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Generation, Transmission and Application of Electricity

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Ontario's Big Construction Projects

In this issue we print articles covering the two very considerable electric railway projects at present demanding the study, more or less intimately, of the people of the province of Ontario. One of these is a section of the general plan of the Hydro-Electric Power Commission of Ontario involving, at the moment, some fourteen million dollars; the other, the report to the Toronto city council on the best means of solving the terminal facility problems of that city, and estimated to cost something over eighteen millions.

Both these schemes are evidently being placed before the public, for their consideration, in good faith. That the Hydro Commission does not let the grass grow under their feet when they once have the mandate of the people is amply evidenced by the tremendous amount of construction work that has been completed by the Commission's engineers during the past few years. It may also surely be taken for granted that the Council of the city of Toronto would scarcely incur an expenditure of some fifty thousand dollars on a semi-rapid transit and central terminal report unless they were convinced of the necessity of such a report and prepared to act on it.

It would appear, therefore, that the province of Ontario has good prospect of becoming a theatre of gigantic electric transportation construction operations in the very near future. Nor must we overlook the fact that the Hydro scheme as at present outlined is merely one small section of an undertaking ultimately destined to cover the whole province, while the Harris-Gaby Cousins report also provides for further heavy expenditures as the conditions warrant.

If one adds to the above the development plans for some half-million horse-power of hydro-electric energy which the Provincial Commission have reported favorably upon to the local Government, it makes "electricity" stand out pretty prominently among the immediate construction possibilities. If other lines of the building trades can show anything like the good prospects of the electrical industry, there is little to encourage the pessimist in the future of the building operations in the province of Ontario. Given a sufficient amount of money to proceed with this work—of which, so far as the layman can judge, there will be an ample supply—the danger of a trade reaction when the war is over appears to be very remote. The only condition that might be feared would appear to be that same old one of unpreparedness, and we would urge on the various authorities concerned that they stand ready to proceed with the various works as soon as the men shall be released from serving the Empire in Europe.

Six Million Plant for Edmonton

On November 22 the electors of Edmonton approved an agreement between the city and the Edmonton Power Company whereby the company is to supply electrical energy to the city for a period of thirty years on a kw.h. basis, the cost varying from 1.3 cents per kw.h. down to .85 cents, depending on the quantity taken, at the bus bar in the substation located in the centre of the city.

The Edmonton Power Company control the water rights on the Saskatchewan River at Rocky Rapids, but on account of the proverbially poor regulation in this district dams will have to be built further up the river. One of these will be placed some ten miles back from the power house.

The scheme of development at this point has been under consideration for some three years by the firm of Sir John Jackson, Limited, who have spent some $150,000 already in gathering their data. Records over this period show that the winter flow of the river is in the neighborhood of 1,000 cubic feet per second, and a flow of 800 cubic foot seconds has been measured. The importance of adequate storage facilities is therefore evident. The choice of the site has been determined largely, it is understood, by the location immediately north of it of a large low-lying tract some sixty square miles in area. This has been surveyed and will be cleared and prepared for an artificial lake to impound the necessary storage.

The estimated cost of the whole proposition is in the neighborhood of six million dollars. This includes an electric railway from Edmonton to the power site, which is placed at one and a half million dollars. The work will take probably four or five years, but that the city may profit immediately by the new agreement the company consents to take over and operate the present steam plant and sell energy at a price of 1.3 cents per kw.h., the city, however, to be responsible for the capital charges. This looks like a considerable saving to the municipality, however, as it has been estimated that the cost of power in Edmonton is approximately, at the switchboard, 2.75 cents per kw.h.

It will be recalled that five offers in all were made to the city of Edmonton to supply the necessary power requirements, and these were reported on by Mr. Willis Chipman, of Chipman & Power, Toronto. The closest competitor was a coal proposition, which suggested that a plant be located at a point near Wabamun, some forty miles west of Edmonton. The final agreement as accepted by the city and the company was drawn up by Mr. W. E. Skinner, consulting engineer, of Winnipeg.

Separate Manholes for Different Companies

The Quebec Public Utilities Commission, with the Dominion Railway Commission, sitting in Montreal on December 20, heard further arguments on the question of providing separate manholes for signal companies and for lighting and power companies in the underground conduits being constructed by the Electrical Commission. This is the first time that the Railway Commissioners have sat jointly with the Quebec Public Utilities Commissioners, the reason for this innovation being that as some of the companies affected hold Dominion charters, the question of jurisdiction may not be raised later in the courts. The Electrical Commissioners asked for sanction of plans for sections 6 and 7 in the business sections.

The Montreal Public Service Corporation, Bell Telephone, G. N. W. and C. P. R. telegraph companies, and others, asked that separate manholes be constructed, contending that there was danger of damage where only one manhole was made; on the other hand, the Electrical Commissioners argued that the present system was safe and that the danger was exaggerated.

Professor L. Herdt, chairman of the Electrical Commission, expressed the opinion that the best protection for the cables was to protect the cables themselves.

Sir Henry Drayton asked Professor Herdt if he had ever known a system of insulation that did not break down. The answer was "No." The chairman responded that if they had not an insulation that would not break down they could not say it was safe to put high potential wires near low potential wires. If the Electrical Commission were willing, however, to take the responsibility for any accident, he did not see why they should not be given an opportunity.

The question also arose as to the provisions of the provincial statute governing the construction of conduits. It was argued that the statute required double conduits, and Prof. Herdt retorted to this that the requirements of the statute were "absolutely obsolete to-day."

The joint commissions ordered their engineers to meet the engineers of the different companies affected and examine their plans. If the terms of the provincial statute needed amendment for safety, application could be made to the Legislature for that purpose.

New Electric Railway in Three Rivers

With a fair amount of ceremony, the Three Rivers Traction Company, a subsidiary of the Shawinigan Water and Power Company, on December 11 inaugurated their electric tramway service. The line, of single track, is about three miles long, and runs in the form of a circle around the city, starting at the Canadian Pacific Railway station, taking in the residential district, along the river front and returning to the station via the chief business thoroughfare. It has been decided to extend the system by building a line to Cap Madeleine, (a popular pilgrimage centre), which will also connect the Wayagamack pulp and paper plant and other industries with Three Rivers. Power is supplied by the North Shore Power Company, two Canadian Westinghouse 250 k.v.a. 550v. d. c. motor-generator sets having been installed for the purpose of the line. The poles are of steel in the residential and business sections and of wood in other districts. A car barn to hold ten cars, with repair shop, has been constructed. The six cars, manufactured by the Ottawa Car Manufacturing Company, are of the pay-as-you-enter type, each car being in charge of one man only who acts as motorman and also regulates the entrance and exit of the passengers. At the inauguration, speeches were made by the Hon. J. A. Tessier, the Mayor of the city and Minister of Roads for Quebec; Mr. Julian C. Smith, the vice-president of the company; Mr. W. S. Soper, of the Ottawa Car Manufacturing Company; Hon. Jacques Bureau, and others.

60,000 Kw. Units Contemplated

President E. M. Herr of the Westinghouse Electric & Mfg. Company, in a recent address before the Railway Club of Pittsburgh, said, "Due largely to the wonderful development in the steam turbine and its direct-connected electric generator, and the remarkably flexible, efficient and easy distribution of electricity, we are on the eve of notable advances in the utilization of electric power.

"First—the modern steam turbo-generator makes it possible to concentrate enormous amounts of power generation in one place.

"Second—this makes possible and advantageous very large individual generating units. The growth in the capacity of generators has really been enormous, made possible by the steam turbine.

"Third—Electricity can be transmitted long distances in large or small quantities and its characteristics changed at will all with small losses and at comparatively low cost."

The speaker then proceeded to trace the development of large generating units as exemplified by certain notable installations of central stations, industrial, and railway plants, and then discussed the effect of the concentration of such a large amount of power in one station. Mr. Herr said the building of units as large as 50,000 and 60,000 kw., was contemplated.

Oakville's White Way

The formal opening of the new street lighting system of Oakville, Ont., occurred on Monday evening, December 6th, when about forty new 1,000-candle-power nitrogen lamps were placed in operation. These lamps are series type 6.6 ampere. This event was also made the occasion of a trip of inspection over some seven miles of the new highway which is being constructed between Toronto and Hamilton, and a dinner which was later given by the town council was attended by members of the Good Roads Commission. Mr. Robert S. Wilson is superintendent of the municipal plant, and to him is due the credit of this very modern and well-equipped street lighting system. We understand that approximately twenty-four more lights will be installed in the near future. Current is supplied to this municipality by the Dominion Power and Transmission Company, of Hamilton

Alberta University has Isolated Plant

Good progress is being made in the installation of the isolated plant in the Arts Building of the University of Alberta. When completed this plant will furnish electric light and power to the various University buildings, which at present derive their supply from the city of Edmonton. This plant comprises six Babcock & Wilcox water tube boilers and two Howden vertical high-speed compound engines direct connected to a Canadian Westinghouse alternator, 240 volts, 60 cycle, 3 phase. This installation has several novel features not found in any other installation in Alberta, as it is going to be used to furnish power to the laboratory. Electric power is used for operating the fans in connection with the heating and ventilation of these buildings.

At the convention of municipal managers and engineers of the various municipalities interested in the Hydro-Electric Distribution System of the Province of Ontario in Toronto the resolution was adopted favoring the elimination of the word Hydro from the title of the Provincial Electrical Inspection Department. The motion was moved and seconded by two of the most prominent engineers in the hydro system.

"Punch"

The British Empire, and Canada its most important unit, faces the new year with unimpaired vigor, uncountable resources, unshaken confidence and redoubled determination.

Uses of Electricity in Construction

and building operations—Indispensable in many operations and growing in popularity with others—Practical and economical

By J. E. Van Hoosear*

A nation, race, or an individual does not stand still, they either advance or fall behind their neighbors. Know more" has been the means of every advance. We are behind the level which has been reached by our competitors if we do not avail ourselves of the advances made in any line connected with our business, and it is my aim at this time to point out progressive methods on the power end of the construction game.

The service to which electricity can be applied in the construction of buildings, both small and large, and of any material, is increasing and will be found indispensable when the builders fully appreciate the worth of the electric motor-driven devices that are now placed at their disposal. It is the aim of the writer at this time to bring out the uses to which electricity is being applied through the motor and otherwise in building construction work, to the profit of anyone connected with the erection of buildings.

Work that can be done by means of electricity is limited only by the desires of the individual, and can be applied from the first operation of clearing a lot to the last operation of polishing the floors.

Starting with the pioneer work of clearing a heavily wooded site that is frequently encountered, a motor-driven wood saw is set up to work into cord wood any timber that may be standing on the premises; next, electricity is used to explode powder in removing stumps or rocks from the site; the excavation is accomplished by means of a motor-driven excavator which deposits the dirt into trucks that haul it to the dumps and in return deliver the rock, sand and cement that is used in the construction of foundation and walls. In a great number of places where the excavation is deep, large quantities of water accumulate, and it is necessary that this water should be removed in order to proceed with the foundation work; this is easily accomplished by means of a motor-driven pump, which needs very little attention, as it can be equipped with an automatic float switch, which will keep the water out night and day. From this stage on, a motor-driven saw will be found very serviceable to do all the rough sawing necessary in the construction of the concrete forms and the building frame.

Motor-driven Mixers

The concrete used for foundation walls, floors and walks is mixed in a motor-driven mixer, and hoisted to different levels for distribution by means of a motor-driven lift supplied with a special dumping bucket. The bricks and other materials are also hoisted to the several floors by means of electric hoists, thereby saving time and adding to the efficiency.

Some little data has been gathered in connection with concrete work in regard to the quantity of power required in mixing and other work directly connected with it. In a reinforced concrete loft building of three storeys, 3,000 yards of material were used. A one-yard mixer driven by means of a 15 h.p. motor handled the material, a saw driven by a 5 h.p. motor cut all the lumber used in making the forms; these two motors consumed a total of 2,000 kilowatt hours, or about 1.5 yards per kilowatt hour. In a steel structure concrete building of eighteen storeys, using 1,782 yards of material, 829 kilowatt hours of electric current were used, showing a consumption of 1 kilowatt hour for each 2.15 yards mixed. The last named job was done by a contractor who owned several gas engine driven mixers, which he had been using for a number of years. He set one of them up to do this work, and after running a couple of days it developed troubles, causing delay and expense. An electric motor was then secured to complete the work, which it did in the usual satisfactory manner. Now, he, like many others who have taken the interest to look into the merits of electric-driven machines, will have no other mode of operation.

The plumber has not been left behind, and if the job is large, he will have motor-driven pipe and thread cutting machines on it to help him with his work.

Plastering Machine

If the outside walls are to be plastered, this can be speedily accomplished by means of a motor-driven compressed air plastering machine which will lay on a coat of cement plaster to any thickness desired. If the building is of steel structure, the beams can be hoisted and placed by means of an electric-driven hoist. In connection with the placing of steel, it has been the opinion of a large majority of those directly interested in this work that the operation can only be accomplished with satisfaction by means of the steam donkey engine; precedent, like a rut in a road, is one of the easiest things to follow, and one of the most difficult to get away from, and I presume is the solution for this. Upon a close study of the matter it is found that the reason for this contention is they either own engine-driven hoists, or have tried to do their work with improvised electric-driven apparatus which was found unsuited to the task, and being dissatisfied with results, would not listen to anyone regarding the up-to-date motor-driven appliances that have speed and control equal to the best of engine-driven hoists; it would be well for anyone who is contemplating getting new equipment to investigate the merits of the electric hoist.

After erecting the steel, the rivets that hold it together are driven home and headed by means of hammers operated with compressed air which is supplied by a motor-driven compressor.

The plaster which finishes the walls is mixed with motor-driven machinery that has been found to give a more thorough mix than was obtained by the old method.

In marble work, motor power is found necessary from start to finish, even to the chiseling and drilling that is necessary in the process of setting it in place.

In fine interior hardwood finish, the electric glue pot is found indispensable and is not a fire hazard.

Electric Sign During Construction

A unique use has been found for electricity by one of our local builders, in the placing of an electric sign on a large building he was erecting, thereby availing himself of a modern way of advertising night and day the class of building erected, and in an up-to-date manner.

In the polishing of a great number of large floors of ball rooms, halls, etc., portable scraping and sanding machines have been built, and are operated by motors that form a part of the apparatus. No other mode of drive would serve the purpose, because of the necessity of cleanliness which could not be obtained if coal or gas were used for the purpose of motive power.

What may be of interest to this body is a unique method

*Before Builders' Congress, San Francisco of mixing and delivering concrete, differing considerably from the old way, and can be used to advantage in cases where very heavy walls are to be built, or in places where the forms cannot be reached from above, and is accomplished by means of compressed air. There are two quite distinct patented ways of doing it. The first requires the usual motor-driven mixer, which in turn deposits the mix of about 20 cubic feet into the upper end of a cylinder shaped tank 4 ft. in diameter and 8 ft. long, cone shaped at the lower end and connected with an 8-in. pipe line that delivers the charge to the forms that may be located a considerable distance away, in some cases as far as 2,000 ft. The charge is driven from the receiver by means of compressed air under 100 lbs. pressure to the square inch at a rate of one charge per minute where the distance is around 300 feet, or about three minutes where the distance is 1,500 feet, and requires a 200 h.p. motor to drive a 1,200 ft. air compressor delivering at 125 lbs. pressure per square inch. The other method uses a smaller tank with 5-in. delivery pipe; the charge of about 10 cu. ft. of sand, rock, cement and water is delivered direct into the tank, no mixing machine being used. The cover is then closed and the compressed air turned into the tank and forces the charge up to the desired location. In passing through the pipe line the material becomes thoroughly mixed. Both of these machines have been used on large tunnel jobs in San Francisco with satisfactory results in cost of delivery of material and quality of work, and there is no reason why they should not be used in building construction as satisfactorily.

Aid of Central Stations

There are many other applications of electricity that could be mentioned, as there are special appliances driven by means of electricity for any piece of work that has to be done in the construction of a building, and it is the policy of the central station companies to aid any party who is looking for information along this line with the object in view of further assisting their consumers in the use of their product.

Ontario's Hydro-radial Development

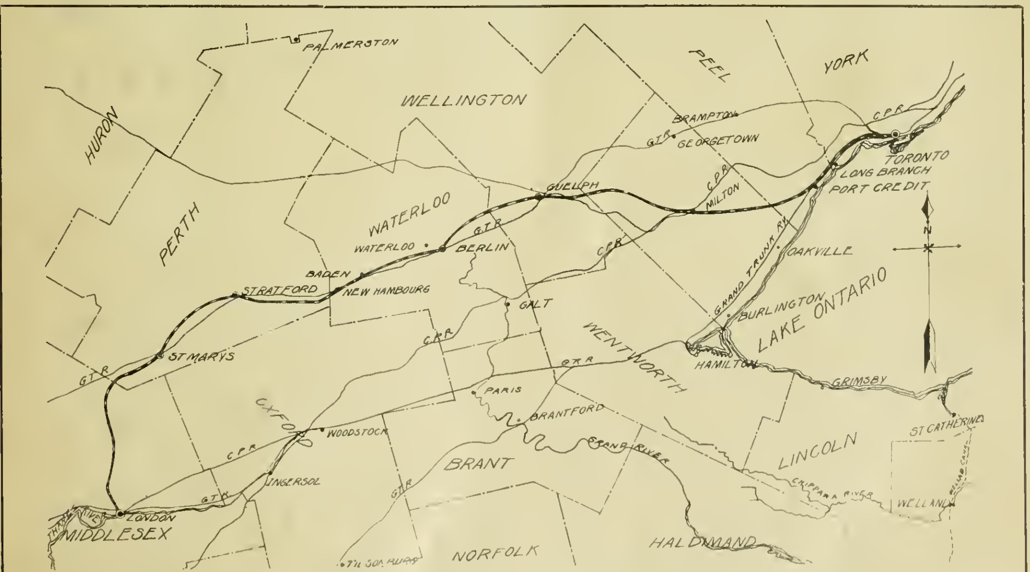
Provincial Commission have outlined plans for Toronto to London trunk line and by-laws are being submitted covering fourteen million dollars

In the map herewith the first section of the extensive hydro radial network, which the Hydro-Electric Power Commission of Ontario propose to construct, is shown. At the coming January elections by-laws will be submitted in practically all the municipalities concerned covering their share of the expenditure. The total amount of bonds to be issued in connection with this section of the road is placed at $13,734,155. This is for a total length of approximately 137½ miles, which works out to a bond issue of about $100,000 per mile. While this looks high, it may be pointed out that the type of construction would be the best obtainable; also an expensive Toronto terminal would be included.

While the exact route of the road has not yet been determined, the following schedule is pretty close to what the Commission will likely finally adopt.

Toronto Terminal-Humber River Section:—From the passenger terminal located near the foot of Yonge Street the line will run westerly to Sunnyside, using Harbor Board property and private right-of-way wherever possible; thence to the Humber River the line will parallel the G. T. R., as at present constructed.

Humber River-Port Credit Section:—From the west limits of the city of Toronto at the Humber River, the line runs westerly parallel to the G. T. R. main line. It crosses the



The Toronto-London section of the Proposed Hydro Radial Scheme.

Credit River at a point between the Lake Shore Road and the G. T. R.

Port Credit-Milton Section:—Leaving Port Credit the line crosses the G. T. R. about one mile west, running thence to a point north of Sheridan P. O., and from there directly to Milton.

Milton-Guelph Section:—Crossing the C. P. R. west of the C. P. R. station at Milton, location runs to Township of Esquesing, thence to Township of Nassagaweya, thence to Township of Puslinch, and thence in the general direction of the Eramosa River to Guelph.

Guelph-Berlin Section:—From Guelph the line continues to Berlin, leaving Guelph in a westerly direction and entering Berlin from the north-east. The location lies north of the present G. T. R. between Guelph and Berlin.

Berlin-Stratford Section:—From Berlin the line runs to the G. T. R. main line, which it parallels to a point near Baden, and thence south of the G. T. R. to a point east of Stratford, where it will cross the G. T. R. and enter the city.

Stratford-St. Mary's Section:—From Stratford the line runs in a westerly direction parallel to the old main line of the G. T. R. to a point north of St. Mary's.

St. Mary's-London Section:—The line runs in a south-westerly direction through St. Mary's and thence westerly, crossing the Canadian Pacific Railway at grade, and over the Thames River, running thence parallel to the old main line of the Grand Trunk Railway to a point near Granton; thence in a southerly direction through Biddulph Township to the northern boundary of London Township; thence in a south-easterly direction from concessions 14 to 10, inclusive, in London Township. From this point the line runs in a southerly direction through concessions 9 to 4, inclusive; thence following the Thames River through concessions 3 to 1, inclusive, in London Township, to a point between the Sarnia Road and the Thames River, a short distance west of the Warncliffe Road outside the north-westerly boundary line of the city of London. Thence the line runs in a south-easterly direction over private property and city streets, crossing over the Thames River in the city of London, to a point on Bathurst Street; thence easterly along Bathurst Street to the London & Port Stanley Railway, which at present terminates on Bathurst Street, immediately east of Richmond Street.

Semi-rapid Transit Scheme for Toronto

Report just handed into City Council advises expenditure of eighteen million dollars—Toronto not ready for complete subway system

As a deliberate discussion of traffic conditions and requirements in the city of Toronto based on authoritative data gathered with apparently infinite care, no previous report approaches in value that just handed in to the City Council by Commissioner of Works R. C. Harris, F. A. Gaby, Chief Engineer Hydro-electric Power Commission of Ontario, and E. L. Cousins, Chief Engineer Toronto Harbor Commission. The report takes cognizance of general conditions covering a very wide range such as growth of population; location of factories; congested traffic points; vehicular traffic; Toronto Railway System; municipal car lines; Hydro Radial possibilities and many other minor factors which may influence the transportation requirements of the city of Toronto during the next quarter of a century. A rapid transit scheme, in the strict meaning of the term, is not recommended, but three trunk radial entrance lines with the necessary yards and terminal as shown in the accompanying drawing. This recommendation is based on the supposition (1) that the city of Toronto acquire the property of the Toronto Street Railway in 1921 and (2) that the waterfront viaduct will be constructed by the Grand Trunk and Canadian Pacific Railways.

The recommendations in the report are as follows:

1. The City of Toronto acquire the Toronto Railway Company at the expiration of the franchise in 1921, and thereafter operate same as a municipal railway.

2. The City should at once make a definite declaration of policy in this regard.

3. If the decision be to municipalize the service, preparatory steps should immediately be taken, in order that upon the date of franchise expiry, the City may enter into occupation and operation, without overholding tenure complications.

4. A Transportation Commission be at once appointed, consisting of representatives from the City, the Toronto Harbor Commission, and the Ontario Hydro Electric Power Commission, so constituted as to afford the City majority representation. This Commission should be vested with all necessary power to plan, control and direct all transportation and terminal facilities of every kind whatsoever, (exclusive of existing steam railways), including present or projected municipal lines within the corporate limits of the municipality, and to prepare and arrange for the acquisition and operation of the Toronto Railway Company as a municipal utility, upon expiry of the franchise rights of said Company; the powers of this Commission to be sufficiently inclusive to embrace all railway transportation facilities as aforesaid, and to be implemented from time to time in order to accomplish the full intent of this recommendation. The Harbor Board and the Ontario Hydro Electric Power Commission, should be represented upon this Commission in extension of the policy of Council already expressed in the appointment of the Board charged with the duty of making this report, and for the same reasons which guided that body in the constitution of such Board, viz.:—That the future transportation facilities within Toronto should be co-ordinated with regard to the services, rights and holdings of the bodies aforementioned, with particular reference to radial entrance and railways, the operations of the Harbor Commission as Trustees for the City, and local street railway service within the City Limits. The Ontario Hydro Electric Power Commission, through their Municipal Radial Railway project, is at present undertaking the construction and development of some 1,000 miles of radial railways, with Toronto as a main terminal focal point; the Harbor Commission as Trustees for the City, control the proposed east and west trunk radial railway entrances, together with the proposed terminal site, contemplated team track delivery yards and general sorting yard, while the City has jurisdiction over all public streets, embracing surface, elevated and underground rights. Even cursory consideration, will demonstrate the necessity of harmonizing all these interests, if transportation problems are to receive adequate and effective treatment. This can best be accomplished by the creation of a Commission constituted as recommended.

5. The construction of the three radial entrance lines, with necessary yards and terminal, as shown on Drawing

No. 18 be proceeded with when conditions warrant and finance permits.

6. A rapid transit system in the strict meaning of the term be not adopted.

7. The radial railway trunk line entrances be used for a semi-rapid transit service, as conditions warrant, to serve the population in the districts lying at present without and adjacent to the existing City Limits.

8. It may be necessary to procure legislation amending existing Acts, in order to give effect to the foregoing.

9. The use of any of the lines, yards, terminals and anything whatsoever, in any way relating or appertaining thereto, by any other railway than those of the Hydro Electric Railway Union and the City, shall not at any time be permitted, until such railway shall have obtained the consent of the Hydro Electric Power Commission thereto.

10. We do not make suggestion as to finance and reimbursement, feeling that this does not lie within our jurisdiction, but is for each to take up with his respective principles.

These recommendations are based on certain conclusions drawn by the members of this Advisory Committee as a result of their researches and deliberations. These conclusions, in part, are to the effect that there is no congestion on Toronto's streets that cannot be relieved by a proper utilization of existing surface lines; that an up-town terminal is not feasible; that ample provision must be made for future expansion and for co-ordination of rail and water transportation; also that the present gauge on the Toronto Street Railway tracks must, for a proper traffic unification, be reduced to standard. The following are the conclusions in full:

Conclusions

After detailed consideration of the various factors, entering into and affecting the problem as hereinbefore recited, we have concluded that:

1. Additional civic car lines laid between now and 1921, without the limits of 1891, but within the limits of 1915, will, after acquisition by the City, of the Toronto Railway Company in 1921, adequately serve all sections within the present City limits; the maximum time necessary to reach extreme destination being thirty-five minutes.

2. The existing surface system of the Toronto Railway Company, if provided with improved equipment and operated at higher service efficiency can be made to adequately serve the City within the limits of 1891.

3. As traffic officers become more efficient in direction and citizens better appreciate the functions of such officials, the movement of rail, vehicular and pedestrian traffic will be greatly facilitated, with consequent saving of time and added safety to all.

4. If a sufficient number of cars of modern type were provided, thereby minimizing overcrowding and the public educated to embark and debark with reasonable speed, it would result in more rapid operation of the railway system, and the facilitation of other classes of traffic.

5. There is comparatively little congestion in Toronto streets. This may be further minimized by regulation of standing vehicles on, and diversion of slow-moving, heavily laden traffic from, main heavily-trafficked thoroughfares in the central area.

Radial Railway Entrance

1. That the following railways entering the outlying portions of Toronto, viz:—

(a) The Toronto & York Radial Railway embracing the

Metropolitan, running north on Yonge Street; the Kingston Road line from the Woodbine; the Port Credit line from Sunnyside; (b) The Toronto Suburban to Lambton, Weston and Woodbridge, from Keele and Dundas Streets, cannot be considered rapid transit interurban lines, as in all cases they operate mainly on the highway, at low speeds. The people of Toronto and the Province have not had the advantages of modern rapid interurban service, such as is operated in many parts of the United States. When the Hydro Radial project becomes an accomplished fact, the system of which the section operating between London and Port Stanley is a happy augury, the entire population of the Province will derive therefrom, tangible benefits, which result to a community from a modern, high speed, properly equipped and efficiently operated system.

2. That the most feasible entrances from the east and west lie along the waterfront route. The entrance from the north may be readily effected by subway construction. The foregoing conclusions were arrived at after careful reconnaissance of the possible routes of entrance for radial railways, in the City and its environs, and detailed survey of one hundred and fifty miles of line.

3. From the viewpoint of economy of operation and utility, it is essential that the terminal be located on the axis of maximum movement. Having regard for the past suggestions for an up-town terminal, we thoroughly investigated this possibility, with the result, that aside from operating considerations, the additional cost of $8,000,000 embracing a four track subway from the waterfront to College Street, and the erection of a terminal at the latter point, proved it unfeasible.

The foregoing indicates the necessity for location on waterfront route.

The same consideration applies also to the location of yards on the waterfront property, in view of its natural advantages.

4. It is prudent to make present provision for future expansion covering trackage for trunk line entrances and terminal facilities, therefore the necessary sites should now be provided for ultimate development.

5. That it is necessary to make ample provision for the co-ordination of rail and water transportation and the proper interchange of all traffic.

6. The radial railway trunk lines should, as the future demands, and the City extends, provide for the operation of semi-rapid transit lines to serve outlying districts.

Rapid Transit Lines

1. The streets in the central area are sufficient to care for future traction and vehicular demands, provided reasonable regulations are enacted, and enforced, governing vehicular and pedestrian traffic.

2. Traffic may be much facilitated by an increase in speed of the existing Toronto Railway units. This entails improved equipment, track, routing and operation, together with the adoption of up-to-date loading and unloading facilities, and the much needed education of the public to embark and debark speedily. The accomplishment of this, together with adequate extension of surface lines, will make it possible to travel from the centre of the present city limits within a thirty-five minute period.

We have been assisted to the foregoing conclusions by the study of Drawings, Nos. 8 to 15 inclusive, showing present volume of traffic with origin and destination, lines of heaviest movement, and street traffic counts.

3 In relation to the matter of change of gauge, notwithstanding that almost every economic consideration declares against it, the dominant factor is that of future traffic unification, between radial, semi-rapid, and city surface lines, and this is impossible without the reduction of the present gauge from four feet ten and seven eighths to four feet eight and one-half inches.

4. As hereinbefore indicated, there is no justification whatever for the construction, in the City of Toronto, of a rapid transit system in the strict sense of the term.

How to Put on a Slogan Sign Campaign

A slogan is a terse, yet complete expression of the goodness, excellence or opportunity-giving qualities of a community. It is a high standard, up to which the people should strive hard to live.

Slogans have been used by progressive and hustling communities as far back as history records. The very fact that a slogan openly avows something makes it necessary that those living in the community live up to what it expresses. There are hundreds of towns which enjoy greater prosperity and greater life and promise since the adoption of a battle-cry for progress.

Keep It Before the People

A slogan is a most valuable asset to any community. But to realize its fullest value, its powers for good, the slogan must be effectively advertised. It must be made known, not only to residents of the place, but also to strangers and to travelers; for all these, directly or indirectly, influence the prosperity of the community.

How, then, can this be done? The transient visitor, passing through the town by boat or train, rarely reads the town's local papers—the mere expression of a slogan by word of mouth means little to him.

Electric Signs Best Medium

But picture to yourself the effect of a brilliant, scintillating, electric sign, dominating the business section of the town, bearing the slogan, the highest mark the people of the community have set for themselves. It is so vivid, so attention-compelling, that the impression is lasting. It literally "shouts it from the house-tops."

The Slogan Sign carries a message stronger than pure commercialism. It is an advertised declaration of the "goodness" of the place. It stands not only for improvement in business conditions, but for a definite moral duty, which each association of individual is called upon to obey. Somehow, the very nature of the slogan implies progress—an "I Will!" spirit—a desire for better living and better times.

What is more in keeping with this spirit than electricity—ever synonymous with light, progress, prosperity?

How to Obtain a Suitable Slogan

A slogan is really a public asset. It primarily owes its existence to the growing-pains of the town. Therefore, the entire community should lend a helping hand to create a slogan typical, representative, symbolical of the ideals of the place. The electrical interests of the community should hold a meeting, to form plans for stimulating interest in the project. Usually the best plan is to work through the most prominent civic body, which may be the Chamber of Commerce, the Board of Trade, Business Men's League or some similar organization. A campaign for suggestions for the slogan may be inaugurated by that body, leaving the decision in the contest to such a committee as they may select.

The central station or the electrical organization should take an active interest in the contest for the selection of a slogan, advertise it in the local newspapers, by circularizing, by postal cards, or all of these mediums. In connection with this advertising, attention should be called to the benefits to the city of a Great White Way. A premium or prize should be offered to the contestant whose motto or slogan is adopted. Partisanship should not be allowed to influence the selection of the slogan. Strict "neutrality" should prevail. The bars should be down for all.

Advertising in the papers, street-car cards, and other forms of publicity insure plenty of slogans coming in for criticism. It is important to stipulate in the conditions governing the giving of the prize that the judges will not necessarily accept one of the slogans submitted, for it is possible that, at the first trial, none may be found sufficiently attractive.

A "Slogan Committee," composed of representative business men, should be the judge. Selecting a slogan is much like selecting a wife: it is for all time; therefore, too much care can not be exercised in adopting a slogan. The slogan may be selected according to the dominant industry of the community, the facilities afforded, the population, or the number of homes. For example, Danbury, Conn., is one of the greatest hat-producing centers of the country. The slogan—"Danbury Crowns Them All"—can easily be understood when we remember that all men are "crowned" by a hat, and most hats are made in Danbury. In every case where a slogan has been selected, the newspapers have, on account of the general interest, kept the public well informed regarding the progress of the slogan sign, and this insures considerable publicity before the sign is completed. As the slogans come in, an eliminating process should weed out the "unfit." The surviving slogans can be sifted down further and further until final selection is made.

Keep the Community Interested

To really make the slogan sign popularly-known and profit-making, it is necessary that wide publicity be given to it through the newspapers and other mediums. The advertisements calling for public participation in the slogan campaign should contain pertinent facts regarding the community. Why the town is a good place to live in, to root for, to boost and to strive to make still better. Why the growth of the town, its future progress, depends on what is being done now. Articles and stories regarding the slogan campaign, the purposes of the slogan, the participants, the winner of the prize, and other items of interest, should be given to the papers. They will help make the slogan the most talked-of thing that ever happened in the town.

As a climax of appeal for public interest in the town's acquisition, a big celebration should be planned and given plenty of publicity in the newspapers. Make sure that everybody knows the nature of the celebration, when the sign will be lighted, and who will be present at the occasion. The leading men of the town, committees from neighboring cities, and others whose presence would add public interest to the event should be secured as speakers. A band should be provided. In reality, it should be a great "get-together" for the citizens of the community. This function should be put into the hands of the representatives of the city at large; it should not be made simply an "electrical" affair. After the dedication, the honor of flashing the slogan sign for the first time should be given to the most prominent man present.

Proper Location for a Slogan Sign

The slogan sign should absolutely dominate the town. It should be set in appropriate surroundings, and where it will be seen by the greatest number of people. The roof of a high building in the right section of the city is generally the best location for the sign.

It should be visible from trains or boats or other transportation lines, that even those who do not stop may see the slogan. It must be remembered, however, that if the sign is not backed up by something, but faces the town from both sides, a two-sided sign is necessary.

What Does a Slogan Sign Cost?

It is impossible to set down the cost-figures of a slogan sign which will be anywhere near correct for all communities. The size of the sign, its structure, its mechanism, and other factors will govern. The contractor, sign man and central station have full facts on the cost of slogan signs. Any one of them can give complete cost data, and will be glad to show photographs of successful slogan signs adopted by other progressive cities.

Electric Sign Campaign

The electric sign is always the forerunner of many other electric signs. In the first place, the wide publicity given the slogan sign turns people's minds towards things electrical. The brilliant slogan sign is a practical demonstration to the business man of how an electric sign would help his business. Naturally, the central station and the sign man will not let this wonderful opportunity for placing more and more signs go by. Advertising, canvassing and other sales methods are pushed with a vim so as to profit most while the subject is hot. The merchants are told of the wonderful success electric sign advertising has always been. They are told why a light town means a bright and prosperous town; that electric signs enhance the value of real estate; that they even increase the earning power of the town itself?

Still, the electric sign is economical. It tells its message in letters of light in the evening—when the day's work is done and the people are in the most receptive mood. Electric signs electrify a community! "Dead" towns are lightless, signless towns—poor places to live in. "Live" towns are always judged by their after-dark brilliancy—their power to attract people from neighboring, unlighted, unprogressive towns. "Live" towns get the lion's share of the buyer's money—at the expense of the "dead" town.

Successful "Slogan" Towns

In the United States hundreds of towns have been literally placed on the map as the result of adopting a good slogan. Examples are: "Topeka Kan., Topeka Will"; "In Kalamazoo We Do"; "The City of Smokestacks and Opportunities," for Everett, Wash.; "Fort Wayne with Might and Main," and so on. A slogan for a town, like a trade mark for a manufactured product, is a valuable asset.

The town of Grand'Mere, P. Q., is about to install a duplicate unit in their power house at Shawinigan Falls in order to provide additional current for power and lighting purposes. Accordingly bids have been called for a 500 h.p. turbine, working under a head of 96 feet; a 300 kv.a., 3-phase, 60 cycle, 2200 volt, 600 r.p.m. generator; and six transformers. Three of the latter will step up the current from 2200 volts to 11,000 volts, and the other three will step it down from 11,000 volts to 2200 volts. Two sets of switchboards will be installed, one at Shawinigan Falls and the other at the distribution point in Grand'Mere. The tenders will close on January 5th.

The Board of Public Utilities of Nova Scotia have refused the application of the Nova Scotia Light and Power Company to increase their capital from six million to twelve million dollars. This latter amount, it is now stated, will be required to finance the development of the Gaspereaux waterfall and the purchase of the Halifax Electric Tramway Company.

In the Public Eye

A budget of comment presented in the interest of public welfare, independent of party politics and with malice toward no one.

Right here at the start let me say that this criticizing of the Government is no pleasant task. I am well aware that the publishers of this paper will get little credit for honesty of purpose. So accustomed is the public to the harpings of the party and corporation press that it has become case-hardened. It has learned to look through the printed articles for the self, party or corporation interest that prompted it. Let it be known then, once for all, that I prefer the Borden administration, with all its sins, to a Government controlled by a party that sought to tie us up to the United States with a reciprocity treaty. But this paper represents a constituency of business men. It realizes that they are tired of seeing politics practised where business methods should be applied. They know that honest criticism is the best medicine for any government—even if you have to hold its nose while you administer the dose. As I have said before, the publishers are not in a position to handle a war contract and do not care to farm one out. I myself have no desire to swagger around in an honorary colonel's uniform. Furthermore, none of the staff want to break into society. We have no fish to fry, soap to boil or peanuts to peddle. We simply want to show that petty politics are no satisfactory substitute for patriotism and that party machines cannot do the work of factory lathes. And permit me to say further, that we believe that things would have been just as bad and probably much worse if a Liberal government had happened to be in power when the war broke out.

* * *

Despatches from Ottawa indicate that the Government is firmly fixed in its resolution to side-step any and all enquiry into the "educative" work of the late lamented shell committee. It is evidently hoping that its work will be so covered by the improved methods under which the Imperial Munitions Board is working that it will be forgotten. But the charge that the sufferings of heroes have been capitalized and made to yield fortunes is one that refuses to die. The Ottawa Citizen, which was early in action against the "profiteers," returns to the charge with a statement that for machining 4.5 inch shells the Motherland has been forced to pay as high as $6.70 per shell, when the work could be profitably done for $2.25 per shell. It also gives figures to show that profits on other sizes of shells were proportionately large. What the public wants to know is how true these figures are.

* * *

The public demand an investigation. They look not to the Conservative political machine but to Sir Robert Borden for that investigation. They feel that the Premier who is a gentleman rather than a politician, has been sinned against. They know that when next Sir Robert Borden visits England he will not want to be pointed out as the sponsor for a Committee that scattered its contracts like so much political graft, while our soldiers cried from the trenches for the munitions they so sorely needed. Sir Robert Borden may be deluded by the men he has trusted but he is not the man likely to stand idly by while the good name of the Dominion is dragged through the dirt and grime of a war scandal. Sir Robert Borden will act. Sir Robert Borden must act to save the reputation of the country he represents and his own political honor.

* * *

According to the Boston Transcript, Bridgeport, Conn., had only 5,000 employees in its factories when the war broke out. Nearly 40,000 operatives are now employed and in another month 20,000 more will be at work in new factories. The population has risen from 102,000 to 140,000 and would be more if homes could be found. The reason: Bridgeport has $175,000,000 in direct war orders besides $100,000,000 in other orders, many of which are war accessories. Has anybody heard of any Canadian city emulating the Connecticut town in orders or growth? Are Canadians asleep? Or did the dear departed Shell Committee shoo the orders across the line?

* * *

It begins to look as if the United States could not be much worse off if she were really at war with Germany. The hyphenated by-products of the Teutonic nations have violated her neutrality, blown up her factories and punched holes in her self-respect. The only recompense they can offer is the German vote. And who knows but by the time the presidential election is on it may be too much of a handicap for either party to carry.

* * *

When the Canadian Government commandeered 15,000,000 bushels of Canadian wheat it caused a sensation more than commensurate with the size of the undertaking. That amount of wheat is only about 5½ per cent. of the Canadian crop and the immediate effect of the coup was simply to entangle the wheat business for a few days so that dealers did not know where they were at. The move on the whole appears to have been political rather than business. It was meant as an answer to the "free wheat" cry in the west—a cry that needs no answer. But as usual, where politics and business are mixed, results were not as expected. It was found that the wheat commandeered was required by millers who had flour to make and dealers who had contracts to fill. To get the tangle straightened out the Government has been busy releasing the wheat to the dealers and millers. It is ever thus when politicians attempt plain everyday business. And yet we entrust the entire business of this trusting young country to the politicians. It is a habit.

* * *

France is enquiring, it is reported, in the United States for 2,000,000 nickel disks and is informed that she can secure them. Of course Canadian nickel will be used in their manufacture. Nothing strange about that. We're used to it. But the well-known United States writer Richard Harding Davis was candid enough the other day to tell his fellow countrymen that the French as a nation had a quiet contempt for people "too proud to fight." So figure it out for yourself: France buys from a people for whom she has contempt goods made from the raw material of a country whose sons helped keep the Huns out of Calais. Doesn't it appear to be about time the Government did something?

* * *

The suggestion that Canada should give credit to the Empire comes from the London Times and should receive immediate consideration. The Thunderer calculates that in the present year Canada's exports will exceed imports by two hundred million dollars and points out that this balance will be at her disposal for any credits that may be arranged for supplies to Britain in lieu of cash payments. That the suggestion is timely everyone will admit. Canadians are of one mind in regard to the war. It is not Britain's war or Canada's war but a war that involves the freedom of the world.

