Westinghouse Electric and Manufacturing Company, read a paper entitled "Some Possibilities of Steam Railroad Electrification as Affecting Future Policies," before a meeting of the American Institute of Electrical Engineers held at Boston, on March 14. At the annual meeting of Engineering Council Mr. Calvert Townley was reappointed chairman of the Water Conservation Committee for the year terminating at the annual meeting in February, 1920.

General Guy E. Tripp was recently decorated with the United States Government distinguished war service medal, which was awarded him for his excellent work in systematizing methods and practice, resulting in the hearty co-operation of industries producing ordnance material for the army. Mr. Tripp's army career has been marked by a series of successes. Entering the army with the rank of colonel as Chief of the Production Division of the Ordnance Department, he was later promoted to the rank of brigadier-general as assistant chief of ordnance. General Tripp has proven himself to be a man of wonderful executive and organization ability. It was he who conceived the idea that production work of the Ordnance Department should be handled from different points throughout the United States instead of through one big head in Washington. This scheme worked out to perfection and was the means of speedy and efficient production. It is to men like Tripp that our country is indebted for the great part they played in assisting in the speedy and victorious end of the world war. Before going into service, General Guy E. Tripp was president of the Board of Directors of the Westinghouse Electric and Manufacturing Company, to which position he returned after the signing of the armistice, and the cessation of hostilities.

B. W. Cowperthwait, general manager of the Northern States Power Company of the Faribault division, as president, opened the 1919 convention of the Minnesota Electrical Association in St. Paul, March 18. H. E. Young, sales manager of the Northern States Power Company, is a member of the executive board of this association. D. F. Parrott of the Minneapolis General Electric Company was scheduled for an address on "Recent Developments in Transmission Line Construction." Two hundred delegates were present.

Mr. T. B. Macaulay, president and managing-director of the Sun Life Assurance Company of Canada, has been elected a director of the Montreal Light, Heat & Power Consolidated, to fill the vacancy caused by the death of Sir Rodolphe Forget.

Mr. Lawford Grant has resumed his former position as managing-director and treasurer of the Eugene F. Phillips Electrical Works, Ltd., Montreal. The vacancy on the Board of Directors, caused by the death of Mr. G. H. Olney, has been filled by the appointment of Mr. A. J. Carroll. Mr. R. H. Balfour has been appointed assistant treasurer, and Mr. A. Richards assistant secretary.

American Welding Society Organized

The first meeting of the American Welding Society was held on March 28, 1919, at the Engineering Societies Building, 33 West Thirty-ninth Street, New York, and the Constitution and By-laws were adopted as recommended by the organization committee:

The following officers were elected:

President, C. A. Adams, Cambridge, Mass.; vice-president (for one year), J. M. Morehead, New York; vice-president (for two years), G. L. Brunner, Utica.

Directors for one year—W. M. Beard, New York; M. H. Roberts, New York; M. M. Smith, New York; L. D. Lovekin, Philadelphia; Alexander Churchward, New York; W. H. Patterson, Pittsburgh; Walter J. Jones, Philadelphia; C. A. McCune, New York.

Directors for two years—R. R. Browning, New York; A. S. Kinsey, Jersey City; Victor Mauck, Conshohocken; E. L. Hirt, South Bethlehem; J. F. Lincoln, Cleveland; H. M. Hobart, Schenectady; D. C. Alexander, New York; H. R. Swartley, Jr., Jersey City.

Directors for three years—L. H. Davis, New York; E. L. Mills, New York; D. B. Rushmore, Schenectady;

James Burke, Erie; D. H. Wilson, Jr., New York; Hermann Lemp, Erie; C. J. Nyquist, Chicago; Alexander Jenkins, Baltimore.

It was voted that the charter should be held open for ten days and that those applying for membership in the American Welding Society before April 8 should be considered charter members. At a meeting of the directors in the afternoon, W. E. Symons was appointed treasurer and H. C. Forbes, secretary.

Nation's Gear Makers to Meet at Cleveland

President F. W. Sinram of the American Gear Manufacturers' Association announces that their annual convention will be held at the Hotel Statler, Cleveland, Ohio, April 14, 15 and 16. The organization includes in its membership representative companies engaged in making gears in the United States and Canada and promises to be of unusual interest to the manufacturing world. For some years past the American Gear Manufacturers' Association has been striving earnestly to affect an organization that would develop definite means for standardizing their products. The coming convention will center its attention on this problem.

Papers will be presented as follows:

"Gear Steels," by Dr. Parker of the Carpenter Steel Company; "Proper Sizes and Materials for Gears"; "Worms and Worm Wheels," by a representative of the Timken-Detroit Axle Company.

The officers of the association are: President, F. W. Sinram of the Van Dorn and Dutton Company, Cleveland, Ohio; vice-president, H. E. Eberhardt of the Newark Gear Cutting Machine Company, Newark, N. J.; secretary, Frank D. Hamlin of the Earle Gear and Machine Company, Philadelphia, Pa.; treasurer, Frank Horsburgh of the Horsburgh and Scott Company, Cleveland, Ohio.

Faulty Installation and Fluctuating Voltage

By T. Schutter

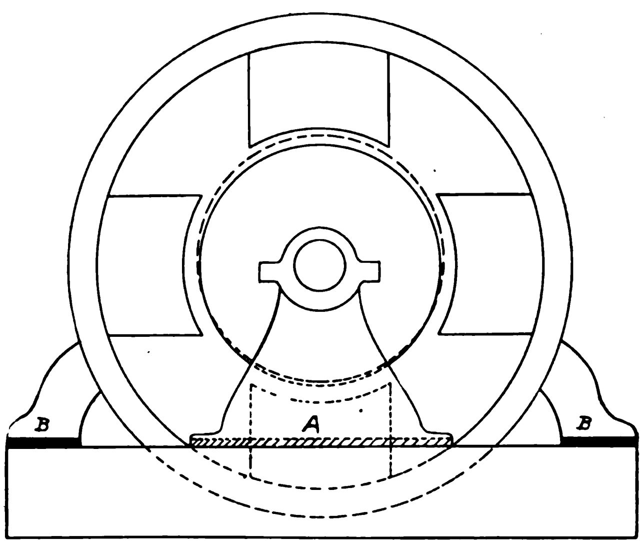
A 100 KILOWATT compound generator, which was belted to an engine, had been removed from one plant to another, and when installation was completed it was tested for service, without load. The load of the plant consisted of lights and motors ranging from ¼ to 10 horsepower, which were operated intermittingly.

When the machine was started the voltage built up very nicely, but as soon as the load was thrown on the voltage would fluctuate, and also spark badly at the brushes. At first it was thought that the brushes were out of the neutral position, but after trying by shifting the brushes backward and forward there was no change in the voltage and the sparking was increased. This only proved that the brushes were set in the proper position at first.

A speed counter was placed on the shaft of the armature, and its speed was checked up and found correct and constant at no load or full load. This being a compound generator it was possibie to have the shunt and series field bucking, that is the shunt field on a pole piece may be connected so as to produce a north pole, while the series field on the same pole piece may be connected so as to produce a south pole. Since the series field windings are connected in series with the armature, the more the load on the armature, the more current would flow through the series field windings, and would tend to neutralize the magneto effects.