No sacrifice is too great to secure that freedom without which material prosperity would be merely an aggravation. Canada must do everything in her power to help bring the war to a successful close. Every bushel of grain, every dollar and every man capable of bearing arms must be at the Empire's disposal till freedom is assured. Belgium has been avenged and the German war machine is in the scrap heap. It is Canada's part not only to offer every assistance to the Motherland but to grasp every suggestion as to how that assistance may best be given. Giving Britain a line of credit will provide this young Dominion with a new sensation, or rather two sensations—pride in being classed among the creditor nations and pleasure that she is able to financially aid the Old Land in her hour of need. It is whispered that the Minister of Finance will insist on our banks loosening up.

* * *

Recruiting has now reached the stage where men must be asked to leave good positions to take their places in the ranks. It is a critical stage. When England reached it she made changes in her rules to make the ranks more attractive. Companies of chums were assured that they would be kept together after enlistment and other promises were given. A Canadian who is enjoying a fair salary hardly feels like taking the plunge until he is assured that he will not be asked to act as batman to some young officer who never earned $10 a week.

* * *

The Government has everything to gain and nothing to lose by being open and above-board in this matter. So many stories have been whispered, so many charges have been flung broadcast that to remain silent must simply be taken as an admission of guilt—an admission that the worst has not been told. Never since Confederation have so many stories of trickery, trafficking and grafting been afloat. They come to this office by the score. All cannot be given because all cannot be investigated. It would take a big staff working overtime to get into them all. But they pass from mouth to mouth, growing with each telling. Probably most of them have not yet reached Sir Robert Borden. His "machine men" probably see that such as do reach him are fumigated, sugar-coated and otherwise specially prepared for his consumption. But even his own party organs are hinting that makers of munitions "have striven to get large profits out of their contracts." The Toronto News (Conservative) charges it all to "stock market booming," but closes its article with the rather ominous sentences: "As in previous crazes a reckoning is coming. It may be close at hand and some very prominent men may be involved in the inevitable disclosures."

* * *

Just one more instance of how the Shell Committee handled contracts. This story has been investigated and can be vouched for, as can the others that have from time to time found place in this column. The owner of a planing mill in an Ontario town went out after a shell-box contract. His application brought the usual answer that all contracts had been let. Imagine his surprise when a shipping clerk in a dry goods house in his own town secured a contract, put up a building, completed his contract and got a renewal. The shipping clerk had no plant, no experience and no business rating. But he knew a man who knew something about how contracts were got. Pretty wise man, wasn't he? Thrifty, too. For he still retains his job as shipping clerk, though he occasionally finds a few moments to run over to the shell-box plant and figure his profits.

* * *

These be pessimistic times. What with criticisms of war methods in England, war contracts in Canada, and hyphenated Germans in the United States, it seems that there is a lot to holler about, and mighty little to holler for. But there is one thing that we can always look to and let our lungs loose in one loud and long hurrah. And that is the British navy. The "hearts of oak" have been modernized into hearts of steel. It has stood between civilization and the iron hand of Prussian militarism. And when the last battle of this war is fought and won—by the British, for some wise man has said "Britain wins only one battle every war, and that the last"—the credit and glory must go not to British arms or British gold, but to the grand old British navy.

* * *

A prominent grain man, in telling why Canada should be prosperous, states that Manitoba, Saskatchewan and Alberta this year produced 700,000,000 bushels of grain, of which 300,000,000 bushels was wheat. He gives $450,000,000 as a conservative estimate of its value. Is it any wonder that the other week Winnipeg had larger bank clearings than Montreal, and that the Prairie City is entering on a new era of prosperity? And with millions of acres of this grain-producing land still waiting for the settler's plow why should Canada worry about the future?

* * *

That all patriotic funds should be controlled and administered by the Government is amply evidenced in Toronto. A recruiting fund having been obtained by a "tag day" and other begging methods which tax the liberal and allow the penurious to go untouched, a quarrel is now under way as to its distribution. In England arrests have been made of people who sought to profit by the epidemic of giving for patriotic purposes. How much of this sort of thing is going on in Canada there is no way of finding out, but I hear of one entertainment for the good cause where the expenses amounted to $625 and the amount turned over to the cause was $25. There is but one remedy. The government should control all such funds. And it should also replenish them by a tax that would make everyone bear his share of the burden.

* * *

Down New York way they're still sending out circulars that tell of desirable investments created by filling war orders in Canada. One of the latest comes from Gilbert Elliott and Company. It advises clients to invest in Canada Foundries and Forgings Company, which has shops at Brockville and Welland. Here are the reasons given:

> "We are advised from sources upon which we can rely, that earnings for the past ten months ending November 1, 1915, are over $900,000, and that the monthly earnings are now running at the rate of $150,000, or equal to $1,860,000 per year, which, after taking care of fixed charges, will amount to over 150 per cent. per annum on the outstanding common stock."

The circular also stated that the company has within the past year filled large orders for shells for the British Government, in addition to its commercial business.

* * *

Why did the Government lease the Transcona car shops to a private company for the manufacture of shells? Well, perhaps you had better ask D. A. Thomas. The Shell Committee was the part of the Dominion Government with which he came in contact. So when the Government proposed to start in to manufacture shells without saying anything about price you can imagine him throwing up his hands and exclaiming "Heaven forbid!" However, what he said to the Government was, "put in a tender." Well, you know that Shell Committee never did care for tenders, any way. It just shied off and the Government with it.

"SEARCHLIGHT"

New "Bell" Building in St. Catharines

On Saturday, October 16th, the Bell Telephone Company took possession of its new building, No. 39 King Street, St. Catharines, Ont. The building is of three storeys, with a frontage of 35 feet by a depth of 70 feet, and provision is made for a future additional storey. A prime consideration in the building and equipping of telephone exchanges, that of fire protection and resistance, was a special feature adhered to, wood being principally eliminated throughout the construction. Structural floors, beams, columns, exterior walls and interior main partition are of reinforced concrete, brick, stone, cement or terra cotta.

One very special feature of the building is what is termed its flexibility. Should more office accommodation be required on the first floor it is only necessary to extend this floor backwards, and when the telephone service grows to such an extent that the present operating room will not accommodate sufficient switchboard it will mean that it and the second floor beneath will have to be extended backwards to provide additional floor space. This can be done at one time or from time to time as required without disturbing the existing service or business conditions.

On the first floor are commodious public offices, with direct access to the manager, business offices and telephone booths. Special provision has been made in the entrance vestibule so that it can be used by the public to telephone after business hours. Plant department is situated in the rear of the public office and terminal and battery rooms are arranged across the front of the second storey, the operators' retiring rooms being at the rear. The entire floor is used for the operating room, at the rear of which to the yard level is a fire escape communicating with each floor.

Capacity for 5,600 Subscribers

The switchboard is located on the third floor and is of the Northern Electric Company's No. 1 common battery type equipped with No. 49 jacks and arranged to give two party service. Capacity of the switchboard is 5,600 subscribers' lines, its present equipment consisting of 2,100 lines. A total of six sections has been installed and in them there are six toll positions, seven subscribers' positions, one position for plugging up cords for lines in trouble and one position for testing. In this room there is also the usual chief operator's desk.

In the terminal room on the second floor there are the usual main, intermediate and relay frames, repeating coil racks, power plant and test board. The testboard is a feature of the equipment, being the installation of the first one of the new type. This board was designed by the telephone company's engineering department, and has all the latest equipment for testing subscribers and long distance lines.

The power plant for this equipment is designed to supply the required electrical energy for the transmission of speech and signalling purposes in connection with the telephone equipment, and consists of various apparatus as follows:—

Machine equipment: two motor-generator outfits, each made up of a 550 volt, 3 phase, 25 cycle alternating current induction motor direct connected to and mounted on a common sub-base with a telephone generator of 5,250 watts, 30 volts capacity. Each motor is supplied with a special oil immersed starting switch and automatic push button no voltage release. The generator portion of this outfit is specially designed for telephone work, being equipped with a large number of segments on its commutator and specially designed pole pieces, with the object of reducing to a minimum any unevenness produced during commutation of the current generated and thus eliminate the introduction of foreign noise on the telephone system. These machines are supplied in duplicate to provide an emergency outfit, in the event of a possible breakdown of one of the charging sets, thus safeguarding against a breakdown of the telephone service from this source and are also used for charging two groups of storage batteries, one main battery consisting of 11 cells of E. S. B. Co.'s type G-21, in lead lined wooden tanks which are supported and insulated from the floor by special oil type insulators mounted on glazed earthenware pedestals. In addition a second battery used to re-inforce the main battery for work in connection with long distance transmission consisting of 11 cells of E. S. B. Co.'s type E-11 batteries in glass containing jars set on glass and trays and mounted on a wooden rack.

The capacities of these batteries are such that in the event of the charging current failing for any reason the batteries will be able to furnish all the power required on the telephone switchboard for two days without being recharged.

Two additional machines are furnished for supplying alternating current for signalling purposes, one set being operated from an outside source of power and the other from the main central office battery. These machines are also equipped with a special attachment of interrupted rings arranged to produce visual and audible signals for particular work in connection with the telephone system.

The control and measuring apparatus for the above equipment is assembled on a main switchboard consisting of three separate Monson Maine slate panels for the control of the motors, charging generators and ringing machines respectively. A separate slate panel is also provided for distributing and fusing the various discharge leads carrying the current drain from the storage batteries to the telephone switchboard.

The main power leads entering the building are brought to a power protection switchboard panel installed in the basement of the building at a point as near as practicable to the point of entrance. This panel is equipped with main fuses, main switch, retardation coils and lightning arresters, and is specially designed to protect the building and the telephone equipment from high tension lightning discharges from the main power leads entering the building from an outside source.

The power plant charging and ringing outfits are assembled in the main terminal and rack room; the storage batteries are located in a separate room arranged for this purpose, the floor of this room being specially treated with three coats of acid resisting paint to withstand the corroding action of the acid used in connection with the storage batteries. The room is also provided with a ventilating shaft arranged to carry away acid fumes formed during the operation of charging the batteries.

During the past year the gross earnings of the Kaministiqua Power Company increased $20,610, bringing the total up to $340,128, while the net earnings of $204,434 show a gain of $23,102, equal to 9.3 per cent. on the capital stock. The working expenses were reduced by $9,150, but fixed charges were $6,600 higher. The sum of $35,000 was put to depreciation and contingencies; the dividend of six per cent. absorbed $131,760, leaving $36,674 to be carried to surplus account.

Electric Railways

Oxy-acetylene gas flame for rail bonding—Gang of three men place ten to twelve bonds per hour.

By J. Rowland Brown*

Rail bonds have been welded to rails by the use of the oxy-acetylene flame for years, but only recently have the obstacles to the general use of the process been removed. These obstacles consisted in the lack of an easily procurable supply of pure gases at a reasonable price and of readily portable tanks, in the use of torches not adapted to the particular job, and of copper wire, with its great power of absorbing gases when melted, for the welding material, and in the absence of a properly designed bond. These obstacles have now been overcome, and in the accompanying view is shown a modern welding equipment at work installing a bond.

The gases required for welding are pure, dry oxygen and acetylene, compressed or dissolved. These can be easily and safely handled in cylinders.

The oxygen is obtained either by the electrolytic decomposition of water or by liquefying air and removing the oxygen by fractional distillation. It is compressed in cylinders to about 1,800 lbs. per square inch pressure. A tank containing 100 cu. ft. of free air is generally used in bonding work as it weighs only between 100 lbs. and 125 lbs.

Acetylene gas compressed in a tank above 30 lbs. per square inch pressure is highly explosive, and between 15 lbs. and 30 lbs. its action is doubtful. To prevent any possibility of explosion the tanks are packed with asbestos fibre having a porosity not greater than about 75 per cent. The asbestos-filled tank is then charged with liquid acetone to about 40 per cent. of the volume of the tank. Acetone has the property of dissolving twenty-five times its own volume of acetylene for each atmosphere of pressure, and as the tanks are charged to 225 lbs., or 15 atmospheres pressure, the tank contains about 150 times its own volume of acetylene gas under perfectly safe conditions. A tank of 100 cu. ft. capacity, weighing about 85 lbs., is generally used.

A fitting is connected to each gas tank consisting of a pressure gauge, a reducing valve and a gauge for indicating the pressure in the hose and at the tank. There is a great variety of torches on the market, but they all consist of a tip having an orifice that controls the size of the flame and the rate of consumption of gas, and a mixing chamber with a shut-off valve for each gas. The best torches are simple and light in construction. The tips used for bonding consume gas at the rate of about 30 cu. ft. per hour each, with the pressure in each hose from 12 lbs. to 15 lbs. per square inch. Regulation to the correct flame is done by adjusting the shut-off valves on the torch and not by adjusting the reducing valves. The acetylene is ignited first and then the oxygen is turned on. As the oxygen is gradually turned on the flame will show an excess of acetylene. This is a reducing flame. Increasing the oxygen will soon produce a distinctly lined bead. This is the neutral flame of approximately equal parts of the gases and is the flame desired for bonding. Increasing the oxygen reduces the size of the head slightly, and produces an undesirable oxidizing flame which consumes an excess of oxygen.

The proper design of bond for use with this process has only recently received the necessary consideration. In the first place, the weld should be made either to the head or the base of the rail. On account of the intense heat of the flame it is necessary to have a sufficient body of copper in the terminal to conduct the heat and to prevent burning or melting away of the terminal while the rail is being brought to the welding point. It is impracticable to weld the rail and the surface of the original terminal which is adjacent to it because the surfaces cannot be properly heated to the welding point. Therefore the welding wire is built up on top of the initial terminal, forming a new tapered bond terminal. The bond now has a tapered terminal which prevents traffic from exerting a destructive shearing action, but causes all wheels or other destructive forces to glance

Bond Installed

Bonding Equipment

off. Another feature of design is the provision of means for keeping the initial terminal about 1/16 in. away from the rail to allow the gases of the flame to escape and not form a pocket when welding into the corner. The cable or ribbons of the flexible portion of the bond must also be protected for a sufficient distance by a sleeve to prevent burning by the flame.

Until recently annealed copper wire has been used for the welding wire or filling-in material, but as copper oxidizes and absorbs gases rapidly when melted it is impossible to produce even a fairly non-porous structure for the built-on part of the terminal with pure copper. A flux wire of non-oxidizing alloy containing a high percentage of copper has, therefore, been developed. This produces a more perfect weld free from porous spots, and is much easier to manipurlate than copper.

It is not necessary to prepare the surface of the rail for the weld, but by some operators it is considered best to grind the surface. Grinding is an extra precaution to insure a uniform contact with the rail and does not demand

*Electrical Engineer, Ohio Brass Company, Mansfield, Ohio; from a paper delivered before the Illinois Electric Railway Association, Oct. 29, 1915.

as careful work on the part of the operator. On exposed rail, one end of the bond is clamped in position while the other end is being welded, and then the clamp is removed while the other end is welded.

Bonding in Paved Streets

In bonding in paved streets one or two paving blocks are removed and the bond is located by embedding the strand in some loose sand. When the rail is not to be ground the operator first coats the surface of the rail with flux metal, as by this method it is easy to see, from the manner in which the metal spreads over the rail, whether or not the oxide has been burned off. The flux metal is then built in between this coating and the initial bond terminal, producing the beveled terminals. A little practice will enable an average track man to control the flame and make a good weld by this method.

It is customary for a man doing welding of this kind to wear a pair of blue glasses, but there is no danger to a spectator and no such eye trouble develops as that experienced when working with or looking at the electric arc.

The connection between the terminal and the rail is very strong mechanically and will resist the shearing strains produced by traffic. In fact, it is impossible to tear the terminal from the rail contact and failure only occurs by fracture through the copper structure. The electrical resistance of the terminal contact is approximately 2.5 microhms, which is slightly more than has been attained by other terminals. This difference is due to the resistivity of the flux metal forming the terminal, which is greater than of pure copper. This difference, however, is negligible and, as there is no depreciation of the contact, it is electrically very efficient.

During welding the terminals of the bond are heated to a bright red and sometimes the strand becomes a dull red for a short distance from the sleeve. This heating does not injure the bond in any way, as the mass of cold metal in the rail acts as a chill and anneals the copper. A series of vibration tests, comparing new bonds with welded bonds that had been cut from the rail, showed that in no case did the welded bonds break down before the unwelded ones.

No Bad Effects on Rails

A study of the effect of heat on the structure of the steel rail has proved very interesting, and after very careful tests and investigations it can be safely stated that the welding process does not have any detrimental effect. It is found that the welding changes the structure of the steel to a depth of ⅜ in. The affected zone does not extend longitudinally beyond the welded terminal of the bond. A dividing line is formed between the fine structure produced by the welding process and the normal structure of the rail. On the lower side of the line the normal structure consists of large pearlitic areas and patches of ferrite characteristic of open-hearth steel. On the upper side of the line the grain is finer, showing a fine pearlitic structure, which is the average structure of the area affected by the welding process.

The rail in the samples was open hearth with carbon 0.74 per cent., silicon 0.174 per cent., sulphur 0.025 per cent., phosphorus 0.020 per cent. and manganese 1.07 per cent., hence the effect of the heating would show up more prominently than in a steel of lower carbon content. Seleroscope readings for hardness checked by tests with a Brinnell machine show the affected areas to be slightly harder than the rest of the rail.

The investigation showed that the areas affected and having a fine pearlitic structure have been heated to the critical point and were rapidly cooled by the mass of surrounding cold metal. The welding had refined the structure for ⅜ in. from the corner and had increased the hardness, but it had not detrimentally affected the steel. It is inconceivable that it could have affected the wearing properties of the rail or caused fractures or flaking.

A complete welding outfit, exclusive of the truck, which can be home-made, can be purchased for from $50 to $125, depending on the make of the torch and the extra accessories required for shop welding. The oxygen and acetylene consumed per bond cost approximately 10 cents, which cost varies with the distance to gas-charging stations. The flux wire used per bond will cost approximately 8 cents, the price varying with the copper market. The cost of labor with grinding of rail will average 6½ cents per bond on straight work and 4½ cents when no grinding is done.

Where rail grinding is done with an electric grinder, three men are required in a gang, while without grinding only two men are necessary. A gang should average ten to twelve bonds per hour on straight work under average traffic conditions. An average cost of installation, therefore, exclusive of cost of bond but including depreciation and interest on investment, is 25¾ cents per bond with grinding and 23½ cents without grinding.

Summary of Advantages

The advantages of this process of welding are as follows:

The investment in apparatus is small, resulting in low interest and depreciation charges. The utility of the apparatus in shop repair work makes it a 365-day-in-the-year machine. The entire equipment is compact and easy to handle and does not necessitate interference with traffic. No electric current is required, a matter of considerable importance in construction work and in a.c., or high-voltage d.c. installations. The welded contact has a high electrical efficiency and is permanent. The bonded joint is moderate in cost and easily inspected. When a length of rail is to be replaced one end of the bond can be cut loose from the old rail and rewelded to the new rail, thus saving the bonds.

Meters on Brandon Municipal Cars Effecting Large Savings—Pay for Themselves in Five Weeks

The Municipal Electric Railway System of the city of Brandon, Man., is an interesting example of the savings that may be effected in current consumption through the installation of electric meters on the cars. Mr. T. Boden, superintendent of the Brandon system, writes of their experience with these meters as follows:—

"We purchased ten Ferranti meters in September, 1914. These meters are the mercury type and have not caused us a moment's trouble. For the first five weeks after the meters were installed, the power consumption was checked daily, and compared with the previous year, our mileage was increased a little. At the same time a saving was made in this five-week period sufficient to pay for the meters. The saving for the year is approximately 20 per cent., and if such a saving can be made on a small system, I don't know what is going to hinder the same savings on a large system. For the first six months a bulletin was issued daily; also one every month, showing total mileage, power consumption and average kw.h. per car mile. Now we only issue the monthly bulletin. The meter record form herewith, Fig. 1, is that used by the motormen daily. Four of the lines for meter readings are used every day; two extra lines are provided in case of a car being changed. The mileage is filled in by the car-barn foreman, he having a list of mileage per trip on all routes. The motormen have needed very little coaching. Before the meters were installed every endeavor had been made to get the motormen to use as little power as possible, and while some motormen tried their best to do so, others seemed to get apathetic.

"The chief complaint one hears against the mercury type of meter is that it is continually getting out of order. In my opinion the chief cause of this is that too many men are allowed to tamper with them. On this system the car-barn foreman is the only man I allow to touch them. Should he at any time have any doubts as to the nature of a fault of a meter his instructions are not to tamper with it. However, this has not occurred yet, as the meters have given us every satisfaction."

BRANDON MUNICIPAL RAILWAY

METER RECORD

Car No.	Working Hours	Meter	Amt. Used K.W.H.	No. of Trips	Mileage
		Meter Reading when left			
		Meter Reading when taken..			
		Meter Reading when left ..			
		Meter Reading when taken			
		Meter Reading when left			
		Meter Reading when taken			
TOTAL		TOTALS			

Route... ....

Date...... . ...

Name ... . No.

NOTE—Loss of mileage through any cause must be reported on back of sheet

The following table gives comparative figures for the last two years, with and without meters installed.

Power consumed, kw.h.	607,996	491,900
Car miles	268,244	278,044
Average kw.h. per car mile	2.666	1.769
Total cost of power for year	$12,159.82	$9,838.00
Savings over 1914		
(Power costs 2c. per kw.h.) ...	2,321.82	
Cost of meters	200.00	

Three Rivers Traction Company gets under way—Best of equipment—Power supplied from Shawinigan Falls

The Three Rivers Traction Company have just inaugurated a tramway service in the city of Three Rivers, Quebec. The Ottawa Car Manufacturing Company supplied the rolling stock—six single end, single truck, one-man nearside cars, also one single truck combination sweeper and tower car, a general description of which is given below.

The car bodies are of semi-convertible type, wood construction, built specially for one-man nearside operation, and single end control. Sides are straight and sheeted vertically with narrow tongue and groove poplar sheeting. There are eight double sash windows on each side of the body. Top sash made stationary and bottom sash made to raise to open.

Fig 1 -Exterior view one-man car—Three Rivers Traction Co.

The roof is of arch type with Brill ventilators in each side, also one in front vestibule. The underframe is of composite construction, having wood sills reinforced with steel plates, which are riveted together to form a complete steel frame. The flooring is ⅞ in. thick tongue and groove, hard yellow pine, covered with hardwood floor matting laid lengthwise in the aisle. The interior trimming is red cherry. The front vestibule is made extra long and step opening extra wide, so that entrance and exit can be made by same. Each opening has an individual folding door and step of

Fig. 2—Interior view typical car—Three Rivers Traction Co.

the builder's standard construction, so arranged that when the motorman opens the door the step drops, and when he closes the door the step folds up. The doors are so arranged that the motorman can operate them singly or both together.

The front vestibule is equipped with brass p.a.y.e. rails, folding curtain behind motorman, and Coleman No. 4 Type fare boxes.

The rear vestibule is circular in shape with an emergency exit door controlled by the motorman from his position in the front vestibule. There is a circular seat which accommodates five passengers running around the rear vestibule. The seats are the builder's standard stationary type, covered with twill weave rattan and with brass grab handle on back. The curtains are pantasote mounted on Edward's metal rollers.

The car is also equipped with the builders' standard push buttons and buzzers, the current procured from batteries. The cars are heated with Consolidated Car Heating Company's type 118 W-S cross seat heaters with ten heaters per car.

The general dimensions are as follows: length of body, 21 ft.; length of front vestibule, 6 ft. 2 ins.; length of rear vestibule, 4 ft.; length over all, 32 ft. 2 ins.; width over all, 8 ft. 6 in.; seating capacity, 36 persons.

The cars are mounted on Brill Radiax trucks, 12 ft. wheel base with 33 in. cast iron wheels and 4½ in. hot rolled axles. Each car is equipped with two Westinghouse 12t-B-2 motors, with one K/10 controller; also Westinghouse schedule S-M-1 straight air brake equipment; also equipped with H B life guards, and an Ideal trolley catcher.

The accompanying photographs illustrate the general appearance of the cars. The bodies are painted olive green with gold lettering and striping.

The Sweeper and Tower Car

The combination sweeper and tower car is the builder's standard single truck sweeper with a tower built on one end. The body or cab is of wood construction, built on a heavy wood underframe which is reinforced with heavy steel plates. The roof is of the turtle back type suppo.ted on steel carlines. The interior of the body is finished in ash, natural finish.

The truck is the builder's standard design, which is extra heavy. The brooms and broom operating machinery are of the builders' standard construction. The brooms are mounted on a heavy shaft which runs in bearings which slide up and down in heavy malleable iron guides. They are driven by a heavy chain and sprocket drive from a main driving shaft, which is directly connected to the motor by a gear and pinion drive, having the same gear ratio as the truck motors. Each set of brooms can be cut in or out by clutches on the main driving shaft. The brooms are raised and lowered by hand winches in the cab; a separate winch is provided for each set of brooms.

The tower is of the builder's standard construction, having a working platform about 6 ft. long by 5 ft. wide with a folding fence all around it. The tower is raised and lowered by a heavy winch inside the cab.

The brooms are driven by a Westinghouse 101-B-2 motor. The truck is equipped with a Westinghouse 101-B-2 two motor double end equipment with K-11 controllers on the truck motor circuit and a R-28 controller on the broom motor circuit.

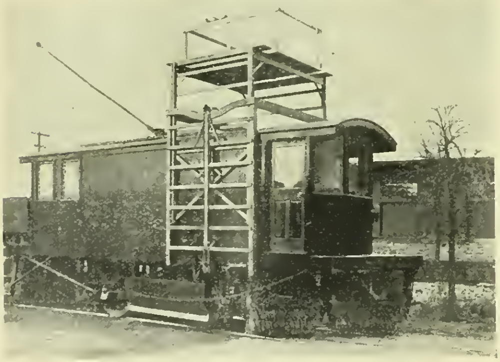


Fig. 3 Combined Sweeper and Tower Car—Three Rivers Traction Co.

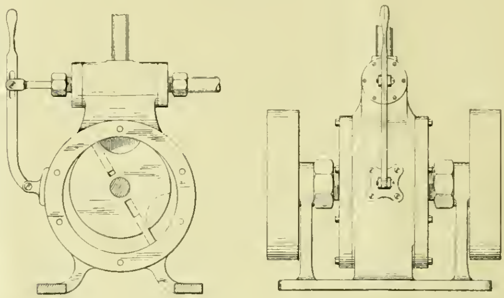
The body is painted olive green with gold numbers, the tower is finished natural, and the truck is painted black. The accompanying photograph gives a good idea of its general appearance.

The Montreal Tramways Company have continued their programme of improving the tracks, and have spent about $500,000 during the past season. Many intersections have been renewed, with a view of facilitating the clearance curves. The system of constructing the roadbed, commenced three years ago, has proved a great success, the use of French tile carrying off the water, thus preventing freezing and the unheaval of the track in the spring. The company have now a total mileage of 270 miles.

The Lachine Electric Repair Company, Lachine, Que., have registered.

Neely Steam Expansion Rotary Engine

A new rotary engine has recently been designed and put on the market by the Neely Rotary Engine Company, Limited, of Toronto. This engine is unique in type and an entirely new invention, and, although a radical departure from established practice in engineering, has stood up satisfactorily under very severe tests. The engine is simple in design, and entirely free from numerous complicated parts. There are no springs, rings, or packings used, and it has no dead centre. It is claimed it will start at any point and has steam expansion for three-quarters of a revolution. It consists mainly of a steam cylinder enclosing the rotary part, with a steam chest on top of the cylinder, all molded in one piece, as shown in cut. This steam chest follows somewhat the idea of the slide valve; it has two steam and two exhaust ports. A sliding valve connected to a lever allows steam to enter one port or the other according to position. The rotar consists of a cylinder of smaller diameter than the steam cylinder, with centre offset so as to bring the rotar in contact with the steam ports in the steam chest. This rotar contains two pockets with two adjustable nickel blades, as shown, one pocket and one blade each for forward and reverse. The pin used to hold the blade cushions the blade out steam-tight against the inside of the cylinder, by means of steam, so that there is no leakage. Steam enters the chest directly, and passes through the ports and into the pocket, impinging on one of the nickel blades for one-fourth of a revolution. The expansive power of the steam is used for the remaining three-quarters of the cycle.



Neely Rotary Engine—Side and End Views

The unique feature about this engine, apart from its saving in space and fuel and the absence of complicated parts, is the fact that when running at a speed of over 2,000 r.p.m. in either direction it may be brought to rest and driven to the same speed in the opposite direction almost instantly. This is accomplished by simply moving the valve in the steam chest, by means of a hand lever, to the other end, allowing steam to enter the opposite ports and so reversing the direction of rotation. When the valve is centred both ports are cut off, bringing the engine to rest. A few of the features of this engine which assure its success and efficien·y are its simplicity, power, economy of operation, durability, and certainty of action and control. The same lever is used for starting, stopping, reversing and controlling the speed. The engine is free from vibration when travelling at high or low speeds.

General manager Brown, of the Ottawa Municipal System, working with waterworks engineer Haycock, has made a report on the conversion of the Queen Street pump house into an electric generating station, which would supply power for the operation of the Lemieux Island pumps of the overland pipe system.

The Dealer and Contractor

A Code of Lighting Applicable to Factories, Mills and other work places—Valuable Information for Engineers, Central Stations and Electrical Contractors (Con.)

Requirements.—The following requirements may now be listed for natural lighting:

1. The light should be adequate for each employee.

2. The windows should be so spaced and located that daylight conditions are fairly uniform over the working area.

3. The intensities of daylight should be such that artificial light will be required only during those portions of the day when it would naturally be considered necessary.

4. The windows should provide a quality of daylight which will avoid a glare due to the sun's rays and light from the sky shining directly into the eye, or where this does not prove to be the case at all parts of the day, window shades or other means should be available to make this end possible.

5. Ceilings and upper portions of walls should be maintained a light color to increase the effectiveness of the lighting facilities from window areas. The lower portions of walls should be somewhat darker in tone to render the lighting restful for the eye. Factory green or other medium colors may be used to good effect.

Classification.—Means for natural lighting may be classed under three broad divisions as follows:

(a) That case in which the windows are located on the sides of the building or in the framework of saw-tooth construction, where diffused light from the sky reaches the work during a large portion of the day.

(b) That case in which windows are located overhead on a horizontal or nearly horizontal plane in the form of skylights, thus furnishing direct light from the sky during a large portion of the day.

(c) That case in which prismatic glass takes up the direct light from the sky and redirects it into the working space.

Method (a) is, of course, the most common of the three, and it may be noted that the saw-tooth or other roof lighting constructions have become very popular and result in an excellent quality and quantity of light for given window areas provided the size and location of windows are in accord with modern practice.

Increasing the Value of Floor Space.—Adequate and well distributed natural light means that certain portions of the floor space which ordinarily would not be available for work, are converted into valuable manufacturing space. In a general way, therefore, the average factory, mill or other work place, if properly designed, should possess natural lighting facilities which produce the best practicable distribution of daylight illumination.

Wide Aisles.—With low ceilings and very wide aisles, workmen located at the central portion of the building must sometimes depend for their natural light on windows located at a considerable distance away from their working position. In these cases it may be possible, in general, to depend altogether on daylight over an entire floor space, even at those times of the day when daylight conditions would be entirely adequate under other circumstances. This statement applies to side windows rather than to skylights or to saw-tooth construction. Fig. 1 illustrates this feature.

Varying Conditions.—In a case of this kind, employees located next to the windows are furnished with suitable daylight in the early morning and towards the latter part of the afternoon, the upper portions of the windows being particularly serviceable in lighting areas at some distance away from the windows. A southern exposure, however, results in such excessive light from the sky during the middle of the day, that heavy shades are nearly always pulled down so as to cover the entire window area. This plan makes it necessary to use artificial light throughout the larger part of the office during the brightest portion of the day, and reduces the daylight at those points where it would supposedly be the best, namely, near the windows. Here the location of the windows is a large factor in the excellence of the daylight conditions, but the manipulation of the shades is perhaps even more important. To avoid such a difficulty, adjustable translucent upper window shades with adjustable opaque lower shades might be employed.

Upper Portions of Windows.—It should be further noted in this illustration that the upper portions of the windows give a reduced illumination in proportion to their areas, to the floor space near them. In rooms of moderate size, therefore, the windows should be placed as near the ceiling as practicable. When the sun shines through windows so located, the direct light must be reduced or diffused. This may be accomplished by the use of ribbed glass in ordinary factory and mill buildings, and in offices by the use of translucent sun shades or awnings.

Tempering the Light.—The light due to the sunshine on such shades and awnings will be as bright as ordinary skylight if the shade is well chosen, and the ribbed glass will be still brighter. If the windows are large, the illumination is likely to be too great near the windows as previously pointed out and it must be reduced. This should not be done, however, by pulling down an opaque shade over the top of the windows because the top portion of the window is the part that is particularly needed to give light to the interior of the room. The better scheme is to employ an opaque shade which should be raised from the bottom of the window. This will reduce the illumination near the window without affecting it over the interior of the room to any marked degree.

Bench Locations.—Fig. 2 shows how benches are commonly located with respect to windows, so that the light received on the work may be most satisfactory. This sets a certain limitation upon the possible arrangement of the work over the floor space, depending on the way the daylight is furnished to the floor area. This limitation can be eliminated almost completely in the case of artificial light through a uniform distribution of lamps overhead. This statement applies to those cases where natural light is transmitted through side windows, and includes a feature specially noticeable in buildings of more than one story. In contrast, the work may be arranged almost independently of the natural light in buildings where the natural light is furnished by overhead windows or through the means of saw-tooth construction.

Window Glasses.—Both translucent and clear glass are employed for factory and mill windows. There is a slight reduction in the transmitted light through ordinary translucent wire glass, but it is often required by insurance regulations for a reduction in the fire risk where a given building is located in close proximity to other buildings. Wire glass is also used quite generally with steel window frames, there being an added protection from the standpoint of fire risk. Wire glass may be obtained in clear form, but its expense in contrast to the translucent form is such as ordinarily to prohibit its use for industrial purposes.

Wire Glass.—Wire glass, also known as ribbed glass, should be used and is advocated for practically all factory and mill windows where prisms are not required. Wires of rather open mesh cause so little reduction in light as to warrant no mention of this feature. Special care should be taken to get such glass as is smooth both on the flat side and on the ribbed side to facilitate cleaning. Wire or ribbed glass gives better diffusion than plain glass.

Prism Glass.—Where the sky outside of the windows is obstructed by buildings, prism glass is recommended if the room is deep. Different kinds of prisms cannot be used to advantage interchangeably. The amount of prism glass required in any case depends much upon the surroundings and to obtain excellent results, of which such glass is capable, it must be used intelligently.

Skylights.—Skylights are sometimes installed in long narrow continuous strips in a sloping roof. The ribs of the ribbed glass are generally so arranged that it is convenient to make them at right angles to the length of the strips. The result is that the sunshine is diffused by the ribs over a narrow area parallel to the strip of skylight, thus lighting one part of the room much more brilliantly than the remainder. If the ribs are installed to run parallel to the strips, they will give a much more general distribution of the sunlight. In the foregoing, the word strip refers to the long belt of skylight and not to the individual sheet of glass. Ribbed glass in vertical windows should generally be placed with the ribs horizontal. They thus roughly fulfill some of the functions of prisms.

Dirt Accumulations.—While translucent wire or ribbed glass reduces the amount of light transmitted through the windows, the roughness of the outside surface of such glass often causes accumulations of dust and dirt, which are more to blame for the reduction of transmitted light in some cases than the translucent nature of the glass itself. Remedies of this difficulty are to secure smooth glass and to resort to frequent cleaning.

Wire Glass as a Safeguard.—Wire glass for skylights is, of course, a practical necessity as a safeguard against accidents due to accidental breakage of the glass or due to objects falling on top of the glass.

Calculations for Natural Light.—In certain typical localities, the average brightness of the sky during business hours is about 250 candles per square foot. This is probably a fair average value for the entire United States. The lower or minimum value of sky brightness, excluding particularly stormy days, may be taken as about 100 candles per square foot. Allowing for a reduction of 25 per cent. for losses in the windows themselves, the brightness of the sky as seen through a window becomes equal to a minimum of say 75 candles per square foot in any directions from which the sky can be seen through the windows. This brightness value if multiplied by the part of the window area through which sky is visible from a given point in the work space gives the available candlepower through the window in question, and this candlepower is then divided by the square of the distance between the given point and the window to obtain the foot-candle intensity of the illumination at the given point.

Method illustrated.—To illustrate this method, consider a hallway 40 ft. long, lighted by a window 5 ft. by 5 ft. at one end, with the sky visible from the darker end of the hall through the upper half of the window only. The illumination at the dark end of the hall will then be equal to:

$$5 \times 5 \times 0.5 \times \frac{75}{1{,}600} = 0.58 \text{ foot-candles,}$$

under the assumed window brightness of 75 candles per square foot. The 1,600 in this calculation results from the square of 40 ft., the length of the hall, or in other words the distance from the point considered to the window; and the factor 0.5 takes into account the fact that the sky is visible through only one half of the window area from the point considered.

Checking the Intensity.—The intensity is not sufficient at this darkest part of the hall since the requirements of Article I of the Code proper call for three times the minimum values given in Article V and the minimum value given in Article V for passageways is 0.25. Three times this value is 0.75 which is somewhat greater than the value found in this calculation. The window area must therefore be increased in size by about 30 per cent., or if this is impossible or impracticable, the hallway must be provided with artificial light at those points where the natural light falls below the requirement.

Calculation for a Skylight.—As another illustration, assume that fine manufacturing work is to be performed under a skylight 20 ft. above the work. If the brightness is assumed to be 75 candles per square foot as before, the minimum intensity must be 3 × 3.5 foot-candles, that is, 10.5 foot-candles, based on the requirements of Article I of the Code. The window area must then equal:

$$10.5 \times \frac{400}{75} = 56 \text{ sq. ft.}$$

Part of Window Area to Consider.—It is important in estimating the illumination of any work room to consider only that portion of the window area through which clear sky is visible, provided the window is equipped with ordinary clear glass.

Sunshine Not Desirable.—In all the work of providing natural light, it should be kept in mind that direct sunshine in itself, from the illumination standpoint but irrespective of sanitary conditions, is not wanted. The idea that sunshine is the important item is a common but an erroneous impression. For example, in saw-tooth construction, the windows do not face the south to get all the sunshine possible, but they face the north to exclude the sunshine. Ordinary windows, on the other hand, face all directions because not enough light can be distributed to interiors from north windows alone. Windows on the other than north fronts admit sunshine to be sure, and this makes sun shades and awnings necessary to exclude the excessive brightness.

(To be continued)

The Grand Trunk Pacific is considering the erection of a power plant of their own in Fort William for the operation of elevators and other purposes. The railway company have been purchasing power from the Kaministiquia Power Company, but claim the load basis of payment is unsatisfactory.

Rules and Regulations re Gas-filled Lamps

The following Rules and Regulations for installation of gas-filled lamps were recently adopted by the Hydro-Electric Power Commission of Ontario, and have been distributed in pamphlet form:

All gas-filled lamps installed in or upon any building or structure in this province, must, on and after the date of this issue conform in all respects to the following Rules and Regulations.

Owing to the danger from defective gas-filled lamps which may have been installed previous to the issuing of this notice, the Commission may require such changes as may be warranted in any installation, if in their opinion there is any danger to life or property.

1. Must be so grouped that not more than 660 watts (nor more than 16 sockets or receptacles) are to be dependent on one cutout except that in cases where wiring equal in size to No. 14 B. & S. gauge is carried directly into keyless sockets or receptacles, the location of which is such as to render unlikely the attachment of flexible cords thereto, the circuits may be so arranged that not more than 1,320 watts (or 32 sockets or receptacles) will be dependent on the final cutout. Where a single socket or receptacle is used on a circuit the limitation of watts permissible on the final cutout shall be the maximum capacity for which such socket or receptacle is approved.

2. Must not be used in show windows or in other locations where inflammable material is liable to come in contact with lamp equipment except where used in connection with approved fixtures where temperature of any exposed portion of same does not exceed 200 degrees Fahr. (93 degrees Centigrade).

3. Must not be used in connection with medium-base sockets or receptacles if of above 250 watts nominal capacity nor with Mogul base sockets or receptacles if of above 1,500 watts capacity. If of above 100 watts, must not, if provided with a shade, reflector, fixture or other enclosure above the socket, be used in either medium or Mogul base types of sockets or receptacles having fibre or paper linings.

4. Fixtures within buildings must be wired with conductors of approved slow-burning or asbestos covering where the temperature to which wire is subjected at any point exceeds 120 degrees Fahr. (49 degrees Centigrade). Where fixtures are placed outside of buildings approved rubber insulated wire is required.

William A. Conner Expires Suddenly

William Andrew Conner, of Plainfield, N. J., died suddenly Monday, December 6th, at his office in Perth Amboy, N. J. He was born in Baltimore in 1859. He began his business career in 1876, in Pittsburgh, in the oil refining business, in which he reached the position of assistant manager for the Standard Oil Company. In 1885 he took charge of the first plant built by the Standard Underground Cable Company in Pittsburgh, and from then to the time of his death he was the head of the manufacturing business of that company, including large plants planned and built by him in Pittsburgh, Pa.; Perth Amboy, N. J.; Oakland, Cal.; and Hamilton, Ont. He was a director for ten years and first vice-president since 1909. He was vice-president of the Perth Amboy Trust Company, in the inception of which he had an active part. He was also a vice-president and director of the Standard Underground Cable Company of Canada, Limited, whose factories were planned and built by him in Hamilton, Ont., in 1911-12. He was a 32 deg. Scottish Rite Mason, and a Knight Templar; a member of the Duquesne Club of Pittsburgh, the Hamilton Club of Hamilton, Canada, and the Plainfield Country Club. He has resided in Plainfield since 1904. He leaves his widow, who was Miss Tupper, of Michigan; a brother, Edward Conner, of Orange, N. J., and a sister, Mrs. Roak, of Brooklyn, N. Y. He was a cousin to Mr. O. T. Waring, of the Standard Oil Company, Mr. E. J. Waring, of Standard Underground Cable Company, and the late Richard S. Waring, who was the founder of the Standard Underground Cable Company and inventor of "Waring" Cables.

Judgment Favors Canadian L. H. & P. Co.