As stated above, this generator and engine were moved from one plant to another, and the men who were installing it at its new location were not electrical but steam engine men, and there was a possibility for them to make an error unknown to them, but all parts were checked up, such as board connections, field connections, brushes, etc., and all were found to be correct. While standing at one end of the generator it was noticed that the clearance between the armature and the pole pieces was not equal all around. At the upper side of the armature it was almost impossible to slide a piece of paper between the pole shoes and the armature surface, while at the lower side there was about three inches of clearance between the armature surface and the pole shoes.

This, of course, was the cause of all the trouble, since by having an uneven air gap the magnetic circuit is unbalanced, which at no load could not be noticed, but when the load was thrown on, fluctuating voltage and serious sparking was the result. The reason for this condition was easily explained. In order to have a uniform air gap all around the armature shims had been placed under the legs of the generator frame where it rested on the bed plate, but when it was installed in its new location these shims were placed under the bearing pedestal, and it can easily be seen how this would raise the armature up closer to the upper pole shoes. It was a very queer coincidence that these shims fitted properly in both positions. Had this been a direct connected generator instead of a belted one such an error would have been impossible because the armature shaft would not have lined up with the engine shaft.



The accompanying figure shows how the error was made. The shims were originally placed at point marked B and in reassembling they were placed at point marked A.

[Note—Through an unfortunate error, the cuts of Mr. Schutter's article on the grinding of brushes in the March issue were transposed with those of the article on installing and wiring a motor.]

The Motor Raced

By T. Schutter

SMALL motors may be connected directly to the line and started without a starting device, but the larger types require a starting box so as to prevent a heavy inrush of current on starting, as this is injurious both to the winding and fuses.

Two forms of modern starting boxes are shown in figures 1 and 2. Fig. 1 is known as a three point starting box, while Fig. 2 is known as a four point starting box. Those types of boxes are used in connection with shunt and compound motors. Fig. 3 shows how a three-point box is used with a shunt motor, and Fig. 4 shows how a four-point box is used with a compound motor, but it should be kept in mind that four-point boxes can be used on shunt motors and three-point boxes on compound motors.

The starting boxes used on series motors have only two points and they are used as shown in Fig. 5.

The following is a little experience which occured to a maintenance man, and for a time he was at a loss as to what had happened or what to do to remedy the trouble. The motor was a five-horsepower shunt machine and was connected to an old style starting in which the re-

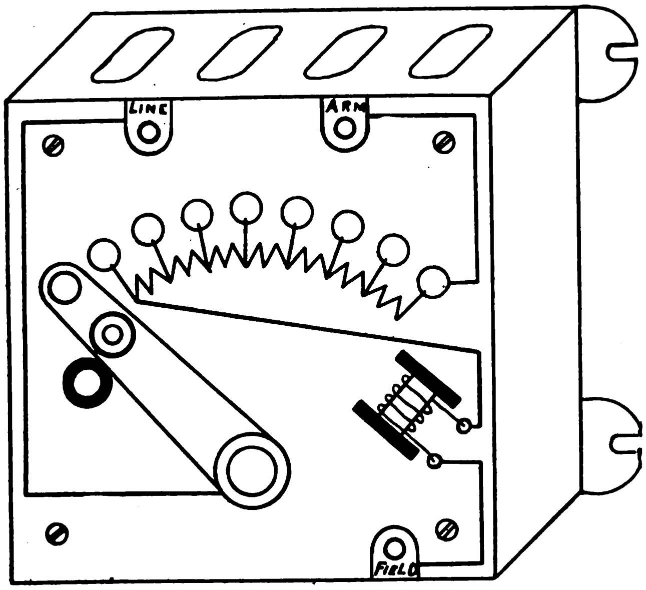


Fig. 1.

sistance units were of the porcelain tube type; that is, the wire was imbedded in porcelain.

This machine had been in operation for many years and at times carried heavy overloads which caused both the motor and the resistance units in the starting box to become extremely hot. On starting this motor one morning, as soon as the starting box handle was brought up to the first contact, which under normal conditions would allow a little current to pass through the armature and a full field current on (trace Fig. 3), which would be the slowest speed position, the armature began to run at an excessive rate of speed or, in other words, the motor raced, which caused the main line fuse to blow out.

The motor was disconnected from the starting box, the fuses replaced and a test made of the motor, and both the armature and the shunt field circuits were found to be in perfect order. Next the lines between the starting box and motor were tested and were also found to be in good shape. On making a test of the starting box circuits it was found that the shunt field circuit was open; this accounts for the increase in speed. When the shunt field circuit is open and a current applied to the armature circuit, it will begin to run on the residual magnetism which is very weak, and which in turn will produce a very small amount of counter electro-motive force and the armature will race. If the source of supply is not immediately cut off, the armature coils (the winding)

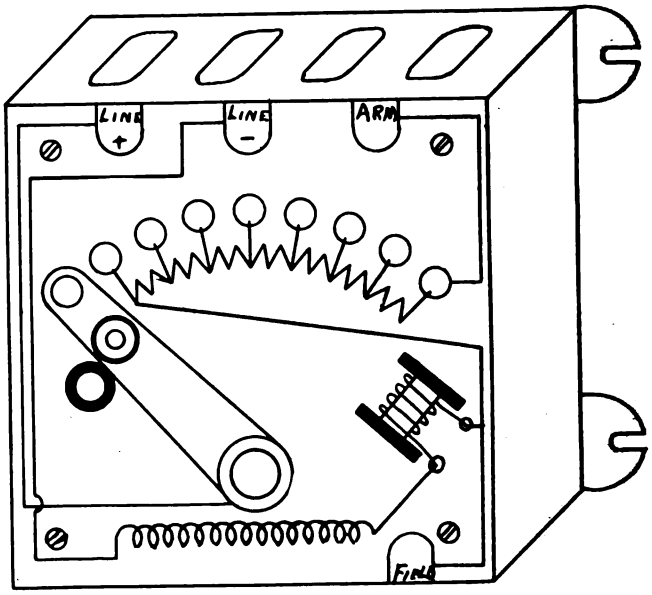


Fig. 2

would be thrown out of the slot and destroyed (coils being thrown out of the slots due to the centrifugal force).

As explained above, the resistance and all wire inside of the starting box were imbedded in porcelain, so for

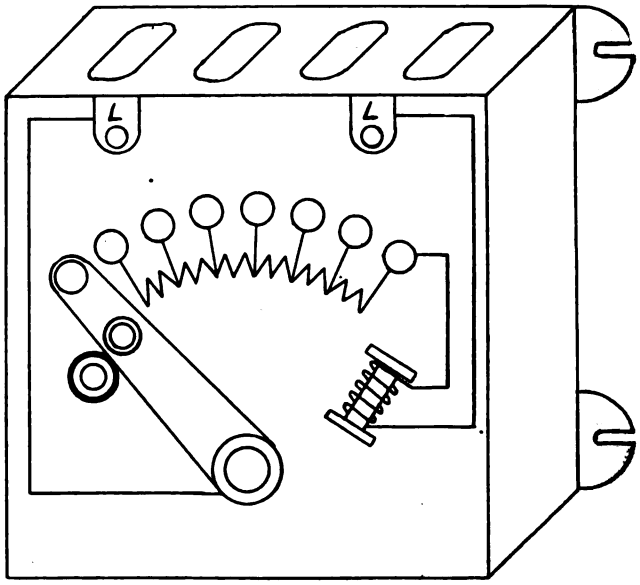


Fig. 5.

this reason it was impossible to make the necessary repair. Still it is impossible to get a new starting box for immediate use so some kind of a repair must be made in order that the motor can be operated. There are two ways in which a temporary arrangement can be made for starting this motor. The first is to discard the starting box and use a water resistance; that is, use a wooden, or a composition, water pail. Fill about three-quarters with clean water and add about two tablespoonsful of salt; place one electrode on one side of the pail in the water and the other electrode on the other and gradually bring them together. In this way the armature current will be regulated. When the electrodes meet, the switch A in Fig. 6 should be closed, so as to cut the water resistance out. The field is connected right across the line. When the machine is to be stopped, the switch A must be opened first and then the field.

The second way to make a temporary repair is as follows: First, remove the reset spring, which is found at the bottom end of the handle, so that the handle may be left at any on full point without the retaining coil being energized (as this is part of the shunt field circuit which is broken), then rim a wire from the side of the switch which runs to the box and conect it to the field terminal (F) on the motor. It will now be seen that the field current is regulated by the line switch, while the armature current is regulated by the starting box, as shown in Fig. 7.

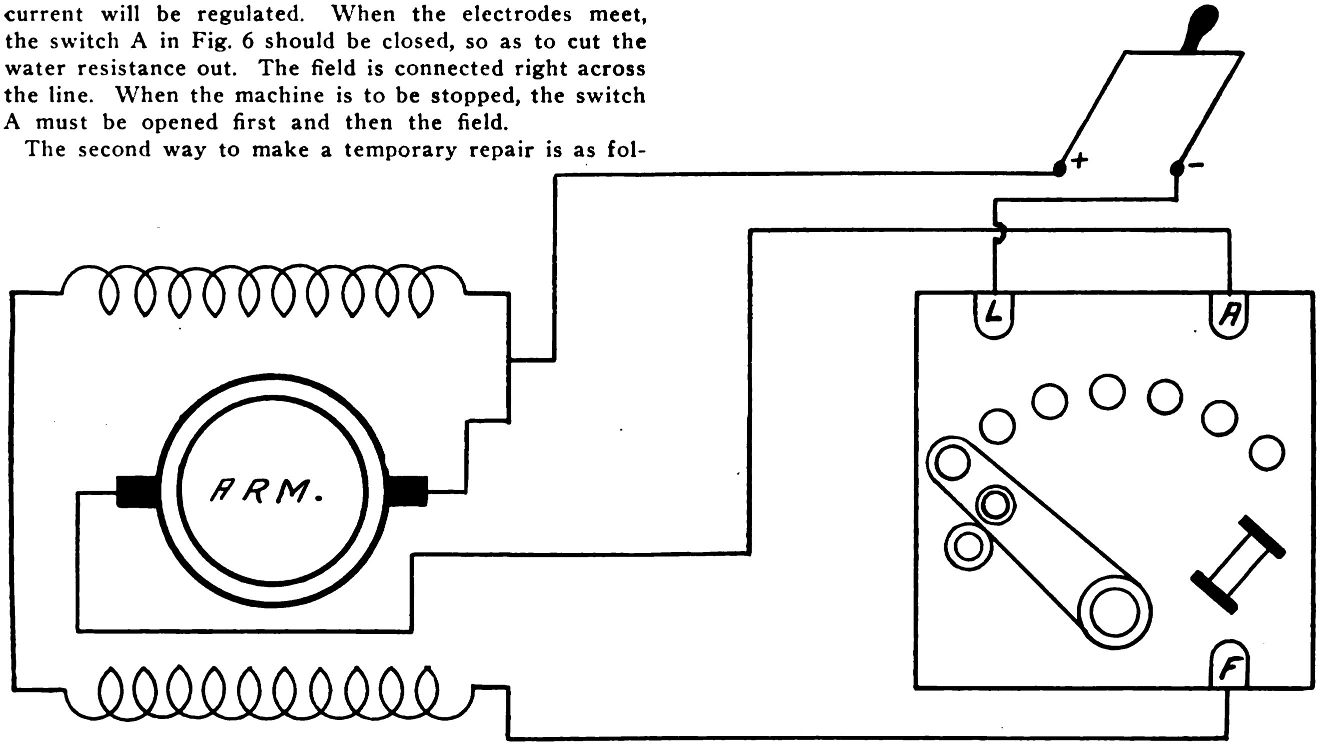


Fig. 3.

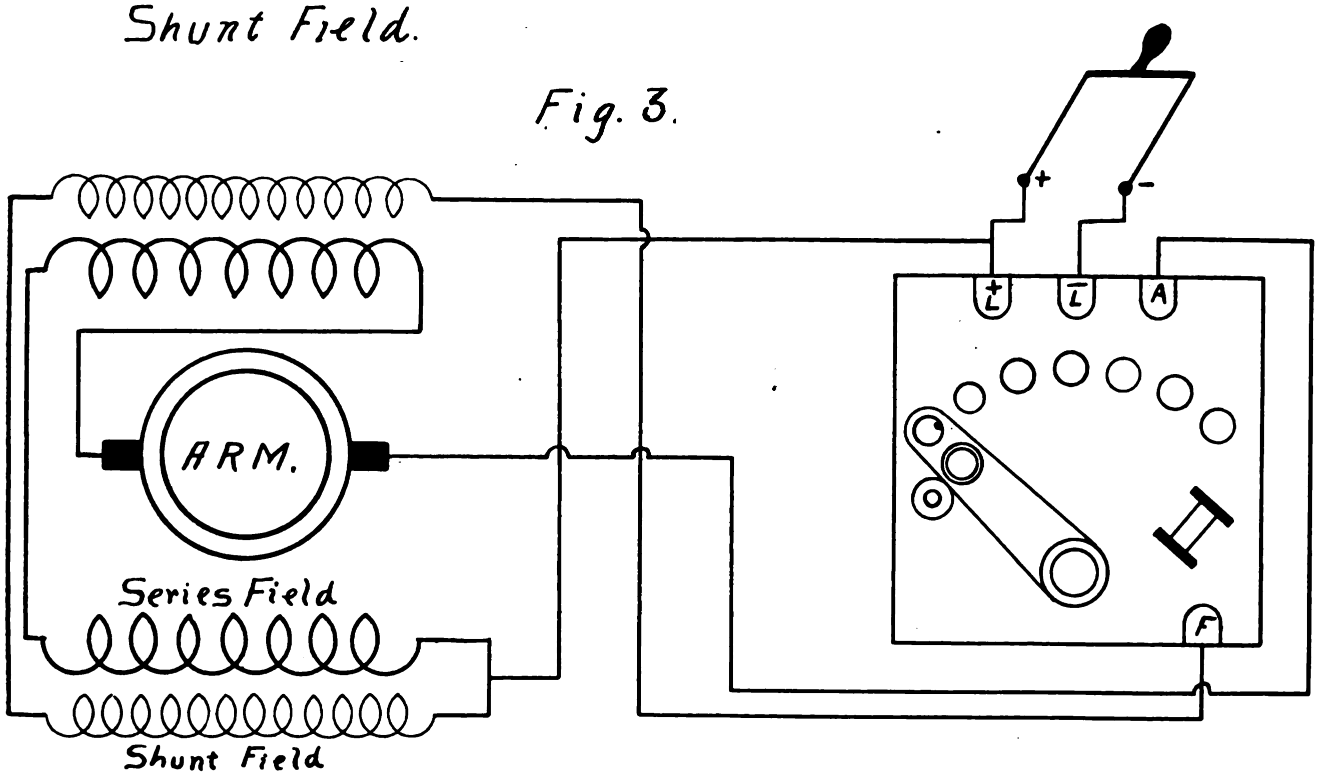


Fig 4.