Judgment has been rendered in the Court of Review modifying the previous judgment of Mr. Justice Archibald in the Superior Court, in which judgment was given for $65,330 in favor of the Fraser Brace Company against the Canadian Light, Heat and Power Company. This amount was due, according to the judgment, on construction work in connection with the plant at St. Timothee. The later judgment reduces this amount to $32,275, and releases the contractors from the obligation of obtaining a final certificate from the J. G. White Company.

The Croaker

Once on the aidge of a pleasant pool,
Under the bank where 'twas dark and cool,
Where bushes over the water hung,
And rushes nodded, and grasses swung,
Jest where the crick flowed outer the bog,
There lived a grumpy and mean ole frog,
Who'd set all day in the mud and soak
And jest do nothin' but croak and croak,
Till a blackbird hollered, "I say, yer know,
What is the matter down there below?
Are you in trouble, er pain, er what?"
The frog sez, "Mine is a orful lot;
Nothin' but mud and dirt and slime
For me ter look at jest all the time.
It's a dirty world!" so the old fool spoke,
"Croakity-croakity-croakity-croak!"

"But yer lookin' **down**!" the blackbird said;
"Look at the blossoms overhead,
Look at the lovely summer skies,
Look at the bees and butterflies;
Look **up**, old feller. Why, bless yer soul,
Yer lookin' down in a muskrat hole!"
But still with a gurglin' sob and choke
The blame ole critter would only croak.
And a wise old turtle, who boarded near,
Sez to the blackbird, "Friend, see here:
Don't shed no tears over him, fer he
Is low-down, jest 'cause he likes ter be;
He's one er them kind er chumps that's glad
Ter be so mis-rable-like and sad;
I'll tell yer somethin' that ain't no joke,
Don't waste yer sorrer on folks that croak."

—From "New Age."

The Commission of Conservation of the Dominion of Canada have issued a report of their sixth annual meeting held at Ottawa, January 20, 1915. Among other interesting papers on conservation topics are two by Mr. A. B. White and Mr. L. G. Denis on the subjects "Water and Waterpower Problems" and "Activities of the Committee on Water Powers."

The People's Telephone Company are negotiating with the Bell Telephone Company to buy out the interests of the latter company in Forest. The dual system at present in operation is not satisfactory.

Western Canada Power Financing

Owing to the refusal of the British Government to sanction the raising in Great Britain of an additional $1,000,000 first mortgage bonds, sanctioned by the present holders, the Western Canada Power Company notifies that it is unable to raise money to pay the half-yearly interest on the first mortgage bonds due January 1st. Meanwhile a committee representing holders of the three year notes,—due in March next, have tentatively agreed to convert these notes at par into seven per cent. preference shares, provided that holders of first mortgage bonds will agree to convert the next two years' interest coupons into preference shares of the same issue. The agreement involves the raising of $350,000 in cash within a period of two years, for the purpose of completing the construction of the third generating unit, and providing for other necessary expenditures, and to this sum the holders of the ordinary shares of the company will be asked to contribute by subscriptions to preferred shares at par.

Electric Furnace Plant in Montreal

The Canadian Electric Products Company, Limited, with a capital of $500,000, are organizing an electric furnace plant, for the manufacture of high grade steel, in Montreal. The plant will be on a two-unit basis, each with a capacity of 25 tons per day. The company will include in its directors Mr. Julian C. Smith, vice-president of the Shawinigan Water and Power Company, and Mr. J. S. Norris, manager of the Montreal Light, Heat and Power Company, which concerns will supply the requisite power. The company, however, is distinct from either of the two companies above mentioned. The Canada Cement Company is installing an electric furnace in connection with the making of shells.

Proper Factory Illumination

The Electrical Manufacturers' Association, 1227 Fort Dearborn Bank Building, Chicago, are distributing invitations and descriptive circulars of a dinner to be held in the near future at which the question of proper factory illumination will be discussed from a number of different angles, as for example: Factory lighting by incandescent lamps; Factory lighting with Cooper-Hewitt lamps; Theory of factory lighting. The invitations are addressed principally to men interested in some phase of manufacturing work and, so, concerned with good lighting in their factories.

Gres Falls Changes Hands

Under the arrangement by which the Shawinigan Water and Power Company have purchased the Gres Falls development from the Union Bag and Paper Company, the Shawinigan Company will furnish the plants of the Union Bag and Paper Company with all the power that the latter require. This undeveloped water power is located 13 miles north west of Three Rivers on the St. Maurice river.

Mr. E. S. Cook representing the firm of Moncur & Cook has been granted two weeks vacation to visit Cincinnati and Lexington, Kentucky. Upon his return he will cover Western Ontario and the Niagara Peninsula for Moncur & Cook.

The Railway and Industrial Engineering Company, Pittsburgh, have issued a copy of their "Progressive Manager" series treating on Burke High Voltage Horn Gap Switches, which are fully described and illustrated.

The Canadian Electric Products Company, Limited, Montreal, Que., have been incorporated.

J. A. Gauthier & Frere, electricians, Montreal, Que., have dissolved partnership.

The Victoria Electric Supply Company, 423 Yonge Street, Toronto, announce that they are moving, on January 15th, into larger quarters at 414 Yonge Street, where they will make use of the entire two-storey building for stock and show-rooms for their full line of electrical supplies and fixtures.

One frequently hears it stated by financial authorities that railway earnings are the best gauge of a country's commercial prosperity. Here are the earnings of our three big railways for the first week of December, as compared with a year ago:

	1915	1914	Increase
Canadian Pacific Railway			
	$3.046,000	$1,766,000	+ $1,280,000
Grand Trunk Railway			
	$1,012,326	$ 865,052	+ $ 147,274
Canadian Northern Railway			
	$ 830,600	$ 502,700	+ $ 327,900

Personal

Mr. Ray Rumpall has been appointed manager of the Bell Telephone office at Goderich, Ont. Mr. Rumpall was formerly in Clinton.

Trade Publications

Fuse Guard Products—Catalogue No. 1, issued by the Electric Fuseguard Company of Newark, N. J., describing enclosed fuses, cut-outs, and boxes of this company. Mr. Irving Smith, 809 Unity Building, Montreal, is sole Canadian representative for this equipment.

Outdoor Sub-stations—The Delta-Star Electric Company, 617-31 West Jackson Boulevard, Chicago, are issuing in pamphlet form, under the heading "Proposal for Delta-Star Equipment," leaflets Nos. 720, 740, 750, 760, 900 and 910, illustrating and describing a complete line of high tension outdoor steel tower sub-stations, pole top switches, wooden pole sub-stations, carbon tetrachloride fuses, bus bar supports, disconnecting switches and surge arresters.

Meters for Automobile Testing—Folder No. 4321, just issued by the Westinghouse Electric & Mfg. Company.

Small Motors—Issue No. 24, published by the Small Motor Department of the Westinghouse Electric & Manufacturing Company, shows a number of illustrations of the fractional horsepower motor and some of its numerous applications. A picture of the large building devoted entirely to the manufacture of this type of motor is also shown.

Wiring Devices—1916 catalogue by the Bryant Electric Company, Bridgeport, Conn. This is a splendidly illustrated, well printed catalogue, fully covering the equipment manufactured by this company and containing besides a quantity of interesting and valuable information for the electrical contractor and dealer.

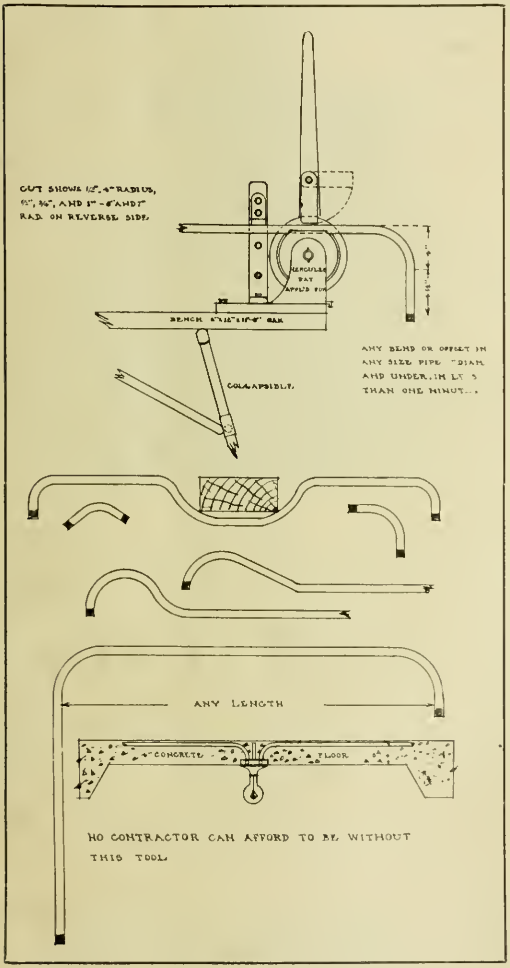
"Canadian" Turbines—Catalogue No. 15, issued by Charles Barber & Sons, Meaford, Ont., describing, with illustrations, the manufacture, operation, and performance of the Canadian turbine water wheel manufactured by this company.

Refillable Fuses—Bulletin issued by A. F. Daum, Pittsburgh, Pa., describing their refillable cartridge fuse shells for electric light and power.

What is New in Electrical Equipment

Efficient Pipe Bender

We illustrate herewith a new pipe bending device invented by Mr. G. E. Phillips, of the MacKenzie Electric Company, engineers and electricians, Sarnia, Ont. The basic principle on which this bender works is that the pipe is pulled around a grooved form, of the radius required, and not forced into shape with wheels or cams. The machine is very simple in construction and arranged to take the pipe from the side, which can be inserted or removed in an instant. With this bender it is possible to make a number of bends on one piece of pipe—bends and offsets being absolutely perfect.



New pipe bending device—the invention of G. E. Phillips, Sarnia, Ont.

The inventor claims a very considerable saving by the use of this equipment. On one job alone, which required all bends to be 4 inches radius, it saved 35 per cent. of the time and paid for itself just twice over. On any job where the contractor's time runs to as much as $150 the price of the machine can be saved in time gained. There is no guess-work about it. Pipes up to 1 inch can be bent cold and single groove machines for work up to 2½ inches will also be covered by this line, but the pipe will have to be heated before placing in the groove. This, however, will give a perfect bend without any flats or kinks whatever.

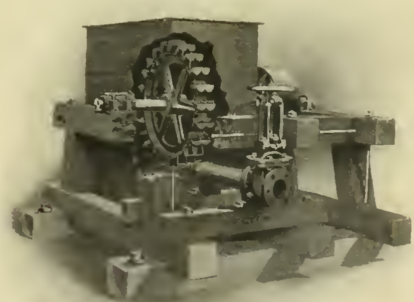
The proper way to rig up one of these machines is to have a 12 foot 2 inch plank 12 inches wide on a collapsible pipe frame. Put the bender on one end and the pipe vise on the other. The supply of conduit to be worked goes on the cross-bars of the frame under the bench. This helps to keep the bench down steady and the material is within reach. One-half inch to 1 inch bender weighs 75 pounds and, of course, cannot be used otherwise than on a plank.

If the saving on small jobs is so considerable it may easily be seen how efficient this machine would be on a job such as, for example, the new Union Station, where the amount of bending required is so considerable. Two or three of these machines would save hundreds of dollars in time and in addition every bend and offset would be perfect.

Pelton Water Wheel

The Pelton Water Wheel Company, San Francisco, in a recent publication give, in sufficient detail, data by which the owner of any small water power may determine whether it is of sufficient size to be worthy of development. This firm encourage development from one-quarter horse-power up. The suggested procedure is as follows:—

First, the amount of water available.—The best method of measuring the water in your stream is by a weir of simple construction. At some point where the stream is of uniform section, place a board across it. This board should have a notch cut in it with both sides and the bottom beveled sharply upstream as shown. The bottom of the notch, which is called the crest of the weir, should be perfectly level, and the sides vertical. In the pond which forms, and a few feet back from the weir, in line with one edge of the notch, drive a stake until its top is exactly level with the crest. Measure the depth of the water over the stake when the stream is flowing, using an ordinary rule for this purpose. The simplest way is to use a stake on which is painted measuring divisions the same as carried by a rule, the beginning point of this measure being placed exactly level with the crest of the weir. By means of a stake thus arranged, it is comparatively easy to make the necessary measurements—the depth of the water, the width of the notch



through which it flows, and the total width of the weir. In building a weir, care should be taken that the width of the notch shall not be less than four times nor more than eight times the depth of the water flowing through it; nor should the notch be more than two-thirds the width of the stream.

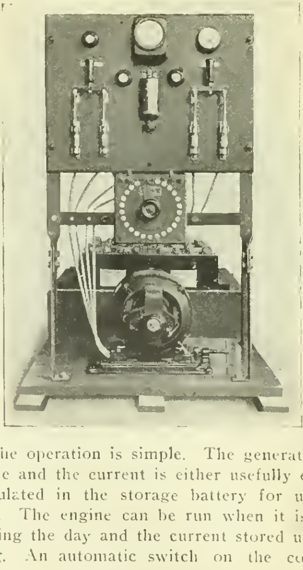
Second, head or vertical fall from the ditch, flume, or other source of supply, to where the wheel is to be placed.—This should be determined carefully, and can easily be done by using a surveyor's level or an ordinary farmer's level, of the type widely used in building drainage ditches. Full instructions for using these instruments are furnished by the manufacturer, so that this phase of the work will not be further described here. If you have not available a level of this type, any land surveyor can quickly give you the desired information.

Third, length of pipe required to secure this head.—If your pipe is already laid, note the diameter and length, and if more than one size of pipe is included in the pipe line, note the length of each size.

Fourth, type of machinery you expect to drive.—If you intend driving an electric generator, note the capacity, speed and whether it is to be used for power, lights or both.

Electricity for Everybody

Electricity need no longer be classed as a luxury obtainable only by those living in thickly settled communities reached by central station circuits. The little generating plant illustrated here makes it possible for anyone to enjoy the conveniences of electricity for lighting, heating and power purposes, no matter how far removed from power lines he may live. They are useful in country homes, on farms, and in small manufacturing establishments in rural districts where they furnish power for lights, for operating fans, vacuum cleaners, sewing machines, washers, heating appliances, and motors driving pumps and small farm machinery. The plant consists of a Westinghouse low-voltage generator and control panel and an Hyray exide storage battery, all of which are mounted on skids, rendering the outfit portable. The generator may be driven by any ordinary oil, gas, or gasoline engine or, if water power is available, it can be used and the electricity will cost practically



nothing. The operation is simple. The generator is driven by an engine and the current is either usefully expended or else accumulated in the storage battery for use at some future time. The engine can be run when it is most convenient during the day and the current stored up for use in the evening. An automatic switch on the control panel maintains a steady voltage on the battery when charging, and an ampere-hour meter shows at all times the exact amount of reserve energy in the storage battery and indicates when to start and stop the charge. The outfits are sold complete without the engine by the Westinghouse Company.

The Electric Tire Pump

Among the many new devices that are constantly being exploited for use in the garage, the tire pump shown in the

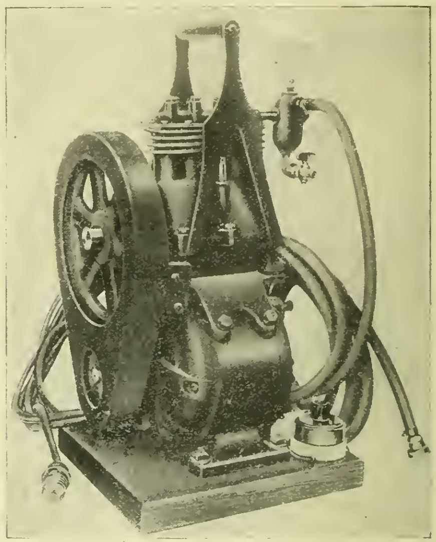


illustration is worthy of mention on account of several unique features. The entire outfit is a self-contained unit, mounted as shown in the illustration. A handle is supplied, allowing it to be easily carried, or it can be mounted on a small carriage if desired. The air pump, which is mounted on the motor, has four cylinders, insuring a steady flow of air. The corrugations on the cylinders assist in dissipating the heat generated by the compression of the air and keep the operating temperature low. Metal pistons, each fitted with two compression rings, are used. The connecting rods and main bearings are made of bronze. The motor used is the well-known ¼ horsepower standard Westinghouse type CA or CD, depending on the nature of the circuit. This pump is called the "Guco" and is manufactured by the General Utility Company, Philadelphia. The complete equipment consists of a motor-driven pump, a pressure gauge, an air hose, an acorn connection and a snap switch for starting and stopping the motor.

Electrical supply houses report an improved demand for goods, the better feeling in general commerce helping the situation. The Duncan Electrical Company, Limited, state that trade is reviving, and that their turnover during the closing months of the year was exceptionally large. Many dealers made very large displays of electrical apparatus during the Christmas week, and some departmental stores also featured electrical domestic equipment.

Mr. G. H. Forster, manager of the Linde Canadian Refrigeration Company, Montreal, has been given a lieutenant's commission in the 148th Battalion.

Current News and Notes

Bagotville, Que.

A by-law was submitted on December 27th authorizing the installation of an electric lighting system to cost $7,000.

Brandon, Man.

Recent reports indicate that the earnings of the Brandon Street Railway System are picking up. Figures for November show a gratifying improvement over the same period a year ago.

Burgessville, Ont.

A by-law was carried on December 21st authorizing an expenditure of $3,500 on a hydro-electric distributing system.

Cobden, Ont.

A by-law will be submitted at the January election authorizing the municipality to spend $20,000 in equipping a plant and distribution system for the village of Cobden.

Hull, P.Q.

The municipality of the city of Hull, Que., are changing over their present system of street lighting (d.c. arcs) to series nitrogen-filled tungstens. This means the replacing of 137 arcs by 300 6.6-ampere, 500-watt, high-efficiency lamps. The line has already been rebuilt. The city are also building a new hydro-electric plant with a capacity of 600 kw., which will supply the necessary power for the street lighting and also for the operation of eight one-million-gallon electrically-driven centrifugal pumps.

Kingston, Ont.

The power committee of the city of Kingston has recommended that the Seymour Power Company, a subsidiary of the Electric Power Company, be asked to submit terms and rates for a supply of power for the city of Kingston.

Mr. Folger, of the local distributing system, is purchasing the necessary material to supply 250 h.p. of energy to the Canadian Locomotive Company.

London, Ont.

A by-law authorizing an expenditure of $101,000 for extensions to the London and Port Stanley System will be voted on at the January elections.

Newcastle, N.B.

The town council decided at a recent meeting to inaugurate an all-day service. It was also decided that Engineer Jackson be authorized to purchase an electric pump for the waterworks system.

New Westminster, B.C.

Mr. Fletcher Shaw, for twenty-five years in the employ of the city's electrical department, and later with the B.C.E.R. Company, died recently at his home in this city.

Norwich, Ont.

A by-law was submitted in the township of North Norwich on December 17th authorizing an expenditure of $3,500 on an electrical distributing system; power to be obtained from the Hydro Electric Power Commission.

Quebec City, Que.

The Public Service Corporation have commenced work on their transformer station in this city. Foundation work has been let to the Sharp Construction Company, and it is understood that the Public Service Corporation will itself complete the work.

Richmond, Que.

The Dominion Railway Commission, sitting in Montreal on December 20, ordered the removal of certain poles erected in Richmond, P. Q., by the Bell Telephone Company and the Great Northwestern Telegraph Company on the ground that they obstructed the approach to the railway station.

Sarnia, Ont.

A by-law will be submitted on January 3 authorizing the expenditure of $120,000 for the purchase of the plant of the Sarnia Gas and Electric Company.

Saskatoon, Sask.

According to the report for November of the city electrical engineer of Saskatoon, that month was the best in the history of the company so far as power consumption was concerned. The surplus for the month amounts to $6,000.

Springfield, Ont.

A by-law was submitted on December 9 authorizing an expenditure of $5,000 on an electric distributing plant.

Staynor, Ont.

A by-law will be submitted authorizing the expenditure of $5,000 to extend and improve the hydro-electric plant and waterworks.

St. Hugues, Que.

The Auer Light Company, Limited, 18 Notre Dame Street West, Montreal, has been awarded the contract to supply the electrical fixtures for the parish church at St. Hugues, Que. These fixtures will be manufactured by the Tallman Brass & Metal Company, Hamilton, Ont., and are of Romanesque Period. They consist of six main fixtures, 36 semi-indirects, 16 brackets, and two three-light posts, also special ornaments for the altar.

St. Thomas, Ont.

Tenders are received up to January 15 for the construction of a municipal transforming station.

Toronto, Ont.

The local Hydro-electric Commission have asked the Board of Control to submit a by-law asking for an additional $1,375,000 for extensions and improvements to the system.

At the recent annual meeting of the Ontario Municipal Electrical Association held in Toronto, Mayor T. L. Church, of that city, was elected president.

The city council unanimously adopted a recommendation of the Board of Control that the Hydro-Electric Power Commission of Ontario be requested to negotiate with the Toronto and York Radial Railway Company for the purchase of the Metropolitan line on Yonge Street. Sir Adam Beck has since stated that negotiations will commence immediately.

Whitby, Ont.

The Whitby Water and Light Commissioners have put into effect a new schedule of rates based on the system of the Hydro-electric Power Commission of Ontario.

Windsor, Ont.

A by-law was recently passed in Windsor, Ont., authorizing extensions to the hydro-electric system amounting to $50,000.

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ADVERTISEMENTS

Orders for advertising should reach the office of publication not later than the 5th and 20th of the month. Changes in advertisements will be made whenever desired, without cost to the advertiser.

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Ontario's Challenge!

A large portion of that section of the province of Ontario supplied with electric energy from Niagara Falls by the Hydro-electric Power Commission of Ontario have just received a very real New Year's remembrance in the shape of a considerable reduction of their light and power rates. It is indeed something to be proud of to be able to say that certain Canadian rates are the lowest on the continent and, so far as we can judge, we believe this distinction applies under the new rates to a number of municipalities in the province of Ontario. The schedule of new rates is printed below, where it will be noticed that in several localities the final household rate is 1 cent per kw.h., which, with 10 per cent. discount, brings the figure down to .9 cent. Unlike many apparently low household rates, too, there is no very formidable joker in the shape of a minimum charge if the consumer uses a reasonable amount of current. These rates are particularly attractive to householders who use electric appliances fairly freely, and particularly to those who cook with electrical ranges.

The basis of the Hydro rates as has been outlined in the Electrical News, but may bear repetition, is as follows: A floor rate of 3 cents per hundred square feet is charged whether or not current is consumed. The minimum floor space is 1,000 feet and the maximum 3,000 feet, so that every consumer must pay somewhere between 30 and 90 cents (discount 10 per cent.) whether he uses the current or not. The first meter rate is now reduced in a number of municipalities to 2 cents per kw.h. for the first 3 kw.h. per hundred

New and amended rates in the Hydro area

	Domestic		Commercial			Power		
Municipality.	1st 3 KWH per 100 sq. ft.	Additional per KWH	First 30 hrs. use per month.	Next 70 hrs use per month.	All over 100 hrs. use per month.	1st 50 hrs. use.	2nd 50 hrs. use.	Add'l Consump.
Acton	4.0	2.0	8	4.0	0.8	3.9	2.6	0.15
Ayr	4.5	2.25	9	4.5	0.9	3.9	2.6	0.15
Ailsa Craig	6.5	3.25	13	6.5	1.3	...	...	....
Baden	3.5	1.75	7	3.5	0.7	3.2	2.1	0.15
Beachville	4.0	2.0	8	4.0	0.8	2.2	1.4	0.15
Berlin	2.0	1.0	5	2.0	0.5	2.0	1.4	0.15
Brampton	2.0	1.0	5	2.0	0.5	2.2	1.4	0.15
Brantford	2.5	1.25	5	2.5	0.15	...	...	....
Caledonia	3.5	1.75	7	3.5	1.75	2.5	1.7	0.15
Clinton	...	....	..	...	....	4.7	3.1	0 15
Doon	4.0	2.0	8	4.0	0.8	...	...	...
Dorchester	5.0	2.5	10	5.0	1.0	5.2	3.5	0.15
Drumbo	...	....	..	...	....	4.7	3.1	0.15
Dundas	2.0	1.0	5	2.0	0.15	2.1	1.4	0.15
Elora	4.0	2.0	8	4.0	0.8	...	...	....
Embro	...	....	..	...	....	4.2	2.8	0.15
Elmira	4.0	2.0	8	4.0	0.8	4.2	2.8	0.15
Exeter	5.5	2.75	11	5.5	1.1	4.2	2.8	0.15
Fergus	4.0	2.0	8	4.0	0.8	...	...	....
Galt	2.0	1.0	5	2.0	0.5	2.0	1.3	0.15
Georgetown	3.5	1.75	7	3.5	0.7	3.3	2.1	0 15
Glen Williams	...	....	..	...	....	3.6	2.4	0.15
Goderich	...	....	..	...	....	3.9	2.6	0.15
Guelph	2.0	1.0	5	2.0	0.5	1.5	1.0	0.15
Harriston	6.0	3.0	12	6.0	1.2	4.8	3.2	0.15
Hagersville	4.0	2.0	8	4.0	0.8	3.6	2.4	0.15
Hamilton	2.0	1.0	4	1.5	0.15	1.5	1.0	0.13
Hespeler	3.5	1.75	7	3.5	0.7	2.3	1.6	0.15
Ingersoll	3.0	1.5	6	3.0	0.6	2.1	1.4	0.15
London	2.0	1.0	4	2.0	0.4	2.0	1.3	0.15
Listowel	5.0	2.5	10	5.0	1.0	3.9	2.6	0.15
Mimico	3.0	1.5	6	3.0	0.6	2.8	1.8	0.15
Milverton	5.0	2.5	10	3.0	1.0	3.9	2.6	0.15
New Hamburg	3	1.5	6	3.0	0.6	3.2	2.1	0.15
Niagara Falls	2.0	1.0	4	2.0	0.4	1.5	1.0	0.1
New Toronto	3.5	1.75	7	3.5	0.7	2.8	1.8	0.15
Norwich	3.0	1.5	6	3.0	0.6	2.9	1.9	0.15
Otterville	5.5	2.75	11	5.5	1.1	...	...	....
Petrolia	4.5	2.25	9	4.5	0.9	3.6	2.4	0.15
Port Credit	3.0	1.5	6	3.0	0.6	2.8	1.8	0.15
Pt. Dalhousie	...	....	..	...	....	2.3	1.5	0.15
Port Stanley	4.0	2.0	8	4.0	0.8	...	...	....
Plattsville	...	....	..	...	....	5.4	3.6	0.15
Preston	2.5	1.25	5	2.5	0.5	1.6	1.1	0.15
Palmerston	5.5	2.75	11	5.5	1.1	4.7	3 1	0.15
Rockwood	4.0	2.0	8	4.0	0.8	3.9	2.6	0.15
Seaforth	...	....	..	...	....	4.2	2.8	0.15
Sebringville	...	....	..	...	....	3.9	2.6	0.15
Simcoe	4.0	2.0	9	4.5	0.9	3.9	2.6	0.15
Strathroy	4.0	2.0	8	4.0	0.8	3.6	2.4	0.15
Stratford	2.5	1.25	5	2.5	0.5	3.1	2.0	0.15
St. Catharines	2.0	1.0	5	2.0	0.15	1.6	1.0	0.16
St. Mary's	3.0	1.5	6	3.0	0.6	3.1	2.1	0.15
St. Thomas	2.0	1.0	4	2.0	0.5	1.6	1.1	0.15
Thamesford	...	....	..	...	....	5.2	3.5	0.15
Thorndale	5.0	2.5	10	5.0	1.0	5.2	3.5	0.15
Tillsonburg	3.0	1.5	6	3.0	0.6	3.5	2.3	0.15
Tilbury	...	....	..	...	....	4.3	2.9	0.15
Toronto	2.0	1.0	5	2.5	0.5	1.5	0.5	0.15
Woodbridge	4.0	2.0	8	4.0	0.8	...	...	....
Waterdown	4.0	2.0	8	4.0	0.8	3.3	2.2	0.15
Wallaceburg	...	....	..	...	....	3.9	2.6	0.15
Weston	...	...	..	...	....	2.9	1.9	0.15
Waterloo	2.0	1.0	5	2.5	0.5	...	...	....
Welland	2.0	1.0	4	2.0	0.15	1.7	1.1	0.15
Woodstock	2.0	1.0	5	2.0	0.5	1.8	1.2	0.15

square feet of floor area, the area being estimated as above. For all extra consumption the rate is one cent per kw.h.; 10 per cent. discount being allowed on the whole bill.

It will be noted, too, that the commercial lighting rate and the power rates have been considerably lowered. The power rate is based on a service charge of $1.00 per h.p. of installed capacity (Toronto $1.35 for first 10 h.p. and

$1.00 in excess of that amount). To this is added a primary meter rate as low as 1.5 cents per kw.h. in certain cases, a secondary rate of 1 cent per kw.h. in a number of municipalities with an almost nominal tertiary rate. In the city of Toronto the secondary rate is .5 cent.

The citizens of Toronto who use Toronto Electric Light service also have cause for rejoicing. The residence rate has been reduced approximately 25 per cent. T.E.L. household rates differ from Hydro rates in that the primary charge is based on the number of rooms. To begin with there is no service charge, so that if no current is used none is paid for. The primary charge is 4 cents for the first 4 kw.h. per room of the consumer's residence; secondary charge is 2 cents per kw.h. for the next 4 kw.h. per room and the final charge is 1 cent per kw.h. with 10 per cent. discount. Added to this the T. E. L. Company supply lamps of 60 watt and over free of charge.

The outstanding feature of these new rates is that electrical cooking, as far as cost is concerned, is within the reach of all municipalities affected by the reduced schedule. Take, for example, a nine room house using 200 kw.h. per month. On the supposition that the floor area is reckoned at 1,800 sq. ft., the Toronto Hydro bill would be: (1) Service charge of 3 x 18 equals 54 cents; (2) primary meter charge of 2 x 3 x 18 equals $1.08, and (3) secondary meter charge of 1 x 144 equals 144 cents. Total account equals $3.06 less 10 per cent. equals $2.76. The T. E. L. Co. rate works out only slightly larger, as follows: (1) first meter charge 4 x 4 x 9 equals $1.44; (2) 2 x 4 x 9 equals 72 cents, and (3) 1 x 128 equals $1.28. Total account, $3.44, less 10 per cent. equals $3.10. Under certain conditions, however, the competing rates are practically the same, and in a few cases the T. E. L. works out lower. Then, too, the discrepancy of 34 cents as shown above may easily be more than accounted for in lamp renewals given by the private company. Either rate, however, is highly satisfactory from the standpoint of the consumer, the manufacturer, the jobber and the electrical contractor. The complete schedule of Toronto Hydro and T. E. L. rates are also printed herewith.

The discount rate for domestic and commercial lighting over the Hydro area is uniform, namely 10 per cent. The power discount is generally 10 per cent. but local conditions have necessitated certain variations. For example, Berlin, Brantford, Preston, London, New Hambourg, Port Dalhousie, St. Thomas, and Woodstock give 10 and 10. Toronto gives a straight discount of 20 per cent. and the following towns 25 and 10: Dundas, Galt, Guelph, Hamilton, Niagara Falls, St. Catharines, Waterloo and Welland.

T. E. L. Rates

Residential Lighting:—1st 4 kw.h. per room per month, 4c.; 2nd 4 kw.h. per room per month, 2c.; balance monthly consumption, 1c.; less 10 per cent.; lamp renewal schedule unchanged.

Commercial Lighting (Meter rate):—1st 30 hours monthly use of demand, 5c.; next 70 hours monthly use of demand, 3c.; balance monthly consumption, 1c.; 20 per cent. discount; plus ½c. per kw.h. for lamps, if desired; lamp renewal schedule unchanged.

Commercial Lighting (Flat Rate):—Up to 1,000 watts connected, 4c. per watt; balance, 2c. per watt; 10 per cent. discount; no lamp renewals.

A. C. Power (550 volt, 3 phase):—$1.25 per h.p. for first 15 h.p. of monthly demand; $1.00 per h.p. for balance of monthly demand; 1½c. per kw.h. for first fifty hours use of demand; .2c. per kw.h. for balance of monthly consumption. Twenty per cent. discount.

D. C. Power (230 volt and 500 volt):—$1.25 per h.p. for first 15 h.p. of monthly demand; $1.00 per h.p. for balance of monthly demand; 2½c. per kw.h. for first fifty hours use of demand; ½c. per kw.h. for balance of monthly consumption; 20 per cent. discount.

Toronto City Rates

The city of Toronto has announced reduced rates for 1916 which will mean reductions anywhere from 10 to 25 per cent., depending on conditions. These rates are as follows:

Domestic—Three cents per 100 sq. ft. of floor area per month, plus 2c per kw.h. for all consumption per month up to 3 kw.h. for each 100 sq. ft. of floor area charged; plus 1c per kw.h. for all additional consumption per month, P.P. discount, 10 per cent.

Commercial—5c per kw.h. for the first 30 hours' use of load per month; 2.5c per kw.h. for the next 70 hours' use of load; 0.5c per kw.h. for all additional consumption per month. P.P. discount, 10 per cent.

Power—$1.35 per h.p. per month of load for first 10 h.p.; $1 per h.p. per month of load for all over 10 h.p.; 1.5c per kw.h. for first 50 hours' use of load per month: 0.5c per kw.h. for second 50 hours' use of load per month: 0.15c per kw.h. for all additional consumption per month. P.P. discount, 20 per cent.

Street Lighting—$8.00 per 100-watt lamp per year. (Unchanged).

Montreal Council Rejects Advice

By a vote of 7 to 22, the Montreal Council has declined to accede to the request of the Council of the Canadian Society of Civil Engineers to appoint an independent board of engineers to report on the aqueduct scheme, particularly the portion dealing with the proposed hydro-electric development of 10,000 horse power for pumping and lighting purposes. The discussion centred on the economic value of this proposition. Alderman L. A. Lapointe, who proposed the appointment of engineers to make a report on the whole scheme with instructions to make whatever suggestions might be deemed advisable, contended that power could be obtained at a lower cost from private companies than was possible under the proposed scheme. Controller Cote defended the plan; he argued that the objections were too late, and that the scheme had been approved by competent engineers, with the exception of the power house plans, which, he said, will be laid before qualified engineers at a later date. Controller Cote declared, and the Mayor agreed, it was imperative that the city should be prepared to do its own lighting in view of the possible formation of a big trust by the lighting and power companies of the city. It was easy to understand, added the Mayor, why these companies were opposed to the scheme. The Council authorized a loan of $1,500,000, a portion of which will be used for the hydro-electric development. The plans for this are being prepared.

The Council of the Canadian Society of Civil Engineers base their opposition to the scheme as it exists today on the ground that it has not been reported on by independent engineers, although portions have been examined from time to time. Criticism is directed by members of the Society particularly to the hydro-electric section, as being very extravagant, several times the cost of developments in the neighborhood, and entailing very heavy annual charges on the citizens, while the amount of power to be generated is problematical. In the issue of the Electrical News of September 1st last, a Montreal engineer criticized the scheme in detail, and gave figures to show that Controller Cote has under-estimated the cost of operation, that there is no justification for installing a plant in preference to taking current from private companies, and that the scheme is financially unsound.

British Industries Fair

In view of the great success of the British Industries Fair, held at the Agricultural Hall, London, England, from May 10th to 21st, 1914, the Imperial Board of Trade have decided to hold the second British Industries Fair at the Victoria and Albert Muesum, Kensington, London, on February 21st, 1916. The Fair will be open for 12 days.

The Fair will be conducted on the same lines as that of 1915, and is intended to extend to British Manufacturers the same advantages as have been derived by continental manufacturers from the Trade Fairs held in their respective countries. Buyers from the United Kingdom and from all parts of the world are invited to the Fair, and as it is intended for the trade only (the general public not being admitted), buyers will have an exceptional opportunity of transacting their business in a minimum of time.

Manufacturers only will be allowed to exhibit, and their exhibits will be strictly confined to goods of their own make. The Trades exhibiting will be:—Toys; Glassware; Fancy Goods; Earthenware and China; Printing; Stationery.

Admission to the Fair will be by invitation of His Majesty's Board of Trade only, and will be restricted to bona fide buyers for United Kingdom and Overseas Markets. Buyers from the Dominion of Canada visiting the United Kingdom during the course of the Fair, i.e., February 21st to March 4th, and interested in the above mentioned trades, should not fail to communicate immediately on arrival in the United Kingdom with the director, British Industries Fair, 32 Cheapside, London, E.C. It will also be to their advantage to notify the Trade Commissioner's office, 3 Beaver Hall Square, Montreal, giving particulars of the firms they represent, and their addresses in the United Kingdom. Any further information may be obtained from C. R. Woods, assistant to H. M. Trade Commissioner in Canada and Newfoundland.

Laurentide Power Co.

The Laurentide hydro-electric development at Grand'-Mere, P.Q., has been formally handed over to the Laurentide Power Company, bonds of which have been sold in New York. The price paid to the Laurentide Company for the property is 70 per cent. of the $10,000,000 stock. Two contracts for the sale of power have been made, 25,000 horse power to the Laurentide Company, and 50,000 horse power to the Shawinigan Water and Power Company, and on this basis it is estimated that the earnings for 1916 will be about $500,000, leaving a surplus of $135,000. When the full output of 125,000 h.p. is sold the company's gross income is placed at $1,250,000. Fixed charges, etc., will take about $450,000, leaving a surplus of $800,000, or 8 per cent. on the stock. The demand for power in the district served by the Shawinigan Company, the prospectus issued in New York states, "is so great that it is expected that the company will anticipate the dates on which it is provided it shall take additional power, and it is fully expected that not less than 75,000 h.p. will be in use in the second year of the Laurentide Power Co.'s operations." The bonded debt of the company, which is less than $60 per horse power, is stated to be less than that of any similar hydro-electric development of the present day.

Winnipeg Sleet Storm Brings Down Towers

A sleet storm in Winnipeg, Man., early last month, resulted in the breaking down of one tower on the lines of the city's municipal transmission system, about 30 miles from the city, and caused about 2 miles of wire to be thrown off the towers of this system. The transmission line of the Winnipeg Electric Railway Company was broken in two places, but the damage, which was not so serious, was repaired by night time. The weather conditions were exceptional for that region, the sleet being of such thickness on the wires that the over-all diameter exceeded 2½ in. The cables of the municipal system have a total area of 278,600 circ. mils and are strung on towers such as the one shown in the accompanying illustration alternating with braced structures, spaced 600 ft. apart. The insulators are of the pin type and the wires are spaced on 6 ft. centres, six conductors per tower. The damage to the municipal system was such as to take twenty-three hours to repair it and place it in service.

Sleet storm doubles up one of Winnipeg municipal towers.

LETTERS TO THE EDITOR

Montreal, January 3rd, 1916.

Electrical News, Toronto, Ont.

Gentlemen:—We noticed on page 21 of the January issue of the Electrical News that the statement is made that Mr. W. E. Skinner, Consulting Engineer of Winnipeg, prepared the final agreement as accepted by the City and this Company for a thirty year power contract, and we would be glad to have you correct this statement, inasmuch as the facts are that the agreement between the Edmonton Power Company and the City of Edmonton is an agreement submitted by the Edmonton Power Company two years ago with modifications made at joint meetings by the representatives of the City, who were Mr. W. E. Skinner and Mr. Bown, the City's Solicitor, on behalf of the City of Edmonton, and Mr. H. H. Hyndman, Solicitor, and Mr. R. S. Kelsch, Consulting Engineer, of the Edmonton Power Company, with further modifications as made by the special power committee from time to time.

Yours truly,

EDMONTON POWER COMPANY, Limited.

At the annual meeting of the Kaministiquia Power Company held in Montreal on January 4, the following directors were re-elected: Sir H. S. Holt, president; Messrs. C. R. Hosmer, vice-president; W. A. Black, managing director; and J. E. Aldred, F. H. Phippen, K.C., and J. S. Norris. Earnings for November, the first month of the current fiscal year, amounted to $23,955, as compared with $18,085 for the corresponding month last year.

Construction Features of Mexico Plant

Described by Mr. R. F. Hayward before Vancouver branch of C. S. C. E.—Fortunately little interfered with by revolutionists.

Nearly all of the prominent men connected with the formation and development of the Mexican Light & Power Company's enterprise have passed away in the last few years. Don Porfirio Diaz, President of Mexico, by whose government the enterprise was made possible, died last year. Sir George Drummond, Sir Edward Clouston and James Ross, directors from the inception of the undertaking, and J. D. Schuyler, consulting engineer for the Necaxa Dam, have also passed away. And now but a few months ago Dr. F. S. Pearson, the engineer to whose fertile brain and energy was due the conception, planning and completion of the undertaking, went down with the Lusitania. It therefore seems a fitting time to call to mind some of the features of the Necaxa development, which, for variety of new problems and difficulties met and worked out, is still quite unique in the history of water power development

Mexico City is situated on a plateau nearly 8,000 feet above sea level, surrounded by a rim of mountains rising from an elevation of from 10,000 to 17,000 feet and including three extinct volcanoes, Popocatepl, Ixtaccihaatl, and The Peak of Orizaba.

A traveller journeying 100 miles in a northeasterly direction from the City of Mexico comes to the rim of a plateau and finds himself suddenly entering a wild mountain region as if from the clouds. These are the slopes from the plateau to the Gulf of Mexico, along which the warm moist air from the gulf, condensed by the cold drift from the plateau above, produces a rainfall which amounts to as much as 150 inches in a year, giving a run-off which, though it varies greatly from month to month, is sufficient to produce large quantities of power from comparatively small watersheds.

The valley of the Necaxa is formed by two limestone ridges and has been filled by successive flows of lava, to a depth of some 1,500 feet. Between the limestone mountains and the lava on each side of this valley the water has cut a channel forming the Necaxa River on the one hand, and its tributary, the Tenango, on the other. At a point some twelve miles below the rim of the plateau this river has cut out a gorge in the basalt 1500 feet deep, and arrives at the bottom in two vertical leaps called Salto Chico and Salto Grande, the upper fall being 360 feet, while the lower one is 740 feet.