Generator Fails to Build Up

A TEN kilowatt generator, which had been standing idle for a considerable time was to be put back into service. After being thoroughly overhauled was belted to a gas engine, but when started and brought up to the proper speed it failed to generate.

After several unsuccessful attempts the electrician who was in charge of the plant was called. He made a thorough examination of all parts and connections (which, of course, were all right). He decided that there was a short circuit in the armature windings. To rewind the armature meant a loss of time which could not be spared very well, but as he claimed nothing could be done unless the armature was rewound, so he at once to make certain adjustments. But after another unsuccessful attempt he gave up the job in disgust and another electrician was called on for help.

The first question that he asked after being told that the armature had been rewound and that the machine had been standing idle was: "How long has this machine been standing idle?" and when told that it was about three years, he smiled and called for a half a dozen of dry cells, and began to disconnect the shunt field leads from the machine. When he received the cells he con-

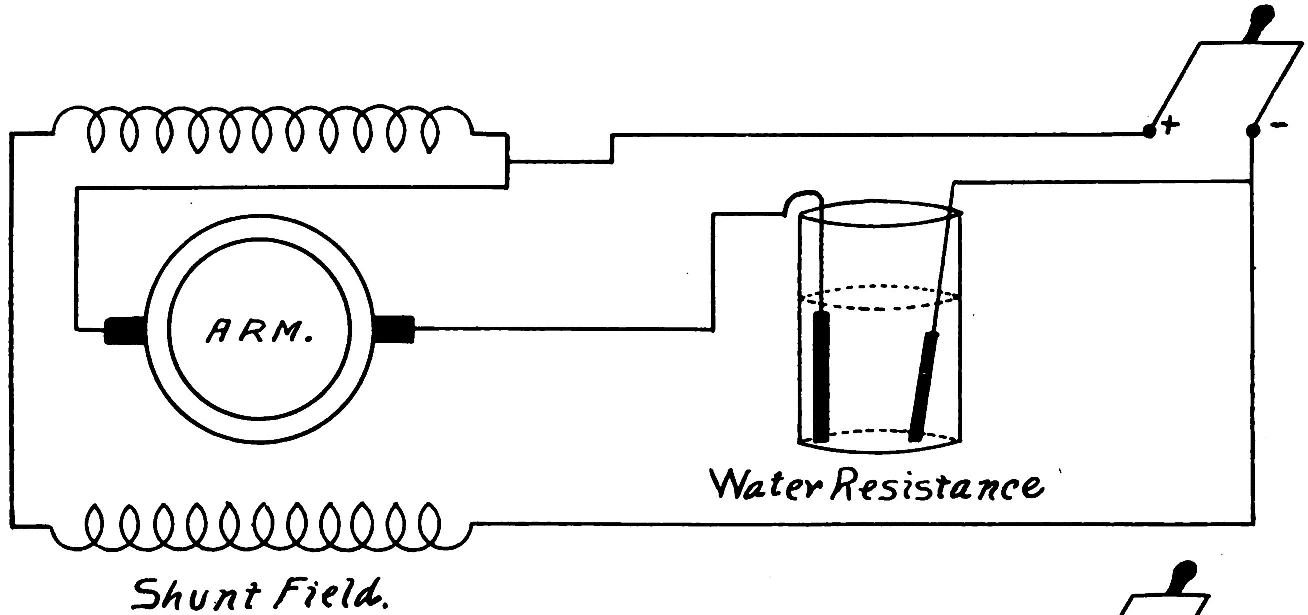


Fig. 6.

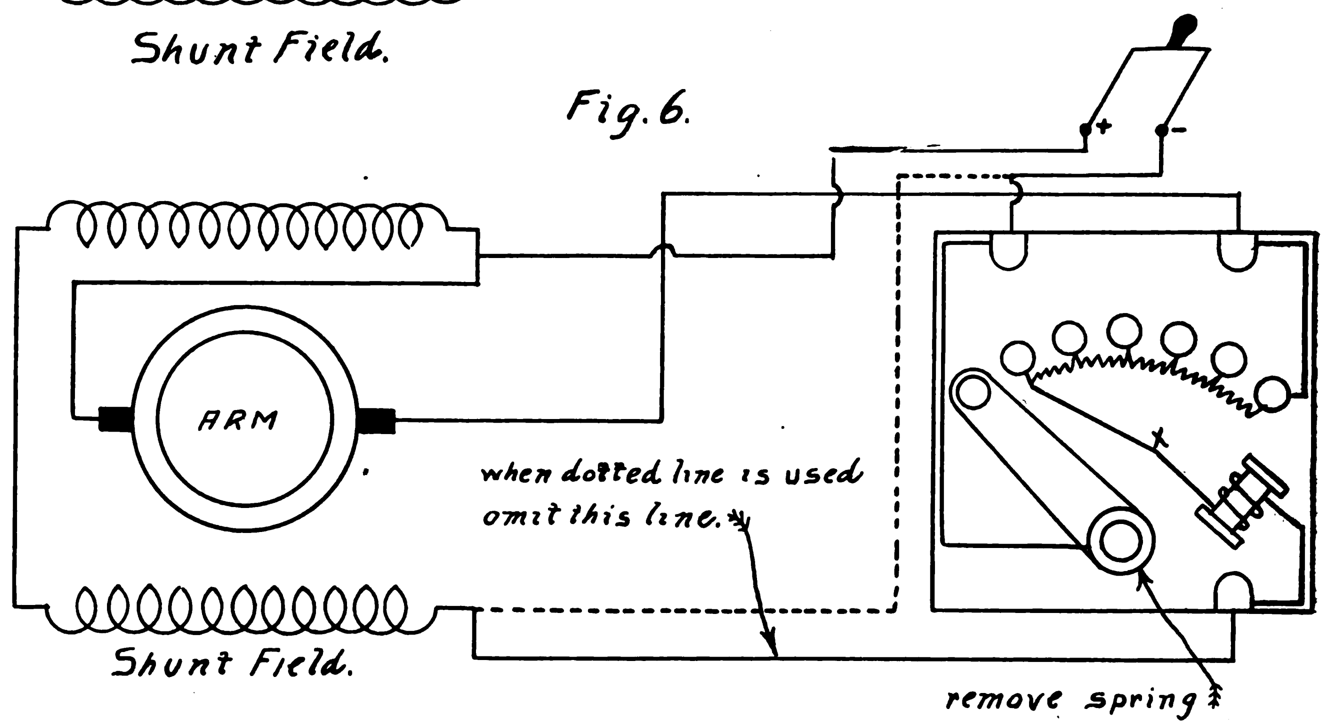


Fig. 7.

set to work stripping the old winding off, made a new set of coils and in due time the armature was put back in the machine and started up again, but the results were no better than at the first trial and again failed to produce a current.