The problem presented to Dr. Pearson was to utilize the power of the river going to waste over these falls and to bring machinery for the plant and all that was required for construction into a wild mountain country, where the sole means of communication was a mule trail, and the nearest railway was thirty miles away.

A three-foot gauge railway, thirty miles long, had first to be constructed, and this, owing to the nature of the country, had to be built with curves of the smallest radius possible for Shay locomotives, and with grades as high as 8 per cent.

In order to make use of the mean annual run-off of the watershed of the Necaxa River, four reservoirs were constructed, and later, when it was found necessary to develop more power to meet the rapidly increasing demand, two other reservoirs were built while a series of tunnels, one of which was two miles long, were built to tap adjacent watersheds.

The construction of these reservoirs involved the building of seven earth dams all of them important structures as compared with other earth dams, and two of them, at least, higher than any earth dam that had previously been built. Some of these dams were built entirely by the hydraulic fill method; the others were a combination of core wall, rock fill, clay and earth fill, placed by hand labor, mules and steam shovels, with some hydraulic fill in the centre.

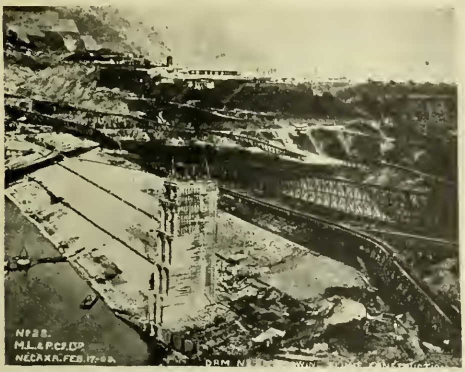
A description of all of these would be beyond the scope of this article, and there is space to refer only to the largest, or the Necaxa Dam. This dam was built entirely by the hydraulic fill method. It was 200 feet high from the bottom of the core trench to the crest of the dam, about 1,200 feet along the crest, and over 1,000 feet on the base from upstream toe to down-stream toe. The slope of the upstream face was three to one, and the down-stream face two to one. The lower toe was a heavy rock fill faced with three feet of rubble masonry laid in cement. The upstream face consisted of the lighter rock fill rip-rapped with stone, and the centre was fine sluiced clay. The total quantities in the dam were about 2,000,000 cubic yards, and in the preparation of the foundations 200,000 cubic yards

First Necaxa Falls, showing temporary plant.

Second Necaxa Falls, 740 ft. high.

Power House and Construction Camp.

of top surface had to be removed. There were three core trenches, one of which was 43 feet deep, and these were built with concrete core walls brought up to a considerable height above the foundation of the dam. All the material was hydraulically filled, and for this purpose a canal twelve miles long was built along the mountain side, bringing a flow of 35 cubic feet per second under a head of 450 feet, which was used in 6-inch monitors for bringing down the clay and rock.



Necaxa dam from upstream toe showing sluicing trestles.

The material was carried to the dam in wooden V-shaped flumes placed on trestles, which were built up as the work progressed. The material was discharged along the edges of the upstream and the downstream slopes, the rocks and heavier material remaining where they were discharged, and the lighter silts and clays being deposited in the pond in the centre. By this means rocks as big as a man's body were carried through the flumes and deposited in the toes of the dam.

This was the first really large hydraulic fill dam that had ever been built, and as in so many engineering enterprises, when very large undertakings are carried out upon the experience of much smaller works, it was found that the methods previously used had to be materially modified.

While there was a heavy mass of rock fill on the lower toe, the rock fill on the upper toe was comparatively light, and the fine clay that had settled in the centre not only filled a bigger space than had been originally intended, but it never solidified, and consequently, shortly before the dam had reached its maximum height, the hydraulic pressure due to the head of semi-liquid clay became greater than the light rock toe on the upstream side could stand, and 500,000 cubic yards of material slid out of the dam early one morning. The work was repaired by sluicing a large quantity of rock into the up-stream toe, increasing the rock fill on the lower toe, and then finally filling the greatly reduced space in the centre with sluiced material. The dam, which has been completed for over three years, is absolutely tight and in every way satisfactory.

Relief valves of 6-8000 h.p. wheels discharging under head of 1500 ft.

From a concrete intake tower, built on the upstream toe of the dam, two 6-foot steel pipes about three-quarters of a mile long conveyed the water to the top of the falls. From this point two inclined tunnels each half a mile long, were built on a slope of about 40 degrees, and inside each of these tunnels was laid, on concrete saddles, three 30-inch welded steel pipes. These pipes, which had to stand a head of 1,500 feet, or over 600 lbs., pressure at the lower end, were flanged and welded, and the joints were made by bolting each length of pipe together with loose flanges and a special rubber gasket. The pipes were laid and started practically without a leak, and have been in satisfactory operation ever since. Later, when an extension of the power house was decided on, a third 8-foot pipe was laid from the dam to the head of the tunnels, and a third inclined tunnel, with two additional pipes, was built.

Necaxa dam, lower rockfilled toe with masonry face.

The power house was located close to the foot of the lower falls. The only access to the site of the power house was by means of a tortuous mule trail down the precipitous sides of the gorge. All the materials for the power house were brought down by means of two 15-ton Lidgerwood inclined cableways, stretched from the top to the bottom of each of the two falls. With these two ways the greatest weight of materials and machinery that could be carried down in a day was about 50 tons, consequently the work of construction of the power house and erection of the machinery was necessarily slow.

The power house consists of a massive concrete steel frame building, in which are installed six 8,000 h. p. waterwheels, driving 5,000 kw. generators, together with an equipment of switchboards and transformers for transmitting the power at 60,000 volts. The wheels are of the impulse type on a vertical axis, so arranged that the high pressure water and the whole of the water wheel is entirely below the generator floor, and are provided with relief valves so that the pressure pipes could discharge in a horizontal direction over the tail race of the power house whenever the pressure exceeded a certain predetermined amount. One of the accompanying photographs shows six of these relief valves discharging at one time under a pressure of 600 lbs.

When it became necessary to enlarge the power house these six water wheels were increased in capacity by enlarging the nozzles, as there was sufficient margin in the generators to produce additional power. But besides this, two 16,000 h. p. units of approximately similar design were added.

The whole design and construction of this plant is of the greatest interest, even though it is not today the newest hydro-electric plant, and when a government in Mexico is formed that compares in any way with the strong effective government of General Diaz, this plant will be of tremendous benefit to the future development of this section of Mexico. It is a remarkable thing that, in spite of all the disturbances in that unfortunate country, the Necaxa plant has never been interfered with to any serious extent.

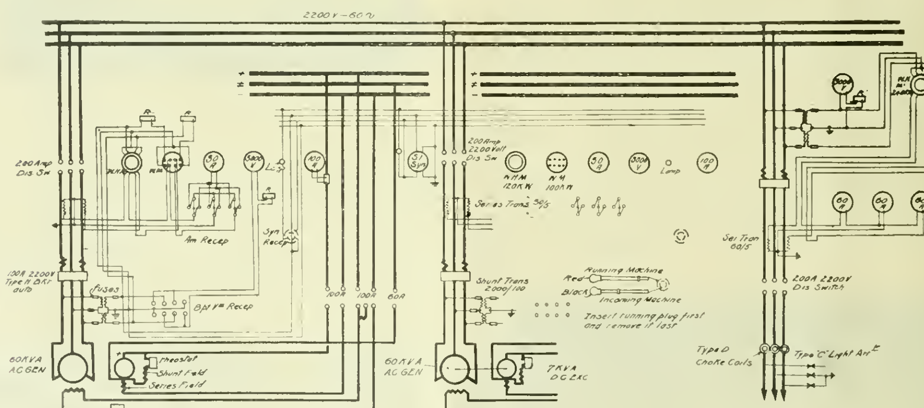
Diesel Installation in Duncan, B.C.

Latest type of this machine operating continuously for many months—High efficiency at all loads—Low rotative speed

By W. Poole Dryer

Particular attention attaches to the new municipal electric power plant at Duncan. It marks a further advance in Diesel engine design and construction. The installation consists of two Morley-Guldner Improved Diesel engines, each of 100 h.p., direct connected to three-phase alternators. Since the plant started operation several months ago, it has carried the entire town load and is giving twenty-four hours' service. It is satisfactory to record that the engines have given continuous service without stoppage, showing that Diesel engine power plant is absolutely reliable and free from mechanical troubles.

The city of Duncan when contemplating building its electric power plant seriously considered generating by water power. However, on making detailed estimates of the cost of the hydraulic installation, it was found, as is frequent with this type of plant, that an excessive initial expenditure would have to be made; and that a very large proportion of the ultimate capitalization would have to be incurred at the beginning, when only a fraction of utilizable power was required. Comparative estimates show that during the early years, while load is building up, the burden of interest charges on a large part of non-earning capital invested in a water power plant are often heavier than the cost of fuel for a Diesel plant; for these oil engines need only be large enough for present requirements, new units being added as load increases. The economic advantage of the Diesel engine is further increased by the fortunate fact that the efficiency of small units is very little less indeed than that of large units. The city council of Duncan therefore placed the contract with the W. Poole Dryer Company, Limited, of Toronto and Vancouver, to supply and erect the complete machinery for a two-unit Diesel electric power plant, including engines, alternators, exciters and switchboards.



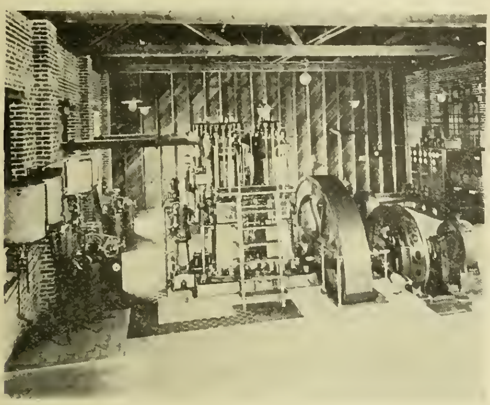
Wiring diagram of Duncan's Diesel power house—Two 100 h.p. engines direct connected to 60 kw. generators.

Morley-Guldner Improved Diesels

As these engines represent an innovation in Diesel design as far as Canada is concerned, it will be of interest to describe their features, showing the radical modifications large Diesel engines have undergone in Europe during the last three or four years. They were built at Bradford, England, by Messrs. Cole, Marchent & Morley, Limited, who are represented in Canada by the contractors of the Duncan plant.

The Morley-Guldner engine was evolved from the standard design of Diesels by Mr. H. Guldner, who was previously chief engineer and constructor of the original Diesel firm. His long experience in the position of a leading Continental authority on internal combustion engines, showed Mr. Guldner two things: first, that the Diesel principle, by its superior economy, was the ultimate solution of the oil engine; second, that owing to faulty mechanical design the Diesel engine had so far been excluded from its full inheritance of wide adoption. He considered anew the whole mechanical construction of the engine, and proceeded to design and construct an improved Diesel engine, which would not only retain the high efficiency of the older engines, but even increase it, and which at the same time could be depended on in operation for freedom from mechanical troubles. Engines made to these designs have been installed during the last few years in remote places all over the world; their reliable operation where skilled attention is not obtainable has justified the modifications made to older Diesel practice.

The true Diesel 4 cycle principle is retained. The elevation of efficiency and the elimination of troubles are obtained by boldly adopting low rotative speeds—none of these engines run at more than 212 r.p.m. This twofold result of low speeds is well worth the change, for nothing so retarded the general adoption of Diesels for years as the attempt to make the engines run at high speeds for which they are



Interior Diesel power plant, Duncan, B.C.

not inherently suited—most of the mechanical troubles were due solely to that cause. The low speeds slightly increase the size of the engine, but ensure great reliability in operation; lower fuel consumption is a necessary concomitant of low speed.

Valve Mechanism

A radical change is introduced into the valve operating mechanism, as will be observed on the accompanying illustration; the cam shaft is fixed low down on the frames, not as in the older Diesels up among the congestion of valve levers at the top of the cylinders. By lowering the cam shaft to this new position, the valves and levers are left very accessible and can easily be removed—a point all operators will appreciate; and the cam shaft itself is now in a very convenient position, being just at the hand of the operator standing on the floor. A further important innovation is that the cam shaft runs in an enclosed oil bath which ensures perfect lubrication and silent operation—the usual Diesel click of the cam shaft is absent. The vertical rods seen in the illustration are the valve connecting rods which are moved up and down by the cams at their lower ends.

Governing

A separate fuel oil pump is used for each cylinder, thereby ensuring an equal distribution of work between the cylinders. The speed of the engine is regulated and controlled by a spring loaded governor which proportions the amount of fuel oil used in each power stroke to the momentary load of the engine. This is effected by the governor automatically adjusting the opening of the fuel oil suction valve, holding it more or less open as the speed varies, and so allowing the excess oil to be pumped back into the suction pipe instead of being forced to the cylinder.

The governor itself is located on the top of the vertical shaft which drives the cam shaft, and it has a speed-adjusting device attached to it by means of which the speed of the engine can be altered while running.

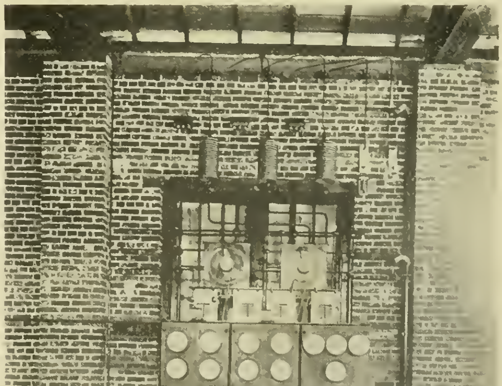
Forced lubrication is adopted, the oil going first to the piston, and then to the gudgeon pin.

Air Compressor

The air compressor is situated at the end of the crank shaft, and is direct driven by it. This position gives accessibility and allows the compressor to be designed according to the best practice. Flat disc valves are used, which, besides eliminating "sticking up" troubles, give a high volumetric efficiency resulting in a small power being required to drive the compressor. The air is compressed in two stages with inter-cooling, and is delivered to the running bottle, where it is throttled by hand at the outlet; this regulation of the blast determines the quantity of oil blown into the cylinders proportioning it to the load demand. In addition to the running bottle two very long starting bottles are attached to each engine; and the reserve capacity of these bottles is so large that the Duncan plant can be started up a dozen times without recharging them. No trouble need ever be feared from loss of pressure, nor need provision be made for independent means of recharging the bottles. As the engines never fail to start with the first blast from the bottles, the excessive reserve of starting power is merely a safeguard against inexpert handling.

Alternators

The two alternators are each rated at 60 kv.a., and generate 2200 volts, 3-phase, 60 cycles. The engine shaft is directly connected to the alternator shaft, which carries the



A neat switchboard arrangement, Duncan, B.C.

exciter armature also. The synchronizing of the two units has proved to be an easy matter; a very heavy flywheel on the engine smooths out the two cylinder impulses, and damping windings on the alternator effectively prevent hunting troubles arising from interchange of current between the two machines.

Switching Arrangements

The switchboard consists of three Westinghouse panels, one for each unit and the other for the outgoing line. Low tension connections only are made to the board, all the 2200 volt switches being foxed on the wall four feet behind. Particular care has been taken to give all the wir'ng behind the board great mechanical strength so that the position of each wire is fixed for all time; attention of this kind assures immunity from short circuits later on and at all times makes the tracing out of connections an easy matter. All leads running from the switchboard to generators are of lead covered wire pulled into conduit.

General Operation

For the series tungsten street lighting system of the town a separate Canadian General Electric panel detached from the main switchboard is installed and works in conjunction with a constant current transformer just behind it.

For the operation of the plant one man per shift suffices; and it will be of interest to mention that the operators in this plant were previously quite unacquainted with the running of Diesel engines. Yet so simple and reliable is the Diesel electric station now, that in its ten months of continuous operation no trouble or mishap has occurred in this plant. Overshading even the great saving of labor and maintenance is the economy of fuel costs compared with steam plants, the actual fuel cost in the Duncan plant being approximately one-third of a cent per kw. hour.

It might be added that the successful operation of the Duncan installation is in no small way responsible to the enthusiastic interest taken in it by the City Engineer, Mr. M. Leighton Wade.

Easy Payment Plan in Appliance Sales

The instalment plan is a well recognized system in general retailing, why not in ours?—Must meet people half way

By Earl E. Whitehorne in Electrical World

If you could go to-day before 500 of the livest central-station managers in the country and should ask all those who don't believe in "easy payments" to stand up, what do you think would happen? A big majority would climb up on their feet and register against it—and yet, if you should ask their reasons one by one, you would find about two answers and no more. A few would tell you stories that would show a trial foreordained to failure because the principle was unintelligently applied and because the proposition was inadequately presented and worse handled. But the rest would say they don't believe in it because—well, just "because"—because they are prejudiced against it and have never tried it or had eagerness enough really to find out what experience in other cities has developed. Yet those other men who held their seats could tell them stories and cite figures that would settle every reasonable doubt.

New to Us, but Old to Others

The principle of installment payments is still new to us perhaps, but it is old and well established in the big broad world of retail business. Pianos have been sold that way for years. Cash registers are sold that way. Good books are sold that way. And so is furniture and real estate, and so are typewriters and phonographs, electric washing machines and vacuum cleaners, and so are other things that cost too much for most of us to buy conveniently for cash or ordinary credit. This generation has adopted this arrangement to facilitate the purchase of those luxuries and comforts that our grandfathers would have continually sacrificed for fear of debt. We want them, and we consider that our families are entitled to them if a way can be found to buy them without risk or worry, and so the "easy-payment" plan has been devised and universally accepted as a proper and commendable expedient.

This is the way it strikes us individually, but as an industry we face it from the other angle.

"Here are these goods," we say. "They cost a lot of money, and it's hard to sell them outright to the average home. Now, what has been the experience of other manufacturers and merchants in such situations?" And we find that other industries have most successfully adopted the easy-payment plan, and there is our answer. Again, on looking deeper we discover that this plan is better suited to the central station than to any other business that employs it, for the central station is already well equipped with full machinery for collecting monthly payments, because easy payments just become an added item on the bill—and there you are! There is no reason why the central station should not do it, but there is prejudice against it, and such prejudice dies hard.

A Few Notable Examples

In Pittsburgh, for instance, the Duquesne Light Company did not believe in easy payments and sold electric washing machines for years for cash. It never averaged better than ten or twelve sales a month in all its territory. Then it offered these machines on a basis of 20 per cent., or $18, cash down, and right away its sales increased to an average of twenty a month. It cut the price to $10 down, and sales increased again to thirty a month. Again it reduced the amount of the initial payment to $5, and the monthly average ran right up to over sixty, and the company is confident that with a little harder pushing it can reach a scale of 75 to 100 machines sold every thirty days. In the month of October this company sold 275 vacuum cleaners of one make alone, this being the machine it featured on an easy-payment proposition.

In Cleveland a prominent dealer sold about six washing machines a month until quite recently an installment offer was made. Already sales have jumped up to thirty or forty a month, and as soon as the campaign develops further this city should be good for a greatly increased output.

Again, in Bloomington, Ill., a good example of a smaller town of 25,000 people, the central station formerly was selling only about ten machines a year until it offered easy payments with $10 as the cash down with the order. In a very short time the average was raised to about ten sales each month, twelve times as much as had been done before, with no more work.

There are unlimited examples of just such experience. I talked the other afternoon with one of the biggest manufacturers of washing machines, and he reeled the cases off too fast to make notes of, though there would be small point in such repetition here. For the thought I want to make is this: that the whole thing boils right down to principle and policy and prejudice. There is no use in citing figures to a man whose prejudice refuses to believe that such good evidence applies to him; and anyone who thoughtfully will turn the matter over in his mind and see the facts and what they offer him can find at hand a wealth of data ready for his use and all the personal testimony he could wish in confirmation. No matter who takes the trouble to inquire and consider can question for one moment in his own mind that the easy-payment plan sells big appliances a hundred times more quickly than the old ways. It has been proved so clearly by so many companies which he knows are just as wise as he is in the operating of a central station that it is no longer a matter for argument where the facts are recognized. His "local conditions" cannot be so "different" that among the many companies large and small where big results have been achieved by easy-payment selling there is not a clear case of appropriate example to guide him. The whole thing simmers down to a simple matter of attitude. Are you willing to adopt a new plan of progressive merchandising in order tremendously to increase your sales, not only of ranges, fireless cookers, washing machines and vacuum cleaners, but of all appliances? For if the principle is good for one it is certainly good for all. Or are you "agin it" just because it is new and strange to you and sounds like trouble?

Why We Need the Easy Payment

"Why should it be necessary?" asks Mr. Skeptic. But as individuals you know just as well as I do. As this manufacturer expressed it: "People can't afford to put down $100 in cash to buy a high-priced washing machine, no matter how much money they have. A woman usually has an allowance for running the house, but she can't squeeze that much money out of any one month's allowance, so she must buy by installments or not at all. We have people who we know could buy out our whole company come in and purchase on the easy plan. Then take the fellow who earns $125 a month—he can't afford to pay down $25 or $50 for a household labor-saving appliance, no matter how much he wants it. He is glad to buy on small payments, however, and his account is just as good on your books as Rockefeller's; and, after all, these are the people who buy the bulk of the machines. It is the man whose wife is doing her own work, or the household with one overloaded servant, that you must adapt your proposition to."

In other words, the people are anxious to buy. Are you willing to meet them half way?

The greatest obstacle to the general immediate adoption of the easy-payment plan, the manufacturers say, is difficulty in convincing the "man higher up." The central-station salesman is "for it," for he knows that it will open up a wonderful amount of business. The commercial manager is not slow to appreciate the opportunity. Yet upstairs sits the Big Chief, and too often the Big Chief says: "I don't mind carrying a good customer if he needs accommodation in the buying of a range. If he comes in and asks for it, we'll sell him on the installment plan, but I don't think we want to advertise broadcast." Yet the salesman knows that the public won't come asking easy payment as a favor. Natural pride won't let it. The central station must either offer easy payment as a special inducement free to all or just give up the thought of doing any worth-while business in the big appliances.

Why should you fear to advertise this policy? Your bookkeepers are making bills out every month to every customer. Another item on the bill adds no appreciable expense to you per bill. Your bills are sent out regularly to every customer. Your regular collectors are available to bring the money in just as they do at present. You are equipped and ready to take on this easy-payment business with a minimum of cost and trouble. To cover cost you can add an item of 5 per cent. to the selling price. (This 5 per cent you can offer as a cash discount too.) Keep the title to the appliance till the final payment is made and you are perfectly secure. For there are ample facts to prove all this. One company, for instance, that now has $80,000 on its books in these accounts finds that it averages less than five appliances taken back each month because of failure to pay, and most of these are soon restored again. Moreover, if manufacturers can sell on easy payments, and if local dealers can make money at it, why should central stations hesitate when really it means just a slight extension in the present scheme of doing business? For it is but a short step from selling energy by the month and selling energy-consuming appliances to the same good customers on the same safe plan.

The Broader Aspect

Some men hang back and say: "Why bother with the washing machine? It brings only an income of about 25 cents a month." I am not talking about one washing machine. I am thinking about the thousand washing machines that you can sell between now and this day next year—and all the suction sweepers and the percolators and the toasters and the rest of the appliances that you can market just as soon as you will make it easy for the public to acquire them. A single washing machine may mean but 25 cents a month, but a thousand of them will bring you an annual income close to $3,000, and that's the way to calculate the power of the easy payment. How many of the gas ranges that are gayly cooking dinners in your town right now would have remained unsold if the people could not have bought by easy payments?

It is time for every central-station manager who has not tried the selling power of the easy payment to rub his eyes and look about him. Is he working day by day just to perpetuate a set of traditional policies, or is he striving to manufacture needed income for his stock-holders, to "make good" on the capital he operates for them in trust? There is no place for personal prejudices in a matter so important in its possibilities.

New Telephone Line in Fraser Valley

For several years the B. C. Telephone Co., Vancouver, has given long distance connection to Chilliwack along a route north of the Fraser river to Nicomen Island, thence across the river through a submarine cable to the south side and along the Sumas road to Chilliwack. Almost every year at the time of high water this cable has been damaged by floating snags, and it was decided to find some other way of crossing the river. Three plans were suggested—placing another submarine cable, building towers and making a long span, or crossing by means of the C. P. R. bridge south of Mission and building a new pole line along the south shore of the Fraser. The last mentioned plan was adopted. The work was completed some time ago and the results from the new lead are very satisfactory.

About nine miles of new pole line was constructed and about fifty miles of 172-lb. copper wire strung. Of the nine miles of pole line built, eight were distant from any wagon road and all material had to be distributed from the C. N. P. railway, which parallels the lead for this distance.

The special features are the short-span crossing of the Western Canada Power Company's 12,000 volt line about one mile south of Mission, and two long spans, one near Miller's Landing and the other at the Sumas River. While the wire generally used was 172 lbs. to the mile, the long spans required a weight of 435 lbs.

Special attention was given this construction in view of the fact that it will form part of the company's line to the Kootenay. The aim of the B. C. Telephone Company is to have an all-provincial line connecting up the different parts of its system, and to that end toll line construction during the past year or two between Vancouver and New Westminster and to the east has been of the very highest grade.

Electric Railways

London and Port Stanley Electrification—First Unit of Ontario's Hydro Radials Operating Successtully—Description of Main Features

After several months of operation by electricity the London & Port Stanley railway system appears to be fully justifying the hopes of the promoters of this scheme and gives promise of working out so successfully from an engineering and financial standpoint that the dream of a network of hydro radials, covering the whole of the province of Ontario, may now begin, with good reason, to take definite shape. Though, as yet, a separate unit in itself and as such, it is believed, able to show a balance of profit over operating and fixed charges, there is no doubt that this road would find its greatest usefulness as the nucleus of a larger system of radiating lines, which would act as feeders and distributers throughout considerable areas in south-western Ontario. Indeed it is the expressed policy of the engineers of the Hydro-electric Power Commission of Ontario that in seeking to standardize their equipments and system of operation they had prominently in mind the conditions that would have to be met in the years to come when Hydro radials shall be as common as Hydro transmission lines are today. For this reason practice that would naturally have been followed on a 25 mile line as a separate unit has, in many cases, been departed from, and plans substituted having in view a network of possibly ten times that amount of road in the near future.

The essential difference between the London & Port Stanley electrification and that of the earlier systems in Canada which have been considered the standard up to the present time is that the operating voltage is 1,500 d.c. instead of 600. This change of course has demanded higher factors of safety at every point and the variations in design have been worked out and undertaken largely on this account. It is of particular interest to note that the increased voltage, as such, is causing no greater operating difficulties than were experienced with the lower voltages.

Though this road is spoken of in general as an electrification of a steam line, it is, in effect, a new road from the bottom up. For many years the line has been leased to various steam railway companies and when it reverted to its owners, the city of London, in 1914, and it was decided to electrify, it was found necessary to overhaul the roadway from one end of the line to the other. To this end the old 56 pound rails were replaced by 80 pound standard steel, ties were replaced by new untreated cedar and the track was reballasted throughout. Fortunately the bridges were found, for the most part, to be in good condition but a considerable amount of concrete curbing had to be built along various parts of the line.

The Rolling Stock

Up to the present time the rolling stock acquired consists of three 60 ton electric locomotives, five 61 foot steel motor cars, three 61 foot trailers and one 61 foot express car with motor equipment. This latter car is well adapted to give a rapid delivery of farm produce into St. Thomas and London. Further equipment includes five 36 foot steam road box cars, four 36 foot steam road flat cars and three 34 foot steam road cabooses. Details of special features in the design of the locomotives and motor cars have been described in earlier issues of the Electrical News and these are supplemented by a number of line drawings

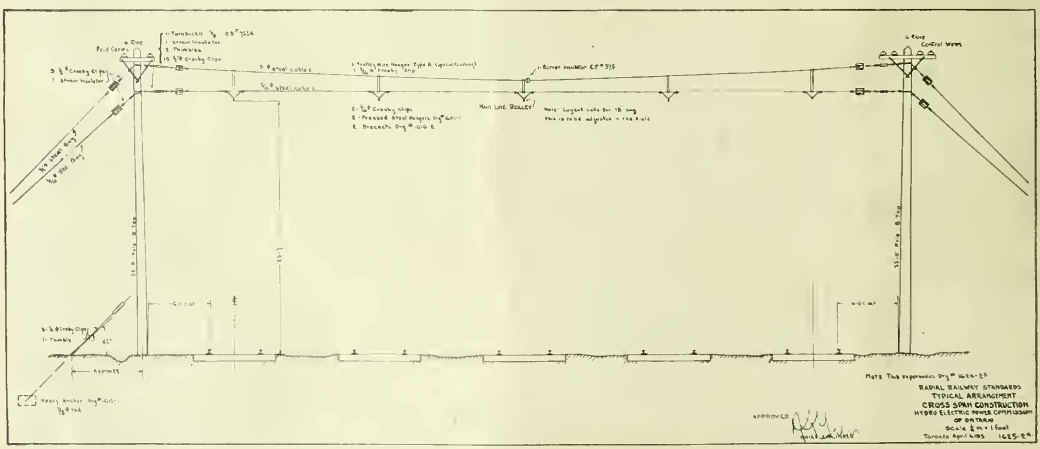


Fig. 1. Standard cross-span construction—Direct suspension for yards and sidings—London & Port Stanley Railway.

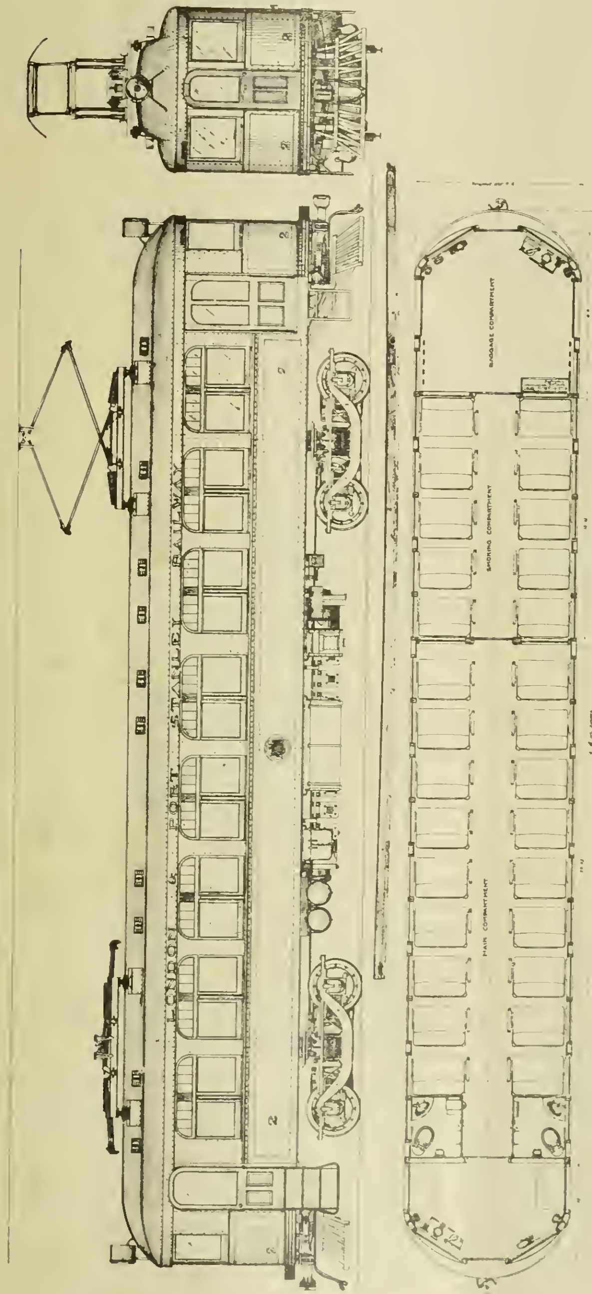


Fig. 2 Plan of three-compartment passenger car typical of rolling stock used on the London & Port Stanley Railway System Note design of pantograph.

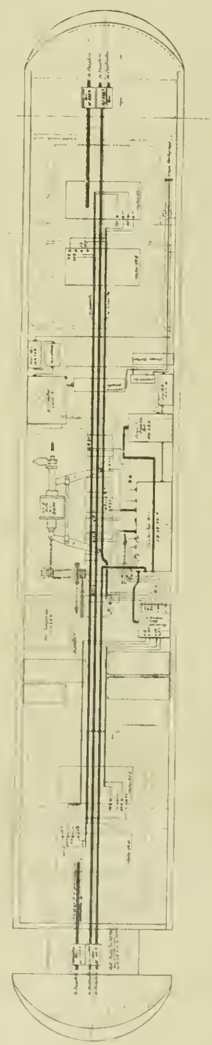


Fig. 3. Figure at left shows wiring diagram and location of electrical equipment.

herewith The specifications of the various cars are also given below in detail.

The locomotives are of the type 404 G. E. and are carried on two swivel trucks, bringing all the weight on the drivers. Equipment is housed in steel box type cab extending over practically the entire length of the locomotive. Each locomotive is provided with four G. E. 251, 750/1500 volt motors, designed for 750 volts across each armature but insulated for 1,500 volts. Two motors are connected permanently in series and the two motor groups thus formed are capable of connection in series or parallel for speed control as desired.

The cab is divided into three compartments, one at each end for accommodating the operator, with an intervening compartment to house the control equipment and accessories. 1,500 v. electric radiators are used for heating.

Each of the motors has an hourly rating of 254 h.p. with 1,500 volts on the trolley. At this rating the locomotives exert a tractive effort of 21,500 pounds. Control is by double-end Type M. standard equipment, a master controller at each operating position actuating the main 1,500 volt contactors by means of a 600 volt circuit supplied from a dynamotor. Multiple-unit train operation is arranged for so that the simultaneous control of all three locomotives coupled together can be accomplished from any master controller. The equipment is designed that the locomotive may haul a train of passenger trailer cars and provide illumination for them.

Current is collected by pantograph slider trolleys having two contact pans pressing against the trolley conductor. Both ends of the locomotives are provided with pantographs. The pantographs are electro-pneumatically controlled from any operating position with 1, 2 or 3 locomotives hauling a train. The pantograph equipments on the motor-cars and express car are identical with those on the locomotives.

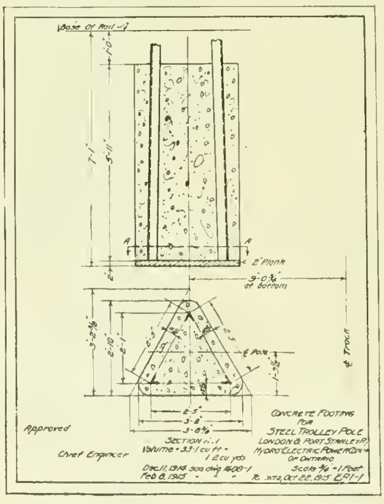


Fig. 4.—Standard steel pole footing

Express Car

Body—Length of body, 59 ft. 6 in.; length over-all, 61 ft.; width over-all, 9 ft. 2¾ in.; height from top of rail to top of trolley board, 13 ft.; truck base, 40 ft.

Truck—Type, National Steel Car Co.; wheel base, 7 ft.; diam. of wheel, 36 in.; tread of wheel, 4 11-32 in.; type of wheel, steel tread; size of journal, 5 in. by 9 in.; diam. of axle, 6 in.

Electrical equipment—Motors, type G. E., 225 B. 750/1,500 V.; motors, 4-125 h.p.; control system, Sprague, type M.; controller, hand control; gear, number of teeth, 57; pinion, solid teeth, 21; type of air compressor, G. E., C. P., 27-A.; size of air compressor, 35 ft.; size of brake cylinder. 14 in.; type of governor, M. L., Form A., G. E. Co.; type of car heater, 1,500 volt Consolidated Car Heater Co.; type of pantograph, G. E. slider trolley; type of pilot, steam locomotive type; type of snow scraper, H. E. P. Comm.; type of headlight, U. S. Incandescent: type of hand-brake, Peacock.

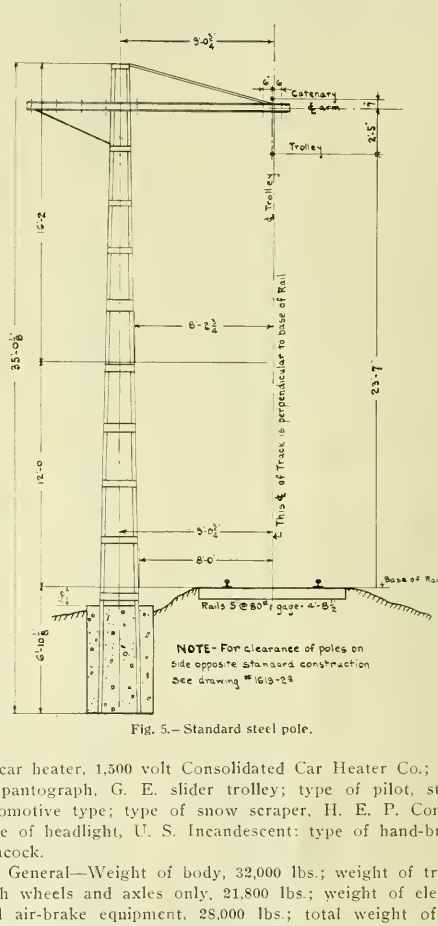


Fig. 5.—Standard steel pole.

General—Weight of body, 32,000 lbs.; weight of trucks with wheels and axles only, 21,800 lbs.; weight of electric and air-brake equipment, 28,000 lbs.; total weight of car complete, 81,800 lbs.

Motor Cars

Body—Length of body, 59 ft. 6 in.; length over-all, 61 ft.; width over-all, 9 ft. 6 in.; height from top of rail to top of trolley board, 13 ft. 5¼ in.; seating capacity, 56; truck base, 34 ft. 4 in.

Truck—Type, Baldwin Locomotive Co., M. C. B.; wheel base, 7 ft.; diameter of wheel, 36 in.; tread of wheel, 4 11-32 in.; type of wheel, steel tread, M. C. B.; size of journal, 5 in. by 9 in.; diam. of axle, 6 in.

Electrical equipment—Motors, type G. E. 225 B. 750/1,500 V.; motors, 4-125 h.p.; Control system, Sprague, Type M.; controller, hand control; gear, number of teeth, 57; pinion, solid teeth, 21; type of air compressor, G. E., C. P., 27 A; size of air compressor, 35 ft.; size of brake cylinder. 14 in.; type of governor, M. L., Form A., G. E. Co.; type of car heater, 1,500 volt Consolidated Car Heater Co.; type of pantograph, G. E. slider trolley; type of car seats, Heywood Bro. & Wakefield Co.; type of pilot, steam locomotive; type of snow scraper, H. E. P. Comm. design; type of headlight, U. S. Incandescent; type of hand brake, Peacock.

General—Weight of body, 40,000 lbs.; weight of trucks with wheels and axles only, 24,000 lbs.; weight of electric and air brake equipment, 28,000 lbs.; total weight of car complete, 94,800 lbs.

Trailer Cars

Body—Length of body, 59 ft. 6 in.; length over-all, 61 ft.; width over-all, 9 ft. 6 in.; height from top of rail to top of trolley board, 13 ft. 5¼ in.; seating capacity, 60; truck base, 34 ft. 6 in.

Truck—Type, National Steel Car Company; wheel base, 6 ft.; diam. of wheel, 34 in.; tread of wheel, 4 11-32 in.; type of wheel, cast iron; size of journal, 5 in. by 9 in.; diam. of axle, 5⅜in.

Equipment—Control system, Sprague, type M; controller, hand control; size of brake cylinder, 14 in.; type of car seats, Preston Car & Coach Co.; type of pilot, steam locomotive; type of snow scraper, H. E. P. Comm. design; type of headlight, U. S. Incandescent; type of hand brake, Peacock.

General—Weight of body, 40,000 lbs.; weight of trucks with wheels and axles only, 20,000 lbs.; weight of electric and air-brake equipment, 2,661 lbs.; total weight of car complete, 62,661 lbs.

Locomotives

Body—Length of body, 28 ft.; length over-all, 37 ft. 4 in.; width over-all, 9 ft. 7¼ in.; height from top of rail to top of trolley board, 12 ft. 10⅛ in.; truck base, 17 ft. 6 in.

Truck—Type, G. E., M. C. B.; wheel base, 7 ft. 2 in.; diam. of wheel, 36 in.; tread of wheel, 4 11-32 in.; type of wheel, solid steel; size of journal, 5½ x 10; diam. of axle, 7 in.

Electrical equipment—Motors, type G. E. 251 K 750/1500 V.; motors h.p. 250; control system, Type M, multiple unit; controller, type C. 107 A; gear, number of teeth, 70; pinion, solid teeth, 16; type of air compressor, 2-C. P. 30; size of air compressor, 35 C. F. per M.; size of brake cylinder, 16x12; type of governor, G. K. 3; type of car heater, 1,500 v. Consolidated Car Heater Co.; type of pantograph, slider trolley; type of pilot, G. E. design; type of headlight, U. S. Incandescent; type of hand brake, rachet and drop lever type.

General—Weight of electrical equipment, 38,950 lbs.; total weight of car complete, 120,000 lbs.

Car Construction

Fig. 2 shows the general floor plan and also exterior side and end views of one of the three compartment steel passenger cars. The car is built of steel, with wood trim; the entire bottom is structural steel, diagonally braced; the end and vestibule framing has special provision against the destructive effects of collision; corner posts and side posts are of channel construction; side sheathing and roof, steel plate; inside trim of car is solid mahogany inlaid in quarter-cut finish; the vestibule is finished in steel with ash trim with the exception of the doors and windows, which are mahogany. Each vestibule has two drop windows, a 26-in. end door, and two 29-in. side swinging doors.