This was about the limit of the owner's endurance, and he flatly demanded of this electrician whether he knew what the trouble was or not, and as a final attempt and after several excuses, asked time until the following day nected them in series and then connected them across the shunt field leads for a few minutes. Then he reconnected the shunt field to the machine and prepared the machine for another trial.

After making a few adjustments the engine was again started and as the speed was increased the needle on the volt meter began to leave the zero point and gradually come up to full voltage, 115 volts.

When the first electrician asked him how and why the dry cells were connected to the shunt field, the second or real electrician simply said: "If you stood still for three years you would loose your strength, and the the same applies to the pole pieces of this generator. In three years they lost their residual magnetism, which is their strength on which the voltage is built up."

The rewinding of this armature was entirely unnecessary as the only thing that was wrong with this machine was that by standing idle so long it lost its residual magnetism, which is necessary to start the generating of an electro-motive force. The residual magnetism may be very weak, but as soon as the armatures begin to cut a few lines of force, a current begins to flow in them and as the field windings are connected in parallel with the armature winding, some of the current is then passed through the shunt fields, which will increase their magnetic strength or lines of force, and in that way full voltage is gradually built up.

Here and There in the Electrical Field

Consul G. K. Donald reports from Sydney, Nova Scotia, that a new electric-power plant equipped with the latest type of high-efficiency turbines, capable of generating 11,500 kilowatts, or about 15,000 horsepower, is to be erected for the Dominion Iron & Steel Company in Sydney by an American corporation. It will be put up so that additions may be made as needed. It is expected to be completed by the fall of 1919.

Vice Consul Richard P. Momsen reports from Rio de Janeiro, Brazil, that the director of the Central Railway of Brazil recently reported to the government the intention of the directorate of this company to install in its workshops an electric furnace for the smelting of ferromanganese, utilizing for this purpose the mineral products of the country. A small chemical laboratory will also be installed for guidance in the manufacture of steel.

According to the Swedish press, the Tingstaede radio station on the Swedish island Gotland is to be opened to the public on March 15, after which date private radiograms, inclusive of business messages, can be forwarded via London to all places in Siberia and to the stations Ekaterinburg, Perm, Tchelyabinsk, and Zlatoust, in European Russia. Radiograms will in general be higher than ordinary telegrams.

A club has been organized by the employes of the Oklahoma Gas and Electric Company at Oklahoma City, Okla. The first meeting was held on March 20, at which 142 employes were present. Officers will be elected at the next meeting and steps taken towards making the organization permanent with regular meetings.

The Railroad Commission of California has authorized increased rates of charge for both gas and electric service supplied by the Western States Gas and Electric Company, Stockton division. The decision grants increases over surcharges allowed for the duration of the war and establishes the new rates on a permanent basis without surcharge features. This is the third rate increase allowed this company since the start of the war.

An electrically cooked dinner was served to 130 employes of the Louisville Gas and Electric Company at the company's office, March 17. The object of the dinner was to stimulate interest in electric cooking. A. S. Witmer, commercial manager of the Louisville Gas and Electric Company, was in charge of the affair. Nine public demonstrations of electric cooking are to be held at suburban locations about Louisville during the remainder of March.

The Pittsburgh Chapter of the American Association of Engineers will have a secretary beginning April 1. This is the first chapter outside of national headquarters at Chicago to have a secretary giving all his time to the work of the association. F. E. N. Thatcher has been selected for the position and will have an office at 1312 Fulton building, Pittsburgh.

The Washington Chapter of the American Association of Engineers at its meeting, March 25, elected the following officers:

President, Harry Stevens, Civil Engineer, Union Trust Company Building; first vice-president, A. Y. Hess, designer, Navy Department; second vice-president, Clegge Thomas, Washington Loan and Trust Company Building; secretary, E. L. Howard, Bureau Yards and Docks, Navy Department; treasurer, O. M. Sutherland, mechanical engineer, Bureau Yards and Docks.

The Kansas City Club of the American Association of Engineers at its meeting, March 21, elected the following officers: Chairman, J. E. Jacoby, consulting engineer, Shukert Building; vice-chairman, W. B. Cast; secretary, R. N. Clarke; treasurer, S. M. Bate.

Stockholders of Cities Service Company at the annual meeting of the company in Dover, Dela., on April 8, will be asked to approve an increase in the authorized preferred capital stock of the company from $100,000,000 to $150,000,000. Cities Service Company at the present time has an authorized capitalization of preferred stock of $100,000,000, of which $70,807,936 is outstanding. The Company has outstanding approximately $31,000,000 of convertible securities, all of which will become convertible into stocks of the company within the next two years. To provide for the conversion of these securities will require approximately $27,000,000 par value of preferred stock, and it is felt provision for this conversion should be made now. No increase will be asked in the present authorized common capital stock of the company, as it is believed that there is no necessity for increasing this at the present time beyond the authorized amount of $50,000,000.

Under a Bill introduced into the Quebec Legislature, amendment is made to the law whereby power companies expropriate land on which to erect transmission lines. At present they are obliged to buy more land than is needed, and the change is to allow them to take only what is actually required.

The Gatineau Development Co., Ltd., of Maniwaki, P. Q., has been incorporated with a capital of $99,000 to carry on the business of an electric light company in the township of Egan, and to deal in electric fixtures and supplies.

Bruce County, Ont., Council plans installation of Hydro-electric system. Clerk, P. A. Malcolmson, Walkerton.

Plans are prepared for equipping Collingwood, Ont., Shipbuilding Company for electric operations. About 800 hp. will be required.

Toronto, Ont., will vote on appropriating $200,000 for the purpose of buying out existing lighting systems in the township and adding thereto. Engineer, Frank Barber, 40 Jarvis Street, Toronto.

It is proposed to submit a by-law to the ratepayers of Stouffville, Ont., on the question of introducing Hydro power and scrapping the present municipal power plant. This plant is operated by steam and since the coal shortage there has been much inconvenience caused by shutdowns.

The town council of Perth, Ont., have granted the Hydro-electric Commission amounts totalling $60,000 for the completion of work in connection with changing over the local system to Hydro.

Now that the war is over, the Administrative Commissioners of the city of Montreal will request the Quebec Public Utilities Commissioners to compel the public utility companies to place their wires in the underground conduits of No. 4 and

No. 6 districts. The Utilities Commission decided, in April last, that the companies be allowed to defer the work owing to the abnormal cost of materials and the difficulty of securing supplies, due to the war.

The annual report of the Toronto Hydro-electric System for the past year shows a gross revenue of $2,353,443, made up as follows: Lighting, $743,914; power, $982,859; street lighting, $300,594; exhibition, $15,748; current supply in bulk to other municipalities, $245,856; income from other sources, $64,472. The expenditures were: $842,251, cost of current; $661,361, cost of operation and management, and $846,164, fixed charges, interest and sinking fund, a total of $2,231,776, showing a net profit in the year's operations of $21,666. The assets of the system are valued at $10,628,232, with gross liabilities of $10,564,253, showing a surplus of assets totalling $63,979.