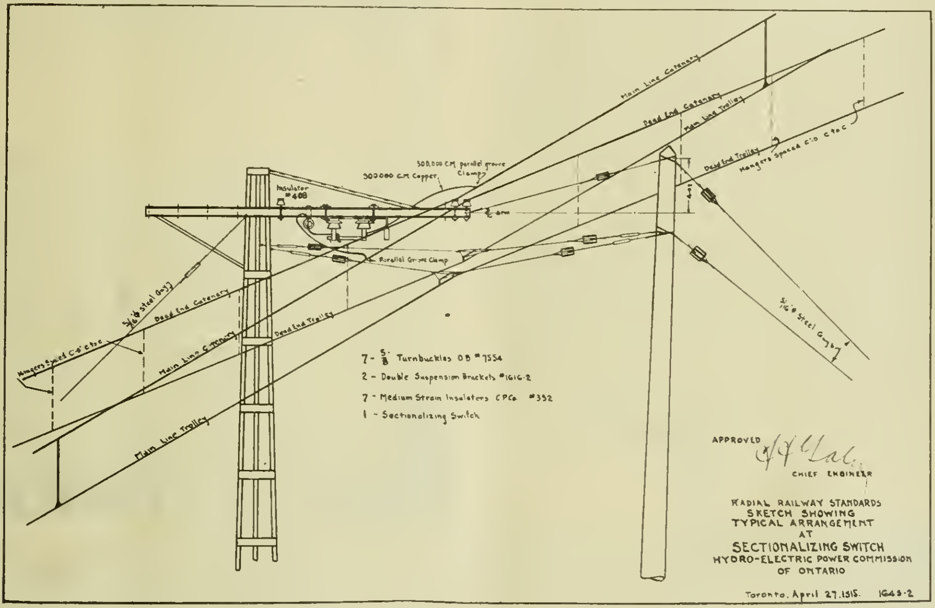


Fig. 6.—Sectionalization switch and equipment—London & Port Stanley Railway.

The interior finish is green, with plush seats of high-back design in the main compartment, and pantasote imitation leather, high-backed seats for the smoking compartment. Solid bronze metal trimmings are used in the main compartments. The toilet rooms are of white sheet steel with white enamel and white steel fittings. The exterior finish of the car is black.

At each end of the car is placed a steam locomotive type iron pilot, on the top of which is a steel plate snow plow controlled by levers from the operating platform.

Lighting and Heating Circuits for Cars

The voltage for the lighting and heating circuits is cut down from 1,500 to 600 volts d. c. by means of a dynamotor. The lighting arrangement consists of five three-cluster semi-indirect ceiling fixtures in the main compartment, one light in each cluster being in series with the corresponding light in the next cluster; also there is a sixth three-cluster semi-indirect ceiling light near the toilet room with its three lights in series with the two lights in the toilet rooms. The baggage room and vestibule lighting consists of two series circuits of five lights each, these circuits being controlled by two three-way switches, one in the baggage room, the other in the vestibule. All lights are controlled from a

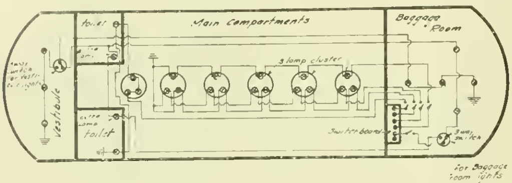


Fig. 7. Lighting plan of passenger cars.

switchboard in the baggage room. All circuits are 600 volts d.c., grounded, with five lights in series.

The car is heated by means of thirty-six electric heaters, placed on the walls, two in the vestibule, one in each toilet, twenty-eight in the main compartments, and four in the baggage room. The heaters are connected in two circuits of 18 each in series, and are supplied from the switchboard in the baggage room.

Lighting Arrangement in Passenger Cars

One of the figures shows the complete wiring diagram of the passenger cars. The lighting arrangement consists of six three-lamp semi-indirect ceiling clusters in the main compartments, five lights in the baggage room, four lights in the toilet rooms, and three lights in the vestibule. The lighting arrangement is to operate five 120-volt lamps in series on the 600-volt service. To obtain this number one lamp in each of the first five main clusters is connected in

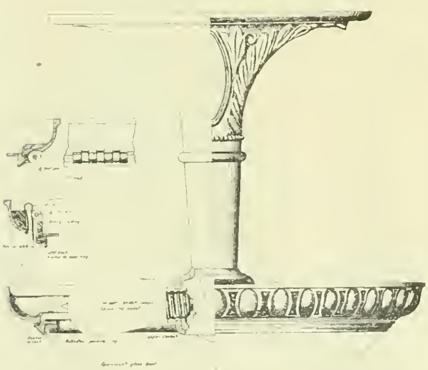


Fig. 8.—Type of semi-indirect unit used on passenger cars.

series with the corresponding lamp in the next cluster. This makes three complete circuits, but if any one of the circuits becomes dead only one lamp in each cluster goes out. The three lamps in the sixth cluster are all in series, together with two lights in the toilets. For the vestibule and baggage room lights a unique scheme has been worked out whereby the motorman may light the vestibule or the baggage room at his convenience for the accommodation of passengers entering or leaving the car. By means of two three-way switches, one in the vestibule and the other in the baggage room, the motorman can, from whichever end he happens to be operating from, turn out the lights in that end without interfering with the lights at the other end, and can, during stops, illuminate both ends.

Control System

The system of control is the non-automatic type M, two-speed multiple unit, arranged to operate the motors in series and series parallel. The two pairs of motors, with their resistances, are all in series on the first point of the controller, the resistances being varied through the first nine points on the controller and short-circuited on the tenth or running point. An electro-pneumatic operated change-over switch is used to make the transition between series and series parallel. Either pair of motors may be cut out by means of a separate handle on this switch. The control system is so arranged that at least six motor cars can be operated as a unit from either end of any car.

The Pantograph

The current collectors are the sliding pantograph type of trolley, two pantographs per motor car. These pantographs are pneumatically raised and automatically lower themselves when the pressure is released. Each panto-

Fig. 9.—Standard steel pole carrying trolley, feed and signal system wires.

graph can be raised or lowered from any operating position in either the motor or trailer car. Each is provided with a cut-out plug to render it inoperative without interfering with the other pantographs. The design of the pantograph is practically standard, with the exception that the legs extend downward through the common hinge. This construction permits of a greater vertical range.

The Source of Supply

The supply of electric energy is taken from the lines of the Hydro-electric Power Commission of Ontario at London and St. Thomas. At these two points arrangements were made for housing the converting equipment in sub-stations already built, so that no new sub-stations were required for the railway system. In London the equipment was installed in one of the sub-stations of the local hydro commission and in St. Thomas space was available in the high tension station of the Ontario Commission. In each of these two stations two 500 kw. rotary converters 13,200 a.c. to 1,500 d.c. were installed. Feed wires are 500,000 c.m. aluminium.

The Overhead Line

The overhead work is carried on triangular steel poles which are utilized for the combined purpose of supporting the feed wires, the trolley wire and the wires of the dispatching system. A pole drawing with cross-arm and showing relative location of the various circuits is shown herewith. Specifications of poles are as follows:—Weight, 800 lbs.; material, galvanized structural steel angles; height, 35 feet; base, concrete, 7 feet in depth, one foot exposed above surface, Fig. 10; cross-arms, 4 in. channel; height of

Fig. 10.—Special design trolley wire hanger.

cross-arm, 26 ft. above rail; distance apart of poles, 140 to 180 ft.; strain test at top of poles, 2,500 lbs. In yards wooden poles are used with span wires, the standard spacing being 90 feet.

Anchoring and Sectionalization

The details of the overhead are shown for the most part in the accompanying line drawings and photographs. The line is anchored every three-quarters of a mile by steel poles. One of these is placed on the other side of the track opposite a standard pole and connected by anchored wire to the next adjoining standard pole.

The trolley and the supply system are sectionalized about every four miles; the sectionalization arrangement is as indicated in one of the illustrations herewith.

Contact System and Type of Suspension

On all main line work catenary suspension is used. The catenary wire is 300,000 c.m. copper, and the trolley is 4/0 grooved. A special design for the trolley wire suspension was developed by the Commission for this contract. A clip with a lip, see figure, fits into a groove on each side of the trolley wire, and is clamped into place and suspended by a hanger to the catenary. These suspension clips are placed every 20 ft. on the main line. In yards, where the poles are most closely spaced, direct suspension is employed as shown

Rail Bonding

Bonds are of 4/0 copper, welded to the outer side of the rail heads. The oxy-acetylene process was used. In practice, the bonds together with a tank each of oxygen and acetylene gas were carried on a light hand car, the whole outfit being operated by one man. Both rails are bonded.

Operating records of such equipment and apparatus are interesting, and it might be pointed out that during the last five months since this road was placed in operation, interruptions to service have been negligible.

Winnipeg Grade Separation

The figure herewith shows Main Street grade separation, Winnipeg, Man., where the tracks of the Winnipeg Electric Railway Company pass under the steam car tracks. This is one of a large number of subways necessary for the separation of grades in this city which will probably be proceeded with in the not distant future.

Every intersection of a highway with a railroad has erected thereon some device by which the public travelling on the highway is protected in a more or less efficient way, depending on the nature of that device. These devices or constructions vary in their effectiveness from the ordinary painted crossboard, which depends for its efficiency on the individual's eyesight, to some form of structure by which the railroad traffic crosses over or under the highway traffic, thereby eliminating any opportunity for an accident.

On account of the flat nature of the site on which Winnipeg is built, grade separation is nearly all done by subways. All subways built, or to be built, are, or will be, such that railroad tracks need be raised only moderately, and street depression allowed.

It is general practice in Winnipeg to place the maintenance of the structure, retaining walls, and foundations in the hands of the railway companies, and for the city to maintain the sidewalks, pavements, and underground utilities and drainage system.

Main Street Subway, Winnipeg, Man.

In the Public Eye

A budget of comment presented in the interest of public welfare, independent of party politics and with malice toward no one.

Mr. McAvity, manager of the Buffalo Forge Company of Berlin, who has been engaged by the Imperial Munitions Board to act in an advisory capacity looks to me like the right man in the right place. He not only has expert knowledge of the manufacture of shells, but is a man of good judgment and wide business experience. He should give valuable assistance to the Committee. The latter evidently means well and if it were built on a somewhat broader gauge could do much to repair the damage done by the Shell Committee. Anyway it is deserving of a chance to show what it can do.

* * *

Huron county struck a new note in the giving line when it refused to make a grant to the recruiting fund. Two reasons are given by the county council for its action. The first is that the Government should pay the cost of recruiting. The second is that there are hundreds of men in the towns and cities who can be much better spared than those who till the soil and raise the food for the men who fight. And both reasons have a certain amount of appeal. Recruiting is just as much government work as clothing and drilling the men who have been recruited. As for the hired man on the farm, he always has been and always will be a scarce commodity. His work is so incessant and such a deadly routine that even camp life is lively compared to it. It is a good guess that if the Canadian army lists were analyzed there would be found a greater proportion of "hired men" and bank clerks than any other calling. You can't blame the farmers of Huron for refusing to further a movement calculated to make them do the hired man's work and "the chores" as well. In all fairness to the Huron council it must be added that it was no spirit of parsimony that prompted their protest. They voted $6,000 a month to the Patriotic Fund—the largest amount voted by any Ontario county council.

* * *

"Gott strafe England" is the cry of baffled rage that comes out of Germany. And well may the Huns ask God to punish Britain, for after more than a year of war it is more than ever evident that the Kaiser can't. Germany, by her "preparedness," has been able to brutalize Belgium, seize the richest part of France, put the steam roller over poor little Servia, and drive the Russians out of Warsaw. But to-day, with the possible exception of one or two small posts in East Africa, she does not hold one foot of British soil. The Empire on which the sun never sets is, by reason of its far-flung dominions, the most vulnerable to attack of any of the allies. But though Germany may sing her hymn of hate she cannot touch even one of Britain's scattered island possessions! On the other hand, the blundering Britisher has swept German commerce from the seas and seized her Pacific islands and most of her African colonies. And in the meantime Britain's "contemptible little army" has grown to a quite respectable gathering of gentlemen in Khaki numbering in the neighborhood of four millions. Even if our politicians and generals do make an occasional blunder it is good to be a Britisher.

* * *

The Minister of Finance hints at another War Loan of $300,000,000. Bring it along, Mr. Minister. The Canadians will take care of it provided it is for the benefit of the Empire. In the words of the song—

"We didn't want to fight, but by Jingo! now we do
We've got the men, we've got the guns, and got the money too."

* * *

One of our subscribers writes us that it is not the duty of trade papers to discuss politics or matters outside of the trade. He may be right. It is true that politics and politicians put the rules of trade carefully to one side before starting to run the biggest business in the country—the country's own business. It is true that no business man would think of running his business on the lines the country's business is run on. He would never think of putting a college professor in charge of a department he knew nothing about simply because he could make a good speech. He would never engage his employees for the simple reason that they had a pull with certain ward politicians. Consequently politics may be a trade apart. But the public have to pay the mechanics who work at this particular trade. Don't you think the said public is entitled to an occasional glance at what its workmen are doing? And how is it going to get it if some paper not "in the game" doesn't break loose occasionally? If a Grit paper criticizes, a Tory paper rushes to the rescue, and the issue is soon lost in the cloud of recrimination that is raised. So sometimes a trade paper stops to wonder why a Government cannot be run along honest business lines, and how long you or I would remain in business if we treated our customers the way the Government treats the public. It is our turn to furnish the public with its "look," and if our readers will bear with us yet a little longer they will discover that they are gazing on the body politic and seeing things, not as they are painted by a Government organ or the opposition critics, but exactly as they are.

* * *

When the cry went forth that this was a war of munitions Australia promptly began to mobolize its state-owned shops for munitions work. Did Canada do likewise? No; Canada—or rather the Canadian Government—promptly sidestepped by handing over the Transcona shops to a private syndicate which is doubtless doing a nice business at a nice profit. Had the Government been big enough to seize an opportunity it could have fitted up the Transcona shops with shell-making machinery at a cost of about $100,000, hired the best mechanics in the country, and turned out at least 5,000 shells per day. Moreover, it would then have been in a position to judge from its own experience just what price should be paid for shells. It would have had at first hand information which would have ended profiteering before it started. But probably the entire cabinet were busy making speeches when the opportunity offered. High-explosive speeches had to take the place of high-explosive shells.

* * *

Britain is said to have black-listed certain United States firms suspected of being affiliated with the Empire's enemies. And from the way the Kaiser's friends in the republic across the way have acted since the war began you would naturally expect the old land to be a bit careful as to whom she deals with. Canadians should follow suit. We have no quarrel with the United States. But within her borders are large numbers of the hyphenated, who are all the more dangerous that they are allowed at large among civilized people. Canadians should be careful that no business of any kind should be placed with them, either now or after the war.

* * *

The protection of the new industries created by the war and its consequent shell orders is to be made the subject of a report from the Economic and Development Commission.

And that report will require the closest scrutiny when it is presented. Even in official Ottawa it is admitted that prices obtained by some manufacturers have been sufficiently high to permit of the scrapping of their plants when the war is over. Of course if these plants can be kept going as business propositions, right and good. But the public will hardly stand for their being fed on Government pap. They've heard so much about munition profits that they'll want to know when the war is over that every Government dollar goes to the man who has fought for his country or those he has left behind him. He who has stayed home and made money will receive scant consideration.

* * *

Sir Robert Borden's New Year's message to the Empire carries with it the hearty endorsement of every Canadian worthy of the name. There may be differences of opinion as to whether the Dominion can raise half a million troops without resorting to conscription, but all are of one mind as regards her intention to try. Everybody is agreed that the war is as much our war as it is the Mother Country's; that our freedom is involved just as hers is. After more than a year of fighting Canadians realize how big is the task that has been undertaken. They also realize that the magnitude of that task proves more than ever how great was our danger. Sir Robert Borden has voiced our unalterable determination to pursue the war to a victorious finish whether it takes half a million or a whole million of our sons and the last dollar that we as Canadians can raise or borrow.

* * *

The report of Sir Alexander Bertram's resignation appears to have been grossly exaggerated. Still there are those who believe that the noble knight will never find his health sufficiently restored to permit of his return to his arduous duties. He has issued two valedictories and received one title. He has explained his position to Sir Sam Hughes and the Toronto Globe. He has not laid down the burdens and cares of office, but he has gone out from among us carrying them with him. It is to be hoped, however, that he will be sufficiently recovered to attend the investigation into the affairs of the Shell Committee which the present session of Parliament can hardly fail to provide.

* * *

Of the $13,000,000 advanced by the Government to western grain growers last spring it is claimed not $1,000,000 has been repaid, and according to the Winnipeg Telegram the farmers are evading payment in the hope that the debt will eventually be cancelled. This, coming on top of the greatest crop in the history of the West, is not encouraging. When the farmer was in need the Government went to his aid; now the Government is in need—of every dollar it can raise or borrow for the purpose of carrying on the war—and the farmer refuses to do his duty. Truly the farmer does not appear in a patriotic or grateful light. Of course the government is secured, but out of a ripe experience the farmer probably figures that a close election might induce a certain leniency. Then again there are stories that shell manufacturers are making enough out of their shell contracts to be able to scrap their plants when the war is over. Does the farmer argue that a Government that buys plants for contractors should also buy seed for farmers? Maybe so. Still, a cry for "free wheat" comes with very poor grace from men who in the hour of need got financial aid from the Government and now in time of their plenty try to evade payment of the money received. And yet if a Government will play practical politics with its people it is not surprising if said people occasionally give the Government a dose of its own medicine.

* * *

When somebody blundered at Ottawa and the patriotic public was led to believe that our boys needed machine guns, the Montreal Star was one of the first to appeal for funds for the good cause. You'll remember the money came with a rush. Then one sad day it was announced that the machine guns were not needed, or could not be bought—or something. Since that time the Star has been busy refunding money to all applying subscribers. At the close of the year it was obliged to confess that there was still $8,000 in the bank, all ready for some one to prove property and take the animal away. By the way what has happened to the money the Government received for this purpose?

* * *

Is Canada to receive no more shell contracts? This idea prevails in certain quarters. Still it was only the other day that Lloyd George was appealing to the patriotism of Glasgow workmen. And that appeal surely carried a conviction that the Empire needs all the munitions her factories can make. Does it all mean that so far as munitions and munition contractors go Canada is not looked on as part of the Empire but rather as a neutral country? Are our contractors put in the "cold business" class occupied largely by our Yankee cousins? Has Britain refused to forget that when men cried from the trenches for shells the Canadian manufacturer came forward with a dollar's worth of shell in one hand while the other hand was held out for $5.00? Are we to give our sons to the Empire by the half-million and yet to have a cold, hard, commercial rating that belies our loyalty? Is Canada as a whole to suffer that a few may become rich? These are questions we are not to ask. The answers might harm some of our alleged leaders. And we must be loyal to our leaders rather than to the Empire and the freedom the continuance of that Empire assures us.

* * *

And now it is claimed that the Allies are placing orders in the dominions for forty million dollars worth of lumber. Tremendous quantities of it are being destroyed on all fronts every day. Norway and Sweden are being swept clean and the Allies now have to go further afield for their supplies. Add to this the amount necessary to rebuild the various war zones and you'll be prepared to admit that the man who has a timber limit is almost as well off as he who rejoices in a shell contract.

* * *

There have been several additions to the select circle of Canada's aristocracy during the last week or two. I haven't the slightest objection to offer but what with honorary colonels, honorary generals, knights, barons, etc., the upper tiers of this young country are becoming a bit crowded. That chap who said there was plenty of room at the top evidently lived before the present war got in its deadly work.

* * *

We are informed from Ottawa that the work of the Davidson investigating commission is almost finished. To criticize that work would probably be considered contempt of court and I would hate to be the only one to receive punishment at its hands. But I fain would ask a question or two. Surely one may venture that far. And my first query would naturally be: "In the Hopkins investigation was it Mr. Hopkins or Mr. Acton who was being investigated?" And following this would it be unwise or unkindly to ask why Mr. Hopkins was not called to the stand? Mr. Hopkins' home is in Toronto, but he is taking most of his meals at the Biltmore Hotel in New York City. I believe he prefers the New York climate and if he does spend an occasional Sunday in Toronto it is because his family still resides in the Queen City. Of course he might have gone to Ottawa as a witness but those attorneys have a way of talking to mere witnesses that does not make their position in the box an attractive one.

SEARCHLIGHT.

The Dealer and Contractor

A Code of Lighting Applicable to Factories, Mills and other work places—Valuable Information for Engineers, Central Stations and Electrical Contractors (Con.)

Section II. Value of Adequate Illumination

Factory and mill owners are concerned in the matter of securing the largest output for a given manufacturing expense. An improved machine tool capable of increasing the product for given labor costs is most attractive, provided its first cost is within returnable limits out of the larger profits. Improved small tools, better methods of handling material, adequate crane service, fire protection, good shop floors, accurate and efficient time-keeping methods, and similar items, vitally concern the shop manager; money is expended to realize excellence in these features because they afford increased economies and protection, thus resulting in a higher efficiency of the plant.

Energy Consumption a Minor Item.—Many arguments leading to the sale of gas and electric lamps for use in factory and mill buildings are based on reducing the lamp operation cost by substituting a new for an older system. Arguments of this kind are of value, however, only when such a reduction in operation cost can be effected without sacrifice in the adequacy of the illumination. It would be a poor policy, in the extreme, to argue a saving in energy consumption by the substitution of one type of lamp for another on a basis of equal candlepower in both old and new systems.

Effect of Good Light on Production.—Arguments of a convincing nature, which insure to the factory or mill manager an increased output through improved illumination service, are of importance and even greater at times than reductions in the cost of illumination for the same quantities of light. In view of the fact that resulting advantages of superior illumination on increased output are apt greatly to exceed economies in operation cost as regards the lighting system, it is a distinct advantage to direct and hold the attention on the former rather than on the latter. This statement will be more apparent when interpreted into definite items as follows:

Advantages of Good Light.—While the necessity of good natural and artificial light is so evident that a list of its effects may seem commonplace, these same effects are of such great importance in their relation to factory and mill management, that they are well worth careful attention. The effects of good light, both natural and artificial, and of bright and cheerful interior surroundings, include the following items:

1. Reduction of accidents.
2. Greater accuracy in workmanship.
3. Increased production for the same labor cost
4. Less eye strain.
5. Promote better working and living conditions.
6. Greater contentment of the workmen.
7. More order and neatness in the plant.
8. Supervision of the men made easier.

In this list it will be noted that items 4, 5, 6, 7 and 8 all have a bearing on accident prevention.

Interpreting the Advantages of Good Light.—While the major consideration in the eyes of the factory or mill owner is undoubtedly and quite naturally the money value of good light in the larger return of both quantity and quality of work which may result from the installation of a superior as compared with an inferior lighting system, it should be noted that it is very difficult to interpret into dollars and cents the value of good light made possible by such returns. This difficulty is due to the necessity of keeping all conditions in a factory or mill section absolutely constant while varying the amount of illumination from poor to good conditions, in an effort to determine the output and its dependency on the lighting facilities. As accurate data becomes available, giving the increases in production for certain specific improvements in artificial lighting, it will doubtless prove helpful to a proper interpretation of adequate light and its worth to any plant.

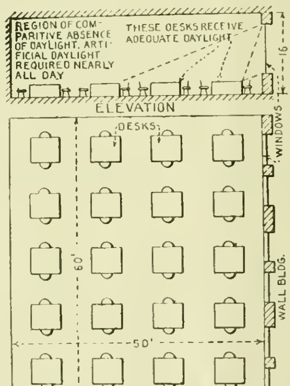


Fig. 1 Large office, window on one side only.

The eight foregoing points are emphasized as forming the most important features in the problem of good lighting. Although difficult to interpret into money values, and somewhat intangible, they are indisputable arguments in favor of the best available illumination from the standpoint of the factory or mill owner.

Practical Example.—Continuing from the manufacturer's point of view, it may be said that certain assumptions as to energy cost, cleaning, interest and depreciation, show that the annual operation and maintenance cost for the illumination of a typical shop bay of 640 sq. ft. area, may be taken at $50.00 If five workmen are employed in such a bay at an average wage of say 25 cents per hour, the gross wages of the men in such a bay, plus the cost of superintendence and indirect shop expense, may equal from $5,000, to $7,000 per annum. In a case of this kind, therefore, the lighting will cost from 7/10 to 1 per cent. of the wages, or the equivalent of less than 4 to 6 minutes per day. We may roughly say that a poor lighting system will cost at least one half this amount (sometimes even more through the use of inefficient lamps and a poor arrangement of lamps), or the equivalent of say 2 to 3 minutes per day. Nearly all factories and mills have at least some artificial light, hence, in general, if good light enables a man to do better or more work to the extent of from 2 to 3 minutes per day, the installation of good lighting will easily pay for the difference between good and bad light, through the time saved for the workmen.

Actual Losses.—Superintendents have stated in actual instances, that due to poor light their workmen have lost much time, sometimes as much as from one to two hours per day or certain days. If good light will add an average of say one-half an hour per day to the output, these 30

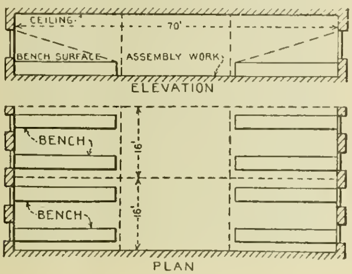


Fig. 2—Benches located advantageously with respect to windows

additional effective minutes represent an increase in output of 5 per cent., brought about through an expenditure equal to ½ of 1 per cent. of the wages for improved lighting, or a saving equal to ten times the expense.

Safety.—While these features are of special interest in the eyes of the manufacturer, the principal item to consider, perhaps, from the legislative side of the question, is the necessity of an act or acts to provide employees of workshops with proper and sufficient illumination from the standpoint of safety. The legal aspect of the safety question in its relation to illumination in factory and mill buildings is a topic of unusual importance.

Section III. Old and New Lamps

The inadequate means available for illumination by artificial methods in the past have contributed to the slowness of an appreciation of the features of artificial light which influence the working efficiency of the eye. Open flame gas burners, carbon incandescent and arc lamps, practically the only illuminants available ten years or so ago, play but a small part in the present approved methods of factory and mill lighting.

New Lamps.—The large variety of comparatively new lamps available for factory and mill lighting includes the mercury vapor, metallized filament, tungsten, gas filled tungsten, metallic flame or magnetic arc, the flame carbon arc, the quartz mercury vapor, and various types of gas arc lamps. Remarkable improvements have thus been made in both the electric and gas lighting fields, the same general rules of applying the lamps covering both of these fields. Possibilities in factory and mill lighting are now attainable which, before the introduction of these new lamps, were either unthought of or impossible. Consideration of the eye as a delicate organ, together with the new ideas of the items which affect its comfort and efficiency, have resulted in establishing certain principles in illumination work, and have directed attention naturally and in a growing manner to the proper use and application of these new lamps.

Section IV. Effects on Factory and Mill Lighting Produced by Modern Lamps

With the introduction of these new gas and electric lamps, broader possibilities have been presented in factory and mill lighting. The use of units of sizes adapted to the purposes, allows results which it has been hitherto impossible to obtain satisfactorily, either by the arc lamp, carbon filament or open flame gas burner, formerly available.

New Possibilities.—It is evident that the introduction of the many new lamps has made possible what may be termed a new era in industrial illumination, a distinctive feature of which is the scientific installation of the lighting units, suiting each to the location and class of work for which it is best adapted. Before the availability in recent years of medium sized gas and electric units the choice of the size of unit for a given location was often no choice at all. In many cases, due to small clearance between cranes and ceilings, or other conditions making it necessary to mount the lamps very high above the floor, but one size or type of unit was available, the carbon filament or open flame gas burner in the former, and the arc lamp in the latter case.

Low Ceilings.—For low ceilings, up to 18 ft., the use either of carbon filament, open flame gas burner, or arc lamps resulted usually in anything but uniform light over the working plane, and often produced merely a low general light which was practically useless for the individual machine. In such instances, individual lamps had to be placed over and close to the machines. With this arrangement, relatively small areas are lighted by each lamp, and the metal shades usually employed, serve only to accentuate the "spot lighting" effect. Such a form of illumination for factory and mill work is unsatisfactory and inefficient, but as stated, was in the past, in many cases, the only available scheme. The absence of lamps of the proper size is no longer an excuse for the existence of such conditions in industrial plants.

(Continued in next issue.)

Divorce the Inspection Dept.

In using their influence to discourage the attempt of the Simcoe Hydro-electric Commission to carry out their advertised intention of installing house, store and factory wiring at the bare cost of time and material, the Hydro-electric Power Commission of Ontario have taken a course which will commend itself favorably to every Ontario citizen who has any appreciation of the situation. As in almost hundreds of other Ontario municipalities, the success of the Hydro scheme in Simcoe depends on the united co-operation of its citizens with the local commission. This necessarily would have been rendered quite impossible had the local committee persisted in its intention of competing with one of the legitimate lines of trade, and in so doing, indirectly antagonized every member of every branch of the retail trade in Simcoe. What is true of Simcoe town is true of every other town and municipality throughout the province, and we are pleased indeed that this precedent has been established, as it will give the electrical contractors the assurance that they are free to go ahead and improve the conditions surrounding their trade without fear of undue interference. As we pointed out in a former issue, the reasonable course in Simcoe or any other town is a co-operative working agreement between the local commission and the local contractors such as, we understand, has now been established. The contractors are as necessary to the commission as the commission is to the contractors, and we take it for granted that the precedent established in this town indicates the policy that will doubtless be pursued throughout the whole province by the Hydro-Electric Power Commission of Ontario.

There is no denying that the Hydro-Electric system of this province has been a wonderful success—due in a very considerable measure to the ability and unceasing activity of the Hon. Adam Beck and his co-workers on the Hydro-electric Commission. But the part played by the citizens of the province must not be overlooked. The success of this scheme was impossible without their co-operation, and its continued success will be very greatly endangered if any considerable part of our population is, for any reason whatever, antagonized. That the support given the Commission by the very great majority of the electrical contractors of the province has been most hearty there is no reason to doubt. The bonds which bind these two elements together have undoubtedly been strengthened by the reasonable attitude assumed in the Simcoe matter by the Ontario Commission, and there is every reason to believe that the loyal support of the entire electrical contracting fraternity will now be more surely and cheerfully given in the future than it ever has been in the past.

The "Hydro" Inspection Department

There is one phase of this question yet, however, which is a thorn in the side of every contractor, every central station, and every municipality engaged in the wiring and installation business. It is this—the inspection of electrical installation work is under the control of the Hydro-Electric Power Commission of Ontario. Under such a system of inspection friction is inevitable. What would the citizens in any municipality say if one of the most prominent hotelkeepers were made license inspector for that district? What would the citizens of Toronto say if no independent inspection were allowed of the great work being carried on in the harbor improvement scheme? And what would have happened? Why should not the control of the Provincial Inspection Department be placed in the hands of a staff appointed by Sir William Mackenzie, for example, who has such wide interests in the electrical business in Ontario? Yet the very ridiculousness of these suggestions makes an answer unnecessary. It is well within the range of possibility that in every one of these suggestions no harm may have come to the public. The work may be carried on honestly and efficiently. In certain cases, however, it would not be so, and in the cases were honesty and efficiency only prevailed the public would not believe it, and even a Government investigation commission would be unable to convince them that somewhere or other there had not been leaks and poor workmanship and favoritism.

And that is just how it works out with the Hydro Commission in control of the Ontario Inspection Department. If Sir Adam Beck wants assurance of this fact he has only to make inquiry of practically any and every inspector attached to the Ontario Hydro Department, of every manager of every local system, of every electrical contractor, and of every central station throughout the length and breadth of Ontario. We have talked with many of these men on the subject of inspection, and we have yet to hear one single approval of its connection in any way whatever with the Hydro Commission.

Should be Independent

The management of the electrical inspection department of the province should be as absolutely segregated from the Hydro-Electric Power Commission of Ontario as it is from the Toronto Electric Light Company, the Dominion Power and Transmission Company, the London Electric Company, and a dozen others which have no voice whatever in the framing of the inspection law or its enforcement. The principle is wrong. It is not according to British ideals of fair play. It is deliberately placing in the hands of one party a weapon which he might use to the disadvantage of another party who has not any weapon whatever to defend himself with. It is only because, in the multiplicity of events that have taken place in connection with the inauguration and carrying out of this great Hydro scheme the people of Ontario have not yet come to realize the situation regarding the organization of the inspection department that this condition has been allowed so long to go unchallenged. At the present time, not only is this scheme proving unworkable—not only is it the cause of deep resentment on the part of competitors of the Hydro Commission—not only is it the cause of endless trouble to contractors and inspectors, who are unable to convince the customers of the unbiased attitude of an inspection department which carries the name Hydro—but the average man is beginning to size up the situation as unreasonable and unfair and unworkable.

Just as the Commission has shown itself capable and willing to anticipate and satisfy the demands of fairplay in this Simcoe matter, so we think it would not only be a wise, but a gracious, course for them to pursue, to divorce their inspection department and use their influence to have it separated entirely from anything associated with the name Hydro and made a separate Government department or a sub-department answerable to one of the Ministers. We have no reason to doubt that the machinery and the men in the inspection department are entirely capable of carrying on the work of inspection throughout the province. They do need, however, a little more freeedom. This they would get under another department. What does Sir Adam Beck say?

Earle Electric, Limited, 72 Nelson Street, Toronto, distributed an attractive little Christmas and New Year's card to the trade this year. This is an excellent idea for the contractor, who is thus enabled to bring his name prominently before his customers and prospective customers at a time when such recollections are likely to be favorable and friendly.

The Railway and Industrial Engineering Company, manufacturers of Burke Horn Gap switching and protective apparatus and outdoor sub-stations, have moved their sales office to the People's Bank Building in Pittsburgh. Mr. L. C. Hart, sales manager of the company, has arranged an exhibit of Burke Horn gap apparatus at their new offices, as well as a very complete file of blue-prints, photographs and data on the application of outdoor equipment.

Application will be made to the Quebec Legislature by the Vercheres, Chambly and Laprairie Tramways Company to construct an electric railway on the south shore of the St. Lawrence, with the right to enter Montreal. It is proposed to conduct operations between Saint Roch and Chateaguay, and from Laprairie to Chambly, with loop lines and connection branches to other places in the counties of Chateauguay, Laprairie, Chambly, Vercheres and Richelieu, and across the St. Lawrence River to Montreal.

An extension to the plant of the Tallman Brass and Metal Company, which will be completed early in the year, will add about ten thousand square feet of floor-space to the electrical department of this company. The building will be equipped with the latest improved machinery, and every known facility for the turning out of fixtures and fixture parts. The rapid growth in the business of this company indicates the progress being made in the illumination field, and the increasing appreciation of the close relation between illumination and art.

Splicer for Fixture Work

A new device of interest to electrical contractors has just been placed on the market by the Canadian Drill & Chuck Company, Toronto, and approved by the Inspection Department of the Hydro-electric Power Commission of Ontario. It is illustrated herewith. This is to facilitate the

Simple device for installing fixtures

making of connections in electric fixture installation and similar work, doing away with the old-time solder and tape and at the some time effecting a very considerable saving in time. The splicer is made of hard rubber. Its design is evident from the accompanying cut.

A Paint Unaffected by Gases

Griffiths Brothers, manufacturers of the well-known Ferrodor rust-proof paint, anti-sulphuric enamel, and similar products, recently received an order from the British War Office for one thousand gallons of a special paint which has been prepared to meet the present difficult and novel conditions imposed by the war. Tests made with Griffith "armour" paint showed that after a thousand rounds had been fired the paint was still in perfect condition. The armour paint is also quite unaffected by asphyxiating gases, which destroy ordinary paint. It is stated that contracts for quantities of this paint are also being closed with the principal manufacturers of heavy artillery. Spielmann Brothers, Reg'd, Montreal, are Canadian agents for Griffiths Bros.' products.

Electric Welding

The Electric Welding Company of Toronto, Limited, has been formed to carry on the business of manufacturing and repairing by electrical process, welding and otherwise, machinery and mechanical apparatus generally. The provisional directors are W. H. Irving, Henry H. Davis and John R. Rumball; capital stock $10,000.

Mr. Frank P. Vaughan, manager of the Vaughan Electric Company Limited, St. John, N. B., was elected a member of The American Institute of Electrical Engineers at a meeting of the board of directors held at New York, December 10th.

Trade Inquiry

Name and address of inquirer may be obtained on application to the Department of Trade and Commerce, Ottawa.

8. Electric pocket lamps and torches, and also electric pipe lighters.—A London company seeks supplies of electric pocket lamps and torches, and also of electric pipe lighters, and wishes to get into touch with Canadian manufacturers in a position to supply these specialties.

Personals

Mr. F. J. Allen has been appointed manager of the Benjamin Electric Manufacturing Company of Canada, succeeding Mr. George C. Knott, resigned. Mr. Allen has been connected with the Benjamin company for several years, and is thus in intimate touch with the various phases of their organization. Under his management we anticipate the business of this company will be carried on no less vigorously than in past years.

Mr. George C. Knott is leaving the Benjamin Electric Manufacturing Company, Toronto, to return to the United States and associate himself with the Wirt Electric Specialty Company, Philadelphia. Under Mr. Knott's management the Benjamin business in Canada has grown to big proportions. A host of friends on this side of the border wish him success in his new undertaking, and hope that the wheel of fortune will carry him north again at no very distant date.

Mr. James J. Martindale, whose name has been so closely associated with Tuec Stationary Vacuum Cleaners in Ontario, is returning to the United States. The agency for Ontario has been purchased by Mr. C. B. Owens, who will carry the Tuec line of cleaners in addition to his present line of Powers temperature regulators.

Mr. L. A. Campbell has been appointed Minister of Mines in the new Government just slated for the province of British Columbia. Though Mr. Campbell is only 44 years of age, and the youngest man in the new Cabinet, he is regarded as one of the best business men in Western Canada.

Hon. L. A. Campbell.

He is probably best known as the general manager of the West Kootenay Power and Light Company, which has had a very satisfactory financial career. He was first elected to the Legislature in 1912, defeating Mayor Taylor of Vancouver. Mr. Campbell was born in Perth, Ont.

Current News and Notes

Abbotsford, B. C.

The town of Abbotsford, Fraser Valley, B. C., has installed a street lighting system, the current being furnished by the British Columbia Electric Railway Co. Twenty lamps are in use and citizens are agitating for the number to be increased.

Arthur, Ont.

Negotiations are proceeding between Mr. Philips, the owner of the local lighting plant, and the councils of Grand Valley and Arthur, looking to the purchase of Mr. Philips' property and its operation as a municipal enterprise in connection Niagara current.

Brantford, Ont.

A by-law was carried on January 3 authorizing the sale of the Galt-Paris portion of the Brantford-to-Galt municipal railway to the Lake Erie and Northern Railway Company.

Calgary, Alta.

Commissioner A. G. Graves has stated that expenditures to the extent of $2,000 will be made in minor equipment for the light and power distributing systems.

Fort William, Ont.

The Ontario Railway Board recently heard arguments between J. C. Murray and the Kaministiquia Power Company regarding a supply of power direct by the company to Mr. Murray, for his theatre. The company claimed that their agreement with the city prohibited them from supplying power direct, and Mr. Murray sought to enforce the supply. The dispute has evidently arisen out of an unsuccessful attempt by Mr. Murray to coerce the city into giving him cheaper rates.

Fredericton, N. B.

The Fredericton Electric Company, Limited, has been incorporated to take over the assets and business of the Fredericton Gas Light Company. The new company will issue bonds to the extent of $130,000, and it is the present intention to make considerable extensions.

Gravenhurst, Ont.

The by-law authorizing extensions to the lighting system, costing $3,500, was carried on January 3.

Haileybury, Ont.

A by-law was passed at the January 3 elections giving the Northern Ontario Light and Power Company a franchise in Haileybury, Ont.

Hamilton, Ont.

The contract for wiring the new hospital has been let to Culley & Breay, King Street West.

Iberville, P. Q.

By a majority of 145, the taxpayers of Iberville, P. Q., have passed a by-law for the sale of their electric plant to the Southern Canada Power Company. The latter has entered into a 15 year contract to supply electrical energy for the public lighting, for operating the waterworks, and for private lighting and power purposes. The same company is now supplying current for the public lighting of St. Hyacinthe, P. Q., and also for the municipal pumping plant.

Kamloops, B. C.

Superintendent Wain, in charge of Kamloops' electric lighting system, has received authority from the city council to make extensive repairs and additions to the street lighting system.

Kingston, Ont.

Mr. J. M. Campbell has declined to sign the agreement under which he is to supply power to the city of Kingston at a $\frac{3}{4}$c rate. Mr. Campbell takes exception to the agreement on the ground that it is unfair and does not even mention the minimum amount of power which the city must take.

Medicine Hat, Alta.

A prominent officer of the Lake of the Woods Milling Company is reported to have stated that the power plant of the company at this point is already taxed beyond capacity, and that additions will have to be made in the immediate future.

Montreal, P. Q.

Application will be made at the next session of the Quebec Legislature to incorporate the Vercheres, Chambly and Laprairie Tramways Company, which proposes to construct an electric railway between Saint Roch and Chateauguay, and from Laprairie to Chambly, with connection branches and loop lines to other places in the counties of Chateaugnay, Laprairie, Chambly, Vercheres and Richelieu, and to cross the St. Lawrence River and enter the City of Montreal.

A committee has been formed by the Royal Securities Corporation, Montreal, to oppose the scheme of the Western Canada Power Company by which holders of first mortgage bonds are asked to convert the next two years' interest coupons into preference shares. It is claimed that the earnings are sufficient to meet the interest, and with the installation of additional machinery there ought to be a surplus after paying interest on further cash needed to pay off the present floating debt and the cost of new machinery. It is also contended that the note holders and ordinary shareholders should bear the burden of further financing and that they should arrange a plan of re-organization which the Royal Securities is prepared to finance if necessary.

According to a report from New York, the Southern Electro-Chemical Company is about to put on to the market nitric acid obtained from extracting nitrogen from the air. Mr. James B. Duke, who is an official of the company, is president of the Quebec Development Company, Limited, which has obtained control of water rights in the Lake St. John district, and which is reported to be contemplating the erection of large works there for the production of nitrates.

Mr. E. Laurie, of the E. Laurie Company, Montreal, agents of the DeLaval Steam Turbine Company, is now in England, having joined the Aviation Corps there. Mr. Laurie received a portion of his training in aviation in Canada. The agency of the DeLaval Company will be continued by the E. Laurie Company in Montreal.

The Probate Court, Montreal, has presumed the death of Captain W. C. Brotherhood, of the firm of Archibald and Brotherhood, electrical engineers, Montreal. There was no direct evidence of his death at the batttle of Langemarck, but the affidavits of two men who were with him in the trench, and which were filed with the will, state that after he was severely wounded he wrote despatches in the trench,

and that he was afterwards buried by a shell which struck the trench.

The Montreal Tramways Company are enlarging the present steam plant from 10,000 horse power to 50,000 horse power, while the Montreal Public Service Corporation, which is allied with the Montreal Tramways Company, propose to instal a steam plant in the city with an ultimate capacity of 60,000 horse power. The first unit will be of 15,000 horse power.

Nelson, B. C.

Mr. H. P. Thomas, city electrical engineer of Nelson, has been granted a substantial increase in salary as a recognition of his splendid work in connection with the Light and Power Department of the municipally-owned plant. Mr. Thomas has also been given full charge of the Nelson street railway system.

New Liskeard, Ont.

A by-law was passed at the January 3 elections giving the Northern Ontario Light and Power Company a franchise in New Liskeard, Ont.

Orillia, Ont.

Beginning with the new year, the light and power rates of the town of Orillia have been readjusted and reductions made varying from 10 per cent. upwards. The domestic meter rates, which formerly were 8, 4 and 2 cents, have been reduced to 7.2, 3.6 and .9 cents—the latter to encourage the use of electricity for cooking. At this rate the market for electric ranges in Orillia should be very considerable.

The municipality of the town of Orillia now have 20,300 lamps connected and 1,524 h.p. in motor load sold. The town gets its power from its own plant, situated on the Severn River nineteen miles distant, over a 22,000-volt transmission line, and obtains auxiliary service from the hydro-electric plant of the Ontario Commission at Big Chute. This latter power is also used for peak and emergency purposes. The town of Orillia also supplies the village of Longford with light and power, the power amounting to 150 h.p., which is used chiefly by the Standard Iron, Chemical and Lumber Company.

Ottawa, Ont.

The Ottawa Electric Company have found it necessary to institute police court proceedings against two citizens of Ottawa who are charged with theft of electricity.

Paris, Ont.

The town council recently passed a resolution transferring their share of the ownership of the water power privileges on the Nith River to the Paris Wincey Mills Company for a payment of $500.

Sackville, N. B.

Mr. J. H. Waterman is making an appraisal of the property of the Eastern Electric and Development Company, Limited, looking to a readjustment of rates.

Sarnia, Ont.

A by-law was carried on January 3 authorizing a contract with the Hydro-Electric Power Commission of Ontario for a supply of Niagara power.

Sherbrooke, Que.

The Eastern Townships Telephone Company have given notice of a considerable advance in their telephone rates.

The City of Sherbrooke, P. Q., is carrying out additions to the equipment of the Rock Forest plant for the purpose of increasing the power by about 750 horse power. This is to meet the very large demand for current for commercial purposes. A contract has been let to the Jenckes Machine Co. Ltd., Sherbrooke, for part of the work. The new equipment includes a water turbine and three 750 k.v.a. water cooled transformers. Further extensions to the second municipal plant, situated within the limits of the city, are under consideration. Mr. M. A. Sammett, of Montreal, is the consulting engineer.

Three Rivers, Que.

The Three Rivers Traction Company proposes to seek authority from the Quebec Legislature to run its cars within the limits of the village of Cap de la Madeleine.

Toronto, Ont.

The Hydro Radial by-laws carried in practically every municipality between Toronto and London. This authorizes the Hydro-Electric Power Commission of Ontario to proceed with their fourteen-million-dollar expenditure on a trunk line between these two cities, following the course outlined in a recent issue of the Electrical News. For the most part the majorities in favor of the by-law were very large.

Estimates prepared by the Toronto Harbor Board for their work of the coming summer indicate a proposed outlay of $2,700,000. Very fair progress was made during 1915 on the reclamation part of the scheme, and work will be resumed as soon as the spring opens.

The Bell Telephone Company has opened a new exchange, known as Belmont, at Eglinton Avenue, North Toronto. A new building has been erected for the purpose. The Company are making an extension to the Brantford Exchange, and in March will commence the addition of two stories to the head exchange in Montreal, necessitating a rearrangement of certain equipment.

Truro, N. S.

The Nova Scotia Board of Commissioners of Public Utilities, after considering the matter of power rates charged by the Chambers Electric Light and Power Company in Truro, N. S., have decided that the tariff must be slightly increased to meet the increased cost of operating. It is estimated that the deficiency can be met by increasing the present 12 cent rate to 13 cents and the 9 cent rate to 10 cents.

Vancouver, B. C.

W. H. Fraser, electrical superintendent of the British Columbia Electric Railway, delivered an address on "The Electric Vehicle and the Central Station" at a recent meeting of the Vancouver branch of the American Institute of Electrical Engineers. Various classes of electrically propelled vehicles were illustrated by means of slides, together with a table giving operating costs under varying conditions. Mr. W. Dalton, of the Mainland Transfer Company, compared the cost of upkeep of electric motors—for short hauls only he believed horses were the cheaper. The computations made by Mr. Fraser applied to the newest type of electric vehicle, which were easier on power.

Watford, Ont.

The Brooke Municipal Telephone Company are planning to extend their lines into Warwick Township, and will require a quantity of general supplies.

Welland, Ont.

The new fire alarm system of the town of Welland is now in operation.

Westmount, Que.

The City of Westmount, P. Q., has reduced the price of domestic lighting from 6c to 5c per kilowatt hour. Eleven years ago, when the municipal lighting department was inaugurated, the charge was 1c per kilowatt hour.

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Generation, Transmission and Application of Electricity

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After all, is Sir Robert the leader?

Do we understand from Sir Robert Borden's attitude in the House that he refuses to hold an investigation into the charges that have been made in connection with the letting of Canadian munition contracts?

If he knows that the charges are false, would one not expect he would jump at the chance of clearing the reputation of his friends? What is the inference if he refuses?

If he persists in sidestepping the issue we believe Sir Robert has missed the chance of a lifetime to show himself a really big man. Will he prove to be what men are saying of him to-day, or will he measure up to the standard of his opportunities?

The Attorney General seeks to draw a herring across the trail in placing responsibility on the British Government. That's not the issue. The Canadian people want to know whether the men holding executive positions have conducted themselves as becomes appointees of a party holding a great public trust, in accord with the honor of citizens of our great Empire and in the best interests of the efficient conduct of our war.

The original Shell Committee undoubtedly deserves credit for the despatch with which they placed orders among manufacturers, who were naturally shy of accepting the responsibilities of big and uncertain capital expenditures. But what conceivable excuse is there for refusing these same manufacturers further orders—even to the extent of turning down an offer to furnish at cost?

Before the public press became aware of the existing conditions, rumors of what was transpiring reached this paper, and we felt it was our duty to bring certain matters to the attention of our readers. Under the caption "In the Public Eye" we have touched upon, possibly, no more than ten per cent. of the information that has reached us, much of which at the present time is unprintable. It has been our endeavor to cover only such points as would further the common cause, and interfere as little as possible with our national military operations.

As we expected, even in this we have found the path of the pioneer proverbially unpaved. We have the satisfaction, however, of having started a protest that is now being taken up by the independent press even of the Conservative party, and that is ringing from coast to coast among our citizens of influence and power who love honor and efficiency more than money or party. We have the satisfaction of hundreds of friendly assurances that our course has been right, and believe we are backed by thousands more who have read and silently approve our stand.

And now, let us get along with our share in this big war. We have placed ourselves on record, and for the present will let matters rest there. No matter how badly we are led, Canada is in it to our last man, our last dollar, and to our last shirt.

Montreal Tramways Extensions

The directors of the Montreal Tramways Company recently decided to make some considerable additions to its steam generating plants in the city of Montreal, and plans have been prepared providing for an ultimate capacity at the Hochelaga plant of the company of about 60,000 horsepower. It has been decided that the company will install large sized turbo-generator units, and the first order has been placed with the Canadian General Electric Company for one Curtis turbine of 12,500 kw. capacity at 80 per cent. power factor, or 15,630 kv.a. This turbine will be the largest machine of its kind in the Dominion of Canada. Orders have also been placed with the Babcock & Wilcox Company for additional boiler capacity, these boilers being of the steel-cased marine type, with superposed economizer, and equipped with superheaters and chain grate stokers.

Further plans call for the linking up of the Hochelaga power house with all the sub-stations of the Montreal Tramways Company by means of 12,000 volt, high tension feeders. Other elaborate extensions are proposed at the sub-stations of the company, the intent being that every effort will be made to preclude interruption to the company's power supply, which it is now receiving under lease from hydro-electric sources and also to make provision for the increased requirements which it is anticipated will develop immediately after the close of the war.

The Montreal Public Service Corporation also contemplate the construction of a large steam plant within the city limits, entirely independent of the plant referred to above. Plans are now in course of preparation. The plant will be equipped with a turbo generator of large capacity.

Power Plant Costs

In the industrial world to-day, power is manufactured, sold and bought just like any other marketed commodity. The cost of production depends on numerous factors—cost of fuel, cost of generators, labor cost, amount produced—and this cost is the chief criterion on which the market price depends. Of interest to the power consumer is (1) what his power costs him, (2) what it should cost, (3) where and why the loss has occurred. At a meeting of the American Society of Mechanical Engineers, in the Engineering Societies Building, on Tuesday, January 11, at 8.15 p.m., Mr Walter N.

Polakov, Superintendent of Power of the New York, New Haven and Hartford Railway, discussed the question of standardization and predetermination of the cost of power. He demonstrated a simple method by which the owner of a power plant of any kind can, without the necessity of study of technical details, determine just how close the cost of his own plant is to the possible minimum cost of such a plant —in other words, how much more he is paying for power than he should pay. Mr. Polakov has spent several years in cost standardization work. At one time he was expert consulting engineer to the Board of Estimate and Apportionment of the City of New York. He has been in charge of reorganization work and introduction of scientific management in several large industrial plants in this country.

Electrical Equipment for a Steel Company

The addition to the plant of the Inland Steel Company at Indiana Harbor, Ind., now in course of erection will include all the advantages of electric drive throughout, including the main rolls. It will be practically a complete steel plant in itself. The addition will consist of open hearth furnaces, blooming and finishing mills. About two years ago, the Inland Steel Company installed electrical apparatus in its plate and sheet mills, the operation of which was so successful that when the decision was made to erect a new mill, electric drive was the only form of motive power considered. Accordingly, a contract was awarded the Westinghouse Electric & Mfg. Company for the complete electrical equipment of the mill including two 5,000 kw. 25-cycle, 2,400-volt turbo-generators complete with surface condensers, exciters, and switchboards; two 1,000 kw. synchronous motor-generator sets; one 15,000 horsepower direct-current motor equipment; two 8,000 horsepower motor equipments, and several thousand horsepower of auxiliary apparatus.

This installation will doubtless be watched with considerable interest by steel plant engineers and operators on account of the many new and novel features. The contract practically doubles in value any one ever given by a steel company for electrical equipment and is exceeded in total horsepower, but not in size of units, only by one other installation. The 15,000 horsepower direct-current motor will be direct connected to a 40-inch reversing blooming mill, receiving its power from the generator of a flywheel motor-generator set. The direction of rotation of the mill motor is obtained by means of voltage control of the generator supplying it with current.

The structural mill consists of one 32-inch reversing roughing mill, and one 28-inch finishing mill of three 3-high mills. Each mill is driven by an 8,000 horsepower (maximum) direct connected direct-current motor and the scheme of control is the same as given for the blooming mill. One flywheel motor-generator set with a generator unit for each motor supplies the power for the mills, and by a special system of control and design of apparatus, the power taken from the line is equalized to practically a constant load with variations of not more than 10 per cent. plus or minus although the load on the mill motors will vary from several thousand horsepower in the opposite direction several times a minute. The energy for the auxiliaries, most of which are direct current motor drives, is supplied from the two 1,000 kw. synchronous motor-generator sets.

Comparative figures of our three chief railways for the first two weeks of the present year and the first two weeks of 1915 show the following very remarkable increases:—

	1916	1915
Can. Pacific Railway	$3,737,000	$2,637,000
Grand Trunk Railway ...	1,847,003	1,533,267
Can. Northern Railway..	1,010,400	665,000

Letter to the Editor

Montreal, January 8, 1916.

Editor,
Electrical News:

I have always been an admirer of the Canadian Electrical News, not only for the information contained therein, but for its physical appearance. That admiration has been greatly heightened after reading in the last few issues of the Journal the articles by "Searchlight." I do not know who Searchlight is, but if he is an engineer, he has a facility of expression and a commonsense way of looking at things that is altogether admirable, and he seems to have a point of view which should be that of the engineer—efficiency in public service.

I recently heard of an Ottawa man, not a politician, who is very conversant with Government methods, and who made the following statement: "The lawyers and politicians in the Dominion of Canada are going to get a jolt in the next ten years, and it is going to come from the engineers." This was before the war.

When this war is concluded, Canada will be saddled with a tremendous debt for railways and other utilities with more or less earning power, and with a war debt which will be a dead burden upon the community, and government simply cannot be carried on under the inefficient direction of lawyer politicians, and broad business men and engineers as representing the highest efficiency must do the work.

Articles such as those of "Searchlight" indicate the trend of the mind of the engineer away from the technical and toward the public service, and the more journals, such as yours hammer this question into the technical men, the sooner engineers as a body will come into their own.

In the past, the majority of engineers have regarded themselves as purely technical men, and rightly so, in many cases, these having their place in a corner of the drafting room with a slide-rule; but, out of this ruck of purely technical experts there will arise men with broader ideas who will grasp the fact that the machines they have to design and operate are those of the civilized community, and when this occurs, I believe that the lawyer politician we have is going to be even more rapidly discredited than in the past, and that commissions and governments will be carried on largely under the direction of men with engineering minds.

My congratulations to "Searchlight" with the expression of a hope that in the interest of engineering he may not suffer eclipse.

Yours very truly,
R. A. Ross.

Beauty in Engineering

Mr. G. R. G. Conway, M. Can. Soc. C. E., consulting engineer, Toronto, and late chief engineer of the British Columbia Electric Railway Company, of Vancouver, delivered an address before the Ottawa branch of the Canadian Society of Civil Engineers on Friday evening, January 21. Mr. Conway's subject was "The Engineer and Standards of Beauty," in which he urges a freer co-operation between engineers and architects in the design of engineering structures, particularly in great public works such as bridges, railway terminals, dams, aqueducts, power houses, highways, etc. The paper was fully illustrated with lantern slides giving examples of engineering structures where this co-operation had been attempted.

Electrical Developments During 1915

Outstanding features are increase in size of generating units, higher voltages in railway work and big reductions in cost of Ontario current

The year just closed, in a wave of returning prosperity along industrial lines, has seen the electrical industry more than keeping apace with the times. It is safe to say that never before in the history of the industry have the people had brought before them, as has been done in the past year, in a more convincing and attractive manner, the manifold uses of electricity. No startling innovations have been made in the electrical field unless it may be the reported wonderful advances of wireless telephony resulting in the hearing of the human voice 5,000 miles distant without the aid of wires, and the almost equally wonderful feat of telephone conversation by wire across the continent. However, progress in the way of further refinements has been made along various lines in a systematic manner, the principal of which are detailed below.

Steam Turbo-Generators

Probably the most striking feature of the year is the tendency to gradually increase the size of steam turbine driven generators. This is a logical steady growth caused by the rapidly increasing use of electricity in the home, factory, office and farm, as well as to the growth of population in large centres. Also the reduction in the rates secured through improved economies in generating and transmitting devices, has resulted in increased load, thus making still larger generating units possible.

Last year the installation of a 30,000-kv.a. turbo-generator in New York was reported; a few weeks ago a contract was awarded for a 35,000-kv.a. unit for the Commonwealth Edison Co., Chicago; and, still more recently, the Duqueane Light Company of Pittsburgh have awarded a contract for a 40,000-kv.a. unit. It is said that units as large as 50,000 and even 60,000 kv.a. are contemplated.

Due largely to the wonderful development in the steam turbine and its direct connected electric generator, and the remarkably flexible, efficient and easy distribution of electricity we are possibly on the eve of a notable change in the manufacture and utilization of electric power. The modern steam turbo-generator makes it possible to concentrate enormous amounts of power generation in one place, and this makes possible and advantageous very large individual generating units. The growth in the capacity of generators has really been enormous, made possible by the steam turbine.

Water Turbo-Generators

Alternators have recently been installed of 30,000 kw. capacity, and in the contemplated development at Niagara Falls 50,000 kw. waterwheel-driven units are proposed, and the electrical companies state their entire willingness to develop and manufacture such machines. In fact, in the next few years, a machine of double this size is said to be not beyond the bounds of possibility.

Rotary Converters

Small size 60-cycle rotary converters, both for industrial and railway service, have been designed, using commutating poles and bracket type bearings instead of the usual pedestal type bearings.

Larger motor-generators have been built of considerably higher speed than formerly used, which has been possible by compensating the generators. This is a generator design feature that previously has not been used to any great extent, but which is now coming into favor primarily on account of its use, making it possible to produce a better machine at a higher speed.

Switchboard, Etc.

A change from asbestos-covered Underwriters' wire to rubber-insulated instrument and control wiring has resulted in certain changes and marked improvements in switchboard wiring details, particularly as affects standard boards of large dimensions, towards increased simplicity and efficiency. Another development of considerable interest is the increasing use of metering and switching equipments for outdoor service in connection with other outdoor equipments, such as transformers, lightning arresters, etc. By combining series tripping self-contained inverse time element oil circuit-breakers with necessary integrating, and, where required, indicating meters, in one weather-proof box, complete low tension control is available and with it the elimination of the charge involved in a complete building for this equipment. These equipments are available for either ground, pole, tower or wall mounting. They are furnished with all internal connections complete so that installation simply presents the problem of connecting into the power lines, placing oil in the circuit breaker tank, and mounting the meter on its panel.

Protective Apparatus

In static protective apparatus, a new electrolyte has been developed for the electrolytic form of arrester. This electrolyte maintains the arrester in operating conditions under temperatures as high as 135 degs. F.; it maintains the film at a higher critical voltage, and provides increased discharge capacity.

Circuit-Breakers

A new line of small and medium size oil circuit-breakers has been put on the market. This line is very extensive, including switchboard mounted, wall mounted and pipe mounted, remote control hand operated and remote control electrically operated; weatherproof and subway forms. Capacities are obtained in individual breakers up to 800 amperes by connecting all contacts of a multiple breaker in multiple; for use as a single pole, capacities up to 3,000 amperes are obtained. The voltages run as high as 13,200. The unique and most important feature of these breakers is the finger contacts, which represent a great advancement. The fingers, flexible in all directions, are separated by a stop and protected from all arcing by separate butt type arcing tips.

Oil breakers have been developed to meet the demand for a high voltage breaker of moderate breaking capacity and price. They are supplied for voltages from 35,000 up to 70,000, and in breaking capacities of about 20,000 to 30,000 kv.a. The tanks are of the floor mounting elliptical form, but may also be mounted on parallel pipe framework, so as to allow the tanks to be removed for inspection of contacts. The terminals are of the condenser type, which have proven so satisfactory in the higher voltage breakers.

Street Lighting

During the last year great strides have been made in the matter of street lighting. The nitrogen-filled lamp has been greatly improved by increasing its efficiency and length of life, and has practically displaced all other means of street lighting. It is not only more efficient and less costly than other sources of high intensity illumination, but also lends itself to a neat appearing fixture, appealing largely to the aesthetic tastes of the general public.

The increasing popularity of the incandescent system, due to the use of high efficiency Mazda C. lamps, has resulted in improvement and development of apparatus used in connection therewith. Briefly, these improvements and developments are as follows: a new line of 60-cycle constant current regulators has been placed on the market; these regulators embody many improvements over the superseded type and have been designed with a view to the close regulation necessary to the satisfactory operation of a series incandescent system. A stationary coil contact current transformer has also been placed on the market; this transformer has been designed for controlling certain classes of series street lighting when it is desirable to mount the transformer out on a pole and operate it from a time switch. As this transformer has no moving parts, it is well adapted to fill this condition. In operating the high efficiency Mazda lamps, it will allow a smaller variation between full load and short circuit than any other device on the market except the moving coil constant current regulator. It is available in capacities of from 1 to 10 kw. and for any primary voltage below 3,300 volts, and any secondary below 7.5 amperes, 25 to 60 cycles.

The high efficiency of the 15 and 20-amp. Mazda series lamps has made them particularly popular for street illumination. To operate them from standard 6.6 or 7.5 amp. constant current series circuit individual auto-transformers have been employed. Recently, however, due to a number of inherent advantages, there has been a considerable demand for a small series transformer to operate a single lamp by stepping up the line current to the higher current required by the lamp. Accordingly, there has been developed an individual series transformer which can also be made to operate a number of small units, insulating them from the high voltage series circuit.

Among the advantages of this individual series transformer for ornamental street lighting may be mentioned that, as they insulate the pole and lamp from the high tension circuit, the use of series lamps is permitted in municipalities where ordinances are in force which prohibit high tension wires being carried on poles in the business district. They save the expense of high-voltage conductors, heavy insulation and high tension absolute cutouts in the pole. On account of the low secondary voltage of these transformers the lamps are as safe to handle as if they were on a multiple circuit. No film cutout is required as each lamp is independent of the others in the circuit; in case of an accident to one or more, the remainder of the lamps on the circuit burn without interruption.

Elevators

During the last twelve months a gearless traction elevator equipment, which is specially designed for high-speed passenger service has been developed. The equipment consists of a full automatic, magnetic controller and a slow speed direct current motor, on the shaft of which is mounted the sheave for driving the elevator. All gearing is eliminated.

Coal Mine Service

It is interesting to note the favorable impression created by the new commutating-pole rotary converter in coal-mining. The chief trouble in mining work has been commutation, because the mining load varies anywhere from ten per cent. full load to one hundred per cent. overload in a very short space of time. In the old machines it was necessary to shift the brushes to prevent sparking and damage to the commutator. Realizing these conditions, this new special rotary converter was developed.

For use in mining where the gathering reel mine locomotive is not especially adapted, a combination trolley and storage battery gathering reel locomotive has been used, which has the advantage of being able to operate on trolley when this is available, and then obtain energy from the storage battery in the mines and other places where trolley construction is not available. The particular advantage of this locomotive is that it can continue to pull cars to and from the rooms if for any reason the trolley voltage fails and can always be operated independent of the trolley voltage.

Motors

There has been a development in the steel industry during the past six months, and in the majority of cases the mills added are driven by motors instead of steam engine. Among the list of drives supplied are several important items, including in particular, several equipments for reversing blooming mills, two 12,000 horsepower units, being the largest electric motor-driven steel mills in the world. The efficiency and many incidental advantages offered by motor drive have gained much prominence for it in the steel industry, and it is now adopted as a rule, rather than the exception. Undoubtedly in the near future there will be a very large increase in the amount of horsepower installed in steel mills for large roll drives. The Bethlehem Steel Company are at present installing in their works a 1,500 horsepower alternating-current motor which will have unusual characteristics in that it has a special type of control, making the motor adjustable speed, independent of load, through about 80 per cent. speed reduction range. The equipment is so arranged that the driving unit will deliver constant horsepower to the rolls through this wide speed range. The efficiencies of the equipment will be very much on a par with a direct current motor using field control, and is quite in contrast with the older methods of obtaining speed regulation with wound rotor alternating current motors where resistance is inserted in the secondary circuit of the motor.

In the field of small motors there has been a general increase in the use of motors for household, office and shop devices. This holds true particularly in the following specialized industries: small motors for use in garages and automobile service stations, small ventilating units, motor equipment for moving picture shows. The motor-driven washing machine and vacuum cleaner continue to be the most popular small motor-driven devices.

In the battery charging field, there have been developments in motor-generator and switchboard equipment for large battery charging stations, and also particularly small motor-generator sets for charging, lighting, starting and ignition batteries used on gasoline cars.

Railways

The demand for Hydro-Radials in the Province of Ontario has been very insistent, as will be seen by the support given the project at the recent elections. They will open up immense possibilities for the development of Ontario, although the full extent of the economic benefits to be derived from the building of these roads cannot altogether be foreseen. There is, however, little doubt that they will be of great benefit.

The greatest step yet taken in steam railroad electrification is the work being done by the Chicago, Milwaukee & St. Paul Railroad in electrifying four complete engine divisions of 440 route miles through the mountains from Harlowton, Montana, to Avery, Idaho. These engine divisions include the heaviest grades on the system. The electrical equipment includes thirty locomotives geared for freight service and twelve locomotives geared for passenger service, all weighing 282 tons each, exclusive of steam heating and lighting equipment. The locomotives are also equipped for regenerative control in descending grades.

There are fourteen sub-stations spaced approximately 32 miles apart, containing 32 motor-generator sets, aggregating 59,500 kw. capacity, with transformers, switchboards and accessories. The selection of 3,000 volts d.c. was based on the eminently successful operation of The Butte, Anaconda and Pacific Railway at 2400 volts d.c. This latter road began electrical operation in 1913 and the comparative figures indicate an annual saving in operating cost of 20 per cent. on the initial investment by the substitution of electric for steam haulage.

The Michigan Railway between Kalamazoo and Grand Rapids is the only road in the world to take power from a 2400 volt third rail, and is also unique in that 1200 volt synchronous converters connected two in series are used in the sub-stations.

In Canada we are rapidly advancing in the use of high voltage d.c. The Montreal Tunnel & Terminal electrification is progressing with 2400 volt d.c. supply for both locomotives and passenger coaches, The locomotives are being built complete here. The London & Port Stanley Railway was opened in July and operates locomotives and passenger coaches on 1500 volt d.c. The Lake Erie & Northern Railway is also operating on 1500 volts d.c. and in addition has the first 1500 volt portable sub-station in operation in Canada. The Toronto Suburban Railway is also electrifying with 1500 volts d.c. Sub-stations are now being equipped and cars built. The 1000 kw. rotary converters with automatic booster control and three-wire features for the Toronto Hydro Electric System, are an entirely new development and the first of their kind ever built.

One Man Cars

A noteworthy development of the year was the introduction of one-man operated cars in a great many American and a few Canadian cities. The jitney service which attained such popular prominence during the summer of 1915 has declined almost as rapidly as it developed, and in some cities has entirely disappeared. Short and spasmodic as it was, however, it has served in many cases as a means of urging railway companies toward greater economies and efficiencies, enabling them to provide better and more continuous accommodation for the travelling public. In order to successfully meet the jitney competition one of the developments has been the use of one-man cars as the means of reducing maintenance cost due to the extra service demanded, and the development of an extremely light-weight and inexpensive, yet reliable, motor with the rating of 17½ h.p. and 24 h.p. These motors weigh approximately 850 lbs.

Sub-stations

Among the general advances noted is the increasing use of outdoor or semi-outdoor types of sub-stations. The marked development in the size of oil insulated, self-cooled transformers has no doubt largely contributed to their introduction, due to the elimination of cooling water troubles. Along these lines we might also mention the fact that the use of automatic sub-stations in connection with electric railways has been advocated, and in at least one instance has been successfully used.

Transformers

There has been very little done in the way of hydro-electric development or other large single developments which would call for any marked increase in either voltage or size of transformer over the preceding year. 5,000 kv.a. O.I.S.C. radiator type transformers have been installed and are operating successfully. Several orders for large O.I.S.C. radiator type transformers have been received and the transformers put into operation, and considerable activity along this line is anticipated in the future.

In America all large high-tension transformers have up to the present time been of the shell type, although in Europe the core type has been used extensively. During the last year the manufacturing companies have developed the core type in larger sizes, which advance should be welcomed by the operating companies, since the core type has some distinct advantages. The use of the large electric furnace in Canada has developed a new field for transformers, especially designed for this purpose, with very high reactance values. The electric furnace in its various applications offers, in fact, a very large field for development in Canada.

Abating the Smoke Nuisance

During the year interest has been aroused in the matter of electrical precipitation of smoke, dust and fumes in various industrial operations, such as smelting. This application calls for transformers of small capacity and high voltage in the neighborhood of 100,000 to 150,000 volts or higher, and capacities from 5 to 75 kv.a. This has required the development of small high voltage transformers at a reasonable cost. Quite a number of such transformers have been built and put in service.

Meters

Minor improvements have been made in small apparatus and meters, and the use of electricity for domestic appliances has greatly increased; this was considerably augmented by the "Electrical Prosperity" Campaign.

Increased Use of Electrical Appliances

Due to keen competition, the increased efficiency in generating and transmitting devices by which power can be generated and transmitted long distances in large or small quantities, its characteristics changed at will with small losses and at comparatively small cost, the reduction in the price of power in the province of Ontario has been so great that certain of the rates are now the lowest on the continent. This schedule of new rates affords some municipalities a final household rate of one cent per kw.h., with ten per cent. discount, that brings the cost down to .9 cents. These rates are particularly attractive to householders who use electrical appliances rather freely, and especially so to those who cook with electricity, so that as far as cost is concerned, electric cooking is well within the range of all municipalities affected by the reduced rates. In Ontario during the last year the increased use of heating and cooking appliances has been very noticeable, due partly to the increased efficiency, utility, and the appreciation of the merits by the public of such apparatus, but largely also to the reduced price of power mentioned above.

The number of towns in Ontario desiring hydro-electric service has been steadily increasing. During the past year the number of municipalities supplied increased from 66 in December, 1914, to 104 in December, 1915, and during the coming year the number is expected to increase to 160.

New High-Efficiency Incandescent Lamp

In incandescent lamps the year has seen the development of an entirely new high-efficiency incandescent lamp with the characteristics of the ordinary incandescent lamp, but having as a source of light an arc with electrodes of tungsten or other refractory conductor, burning in an inert gas such as nitrogen or argon. Working on the principle that the filament of an incandescent lamp gives off a strong negative discharge, this lamp was designed with an additional electrode seated adjacent to the filament, and charged from a positive potential. This sets up a current between the filament and the electrode and acts as an ionising agent on the arc gap, making it conducting. This ionising circuit is connected in parallel with the arc, through a single pole switch and resistance. To put the lamp in operation the ionising circuit is completed for a few seconds and then broken by means of the switch; the result is a momentary arc between one of the electrodes and the filament, followed by an arc between both electrodes. As a result of continued experiments a satisfactory filament having powerful ionisation properties has been evolved.

The parts of the lamp are concealed in an ordinary incandescent lamp bulb, which, after being exhausted of air, is filled with nitrogen at a pressure of approximately two-thirds of an atmosphere. As compared with the carbon-arc lamp the new lamp is very simple, no regulating mechanism is necessary, and there is therefore a saving in the cost of production. The loss of light caused by the obstruction of the electrodes is small compared with that in the carbon lamp, and there is no trouble from flickering or arc wandering. Moreover, as the arc is completely enclosed, there is no danger from fire, no recarboning is required, and the lamp needs no attention while in use.

High Efficiency Incandescent Lamp

New type of incandescent lamp, with characteristics of ordinary lamp, but having as a source of light an arc, burning in an inert gas between tungsten electrodes

A new type of high efficiency incandescent electric lamp is described in a paper presented to the Institution of Electrical Engineers by Messrs. E. A. Gimingham and S. R. Millard. In 1913 experiments were started in the lamp research laboratory of the Edison and Swan United Electric Light Company with a view to making a lamp having the usual characteristics of the ordinary incandescent lamp, but having as the source of light an arc having electrodes of tungsten or other refractory conductor burning in an inert gas approximately, two-thirds of an atmosphere. When connected to a continuous-current circuit through a resistance the current passing through the coil A produced sufficient heat to cause the expansion strip B to warp, thus separating the electrodes E E' and striking an arc between them. The temperature of the heating coil then dropped to a very dull red heat, due to the resistance introduced by the arc itself. The heat from the arc was more than sufficient to keep the expansion strip hard against the stop F, and thus

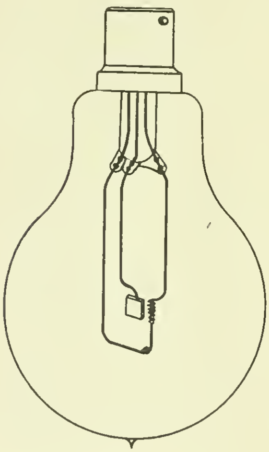


Fig. 1.

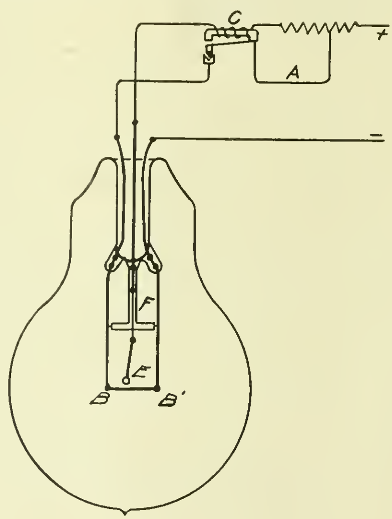


Fig. 2.

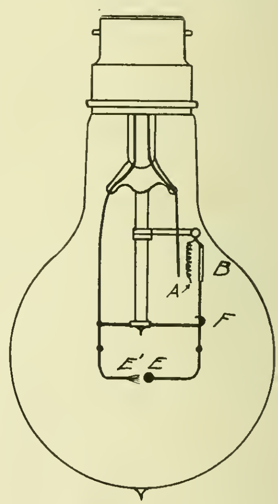


Fig. 3.

such as nitrogen or argon. The first lamps constructed were made with the electrodes in contact, one being connected to an expansion strip of copper or other material having about the same coefficient of expansion. A spiral filament of tungsten, or molybdenum, was mounted close to the strip and connected in series with the arc circuit. To prevent the strip moving too far and the arc breaking, a thick wire was sealed into the glass support, this wire acting as a stop and maintaining the correct gap. For alternating current lamps the electrodes were constructed of fused tungsten, and were of equal size. In the case of one of the continuous-current lamps the positive electrode was made of a globule of fused tungsten and the negative electrode consisted of a number of tungsten wires or filaments mounted in the form of a brush.

The parts were assembled as shown in Fig. 1, and sealed in an ordinary incandescent lamp bulb, which, after being exhausted of air, was filled with nitrogen at a pressure of, to maintain the requisite length of gap. The arc burned steadily, and the electrodes emitted an intense white heat. But the lamp was unsatisfactory. One trouble was that the electrodes tended to stick together, with the result that the expansion strip failed to separate them. Moreover, a considerable amount of sputtering took place, thus shortening the length of the lamp's life. Ultimately, however, a lamp was developed which had a life of over 100 hours.

An Additional Electrode

Later the problem was attacked in a totally different way. It is well known from experiments made by Sir J. J. Thomson, Dr. Fleming, and others that the filament in an incandescent lamp gives off a strong negative discharge, and if an additional electrode seated adjacent to the filament be charged to a positive potential a current passes between the filament and this electrode. This principle was applied in developing the new lamp. The first attempts were made with a view to constructing an alternating-current lamp, consisting of two small globules of tungsten fixed a definite distance apart. In order to break down the resistance within the arc gap a filament was mounted adjacent to the electrode, this filament, when made to glow brightly for a few seconds, acting as an ionising agent, thus making the arc gap conducting. This ionising circuit was connected in parallel with the arc through a single pole switch and resistance. To put the lamp into operation the ionising circuit was completed for a few seconds, and then broken by means of the switch, the result being that an arc was momentarily struck between one of the electrodes and the filament, this being followed by an arc between both electrodes, the filament acting as the ioniser being then entirely cut out of the circuit. This lamp proved to be a great improvement upon the previous one. Attempts were then made to construct a lamp for continuous-current circuits.

At first the construction was similar to that of the alternating current lamp, with the exception that the negative electrode was smaller. To put the lamp into operation the filament acting as the ioniser was brought to a high state of incandescence and then cut out of circuit by means of a switch in the positive lead. Difficulties, however, were experienced in inducing the arc to leave the tungsten filament ioniser and pass to the negative electrode. This trouble, it seems, was due to the difficulty of bringing the negative electrode to a temperature high enough to form an arc. In the alternating-current arc the electrode which momentarily formed the arc with the ioniser helped to form the arc proper, but with the continuous-current lamp the arc persisted in passing between the positive electrode and the ioniser. Later negative electrodes were made which the arc would strike, but it was considered necessary to provide thoroughly for the protection of the ioniser. It is well known that several refractory oxides possess to a very high degree the property of emitting electrons, and experiments were therefore made with mixtures and combinations of tungsten with zirconia, yttria and other oxides of the refractory class.

Evolution of a Satisfactory Filament

As a result of continued experiments a satisfactory filament having powerful ionisation properties was evolved. It was found that if filaments were carefully made they were not destroyed by the action of the arc, and that they lasted considerably longer than a filament of pure tungsten, this being, no doubt, due to the difference in the physical state of the two filaments. Difficulties, however, still remained. The action of the arc naturally destroyed, after a time, the ionising properties, and in some cases difficulties have been experienced in re-striking after the lamp has been in use for 200 hours. This deterioration of the ionising properties of the filament, however, was only local, being merely around a short length directly opposite the anode. To overcome this a short length of expansion strip similar to that used in the lamp shown in Fig. 1 was linked between the anode and stem lead. A lamp constructed in this manner is shown in Fig 2, which is a lamp suitable for working with continuous current. Three leads, it will be noticed, pass through the lamp stem. On one is mounted the electrode E, while the other two hold the filament acting as an ioniser B B'. The positive main lead is divided into two circuits, one of which, A, passes through a resistance, and the contacts of the electro-magnetic switch C to one pole of the ioniser B, the other being taken through a resistance, and the coil on the electromagnetic switch to the positive electrode of the arc circuit E. The negative main load is connected to the remaining ioniser lead B'. When the lamp is in operation the current first passes through the ioniser circuit, causing the filament to incandesce at a temperature sufficient to ionise the gas between it and the positive electrode E. At first a small current flows in the arc circuit, this current rapidly increasing until the cut-out is operated. This breaks the ioniser circuit until the arc is struck, the striking being assisted by the removal of the ioniser circuit which previously shunted the arc circuit. The heat rising from the arc causes the expansion F to warp, and this moves the arc to another position on the ioniser.

Source of Light

On switching off the current the electrode returns to the original position, having left the inactive part and coming to rest opposite the still active portion of the ioniser. By this means the lamp may be restarted at any period of its life without difficulty. In this lamp practically the whole of the intense white heat emanates from a small globule of fused tungsten 1/10-in. in diameter. Any size or shape of electrode may be made, the construction of the higher candle-power lamps being as shown in Fig. 3. Here the expansion strip is dispensed with, for with a powerful arc there is a great tendency for the arc to pass across the shortest gap. In this case, after striking from the filament to the edge of the electrode the arc rises to the thickened portion immediately opposite. As compared with the carbon arc lamp the new lamp is very simple. No regulating mechanism is necessary, and there is, therefore, a saving in the cost of production. The loss of light caused by the obstruction of the electrodes is small compared with that in the carbon lamp, and there is no trouble from flickering or arc wandering. Moreover, as the arc is completely enclosed, there is no danger from fire. No re-carboning is required, and the lamp needs no attention while it is in use.

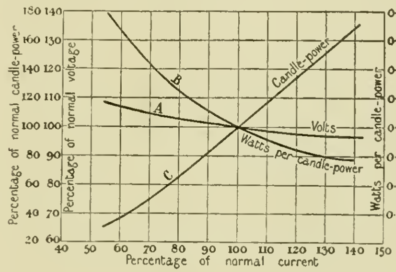


Fig. 4.

The curve A, Fig. 4, shows the percentage variation of pressure with current, and it will be seen that the curve is similar to that of an ordinary arc, though it indicates that the stability is greater. The pressure across the arc steadily decreases with an increase of current, and if continued until the sputtering point is reached the pressure suddenly drops. A representative efficiency curve is shown at B, which shows the efficiency for the normal working current to be 0.5 watt per international candle-power, or two candle-power per watt. The current may be increased until the tungsten reaches the sputtering point, at which the efficiency is .3 watt per candle-power, or 3.33 candle-power per watt. Curve C, in Fig. 4, shows the variation of candle-power with current.—Engineer.

Do Not Constitute a Hazard

The city of Woodstock recently applied to the Dominion Railway Commission for an order to force the G. N. W. Telegraph Company to place their wires underground in that city. The Commission has replied that they have no power to make such an order unless it can be shown that the present conditions create a fire or life hazard. The argument of an aesthetic betterment is not sufficient.

In the Public Eye

A budget of comment presented in the interest of public welfare, independent of party politics and with malice toward no one.

The real test of sacrifice is now at hand. It comes not in the call for half a million men, but in the answering of that call. It comes when men who love not war but peace, not the blare of trumpets but the quiet fireside, are asked to prove that they love their country more than all else they hold dear in life. It comes when men are asked to give up good positions with the ease and comfort that accompany them, to serve as privates in the ranks—to face hardship and death, not for glory or love of excitement, but as their duty to that Empire that has guaranteed them liberty and the pursuit of a certain amount of happiness.

* * *

By the way, it looks from here as if Mr. Acton made an awful mess of that Hopkins clothing charge. He made his charge as bold as any lion and then when he got in front of Sir Charles Davidson he wanted to apologize so hard that he hired a lawyer to help him do it. He was evidently so unused to court procedure that he became nervous and engaged a lawyer even more nervous than himself. It never occurred to either of them to ask to have Hopkins' Toronto partner called for examination. To be sure he is a silent partner, but who knows but that the commission might have induced him to break his silence. There was Hopkins' bank account. Might that not have thrown some light on what happened to Hopkins in connection with one or more contracts that seem to have got tangled up with his real estate business. It might have shown where the money came from that is keeping Mr. Hopkins in New York. Or, if Mr. Hopkins' silent partner had been called might he not have been able to explain just why Mr. Hopkins had at this somewhat inconvenient season ceased to bother about clothing contracts and taken such an extended vacation. Mr. Acton either went too far or not far enough. He should never have put his charge in print unless he intended to fight it all the way through. The sudden fright he developed reflects credit neither on himself nor on the trade press.

* * *

For, you know, even if the Purchasing Committee never gave a contract to a real estate man, there is ample evidence that the Shell Committee was not too proud to give a shell-box contract to a shipping clerk or to a general storekeeper. The latter instance occurred down in Victoria County—at Fenelon Falls, to be more exact. The man who got the contract was C. W. Burgoyne, who with his father, forms the firm of W. Burgoyne and Company, which carries on a general store business. Now you can't very well make shell-boxes in a general store, you know, so Mr. Burgoyne looked around for somebody to do the work, and finally sublet to Alfred Tiers, who conducts a small planing mill in Fenelon Falls. The latter couldn't do all the work but by purchasing parts from a third party he was able to complete the contract.