Officials at the plant of the Pacific Smelting Company's works at Edmonds, B. C., state that through electric smelting they are able to manufacture calcium carbide giving five per cent. higher gas yield than that manufactured under the older method. It is stated that plans are being drawn for a large and permanent plant for this company.

Foreign Trade Opportunities

The Bureau of Foreign and Domestic Commerce, Washington, reports the following inquiries for electrical goods. Further particulars may be had by addressing the bureau, mentioning the numbers given:

28897.—A man in Italy desires to receive an exclusive agency for the sale of electrical machinery, magnetic sheet steel, batteries, frequency meters, phrasometers, current compters, instruments of precision, electric apparatus for mines, for chemical industries, and for electric railways; also, insulating material, mica paper, varnish, fiber and cable insulators, medical applications, marine installations, magnetos, telephone apparatus, and telephone switchboards. Correspondence may be in English. References.

28918—A merchant in France desires to purchase and secure an agency for the sale of all sorts of electrical appliances and apparatus, such as motors, heaters, lighting fixtures, and tools. Terms of payment, cash against documents. Correspondence should be in French. References.

28928—A man in Italy wishes to secure an agency for the sale of electrical materials and machinery, automobiles and accessories, including pneumatic tires, rubber articles, technical articles for surgery, machinery of various kinds, greases, oils for lubricating, asbestos fittings, glass vials, bottles, etc. Payment guaranteed through bank deposit. Correspondence should be in Italian.

28930—A man in Belgium desires to secure an agency for the sale of all kinds of electrical supplies and material. Correspondence may be in English.

28959.—A merchant in France desires to represent manufacturers and exporters for the sale of locomotives, machinery and materials for railways, steamships, gas and electrical plants, waterworks, mining, construction work, etc. Correspondence may be in English.

28960.—A business man in Norway desires to secure an agency for the sale of electrical motors, transformers, storage batteries, dry cells, wires, cables, resistance alloys, apparatus for cooking and heating, insulators, insulating materials, tapes and other electrical supplies; also varnish, carbon and metal brushes, metals, transformers and dynamo plates, tools, etc.

28966.—A large import-export house in the United States with branches in Holland and Java desires to enter into negotiations with manufacturers of general machinery, motors, commercial motor cars and other technical articles for an exclusive agency in the Dutch East Indies. Reference.

28993.—A man in Sweden wishes to purchase electrical goods, wires, cables, motors, fans, dry batteries and other suitable goods. Reference.

28975.—A man in Switzerland desires to secure an agency for the sale of machinery, electrical apparatus and tools. References.

Obituary Notes

Emil C. Braun, for fifteen years connnected with H. M. Byllesby & Company as an electrical engineer and valuation expert, died suddenly at his apartments in the Bradley Hotel, Chicago, March 23, as the result of a fall which caused a hemorrhage. He was born in Germany in 1868 and came to this country in 1893 in charge of the German electrical exhibit at the World's Columbian Exposition, Chicago. He was educated at the universities of Frankfort and Berlin.

Herbert W. Kent, manager of the Northern Electric Company at Vancouver, B. C., died recently. Previous to going with the Northern Electric Company he had been for many years manager of the B. C. Telephone Company. His home town was Peterboro, Ont.

Burnett C. Kenyon, formerly president of the Diehl Manufacturing Company and for the past two years purchasing agent for the Crocker-Wheeler Company, died suddenly at East Orange, N. J., the past month at the age of 54 years. Mr. Kenyon had been associated with the electrical manufacturing industry for many years. Mr. Kenyon resigned from the presidency of the Diehl Manufacturing Company about four years ago, becoming associated with the Crocker-Wheeler Company.

Removal

The entire executive staff of the Okonite Company was transferred on April 1st from 501 Fifth Avenue, New York City, to the company's plant at Passaic, N. J., where their main office will hereafter be located.

A sales office will be retained at 501 Fifth Avenue, New York.

Trade Notes

The Edison Storage Battery Company, Orange, N. J., have a new price list, effective March 1, 1919, reducing the price of type A, B and C Edison cells approximately 16 per cent. This company is also boosting prosperity by using the slogan: "Procrastination murders industry—stir things up!"

The Quigley Furnace Specialties Co., Inc., of 26 Cortlandt Street, New York, has just published Bulletin No. 11, describing the Quigley system for preparing, distributing and burning powdered fuels. This has been developed as the result of twenty years' practical experience in the selection and application of fuels and in furnace design and operation. It has been in successful operation for some time in a variety of furnaces.

The Heine Safety Boiler Company, of St Louis, Mo., have just completed the printing of the latest edition of their "Boiler Logic," an 86-page treatise on steam boilers. This takes up in detail fundamental consideration of boiler design, the practical baffling of water tube boilers, the adaptation of boilers to different fuels, firing and service, and overloads.

Preliminary Bulletin No. 113, illustrating and describing the Wheeler Steam Jet Air Pump, is now being distributed by the Wheeler Condenser & Engineering Company, Carteret, N. J. This pump includes the valuable features of two or more steam jets working in series with a condenser between the jets—a feature which enables this type of pump to perform a given duty efficiently.

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Statement of the Ownership, Management, Circulation, Etc., Required by the Act of Congress of August 24, 1912

Of "Electrical Engineering," published monthly at New York, N. Y., for April 1, 1919.

State of New York, }
County of New York, } ss.

Before me, a Commissioner of Deeds in and for the State and county aforesaid, personally appeared Frank A. Lent, who, having been duly sworn according to law, deposes and says that he is the Publisher of "Electrical Engineering," and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management, etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, embodied in section 443, Postal Laws and Regulations, to wit.

1. That the names and addresses of the publisher, editor, managing editor, and business managers are:

Name of	Post office address
Publisher, Frank A. Lent,	258 Broadway, New York
Editor, Frank W. Hoyt,	258 Broadway, New York
Managing Editor, None.	
Business Manager, Frank A. Lent,	258 Broadway, New York

2. That the owners are: (Give names and addresses of individual owners, or, if a corporation, give its name and the names and addresses of stockholders owning or holding 1 per cent or more of the total amount of stock.)

Frank A. Lent, 258 Broadway, New York

3. That the known bondholders, mortgagees, and other security holders owning or holding 1 per cent or more of total amount of bonds, mortgages, or other securities are: None.

4. That the two paragraphs next above, giving the names of the owners, stockholders and security holders, if any, contain not only the list of stockholders and security holders as they appear upon the books of the company, but also in cases where the stockholders or security holders appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting, is given; also that the said two paragraphs contain statements embracing affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner; and this affiant has no reason to believe that any other person, association, or corporation has any interest direct or indirect in the said stock, bonds, or other securities than as so stated by him.

FRANK A. LENT, Publisher.

Sworn to and subscribed before me this
2nd day of April, 1919.

ROY I. WAKEMAN,
Notary Public New York County, 242;
New York Register No. 10231.
My commission expires March 30th, 1920.