* * *

Before its completion Mr. Burgoyne secured a second contract for an additional 25,000 boxes. This one was handled more scientifically, as Burgoyne and Tiers formed a partnership which did the work under the name of C. W. Burgoyne & Co. Now if the government was anxious to prove that the Purchasing Committee did not let a clothing contract to a real estate dealer shouldn't it be just as anxious to disprove that the Shell Committee let a shell-box contract to a general storekeeper? Isn't it really more necessary that the shell-box matters be cleared up because the Shell Committee was a creature of the Canadian Government handling money in trust for the Imperial Government? The Dominion Government has a sort of right to do as it pleases with its own money, but it owes it to Canada and to the British taxpayer as well, to show that every cent of Imperial funds placed with the Shell Committee was placed properly and to the best advantage. It is up to the Dominion Government to show that the shell-box contract let to a general storekeeper in Victoria County was not placed to relieve either political or "commercial depression brought on by the war."

* * *

One shell manufacturer is credited with the statement that at the end of the year he will ascertain his profit and pay over to the Patriotic Fund every cent in excess of his average usual profits for the last five years. I don't doubt it for a moment. Every man who has received a shell contract is not necessarily a highwayman with a gun held to the Empire's head. Many a shell contractor has taken the work for the joint purpose of giving his workmen employment and furnishing the Empire with the munitions she needs. He neither sought nor received the tremendous profits some others have boasted of making. But with the air full of rumors of tremendous war profits only an investigation will clear the air and let in the light on the vexed question, "Are there profiteers? If so how did they get their contracts?" There must be a reason.

* * *

The Minister of Militia has asked that "men of standing in business, professional or mechanical life, will send their names to him." He conveys the idea he wants them as officers for he is further quoted as saying "We want to know who is who before we make appointments or permit the raising of any new regiments under new auspices." But naturally the question arises as to whether the Minister means what he says or is simply making a bluff to cover some of the practices that have hitherto governed the appointment of officers. Let me cite an example. A well-to-do financial man of Toronto was anxious to do his bit. His years and experience did not exactly fit him for too heavy work, but in this hour when every man is needed, he thought he might act as paymaster, thus relieving some husky young officer for more active work. He wrote to Ottawa for an appointment and was referred to the officer commanding No. 2 Division. The latter told him his application would receive consideration. Some days later a friend called him aside and told him he would get the appointment but he had first to secure the influence of two Toronto men, local members of the Provincial Parliament. He told the whole bunch to go to Hades—wherever that is.

* * *

Now if Sir Sam was as frank as he is loquacious would he not have wound up his statement with "only those having political influence need apply." For the past has shown that numbers of officers have been chosen not because of their fitness or capacity but for the amount of political pull they can develop. There are hundreds of incapable Canadian officers now stalled in England, so I am told. They may easily be found around the Savoy Hotel in London, having a good time at the expense of the Canadian taxpayer. With rare exceptions the efficient have reached the front.

* * *

The following from the Ottawa Evening Journal of the 10th inst. speaks for itself:

"In talking over the matter, Sir Sam Hughes mentioned that his chief intelligence officer was a Canadian of German birth, whose father was now an officer in the German army, whose mother was the daughter of an Austrian general, and whose brothers were officers in the German army. This officer is described by General Hughes as one of the very best in the Canadian army."

* * *

The dignified and talented president of the Bank of Commerce has paused for a moment to hand us a little more advice. He tells us we should economize. He doesn't go a step further and tell us to put the money we save by our economy in the bank. Why should he? Any fool knows that the only way to start saving is to open a savings account. And when the bank gets it of course it will help to carry on the war to a successful issue or help to move the crop. Of course it will—or at least that part of it that isn't sent on to New York to be put out on call loans to Yankee stock speculators and stock brokers. Or maybe it is needed to be loaned to Canadian promoters for investment in Brazil and Mexico. When hard times strike this country our banks immediately proceed to economize by refusing business men the necessary funds to carry on legitimate trade. Does the money they refuse lie idle for that reason? Well, not according to the annual bank reports.

* * *

The same government which pays 5½ per cent. interest on war bonds keeps the rate of interest on post office savings at 3 per cent. Does said government wish to convey the impression that its bonds are twice as great a risk as money in the post office, or is it merely trying to create a market by offering bonds at bargain prices? Surely the government wants the people to save. Why not pay them a more attractive rate of interest till they have saved enough to invest in bonds? Why not encourage thrift among our people?

* * *

"One-half this country's daily papers are edited by Sir Robert Borden, the other half by Sir Wilfrid Laurier. The editors are so many liveried office boys to the Premier and leader of the Opposition."—Toronto Telegram.

* * *

Will the Minister of Militia deny that he is directly or indirectly financially interested in the Ross Rifle Company?

* * *

The Shell Committee, its alleged crimes and self-asserted virtues, has been brought before Parliament by Dr. Pugsley, a Liberal statesman who has probably been taught that he who is without sin should throw the first stone. It is to be regretted that what should be only a business proposition is thus being made more and more of a political question. It is unfortunate that Sir Robert Borden failed to listen to the voice of the more independent of the Conservative press and order a full and free investigation into the workings of that committee. If there was nothing to hide he had nothing to lose. If there was something to hide a full investigation ordered by himself would free him from all blame and responsibility. Dr. Pugsley has made so many charges, though insignificant in comparison to the real facts, that an investigation should follow and if any or all of the charges are sustained the Government must share responsibility with the Shell Committee and the profiteers. I have felt from the first that such an investigation was necessary for the protection of the manufacturing interests of Canada and with me those interests come before the political welfare of Sir Robert Borden, whom in many ways I admire.

* * *

In a recent issue, concerning shell committee charges, the Montreal Star, (Con.) says:

"In any case, the Government cannot permit these shocking and humilitating charges to remain uninvestigated."

That the indiscriminate handling of support for soldiers' families is working out badly in both directions is shown in numerous instances. A private in a certain platoon in the — battalion boasts that he is at present drawing $160 per month whereas he never before drew more than $50 per month. He is an employe of the T. Eaton Company, which generously allows him full pay and he gets in on all the funds. On the other hand an acting-sergeant informs me that although he has been at the Exhibition camp for nearly a month his dependents have not received a cent from any source and that even part of his pay has been held back for fear he'll elope with his uniform. Some kinds of patriotism are too profusely fertilized and some are simply starved. But then no British people ever did develop a government that was big enough to handle a war.

* * *

To all appearances the British people have awakened and decided to "get on" with the work. The British papers are warning, mildly as yet, the world not to tread on the lion's tail. The London Standard puts it:

"Germany is now clothed in a white sheet. She and America are joining hands in the noble task of bullying the nation that has respected every law of humanity and has persistently interpreted the law of nations to her own disadvantage.

"Poor England. No moral crime can be laid at our doors, but we are interfering with the war profits of American manufacturers, so we must raise our blockade and thus prolong the war, and this is asked for in the name of humanity.

"There is one comfort for us miserable sinners: President Wilson and Count von Bernstorff will knock at our door in vain."

* * *

The attitude of our Australian cousins towards the munition-making business is in humiliating contrast to the conditions under which this work has been carried on in Canada. Over in Australia, Government and private factories scorn to accept exorbitant "blood" profits at the expense of the lives of their sons and brothers at the front. As an example we may quote the West Australia War Commissions Company, Limited, organized when the war broke out under state supervision by leading public and business men of the state. The whole capital was furnished by public supscription on the understanding that there should be no dividends and that the price of the manufactured articles should be as nearly as could be fixed the actual cost of those articles. It was further stipulated that any profits remaining after the repayment of the paid-up capital after the war should be devoted to patriotic or charitable purposes incidental to the war. The same spirit evidently animates private companies, who have undertaken contracts from the Government at certain named prices on the understanding that if these are greater than the actual cost of production of the article the balance shall be refunded.

In comparison with this truly patriotic attitude Canada merely offers examples of the operations of our late shell committee such as the original letting of contracts at $6.70 per unit which have later been reduced to $1.85; the boasts of our financial magnates of huge war profits; and the scandals attaching to other purchases.

If these men, our leaders, represent Canadian culture, is not the world saying that it at least compares "favorably" with the German type?

* * *

When are we going to get some information concerning the Ross Rifle? Rumors suggest that after the disastrous fight at Langemarck the British Government made a report to Ottawa concerning the rifle. If so, why is this report not made public?

* * *

And then again—but oh, what's the damn use?

SEARCHLIGHT.

Electric Railways

Rapid Transit in Toronto—An independent solution of the city's needs—Subways north and west, east lines elevated.

By Ernest V. Pannell, A. M. I. E. E.

Since the Arnold report on the rapid transit problem in Toronto was presented in 1911 the demand for transportation facilities has still further exceeded the accommodation therefor. Congestion in the business districts is particularly pronounced, owing to the concentration of the transitory population induced by large office buildings in a circumscribed area and to the necessarily slow speeds afforded by a surface car system in such a section. The provision of faster transit would tend to open out both the business and residential areas and enhance the taxable value of property contiguous to the railway system. It is not to be supposed that a costly proposition such as a true rapid transit scheme can, during the first few years of its life, offer good service and, at the same time, make an adequate return upon the capital invested. From the viewpoint of civic betterment, however, as exemplified by increased property values, better residential conditions and wider distribution of the community, its value can hardly be capitalized. Where such an urban railway offers facilities for the ingress of interurban lines from the outlying townships to the heart of the city its value is still further enhanced and a definite increase of population may be expected to follow. To quote from one of the Municipal Reference Bulletins issued by the city of Chicago; "Free and easy intra urban transportation is as important to the inhabitants of cities as the circulatory system is to the human body. The question in large cities is to provide for sustained growth without congestion . Where density and intense concentration of population obtain at the expense of proper sanitary conditions, wholesome tenements and decency; cheap, adequate and rapid transit from the outlying zones of the city is one of the solutions of the problem."

That the necessity for rapid transit is not confined to cities of over one million population may be gauged from the fact that in Melbourne, Australia, with its 600,000 inhabitants, the sum of $14,000,000 is being expended by the Victorian Railway Commissioners for a comprehensive electric railway project to serve the city and suburbs. Similarly, Sydney, New South Wales, with a population of 650,000, is embarking upon urban railway improvements involving inter alia a bridge across the harbor which will cost some $15,000,000. Boston, Mass., with little more than 700,000 people, has one of the best rapid transit systems in the world, comprising subway, elevated and surface railways. Coming still nearer home, the city of Montreal has under consideration the equipment of a subway system to relieve the street congestion, which scheme in its entirety is estimated to cost $20,000,000.

In view of the extremely heavy capital outlay involved

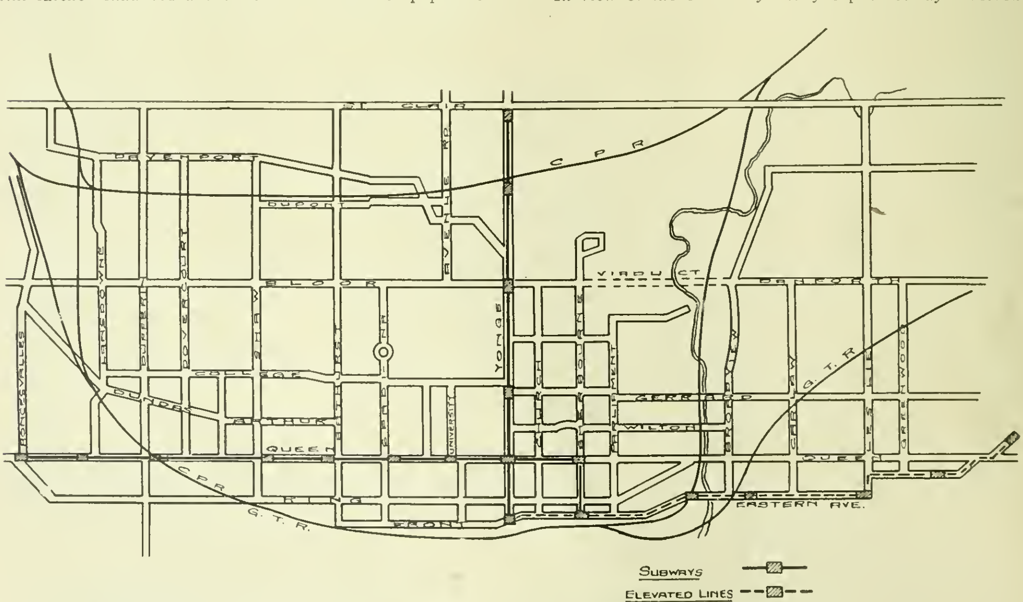


Fig. 1. Plan of the City of Toronto showing the main streets upon which car tracks are situated and the location of the Rapid Transit Lines.

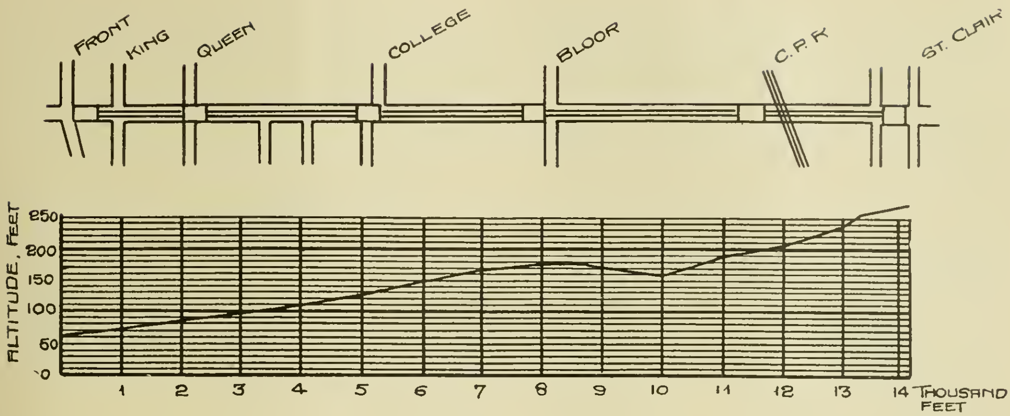


Fig. 2.—Grade Profile of Subway—Yonge Street Division

in urban rapid transit undertakings, therefore, it is only to be expected that where engineered solely by private enterprise and on the basis of a more or less limited franchise, such projects will afford barely sufficient service to satisfy the demands. The fact that the city so largely benefits from the presence of the railway suggests that the lines should be built under civic auspices and operated by a lessee company subject to a city Rapid Transit Commission. That the commission be composed mainly of practical electric railway men goes without saying.

True rapid transit facilities can never be afforded on the streets of a crowded city; the railway system must therefore be sunk below or elevated above the street surface. In most large cities at the present day a compromise of both forms of construction is used, it being usual to employ subways only where narrow streets, residential property or other good reasons preclude the erection of elevated lines.

cannot be denied that the streets of Toronto are not, as a rule, adaptable for the construction of elevated roads. The constructional work proposed in the present article is summarized in Table 2, and the routing is shown in the plan, Fig. 1.

TABLE II.

Routes of Rapid Transit Lines

1. Subway, Yonge Street, Front to St. Clair, 2.70 miles.

2. Subway, Queen Street, Sherbourne to Sunnyside, 4.30 miles.

3. Elevated, Eastern Ave., Yonge Street to Kingston Road, 3.60 miles.

The whole of the above is, of course, double-track, the total track-mileage, equipped for 600 volt d.c. working, is therefore 21.20. It would be proposed to construct the system in the order given above, a two-year interval being

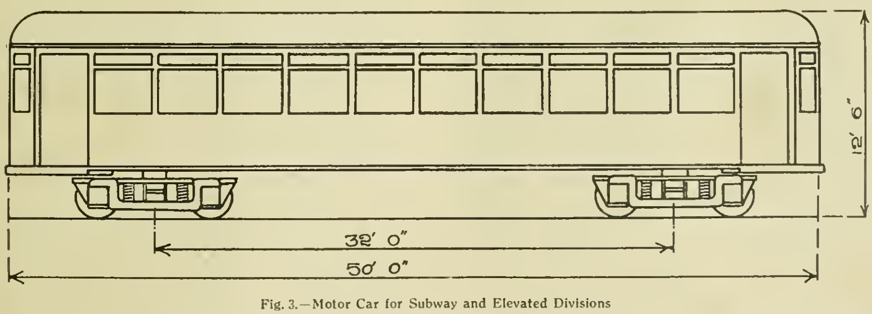


Fig. 3.—Motor Car for Subway and Elevated Divisions

TABLE I.

Forms of Construction Adopted for Urban Transit

Subways.—Paris, Buenos Aires, Budapest.

Elevated.—Chicago, Liverpool.

Combined Subway and Elevated.—London, New York, Brooklyn, Boston, Philadelphia, Berlin, Hamburg.

A modern elevated railway is far in advance of the earlier types of construction common in Chicago and Manhattan. By the use of a solid floor and track ballast, noise is reduced to the minimum and a permanent and not unsightly form of structure is obtained. The advantages in point of cost, hygiene and convenience to the travelling community are all with the elevated system. Unfortunately, however, it

allowed to elapse before commencing the construction of the several divisions. It is believed that Division 1 is the most important, as regards the relief of congestion and provision of transit to the northerly sections of the city. This subway would accelerate traffic along the main artery of Toronto and coming to the surface at St. Clair Avenue would effect a physical junction with hydro-electric or other interurban lines running north out of the city. The southern terminal would be contiguous to the new Union Station, and covered ways would be erected to communicate with the steamship landings. Periodic service of through cars to points as far north as Lake Simcoe could, of course, be provided through the tunnel. The stations in the subway would average one-half mile apart and be located at Front, Queen, College and

Bloor Streets, North Toronto, and St. Clair Avenue. The station arrangement at the south end of the line, as will be seen, would tend to relieve the street congestion at King and Yonge Streets, besides minimizing the amount of excavation in the vicinity of the city's tallest buildings.

The main east and west subway running from Sunnyside would follow Queen Street to Sherbourne Street, a spur down Sherbourne to Front being opened up at the same time as Division 3. The total length, including the spur, is 4.30 miles of double track, and opportunities for the through

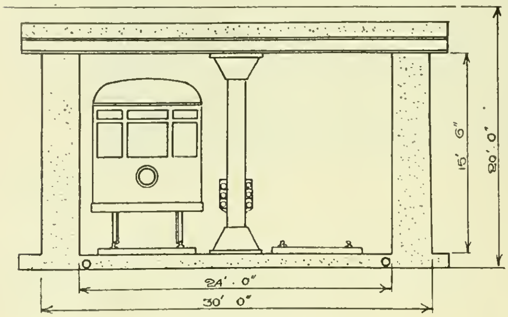


Fig. 4.—Section through Subway

running of radial cars would be provided, as in the case of Division 1. The Yonge Street station on this line will afford passengers an opportunity of exchanging with the Yonge Street subway, whilst the carrying of the line through to Sherbourne Street will again assist in keeping the main street free from unnecessary foot passengers.

Division 3 consists of an elevated railroad extending east from the Front Street station along Front Street and Eastern Avenue to the junction of the Kingston Road and Queen Street. The line would be carried over the River Don by a truss bridge and another bridge would be necessary to cross Queen Street at the Woodbine, several changes of alignment would also occur in this line and a down grade of five per cent. would bring the tracks to the level of the Kingston Road at the eastern terminal. Through running with the eastern lines would be effected just as with the other divisions. The district covered is expected to become in the near future one of the city's busiest manufacturing areas; little or no depreciation of property need therefore be feared as a result of the railway; indeed, the value of the factory sites would be enhanced by the advent of rapid transit for the factory help.

The summarized particulars of the cars proposed for use on the three different lines are as follows:—

TABLE III.

Motor Cars for Rapid Transit System

Construction	Semi-steel
Length over Bumpers	51 ft. 0 in.
Height from Rail	12 ft. 6 in.
Width, overall	8 ft. 6 in.
Capacity, seated	50
Capacity, maximum	100
Motors per Car	2
Motors, type	GE-233
Motors, rating kw.	105
Truck wheelbase	7 ft. 0 in.
Truck centres	32 ft. 0 in.
Weight, body	30,000 lbs.
Weight, trucks	23,000 lbs.
Weight, equipment	12,000 lbs.
Weight, total	65,000 lbs.

As will be noted, a light form of car is proposed in order to reduce the energy consumption consequent upon the type of service. It is not considered desirable to run street cars over the rapid transit tracks, the schedule speed and acceleration together with the high traffic density render it necessary if full use is to be made of the subway to confine the operation to one type of car of approximate design.

Summarized particulars of the three rapid transit routes with their respective operation characteristics are given in Table 4.

TABLE IV.

Particulars of Rapid Transit Routes

Division	I.	II.	III.
Route	Yonge St.	Queen St.	Eastern Ave.
Length, miles	2.70	4.30	3.60
Construction	Subway	Subway	Elevated
Number of Stations	6	9	7
Average Run, feet	2840	2850	3160
Operation			
Schedule Speed, m.p.h.	15	15	15
Acceleration Rate	1.50	1.50	1.50
Braking Rate	2.00	2.00	2.00
Normal			
Headway minutes	4	4	4
Cars per Train	2	2	2
Trains per Hour	15	15	15
Passengers per Train	100	100	100
Passengers per Hour	1500	1500	1500
Cars in Service	12	18	16
Rush			
Headway minutes	1.5	1.5	2.0
Cars per Train	2	2	2
Trains per Hour	40	40	30
Passengers per Train	200	200	200
Passengers per Hour	8000	8000	6000
Cars in Service	32	48	30

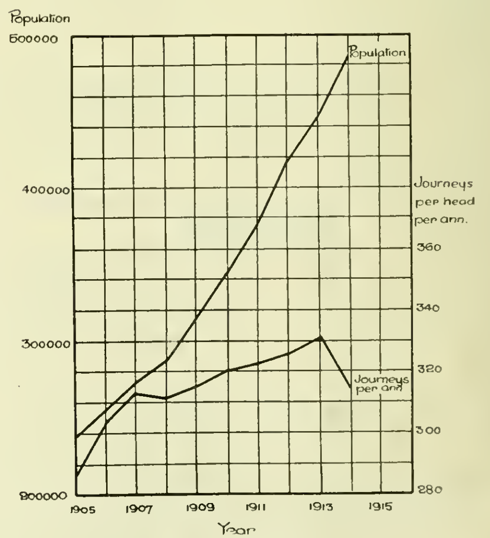


Fig. 5.—Urban travel of the population of Toronto.

Typical speed-time and power-time curves have been plotted (Figs. 6 and 7) for the regular two-car train fully loaded. As will be seen, the chief physical factor which modifies the operating characteristics is the average grade up Yonge Street of 1.5 per cent., which calls for heavy current inputs on the uptown trip but permits the trains to coast almost the whole distance downtown. The energy consumption expressed in watt-hours per ton-mile amount to 85 for the uptown journey but only to 20 for running in the southward direction, as in the latter case the motors are not taken past the series position. The east and west lines are practically level throughout.

The power requirements are estimated as follows:

TABLE V.

Power Consumption

Car miles per day	18,000
Ton-miles per day	720,000
Watt-hours per ton-mile	70
Total watt-hours	50,500,000
Hours of operation	20
Average load, kw.	2,520
Maximum load, kw.	6,310
Sub-station capacity, kw.	7,500

It is assumed that the railway would purchase high tension current delivered to the sub-station busbars where it would be converted to 650 volt continuous current and distributed through feeders in the tunnel to the third rail.

The plan (Fig. 1) shows the principal streets of the city and their relation to the Rapid Transit System. The natural criticism is that little or no service is provided for the north-west and north-east corners of the civic area; it is assumed, however, that the street railways in conjunction with the subways will serve these districts. It will be noted that on the east and west route particularly every station is situated at the foot of one of the avenues extending north. Where surface tracks are installed upon these avenues the interchange of rapid transit passengers to the street cars will be provided for; the ultimate arrangement will, of course, be for the street railway tracks to connect the subway and elevated lines in the south with St. Clair Avenue in the north. Similarly, the Yonge Street line will afford connections of the utmost importance at College and Bloor Streets and St. Clair Avenue. The opening of the Bloor Street Viaduct will afford means for a crosstown surface car system extending from the Humber to the Scarboro' town line; on such a line as this an average speed of ten miles per hour could be maintained, and, indeed, the relief

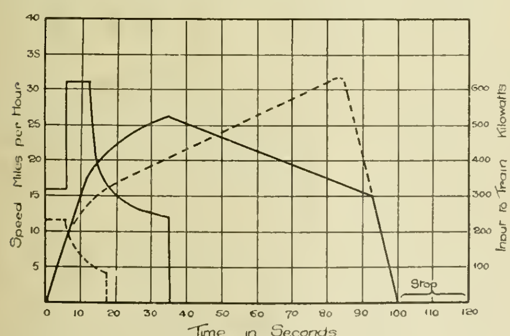


Fig. 6.—Speed-time and energy curves for typical runs between Front and Queen Streets. Distance 2640' Grade 1½%.

of congestion effected by the subway lines will divert more of the street car services to the uptown tracks, where more rapid service can be given. The Yonge Street subway service will bring St. Clair Avenue within twelve minutes of Front Street and a fast crosstown schedule maintained on the surface tracks will bring every part of the city within thirty minutes' ride of the business section. It is not possible to issue free transfers available between the rapid transit and surface lines, but in view of the demonstrated willingness of the public to pay for rapid travel this is not expected to act as a deterrent to traffic. Nothing is more detrimental to the ultimate success of a railway enterprise than the initial adoption of cheap fares and privileges which it may afterwards be found necessary to withdraw with consequent ill effect upon the goodwill of the community. An uniform fare of five cents would be suggested for the

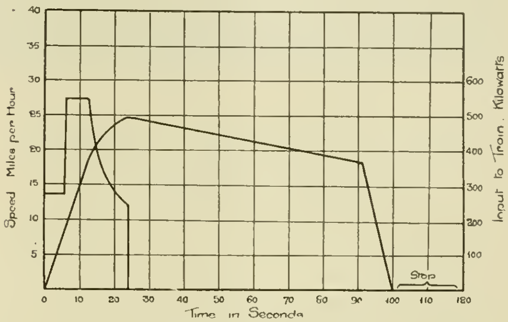


Fig. 7.—Speed-time and energy curves for a run between Yonge and Sherbourne Streets—Distance 2640'—Grade level.

whole subway and elevated lines, good for transfer over the three divisions.

TABLE VI.

Estimated Cost of Construction of Rapid Transit Scheme

	Division I.	Division II.	Division III.
Construction work, including subway excavation, concrete, steel, track and third rail, stations, and signal equipment	$6,750,000	$10,750,000	....
Construction work, including erection of elevated structure, concrete footings, track fully floored and ballasted, third rail, stations and signal equipment	....	....	$2,160,000
Cars, 50 ft., semi-steel construction, each equipped with two 105 kw. motors, control and air brakes	420,000	625,000	396,000
Sub-stations, total capacity 7,500 kw.	120,000	120,000	120,000
Feeders, lead covered, paper laid on brackets in subway and along elevated structure	20,000	30,000	24,000
Car Houses, offices and buildings	60,000	80,000	40,000
	$7,370,000	$11,605,000	$2,740,000
Engineering and contingencies, 10 per cent. ..	737,000	1,160,000	274,000
	$8,107,000	$12,765,000	$3,014,000

The estimated first cost of construction and equipment will be found in Table 6. This exemplifies the extremely heavy costs pertaining to rapid transit construction, particularly of the subway type. Nevertheless, the problem has to be faced in every city when the industrial and business

(Continued on page 32)

The Dealer and Contractor

A Code of Lighting Applicable to Factories, Mills and other work places—Valuable Information for Engineers, Central Stations and Electrical Contractors (Con.)

Section V. General Requirements of Artificial Lighting

The following requirements for factory and mill lighting are made all the more important by the peculiar limitations and the wide variety of conditions to be found in factory and mill buildings and in factory and mill work:

1. Sufficient illumination should usually be provided for each workman irrespective of his position on the floor space.

2. The lamps should be installed and selected so as to avoid eye strain to the workmen.

3. The lamps should be operated from sources of supply which will insure reliable illumination results, particularly on account of the demoralizing effect produced by intermittent service, just when the light may be most needed.

4. Adequate illumination should be provided from overhead lamps so that sharp shadows may be prevented as much as possible, and in such measure that individual lamps close to the work may be unnecessary except in special cases.

5. The type and size of lamp should be adapted to the particular ceiling height and class of work in question.

6. In addition to the illumination provided by overhead lamps, individual lamps should be placed close to the work if they are absolutely necessary in the eyes of a lighting expert, and in such cases the lamps should be provided with suitable opaque reflectors.

These requirements may now be met by means of the new types of gas and electric lamps, one type of which can usually be found for practically each factory and mill location, specially adapted to the general physical conditions of the location as typified by the clearance between cranes and ceiling and other similar items.

Section VI. Overhead and Specific Methods of Artificial Lighting

Factory and mill lighting may be classified under two general divisions: first, distributed illumination furnished from lamps mounted overhead; and second, specific illumination furnished by individual lamps located close to the work. For practical purposes this classification is sufficient. In numerous cases a combination of these two methods becomes necessary.

Mounting the Lamps High.—Where the lamps are high enough to be out of the line of ordinary vision, and are of a size and so spaced as to furnish illumination at any position of the floor where work may be carried on, the system is referred to as the overhead method of lighting. This method has many advantages. Its general adoption, which has been somewhat slow, has increased with the appearance of the many new types of lamps and with the growing appreciation of the value of good lighting.

Where a small amount of general or overhead lighting is coupled with specific lighting from individual lamps, a large part of the floor space in many shops is in relative darkness, and much dependence must be placed on the hand lamps close to the work. The small number of overhead lamps generally used in such cases, furnishes merely a small amount of additional illumination over the floor space which is not sufficient to be of much value. However, where sufficient intensity is provided by general illumina-

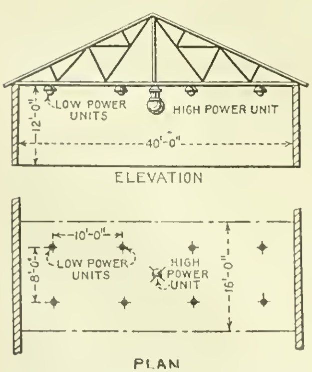


Fig. 3. — Diagram showing alternate schemes for lighting a low factory section. This contrasts the use of large and small lamps for mounting height of 12 feet.

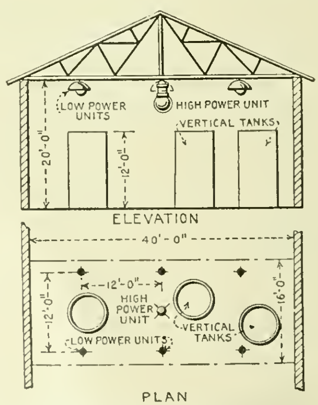


Fig. 4.—Diagram contrasting the use of large and medium-sized lamps for mounting height of 20 feet.

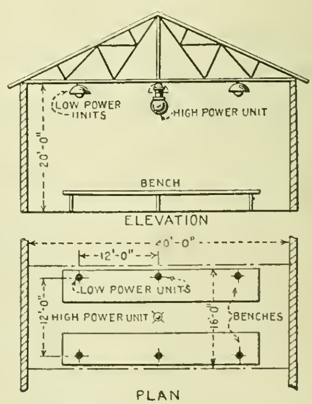


Fig. 5.—Diagram of same factory space shown in Fig. 4, but with a different class of work. This view contrasts the use of large and medium-sized lamps for a 20-ft. mounting.

tion, this is often a very effective means of lighting a large work-room.

Low Ceilings.—Locations with low ceilings, until recently, have been lighted by the individual hand lamp method, because the old carbon filament lamps, being of low candlepower, could not well be used close to the ceiling, while the old type of arc lamp was often impracticable, due to its large physical size, as well as its relatively high candlepower. This statement is subject to some modification, because low candlepower units have sometimes been used in clusters for low ceilings as a compromise between a single small or a single large unit, this scheme being, how-

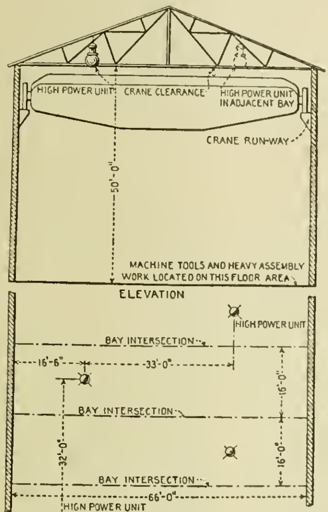


Fig. 6.—Diagram showing the use of large lamps for a mounting height of 50 feet.

ever, usually insufficient and unsatisfactory in comparison with modern methods of lighting. In a particular manner, therefore, suitable illumination has been difficult with low ceilings.

New types of gas and electric lamps have a range of candlepower from very low to very high values, and the overhead system with the elimination of individual lamps is thus possible; in other words, a size of gas or electric lamp may now be selected from a large available list of sizes for nearly every factory or mill condition.

Section VII.

Various Locations Illustrated.—There are two main items to consider in deciding for or against high candlepower lamps for the factory or mill. First, how high are the lamps to be mounted; and second, will the light at any given point on the machines or other operations be satisfactory if it comes from a few lamps or should it come from many sources? If the ceiling or overhead construction is under 16 feet, lamps of high candlepower can hardly be used in sufficient numbers to produce uniform illumination over the floor space. If they are to be mounted at a height between 16 and 25 feet, it is largely a question of whether light from a relatively few lamps will produce satisfactory results. For mounting heights over 25 feet, lamps of high candlepower possess some advantages, chief of which is their large volume of light for given energy consumed, always provided the light is effectively directed towards the floor.

Three Groupings.—These three groupings by mounting heights are conveniently shown in Figs. 3, 4, 5 and 6. In Fig. 3 a single shop bay with a ceiling height of 12 ft. is shown as typical of the first grouping. The single high candlepower lamp furnishes approximately the same amount of light to the machines as do the eight small lamps. Note, however, that the illumination from the large lamp is not nearly as uniform as that from the small lamps, although the spacing of both the small and the large lamps as represented in this illustration is typical of many actual installations. Note also, that the shadows cast by the large lamp at certain portions of the floor space must be so marked as to make the illumination it furnishes very inferior in this respect to the illumination from the smaller lamps, because of their larger number.

Here, if the number of large lamps for the given floor area be increased in an endeavor to make the illumination more uniform and to reduce the shadows, the expense, as compared with that for smaller lamps, makes the large lamps a very unfavorable proposition. These two features are the basis for stating that in general large lamps are not desirable for mounting under 16 feet, and an analysis of conditions, together with a careful and unbiased comparison with the illumination produced by smaller lamps, will nearly always bear out this conclusion.

Second Grouping.—In Fig. 4, a 20 ft. ceiling has been selected as typical of the second grouping, a single shop bay being shown. Here the work is assumed to be rough assembly, mostly on horizontal surfaces, and the single high candlepower lamp, besides giving more nearly uniform illumination, because the light is distributed more broadly due to the increased height, is correspondingly more satisfactory as to shadows produced by the large lamp in the preceding illustration (Fig. 3), on account of the improved direction in which much of the light reaches the work. In this case, the arrangement of both large and small lamps is typical of many existing installations.

In Fig. 5, however, although the height is the same as in Fig. 4, the work is quite different, being conducted on the inside of large vertical tanks. It would obviously be impossible to perform this work by the light from the single large lamp as well as with that from the larger number of medium sized lamps, even if the actual amount of light from each was the same, on account of the poor direction of the light at certain positions of the work from a single unit in such a case. The medium sized lamps furnish approximately the same quantity of light and yet no matter where the tanks

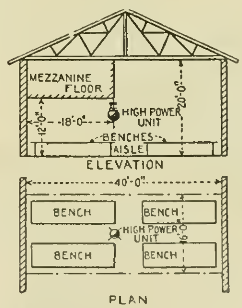


Fig. 7.—A very poor arrangement of artificial lighting by means of large lamps mounted too close to the floor. Compare with improved plan in Fig. 8.

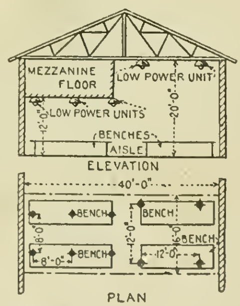


Fig. 8.—Illustrates an improved scheme over that shown in Fig. 7, made possible by the use of smaller lamps.

may be placed, they will receive considerable light from the medium sized lamps directly over or nearly over them, at least far more than is apt to reach them from a single unit in every other bay (the assumed arrangement of the large lamps).

For this second grouping of mounting heights, then, the large lamp may or may not be adapted, depending on whether the reduction of shadows is of much importance, as is the case in Fig. 5. The large lamp is, however, more likely to be satisfactory here than in the first case (Fig. 3), because of the better distribution of the light due to the higher mounting, a fact made evident in Figs. 3 and 5 on account of the decreased number of small lamps and the increase in their size made possible in Fig. 5 as compared with Fig. 3, where the mounting is lower. By the same line of argument, it can be shown that for higher mountings, large lamps are still more likely to prove satisfactory. In Fig. 5, the number of large lamps might have been increased for the given floor area, but to have done so would mean that the cost for the lamps themselves and for the energy and upkeep to maintain them would be excessive in comparison with the smaller types of lamps.

Third Grouping.—In Fig. 6 the third grouping of mounting heights is shown with the lamps about 50 feet above the floor. In this illustration the distribution of the light from the large lamps will be far more satisfactory both for flat and tall work than in the two preceding cases. It will be noted further that the increased height of the lamp causes the light to fall in such directions as to evenly distribute it over the entire floor space taken care of by this one lamp in much better shape than for the lower mounting heights. (See also Figs. 7 to 9).

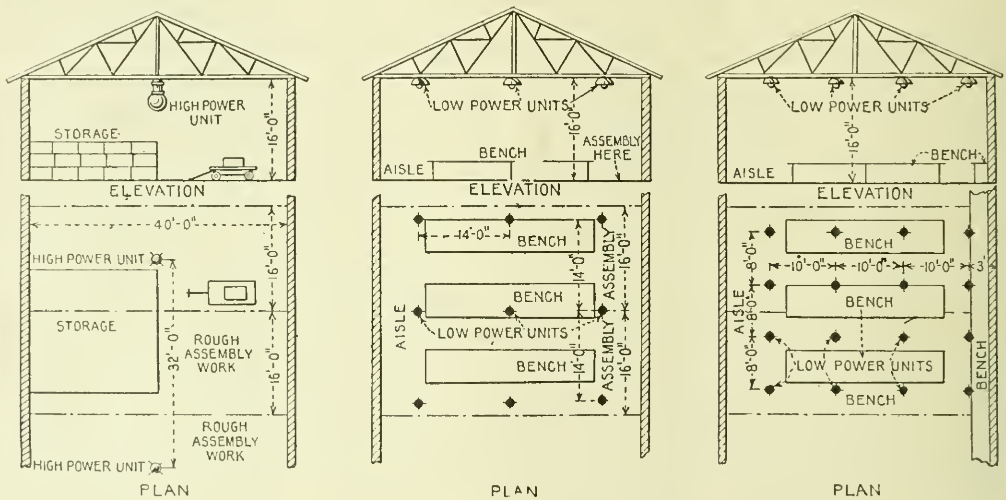


Fig. 9. Fig. 10. Fig. 11.

These three illustrations show various ways in which a factory space with 16-ft. girder clearance can be handled, depending on the class of work performed. Fig. 9 is fairly satisfactory for storage spaces, and either Fig. 10 or 11 can be employed for bench assembling or manufacturing. Fig. 11 is to be preferred where the class of work consists of the handling of small machinery parts.

Section VIII.
Lighting Circuits for Electric Lamps and Supply Mains for Gas Lamps

The question of lighting circuits is mentioned here with particular reference to factory and mill conditions, where motor loads are apt to be large in comparison to the energy consumption of electric lamps which are in service. In some cases, the proportion of motor load to lighting load is in the ratio of 10 to 1, in others 7 to 1, and so on, and the varying demands on the circuits by motors may greatly affect the lamps. Hence it is important to maintain strictly separate supply circuits for the lamps in order to avoid varying voltage which is apt to result if the motors are connected to the same circuits with the lamps.

Constant Voltage.—In addition to the superior illumination resulting from lamps supplied from constant voltage mains, some types operate with longer life or very much better mechanically when supplied with constant voltage than otherwise. These features will therefore generally more than offset the somewhat greater cost of maintaining separate circuits for each class of service. In like manner and for similar reasons, it is advisable to place gas lamps on supply lines separate from those delivering gas for power purposes.

(To be Continued)

Rapid Transit in Toronto

(Continued from page 29)

districts are concentrated and the population passes the half million mark. As already mentioned, it is not to be supposed that plans for the whole of such a scheme could be put into hand at once, but rather that the three divisions be commenced upon at two-year intervals, or, if thought desirable, that the work be still further subdivided. The substitution of elevated railroads for the subway divisions would greatly reduce the initial costs, but a new routing would in this case have to be adopted, which would considerably modify the service offered by a line cutting through the heart of the city. The subway construction costs have been based upon the cut and cover system being employed, which entails the roadway being opened up and excavation proceeding as for an open cut. Although involving temporary inconvenience, this avoids the heavy cost, and no small danger involved in timbering the roadway and mining beneath it.

For the main east and west route the possibility of an elevated or surface road routed along the water front has been considered, but the conclusion is that such a line would be situated too far south of its tributary population. The Eastern Avenue line is, indeed, open to the same objection in a lesser degree, but is believed to be justified in view of the development of the Ashbridges Bay district for industrial purposes.

Are You A Member of the O. E. C. A.?