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Supplies (Electrical)—
General Electric Co., Schenectady, N. Y.
National Metal Molding Co., Pittsburgh, Pa.

Supplies (Telephone)—
Southern Electric Co., Baltimore, Md.

Surfacing (Steel and Tin)—
Erdle Perforating Co., Rochester, N. Y.

Switchboards (Light and Power)—
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
General Electric Co., Schenectady, N. Y.
Westinghouse Elec. & Mfg. Co., East Pittsburgh, Pa.

Switches—
General Elec Co.
National Metal Molding Co., Pittsburgh, Pa.
Southern Elec. Co., Baltimore, Md.
Westinghouse Elec. & Mfg. Co., East Pittsburgh, Pa.

Tape—
Okonite Co., The., New York City.
Standard Underground Cable Co., Pittsburgh, Pa.

Terminals (Cable)—
Standard Underground Cable Co., Pittsburgh, Pa.

Testing (Electrical)—
Electrical Testing Laboratories, New York City.

Theater Dimmers—
General Electric Co., Schenectady, N. Y.

Transformers—
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Enterprise Electric Co., Warren, Ohio.
General Electric Co., Schenectady, N. Y.
Kuhlman Electric Co., Bay City, Mich.
Thordorson Electric Mfg. Co. Chicago, Ill.
Moloney Electric Co., St. Louis, Mo.
Westinghouse Elec. & Mfg. Co., East Pittsburgh, Pa.
Weston Elec. Inst. Co., Newark, N. J.

Transformers (Bell Ringing)—
Kuhlman Electric Co., Bay City, Mich.
Thordorson Electric Mfg. Co., Chicago, Ill.
Southern Electric Co., Baltimore, Md.
Westinghouse Elec. & Mfg. Co., East Pittsburgh, Pa.

Turbines (Steam)—
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
General Electric Co., Schenectady, N. Y.
Leffel & Co., James, Springfield. Ohio.
Westinghouse Elec. & Mfg. Co., East Pittsburgh, Pa.

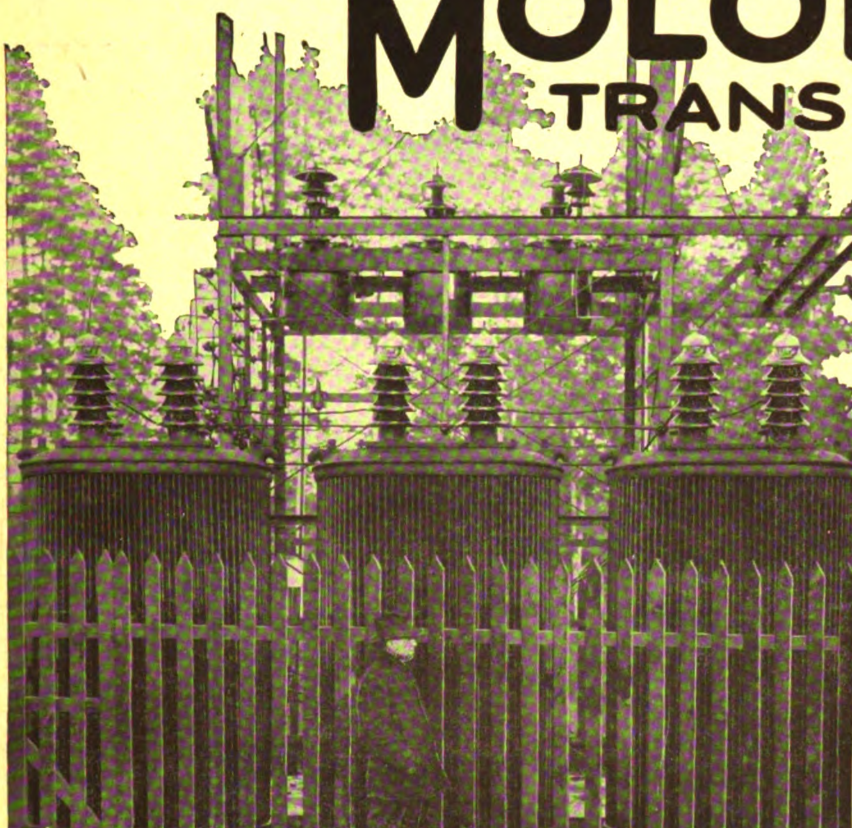
Ventilators—
Erdle Perforating Co., Rochester, N. Y.

Washers (Iron, Steel and Mica)—
Erdle Perforating Co., Rochester, N. Y.

Water Wheels and Turbines—
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Leffel & Co., James, Springfield, Ohio.

Wires and Cables—
American Platinum Works, Newark.
American Steel & Wire Co., New York City.
Detroit Insulated Wire Co., Detroit.
General Electric Co., Schenectady, N. Y.
Moore, Alfred F., Philadelphia, Pa.
Okonite Co., The, New York City.
Phillips Insulated Wire Co., Pawtucket, R. I.
Roebling's Sons Co., John A., Trenton, N. J.
Rome Wire Co., Rome, N. Y.
Southern Electric Co., Baltimore, Md.
Standard Underground Cable Co., Pittsburgh, Pa.

MOLONEY TRANSFORMERS



represent the results of thirty years' experience and specializing in Transformers only.

MOLONEY ELECTRIC CO.

St. Louis, Mo. Windsor, Can.

OFFICES:

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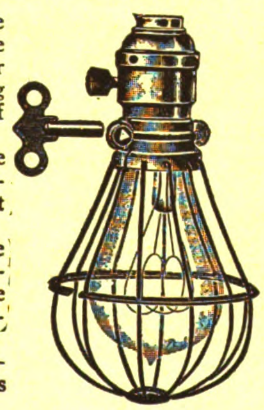

Thousands of lamps are needlessly exposed to breakage and theft—make your bid for this mighty market by offering the simple preventive of "Loxon Guards."

A special key secures the guard in place—only the possessor of the key can get at the lamp.

"Loxon Lamp Guards" are low in cost to the user and remarkably profitable for the dealer, jobber or central station to handle.

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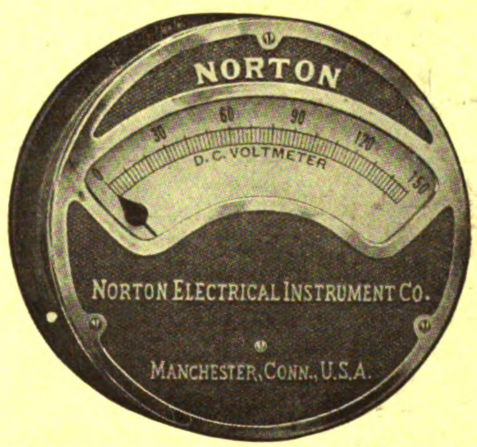


NORTON Instruments represent QUALITY ACCURACY and DURABILITY

Prompt Service and Satisfaction Guaranteed

It will pay you to write for Discounts.

Norton Electrical Instrument Co.

MANCHESTER, CONN., U. S. A.

Vol. 53 FEBRUARY, 1919 No. 2

ELECTRICAL ENGINEERING

A Monthly Journal for All Interested in the Practical Application of Electricity

Published at 258 Broadway, New York

ELECTRICAL ENGINEERING

continues to present to its readers the news and technical discussion of the application of electric power in central plants, the manufacturing industries, the farm, the household, and in every department of activity. Special features this month are the following:

Electricity in a Southern Textile Mill, showing many uses of the power in a model plant.

The Question of Hydro-Electric Development in the Eastern States, by D. H. Colcord, with illustrations.

The Electric Heating of Houses, giving the results of an investigation by a Canadian commission.

Lifting Magnets, by J. Gintz, Jr., with illustrations, giving directions for winding.

Commutator Troubles and How to Cure Them, a practical paper discussing difficulties that frequently confront the electrician.

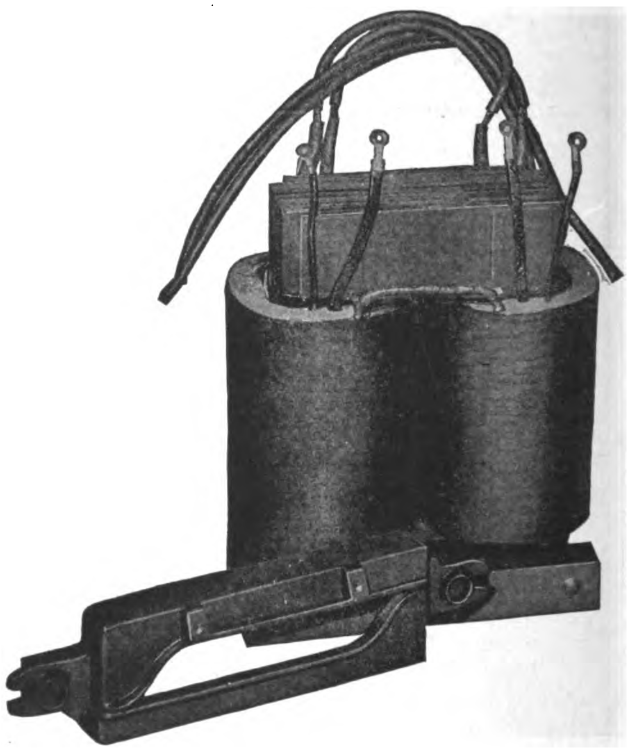
The Growth of Electrical Public Service in various States during the past five years.

The Part that Electricity Will Play in Welcoming Home the Returning Soldiers.

In addition to these there are interesting news items from electrical fields the world over.

Core Type Transformers for Distribution

have higher all-day efficiency because their iron losses are lower than those of the shell type. Since the form of construction allows the core type to be insulated more readily, it is more rugged, and easier to repair. That is why we chose this type for



PEERLESS TRANSFORMERS

Form-wound vacuum-dried, impregnated coils—silicon—steel cores—these are some of the features that you should demand.

You dont have to insist—you can be sure you will get them and every other refinement that transformer specialists can give when you specify

"PEERLESS"

The Enterprise Electric Company

Warren, Ohio

"Transformers of all kinds for all purposes"

Vol. 53 MARCH, 1919 No. 3

ELECTRICAL ENGINEERING

A Monthly Journal for All Interested in the Practical Application of Electricity

Published at 258 Broadway, New York

Electrical Engineering

reflects in its pages the resumption of activities in many fields of industry that felt the restrictions of war. More than ever before in their history will the various industries make use of electrical power, and this magazine will continue to describe new, novel and important installations. This month a description is given of the applications of electrical power in milling and the stone industries.

It is unquestioned that America's foreign trade is on the eve of a most tremendous development. Our electrical machinery and appliances are world-famous, and the opportunities for them in many foreign markets are presented.

The growth of our electrical railways and the increase in central power and lighting plants throughout the country during the past five years has been marked and steadfast, and this is set forth in official figures.

As usual, we give articles full of useful, practical hints and suggestions. These are not theoretical discussions, but represent the experience of men who have done the things about which they write.

Are Your Old Transformers Eating Up Profits?

Tests recently made on a large distribution network show that transformers built a few years ago have so much higher iron losses than modern ones that handsome savings can be made by replacing and junking the "old-timers."

For instance, if a new 5 kva. transformer is substituted for one ten years old the saving in power will pay a 16% return on the additional capital investment. The iron used in early days aged so as to increase losses by 30 to 50%—a condition which has been removed by the use of silicon steel. Before deciding on your construction program, find out how many "profit-eaters" are on your lines. The field test is easily and cheaply made. Two men with a wattmeter can do it quickly by removing the primary fuses and reading the no-load losses from the secondary side. By comparing these with the guaranteed figures in the "Peerless" catalog, you can tell how many watts you are losing. Knowing your power cost, it's easy to see what you can save by installing

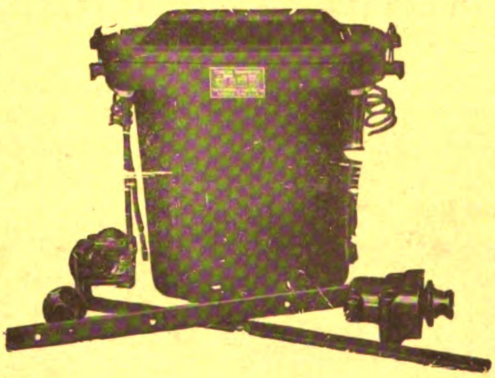
	Iron Loss	
Age (years)	5 kva. (watts)	10 kva. (watts)
1-4	40	70
4-5	50	82
5-6	50	85
6-9	60	100
9-11	85	132
11-19	95	167

Data on Transformers of Varying Ages, 2200 to 220/110 Volts

PEERLESS TRANSFORMERS

Their silicon steel cores show practically no increase in losses—that means they will not "grow old" in service; no need to replace them except for accidents, or a growth of load.

The cool running of **"Peerless"** Transformers on no-load means that they have a greater reserve capacity during the short daily lighting peak. Their core type of construction aids the circulation of cooling oil and is better able to withstand the shock of lightning surges.



"Peerless" Transformers in sizes up to 10 kw. are contained in plain cast-iron cases, with pole-mounting hangers and primary cutouts furnished. Above 10 kw. the cases are of corrugated cast iron or sheet steel with all seams welded.

You can't afford distribution failures—that means "Order Peerless."

The Enterprise Electric Company

Warren, Ohio

"Transformers of all kinds for all purposes"

Vol. 53 APRIL, 1919 No. 4

ELECTRICAL ENGINEERING

A Monthly Journal for All Interested in the Practical Application of Electricity

Published at 258 Broadway, New York

Electrical Engineering

has told on various occasions of the important part played by electricity in its many forms towards the winning of the Great War. This month particularly interesting developments of electrical science in the same line are told.

Perfecting the Submarine Detector is a very dramatic account of the manner in which one of the worst menaces of the entire war was met and finally conquered. Of course the Government cannot permit the mechanical details of the device to be made known yet.

Electric Drive for the U. S. S. "New Mexico" gives particulars of the remarkable electrical equipment the navy is installing in its most recent ships.

Advantages of the Electric Drive is a consideration of the new equipment from the military point of view by a naval engineering expert.

A Big Turbine-Generator Equipment is an illustrated account of one of the most modern and powerful installations in an electric light central station.

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