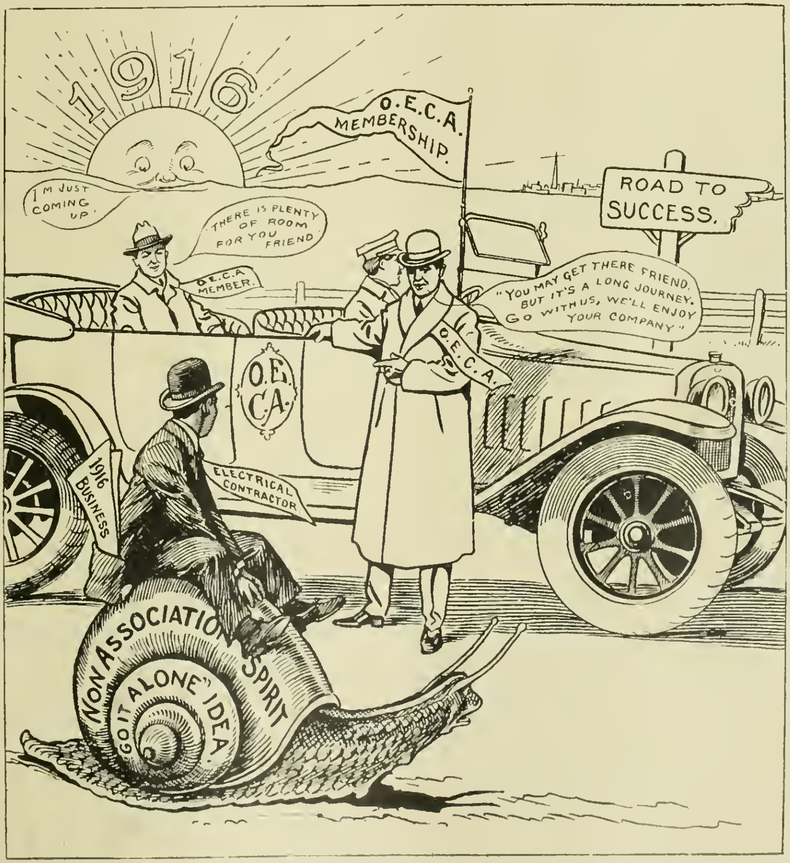
Join the O. E. C. A., the Ontario Electrical Contractors Association—Then, get behind it with your brains, your experience and your enthusiasm

The very generally accepted idea of organizations and associations of various sorts is that they are formed for protective or defensive purposes. This is only true within certain limits. It is easily understandable, however, how this conception has arisen, because of the circumstances surrounding the organization of many such associations. In a vast majority of cases they have been called into being only when the rights of some particular class appeared to be threatened by encroachments on what they conceived to be their rights. The crisis over, the average association either disbands or drags along a lingering existence until some fresh upheaval again threatens the rights of the members and so spurs them once more to action.

This is not the right idea.

The operations of the commercial world are divided into fairly clearly-defined sections, the different elements of each section being so closely inter-related that the failure of any single element to do its share in the general scheme of co-operation interferes adversely with the common ultimate aim of the whole section. Such a section is that composed of men associated, in whatever capacity, with the electrical trade—manufacturer, central station, dealer, jobber, and contractor—all are vitally interested in the rapid development of the electrical industry.

It follows that an association of any element in the electrical trade should not consider itself on the defensive as regards any other element in the same trade. The aim should be a closer working arrangement with all the other elements. An electrical contractors' organization has it in its power to help the central station organization. Both of these can help the manufacturer, and so on. The "vice versa" is equally true, of course. There is no room for war among these various elements, no reason, no possibility of



Acknowledgements to National Electrical Contractor.

A snail or an automobile, alone or with the "boys"—Which?

gain in it. The success of each is inseparably bound up with the success of all the others.

And this brings us back to the starting point—don't wait till you imagine your rights are being trampled on by someone before you begin to take an interest in your association. Take hold **now**. Your association is an organization for constructive purposes. It is one of only four or five cogs in the electrical wheel. One missing cog, therefore, means terrible inefficiency in the operation of that wheel, and continually threatens to wreck the whole machine. Don't wait. Get in and carry your share of the load so as to guarantee the smooth operation of the whole machinery of the electrical business.

The electrical contractors of the province of Ontario recently formed an enthusiastic association of their members. Possibly it was fear of some encroachment that brought them together. But the ideal of this association has been raised. Officered by enthusiastic men, the vision of this organization has rapidly grown broader, until they now see themselves as an important responsible section of the whole electrical industry. Their organization is no longer a necessity—it is a **duty**.

Are you as an individual, then, **doing your duty** by the industry with which you are associated and from which you make a living?

We take the liberty of urging upon every electrical contractor in this province that he consider seriously and with an open mind the question of his relation to the Ontario Electrical Contractors' Association. Are you a member? If not, why? Don't let the argument that you "can't get anything from it" carry any weight with you. Ask yourself, rather, "Couldn't I help?" Think of the influence for good that a united association of electrical contractors can wield—how you can further the development of the industry —how you can help to smooth over little misunderstandings, as in the recent Simcoe matter—how you can lend your weight to needed legislation.

If you are a unit in the electrical contracting business, get up and acknowledge it. Don't be a dead one. Don't be a clog on other men's progress as well as your own. Join your association, and, after you have joined it, take an interest in it, and give it the benefit of your own ideas and experiences. The possibilities of development in the electrical business are beyond imagination. Are you going to sit idly by and watch the other fellow do your work, or are you going to put your shoulder behind the wheel and **push?**

Relation of Jobber to Contractor

The relation of the jobber to the contractor and the protection given by the jobber is one of the most important points at issue at the present time in the electrical contracting business. Mr. Arthur J. Newell read an interesting paper recently before the New England Electrical Contractors' Convention in Springfield, in which he outlined a number of instances where the co-operation of the jobber, to say the least, is not apparent. These are quoted below. Mr. Newell makes a strong appeal to the electrical contractors to stand together and assert their rights. He asks them to remember that the electrical contracting business is no longer in its infancy but is a legitimate, dignified and well-established business, filling an important place in the commercial world. He urges the contractors to stand up like men for their rights and if it is shown that they are being used unfairly by any part of the business world, to "show their teeth" and insist that they receive proper treatment.

1. A concern in the dry goods business was in the market for a quantity of wiring material. A schedule of the material required was drawn up and sent to the jobbers. A contractor of A-1 standing also sent the schedule to the jobbers, and when the prices were received by the dry goods house the contractor was shown the jobber's quotations, he being a friend of the buyer, and in every case the dry goods concern had been quoted as good prices and in some cases better than these same jobbers had given to the contractor. This is the way the trade is protected.

2. A contractor received an order for reflectors and sent the order to a jobber with instructions to ship direct to the customer in order to save expense. The shipment was made direct and also the bill was sent direct to the customer. The prices given the customer by the jobber were as good as had been previously quoted the contractor by this same jobber. If this was not a mistake, then the jobber was trying to show the customer that they had better deal direct. If it was a mistake, it shows that this jobber was in the habit of selling direct to this class of customers and making them as good prices as he made the contractor.

3. Certain electrical material handled by a jobber was required for a new building. The electrical contractor on the building obtained a quotation from the jobber and afterwards found that this jobber had given to the general contractor the same quotations that he had sent to the electrical contractor. This electrical contractor had good credit.

4. Special lighting fixtures were required for a building. These special fixtures were controlled by one jobber. A quotation was made to the owners, in which 10 per cent. was reserved for the electrical contractor on the building. The owner goes to the jobber and asks him how much profit there is in the quotation for the contractor, and he is frankly told 10 per cent. The owner then states that he will give the jobber the order if he will give him the 10 per cent. The jobber accepts the offer and the contractor is ignored.

5. An electrical contractor does a job on a stock and time basis. The concern for whom he did the work sent his bill to a jobbing house, and they marked on the bill against each item the price at which they would have sold the material, and these prices were those regularly given to the trade. Fine co-operation!

6. At a meeting of the electrical contractors a jobber boldly asserts that he never sends his catalogues and discount sheets to men who are just started in business, and that he always looks out for the established contractor. The very next day his catalogue with full discount sheets was received by two workmen just starting in business. You will find the catalogue and discount sheet of almost all jobbers in the hands of all classes of customers, and the net prices give little protection to the contractor and not near enough for the contracting business.

7. At one time a jobber sent out a salesman who called on the electrical contractors only, and this salesman would solemnly place his hand over his heart, raise his eyes to heaven and affirm that he never called on the contractor's customers, and he told the truth; but his house sent out another salesman equipped with gum shoes who called on the contractor's customers only, and I understand this gum shoe artist was reprimanded one time because he happened to make a social call on an electrical contractor who was his personal friend. Is there any wonder that we contractors

place a lot of interrogation points after statements made by some of the jobbers?

8. A young man who has worked as a helper for about two years goes into business, and although he was not even a journeyman and without any business experience, yet he figured and secured some large contracts at very low prices. A jobber gives him extended credit, and carries his account for a long time. At last he failed and the jobber was the heaviest creditor. Now all such losses have to be borne eventually by the electrical business. During all the time that the young man was in business the other legitimate contractors had to meet ignorant competition that was being subsidized by a jobber.

In concluding Mr. Newell made the following suggestions to his electrical contractor hearers:—

"That you pay your bills promptly and not be under obligations to the jobbers for extended credit.

To give more study to the art of selling goods and to keep your place of business and stock in better condition.

To refuse to purchase goods from any jobber who sells to the contractor's customers in any place, even though he is "good" in your own town. Also favor those manufacturers who will sell to us direct.

To have a committee to whom cases of improper treatment can be referred and who can negotiate with the manufacturers and try and break down the special privileges now accorded the jobber unless they discontinue selling our customers.

To learn to use the mails and make unnecessary the sending out of expensive salesmen. Also, let us discourage being entertained by our creditors.

That we will work together and stand up for our rights like men, and while according fair and generous treatment to all, let us remember that we are in a legitimate, dignified and important business and are entitled to, and can command, fair treatment from everyone."

Finding re Economy Fuses

As a result of a permanent arrangement between the Underwriters' Laboratories, Inc., of Chicago and the Bureau of Standards that any matters in dispute between the manufacturer of a device and the Underwriters' Laboratories should be submitted to the Bureau of Standards for decision, the following question was recently submitted to the Bureau. This was a joint appeal of the Underwriters' Laboratories and the Economy Fuse and Manufacturing Company of Chicago:

"Has it been shown that the use of the fuses manufactured by the Economy Fuse and Manufacturing Company results in no greater fire or accident hazard than the use of other cartridge enclosed fuses at present listed as standard by Underwriters' Laboratories, Inc.?"

A considerable amount of evidence was submitted by both parties to the Bureau of Standards, and in addition the Bureau made many tests of fuses both in their own laboratories and in operating power plants. Some of these tests were made in accordance with the specifications of the Underwriters' Laboratories, but some were also made under conditions prescribed by the Bureau or suggested by fuse manufacturers. The objects of these tests were, largely, to determine the relative performance on heavy overloads of Economy fuse and standard enclosed cartridge fuses, and further, to determine to what extent the performance of such fuses might be adversely affected by protracted service under normal conditions. The question was carefully considered in its various aspects by a committee of technical men connected with the Bureau. A report of some twenty-five typewritten pages has been submitted, followed by a Conclusion and Finding, both of which we reproduce herewith:

Conclusion

"It appears from the foregoing resume of the bureau's investigation that the Economy fuse, when new and properly filled or refilled, operates satisfactorily under the most common working conditions of overload and moderate short-circuits when in circuits with low inductance, and posessses some marked advantages over the approved fuses with which it has been compared. This fuse is, however, distinctly inferior to most of these approved fuses under severe short-circuit conditions. It has not yet been established that it will not introduce hazards peculiar to refillable fuses, owing to deterioration from repeated blowing of the fuse elements in the same casing and possibly from long-continued subjection of the fuse to the working current. The approval of the present type of Economy fuse for unrestricted use would therefore result in a lowering of the standard of fuse performance under severe test conditions, and might introduce hazards in actual use the importance of which it is difficult to estimate at this time. The experience with the present type has not yet been sufficient to determine whether the total hazard is greater or less than it is with approved fuses as they are actually used in practice. The investigation therefore leads to the following finding:

Finding

"It has not been shown that the use of the fuses manufactured by the Economy Fuse & Manufacturing Company will result in no greater fire or accident hazard than the use of inclosed Underwriters' Laboratories, Inc.

"On the other hand, the evidence in the case does not show that the use of Economy fuses has on the whole resulted in any greater fire or accident hazard than is involved in the use of standard enclosed cartridge fuses.

"In comparison with fuses listed as standard by Underwriters' Laboratories, the fuses at present manufactured by the Economy Fuse & Manufacturing Company have been shown to possess certain features which tend to increase the hazards involved in the use of fuses and other features which tend to reduce such hazards. The relative importance of these features can be determined only by extended experience under working conditions.

"It is therefore recommended that Economy fuses be not approved at present for general use on the same basis as fuses now listed as standard by the Underwriters' Laboratories, Inc., but that a continuation and extension of their use be permitted by municipal and underwriters' inspection departments under conditions where their performance can be observed by each inspection department until sufficient experience regarding their performance under service conditions can be obtained to justify an unqualified approval or refusal to approve."

Shawinigan Laboratories Limited

Shawinigan Laboratories, Limited, have secured letters patent incorporating Howard Murray and William S. Hart, managers, Julian C. Smith, Jesse C. King, Frederick T. Kaelin, engineers, Howard W. Matheson and Theophilus H. Wardleworth, chemists, all of the city of Montreal (a) "to carry on the business of chemical, electro-chemical, mechanical, electrical, metallurgical and electro-metallurgical engineering in all branches; (b) to make tests, investigations, assays and analyses and reports of all kinds and to advise upon processes, operations, patents, etc." Capital stock \$25,000; head office Montreal.

The Athabasca Power Company, Limited, has been formed with a capital stock of \$100,000 and head office at Winnipeg.

Toronto Contractors Elect Officers

The annual meeting of the Toronto Section of the Ontario Electrical Contractors' Association was held on Wednesday evening, January 19, at their rooms at 2 College Street. The following officers were elected: president, George T. Dale, manager Electrical Maintenance and Repairs Company; first vice-president, G. D. Earle; second vice-president, Alfred S. Prout; treasurer, A. Wales; secretary, E. A. Drury; executive, Messrs. Leslie, W. H. Lodge, and M. Nealon; auditors, Messrs. Dolson and R. D. Earle.

At this meeting discussion chiefly centred about the drafting of a by-law which it is the intention to distribute in a few days among the electrical contractors of the province for discussion and suggestions. An admirable by-law has been prepared by a committee of which Mr. W. H. Lodge is convenor, and it is hoped that the Association will have something tangible to bring before the members of the local legislature at the next session.

I. E. S. Mid-winter Convention

The mid-winter convention of the Illuminating Engineering Society, will be held in New York city Thursday and Friday, February 10th and 11th. 1916, at the Engineering Societies' Building, 29 West 39th Street.

Among the papers which will be presented at the convention are: "Lighting and the Panama-Pacific Exposition," by D'Arcy Ryan; "Theatre Lighting" by Bassett Jones; "Colored Glass in Illuminating Engineering" by Dr. H. P. Gage; "Illuminating Engineering Photographs" by B. H. Norris; "Lighting of Public Service Buildings in New York" by C. L. Law and Thomas Scofield; "Gas Lighting of a Prominent Building in Philadelphia" by J. D. Lee; "Candle-power Measurements of Series Gas Filled Incandescent Lamps" by Ralph C. Robertson; "An Interlaboratory Photometric Comparison of Glass Screens and of Tungsten Lamps in Modern Color Differences" by G. W. Middlekauff and J. F. Skogland; "An Average Eye for Heterochromatic Photometry and a Comparison of a Flicker and an Equality-of-Brightness Photometer" by F. K. Richtmyer and E. C. Crittenden; "An Integrating Sphere" by E. B. Rosa and A. H. Taylor.

Winnipeg Jovians Holding Bonspiel

Members of the Winnipeg Jovian League are holding their annual Bonspiel at the Granite Curling Rink, Winnipeg. Eighteen rinks have entered which are skipped by the following: W. G. Chace, F. W. Brownell, L. B. Dickson, A. W. Lamont, A. H. Steveton, L. J. Papineau, R. F. Howard, J. H. Schumacher, H. M. Fenley. W. P. Brereton, J. Bloomer, J. G. Glassco, J. Garrett, F. E. Filer, R. H. Mainer, J. H. S. Madden, G. L. Guy, and L. Conrad. Play started on December 19 and the competition will wind up January 19. Games are only played in the evening. There are two cups which will be presented to the winning rinks at the first regular luncheon held after the termination of the Bonspiel. The regular luncheon of the Jovian League, which was to have been held on January 5, has been postponed until January 19. It is interesting to note that no less than 18 Jovians from Winnipeg have gone to the war.

Trade Inquiries

45. **Aluminium collector bows.**—A Yorkshire manufacturing company asks to be placed in touch with actual Canadian manufacturers of aluminium collector bows for tramway work. Sketch of same may be seen at the Department of Trade and Commerce, Ottawa.

Personals

Mr. A. J. Carroll has been appointed Montreal district manager of the Eugene F. Phillips Electrical Works, Limited, Montreal. Mr. Carroll has been with the company for many years.

Mr. C. F. Down, manager of the Canadian Tungsten Lamp Company at Winnipeg, recently attended a convention of branch managers held in Hamilton from the 17th to the 22nd of January. In Mr. Down's absence Mr. F. K. Tully had charge of the Winnipeg office.

Mr. H. N. Keifer, sales engineer of the Northern Electric Company, Vancouver, who has taken a very active interest in the affairs of the Vancouver section of the American Institute of Electrical Engineers since locating in Vancouver, has been recently elected secretary of the local section.

Spencer & Aspinall Ltd., electrical and mechanical engineers and electrical jobbers, have removed from the New Birks Bldg., Montreal. to 340 University Street.

Lyman and Lyman Limited

Mr. Frank D. Lyman has purchased the stock, assets and goodwill of the railway and supply department of John Millen and Son, Limited, Montreal, and is now carrying on business at 323 St. James Street, Montreal, with a branch at 90 Adelaide Street West, Toronto. Stocks are carried at both the Montreal and Toronto warehouses. As soon as a Dominion charter has been granted to a new company now formed, the business will be conducted under the name of Lyman and Lyman, Limited. Mr. Lyman has been manager of the department now acquired by him since it was started some nine years ago by John Millen and Son, Limited. The new firm holds a large number of import English, French and United States agencies.

Trade Publications

Starting, Lighting and Ignition Equipment—circular 1532-B, by the Automobile Equipment Department of the Westinghouse Electric and Manufacturing Company, describing the different details of the electrical equipment of an automobile. Diagrams are given on the mountings, and views are also shown of the equipment mounted on several different types of automobile engine.

Brush Switches—bulletin No. 61, being distributed by the Canadian Krantz Electric and Manufacturing Company, Limited, Toronto, describing, with illustrations, their safety brush switches.

Motor Starting Switch Condulets—bulletin 1,000-D, distributed by the Crouse-Hinds Co. of Canada, Ltd., Toronto, supplementing their catalog No. 1,000; illustrating and describing motor starting switch condulets.

Trolley Guards—Folder issued by the Ohio Brass Company, Mansfield, Ohio, describing, with illustrations, the "National" Trolley Guard, manufactured by this company.

Westinghouse Publications—Leaflet 3765. describing No. 307-V railway motor, 41 and 34 kw.; leaflet 3849 on type E A switchboards; leaflet 3551-A on alternating current magnet switches type F; leaflet 3833 on No. 306-V railway motor, 50 and 41 kw.; leaflet 3837 on No. 333-V motor, 90 kw.; leaflet 3835 on No. 547-A railway motor, 60 kw.

Electric Fans—Catalogue S-A, by the Westinghouse Electric and Manufacturing Company, describing the electric fans of this company for the season of 1916; well illustrated.

Measuring Instruments—Catalogue No. 15, issued by L. M. Pignolet, 78 Cortlandt Street, New York, describing electrical measuring instruments manufactured by this company.

What is New in Electrical Equipment

Northern Junior Low Voltage Lighting Outfit

To meet the demand for a low priced farm lighting outfit, the Northern Electric Company, has developed their "Northern Junior" 32 volt outfit. This outfit has been placed on the market, primarily to meet the needs of an equipment which will take care of the simple process of charging a storage battery with a generator, and then dis-

charging, to light or use the energy for other small power purposes. Before the "Northern Junior" outfit was brought out, the company confined their sales to the "Northern Special" outfit. With the "Special" the semi-automatic feature of using the generator as a motor to turn over the gasoline engine was available, and energy could also be taken from the battery, for lighting or other purposes, while it was being charged. The new outfit complete, consists of a storage battery, in either glass or rubber without C. E. M. F. cells, charging generator, controlling switchboard, gasoline engine, and skids for holding generator and engine. While the switchboard for this outfit will not permit the generator to be used as a motor to assist in turning over the engine, the engine starts very easily by hand, and, on that account, there are many owners who would prefer the cheaper "Junior" outfit. The "Junior" switchboard is

The "Junior" Switchboard.

mounted by means of wall braces, which give it a somewhat neater appearance, than the use of supports reaching to the ground. An automatic switch is furnished with "Northern Junior" switchboards, which is connected between the generator and battery. When the generator voltage reaches a predetermined amount, the switch automatically connects the two together, so that charging goes on properly, after the operator establishes the proper value of charging current by means of the generator field rheostat. If, for any reason, the voltage should fail, the automatic switch will operate on reverse current and open to disconnect the generator from the battery. These outfits can be furnished for any number of lights, and of sufficient capacity to take care of the operation of household current consuming devices, where the owner wishes to enjoy the convenience of city service.

The Dominionlite

The illustration herewith represents the most recent creation of the Jefferson Glass Company, Toronto. This unit is known as the "Dominionlite," and is specially adapted for store lighting, offices, schools, libraries, public buildings, railroad stations, warehouses, etc. The unit consists of two parts—a lower semi-translucent bowl and an upper semi-

translucent larger bowl which serves the purpose of a false reflecting ceiling. The bowl is suspended by three rigid rods attached to a point above the socket. This unit is designed for 250 watt tungsten lamps or 300 watt nitrogen-filled lamps.

Moved to Larger Quarters

The Volt Electric Company, Limited, Toronto, have moved their quarters from 41 Britain Street to larger and more attractive premises at 37 Queen Street East. An excellent ground floor showroom and more than a thousand feet additional floor space will be available.

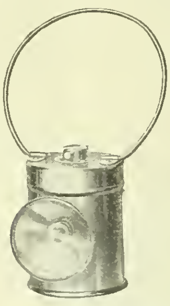
The Hydro Electric Power Commission of the Province of Ontario are calling for tenders for the construction of an extension to the South Falls power house. A 750 kv.a unit will be added to this plant, together with transforming and switching equipment for transmission at 22,000 volts to Gravenhurst and other municipalities in that vicinity.

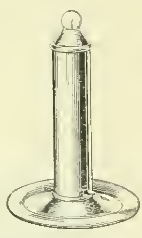
Canadian Eveready in New Quarters

The expiration of the old lease, and the necessity for more space due to the increasing demands of a growing business, has resulted in the Canadian Ever Ready Works moving to new quarters in the new Purman Building, Adelaide Street West, Toronto.

The new quarters are about twice as large as the old ones, and occupy the whole top flat, with floor space of about 12,000 square feet. This space is equally divided, one-half on either side of the lightwell, the two being connected by a covered-in steel causeway for the passage of loaded trucks from one department to the other. In the west wing is the general office, the superintendent's office, a small office for salesmen, the warehouse or storage rooms, and the shipping department. The east wing is the factory, where the Ever Ready products are manufactured. This factory is motor-driven and is scientifically and systematically laid out so that the articles in the process of manufacture may go as directly as possible from one operation to the other. Batteries are manufactured, tested and packed in their cartons ready for the warehouse, before leaving the factory. A special fireproof chamber has been provided, according to the rules of the Fire Underwriters, for the cauldrons for melting wax required in sealing the batteries.

While not completely settled in the new quarters, the Ever Ready Works are already turning out from 2,500 to 3,000 complete batteries daily. The works employ at present about eighteen men in the factory, which force will shortly





be enlarged to thirty, and ultimately to about fifty. A constant force of five men is required in the warehouse and shipping department. The present stock, consisting of miniature lamps and automobile lamps, both regular and type C nitrogen-filled mazda, flashlights and small batteries, to the value of upwards of $100,000, is systematically stored so that on the shortest notice shipments can be made quickly and accurately. Orders are filled complete before being passed to the shipping department, thereby eliminating any chance of error.

The Ever Ready works will, it is claimed, when finally completed, have the most up-to-date and efficient factory for such products in Canada. Complete list of articles manufactured by them include: flashlights, flashlight batteries, standard type dry cells, fireproof battery boxes, multiple live spark batteries arranged in waterproof boxes for out-of-doors and marine work, miniature auto lamps, non-sulphating storage batteries, testing instruments and pocket meters. They are also about to place on the market an electric starter for Ford cars. The cuts shown are two of the latest additions to the Ever Ready flashlight family. They have been manufactured to meet the popular demand, and are proving a valuable addition.

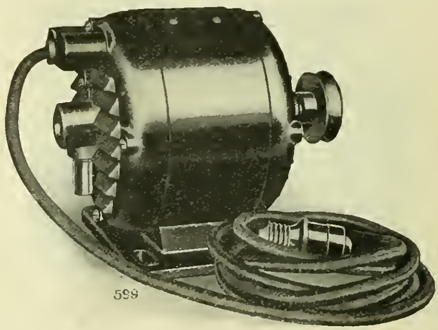
Cie (La) de Telephone de Valcourt, Ely, Que., have registered.

New R & M Motor

The new motor shown herewith is a special design developed by the Robbins & Myers Company, Springfield, Ohio, for washing machine service.

The end heads are cast in a special form which gives absolute protection from water which may splash on the motor, while at the same time they are open and permit a free circulation of air through the motor. The ventilation is assisted further by a fan on the shaft.

The base is provided with four holes for fastening the motor machine. It is cast separately from the motor frame and is attached to the frame by four screws. It can be



attached to the top of the motor, permitting of overhead mounting when this is desired, without making it necessary to turn the motor over and invert the end heads.

The motor terminals are protected by an iron box which fits over the M, and is held in place by two screws. The cord enters this box through a hole which is provided with a rubber bushing. The motor is furnished complete with ten feet of reinforced cord and a separable plug. It is also fitted with a V-groove pulley.

The bearings are made of phosphor bronze and are lubricated by wick oilers. The lubricating system is constructed as to prevent any leakage of lubricant which might soil the clothing.

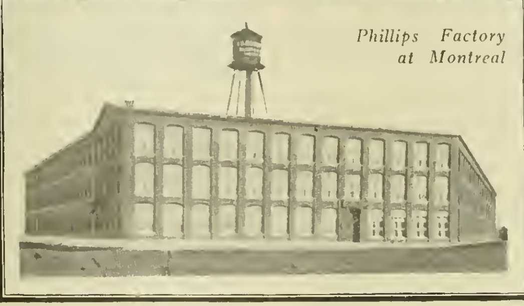
The motor can be furnished for direct current of all standard voltages and for alternating current of all standard frequencies and voltages. The speed on direct current and 60 cycle alternating current is 1750 r.p.m.

Obituary

Thomas Kennedy, president of the Sarnia Gas and Electric Light Company, Ltd., is dead.

Mr. Robert Archer recently died at his home, 806 Sherbrooke Street West, Montreal. Mr. Archer was one of that city's best-known business men and was a director of the Bell Telephone Company and of the Northern Electric Co.

Central station men all over Canada will learn with deep regret of the death of S. G. Chambers, manager and owner of the Chambers Electric Light and Power Company, Truro, N. S. Mr. Chambers has been supplying light and power to the town of Truro for nearly thirty years, being one of the pioneers in the electric business. Mr. Chambers will also be greatly missed by the Canadian Electrical Association, in which he has always taken a keen interest, and at whose conventions he has frequently been a prominent figure.


Phillips Factory at Montreal

High Tension Cable

Photo Actual Size

13,200 Volts Pressure

No. 3/0 B. & S. three-conductor, paper-insulated and plain-lead-covered cable, for a working pressure of 13,200 volts. Supplied and installed to specifications of Engineering Department, Toronto Hydro-Electric System.

ACTUAL DIMENSIONS

Conductors—3/0 B. & S., composed of 19 strands, each	.094″dia.
Thickness of dielectric on each conductor	.210″
" " " in belt	.210″
" " lead sheath	.150″
Overall diameter	2.640″

Eugene F. Phillips Electrical Works LIMITED
Head Office and Factory, Montreal
Branches at Toronto, Winnipeg, Calgary and Vancouver

Current News and Notes

Amherstburg, Ont.

The Town Council of Amherstburg, Ont., are planning extensions to their present lighting system.

Bassano, Alta.

The Trusts and Guarantee Company, Calgary, announce that tenders will be received up to January 28 for the purchase of the assets of the Alberta Electric Company, which controls the lighting system in the town of Bassano, Alta.

Calgary, Alta.

Commissioner A. G. Graves, at a recent banquet of the Calgary branch of the Canadian Society of Civil Engineers, outlined the power situation in the city of Calgary and pointed out that power rates in that city compared more than favorably with Winnipeg, Toronto, and Montreal. Mr. Graves gave a number of interesting examples, and showed by diagrams a number of cases where these costs were considerably less. He further stated that the city's present contract with the Calgary Power Company was a favorable one for the city.

Cobden, Ont.

A by-law recently carried authorizing an expenditure of $20,000 on an electric plant.

Forest, Ont.

A by-law recently carried authorizing the introduction of Niagara power through the Hydro-electric Power Commission of Ontario.

Granby, Que.

The Electric Light Committee have been instructed by the village council to employ an electrical engineer to make a report on a supply of electric power to this corporation.

Hamilton, Ont.

An automatic telephone department has been installed in the local hydro offices. At present about twenty-five telephones connecting the various departments are in operation, though central equipment for a considerably larger system has been installed.

Hensall, Ont.

The hydro by-law submitted on January 4th authorizing an agreement with the Hydro-electric Power Commission of Ontario was carried.

Highgate, Ont.

A by-law passed authorizing an expenditure of $7,000 on an electric system; power to be obtained from the Ontario Commission.

Kilsyth, Ont.

The Derby Telephone Company, Limited, Kilsyth, Ont., have been granted a charter.

Lenore, Man.

The electric light plant at Lenore, Man., was damaged by fire recently. This plant is owned by Messrs. H. W. Pline and H. M. McKay.

Lethbridge, Alta.

Mr. Grace, of the Grace Coal Mine, is negotiating with the municipal power plant for the supply of a block of power for mining operations. The mine is situated about one mile from the power house.

Montreal, P.Q.

Preliminary contracts have been awarded in connection with the power plant extensions of the Montreal Tramways Company. It is announced that the contract for boilers has been let to Babcock & Wilcox, Limited, and for a turbo-generator to the Canadian General Electric Company.

The Federal Government will build a wireless station at Cote St. Michel, Montreal. The present site at Tarte Pier, Maisonneuve, is to be abandoned. The new station will be of a more powerful type, and will complete the chain of stations from Cape Race and Glace Bay to the Great Lakes.

Lieut. H. M. Scott, for many years associated with Mr. Henry Holgate, consulting electrical engineer, has joined the 148th Battalion, of which Mr. Paul F. Sise, vice-president and general manager of the Northern Electric Company, is adjutant. Lieut. Scott is an associate member of the Canadian Society of Civil Engineers.

Judgment has just been rendered in the Supreme Court by Mr. Justice Maclennan awarding the Nova Scotia Construction Company the sum of $175,332 for work done under various contracts in connection with the power company's hydraulic developments at St. Timothy. It is stated by the power company's attorneys that an appeal against this judgment will be entered.

Nelson, B.C.

The annual statement of the electric light department recently made public by the city electrician, H. P. Thomas, showed a net profit of $10,613 on the year's operations.

Park Hill, Ont.

The by-law recently submitted to the electors re Niagara power to be supplied by the Ontario Commission, carried.

Sherbrooke, Que.

The contract for a new turbine to be installed by the city has been awarded to the Jenckes Machine Company.

Three Rivers, Que.

Notice has been given by the North Shore Power Company that they will apply to the next session of the provincial legislature for authority to extend their operations beyond the limits of the district of Three Rivers, and more especially in the municipalities of Portneuf and Lotbiniere.

Toronto, Ont.

The "Belmont" exchange of the Bell Telephone Company's system was opened for service on Tuesday, January 11. This includes all of the old district of North Toronto north of Rosehill Avenue and will supply approximately 1,500 customers. Bell Telephone rates are now uniform within the municipal boundaries of the city.

Wellesley, Ont.

A by-law carried authorizing the expenditure of $7,500 on an electric distributing system; power to be obtained from the Ontario Commission.

Windsor, Ont.

It is announced that formal permission has been granted by the United States Government to a Detroit corporation, the Federal Light and Power Company, to transmit hydro power from Windsor to Detroit.

Wyoming, Ont.

A by-law carried authorizing an expenditure of $6,000 on an electric distributing system. Power will be obtained from the Ontario Commission.

Zurich, Ont.

A Hydro-electric by-law authorizing the introduction of Niagara Falls power was recently carried.

Electrical News
Generation, Transmission and Application of Electricity

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A Record in Continuity of Service

For completeness of installation and continuity of service the Kaministiquia Power Company has few equals, in hydro-electric power developing stations in Canada to-day. The plant is situated at Kakabeka Falls, and delivers its entire output to the twin cities of Port Arthur and Fort William. These cities, at the head of Lake Superior, occupy a strategical position in the commerce of Canada, being the transfer point between the east and west. West-bound merchandise is here transferred from boat to rail, or stored for delivery during the winter months, and east-bound grain, forest and mineral raw products forming the return cargo are transferred from rail to boat. The transfer facilities required to handle this immense traffic must necessarily be the most reliable obtainable. Electricity has been almost totally used; power being obtained from the Kaministiquia Power Company.

The plant, which is now complete, has a total development of approximately 30,000 h.p. The original installation was commenced in 1905, was enlarged in 1911, and completed in 1915. The details of additions, which consist of a reinforced concrete aqueduct one and a quarter miles long; the installation of butterfly valves as headgates to penstocks, with their control apparatus; erection of a steel penstock, a 12,500 h.p. turbine, and a 9,375 kv.a. generator with the necessary transformers, switching apparatus, etc., are explained in detail elsewhere in this issue.

After nine years of operation the company shows a record for service continuity that, we believe, is not surpassed by any hydro-electric plant in the world. Trouble, inconvenience, or delay from ice, backwater, or water shortage, are unknown, and from all causes the total interruptions to the system have not exceeded twenty minutes in any one year. For the past year this record was cut to four minutes. Whether it is the design of this plant, the favorable local and climatic conditions, the vigilance of its officers, or a combination of all these, this is a record that proves the ability of a hydro-electric plant to give what is to all intents and purposes a perfect service. We take our hats off to Mr. W. L. Bird and his staff.

After studying the operating records of this company, the advocate of standby steam plants as auxiliaries to hydraulic plants will find many of his pet arguments vanish. And what is already an accomplished fact at Kakabeka Falls is without a doubt the standard to which other hydro-electric plants are approaching. The line along which greatest progress has been made during the past few years, in operation, is probably in the way of increased continuity. The "emergency" argument of the "standby" advocate is thus gradually losing its force. The value of such an auxiliary in certain cases for peak load requirements is, of course, another matter.

Systematic Water-power Researches

"Substantial progress has been made by the various organizations of the Dominion and Provincial Governments in investigating the water resources of the Dominion. The only province that is not now provided with some form of water resources investigation is New Brunswick, but negotiations, now under way, will probably lead to some satisfactory arrangement in the near future. Manitoba, Saskatchewan, Alberta and British Columbia have permanent systematic hydrographic organizations under the direction of the Minister of the Interior. Ontario is gradually being covered by the hydraulic division of the Ontario Hydro-Electric Power Commission. Quebec is being looked after by the Quebec Streams Commission and the chief engineer of Hydraulic Forces. In Nova Scotia there is a co-operative agreement between the Dominion Water Power Branch of the Department of the Interior and the Nova Scotia Water Power Commission. The field investigations of these organizations are being published in a very satisfactory form, although there has been some delay in publishing the data promptly, following the completion of the calendar or water year, as the case may be. The chief engineers of the above organizations have had several informal conferences with a view to co-ordinating, systematizing and standardizing their work, and also to facilitate the publication of the data in a uniform way and promptly. The net result of these informal discussions will be that in the near future, Canada will be completely covered by efficient and effective organizations charged with the responsibility for investigating, in the most complete and comprehensive manner consistent with the dictates of economy the water resources of the Dominion."
—Mr. James White before C. S. C. E., annual meeting.

The latest statement of Dominion finances, covering the period from April 1, 1915, to February 1, 1916, shows an increase in revenue from all sources of approximately $30,000,000 as compared with the same period a year ago. Also, expenditures have been reduced by $18,500,000. Our revenue position for 10 months is therefore improved to the extent of $48,500,000 as compared with the same period of 1915, or at the rate of $58,200,000 a year.

How to Overcome the Jitney Problem

Superintendent McCauley of Calgary's street railway system, believes that he can save the city at least one-third of the cost of operating certain lines of its street railway system by putting into force one-man cars on these lines. The first car thus operated is now being tried out. On the one-man cars the motorman acts both as motorman and conductor. Entry is made through the front of the car, and the back vestibule is set aside for a smoking compartment. Practically no time is lost by the motorman in stopping to take on or let off passengers and collect fares, the box for this purpose being set immediately at the door. Mr. McCauley has declared his intention of extending the service to other lines if it proves satisfactory.

Several other cities throughout Canada have announced their intention of trying out this method of street car operation, the cities of Port Arthur and Fort William having taken the matter up seriously. At Brandon, Man., one-man cars have been in operation now for two years and are said by the municipal authorities of that city to be furnishing an altogether satisfactory service at minimum cost. These cars are operated on the pay-as-you-enter system, and it has been found that the motorman can not only attend to his car, but also supply transfers when needed, open and close the door, and still maintain prompt and efficient service. The most recent installation of one-man cars in Canada is on the lines of the Three Rivers Traction Co., described in a recent issue.

Vancouver Companies Asked to Lower Rates

With a view to affording relief to citizens in the matter of telephone, gas and electric light rates the General Utilities committee of Vancouver City Council recently interviewed the British Columbia Telephone Company and the British Columbia Electric Railway Company officials relative to the possibility of securing reductions in the present rates being charged citizens for the respective services above enumerated.

Mr. Halse, commercial superintendent of the Telephone Company, met the committee with a very frank explanation of the company's finances and earnings, which he claimed to be irrefutable evidence that it was utterly impossible for the company at the present time to grant a reduction in the charge for any of their services.

General Manager George Kidd, of the B.C.E.R., was equally emphatic in explaining that his company was not in a position financially to grant any concessions to the citizens. The electric light and gas departments were the only ones making profits, and these were being applied to help offset the losses on the railway. A reduction in the rates would affect the company's general revenue and would only hasten the end. How long they could go on losing was a question, but they could not add to the burden now being carried. General Manager Kidd likewise reluctantly turned a deaf ear to suggestions that the price of lighting be reduced for two months as an experiment, or if the latter could not be granted, that the monthly charge for meter rent be eliminated.

Edmonton's Power Problems

The power question in Edmonton does not appear to be settled yet. In November, 1915, the electors approved a contract with the Edmonton Power Company, subject to the ratification of the Provincial Legislature. The Legislature has not passed on it yet, as it only meets some time this month. Meanwhile, other interests are making offers of cheaper power to the city. One of these is Mr. H. W. Adcock, of the Athabasca Power Company, Winnipeg, for whom Kerry & Chace, Limited, of Toronto, are acting as consulting engineers.

The Alliance Trust Company, of Calgary, representing R. B. Bennett, Senator Lougheed, and others connected with the Calgary Gas Company, have also made an offer to take over the present power house and sell power to the city at a rate approximately 20 per cent. lower than that called for under the present contract with the Edmonton Power Company. This offer is under consideration by the city council at the present time.

A Conundrum of the Day

"Should the chief intelligence officer of the war department of Canada be a German, with brothers in the German army?

"Should there be other Germans in the Government service here? A number there are.

"Is Canada at war with Germany or playing marbles?"—Ottawa Journal.

Good! and for heaven's sake will Ottawa cease playing politics?

Weekly Electrical Luncheon

A luncheon, under the name of the "Wednesday Electrical Luncheon," is held every week at Cooper's Restaurant, Montreal. The object is of a social character, to devise a means by which men engaged in the various electrical branches can meet and informally discuss between themselves questions of common interest and to get better acquainted. The luncheons so far have been well attended. The committee, of which Mr. W. H. Winter, of the Bell Telephone Company, is chairman, is representative of the different sections of the industry. It is composed of Messrs. W. J. Camp, C. P. R. Telegraphs; A. C. Towne, Johns-Manville Company, Limited; H. Hulatt, Grand Trunk Telegraphs; A. J. Carroll, Eugene F. Phillips Electrical Works, Limited; R. H. Hyde, Northern Electric Company, Limited; S. W. Smith, Electrical Equipment Company, Limited; P. T. Davies, Montreal Light, Heat and Power Company; and C. B. Ellis, Northern Electric Company.

Letter to the Editor

The Editor,
Electrical News:

> "Wireless telegraphy is causing the deaths of hundreds of birds. T. E. B. Pope, of the Milwaukee Museum, told a class to-day. 'Recently, in San Francisco, pelicans were seen dropping dead from the air into the ocean, having been killed by wireless waves,' said the speaker."

The enclosed clipping from a Chicago daily speaks for itself. Why such men, who understand nothing about electrical discharges, are believed and given considerable publicity when they utter statements regarding the so-called mysteries of electricity, is more than I can understand. Evidently the honorable T. E. B. P. never read that high frequency currents rarely kill and that the potential gradient at only a small distance from a radio mast is insufficient to kill the most sensitive form of life.

Hoping that you will spread the news and warn against believing everything the dailies print, I am,

Very truly yours,

H. E. Weightman.

Chicago, January 27, 1916.

England's Malady—The Party System

By Cosmo Hamilton

One night, with the memory of the South-African War still stamped upon his leonine face, a little old man whose small eyes were charged with a kind of prophetism went into his study, threw down the notes of a speech that he had just delivered in the House of Lords, sank rather feebly into a chair, and burst into tears.

There were two younger men in the quiet room; tall, wiry men on whose faces and figures discipline had laid its restraining hand—soldiers both. Their sympathy was inarticulate. And then the old man spoke.

"Curse those fools!" he cried. "Curse them! They won't listen to me. I am a mere damn' soldier. I am talking facts, and they know it; but the system, that unique and criminal system of party politics, renders them absolutely impotent even if they desired to take advantage of the evidence that I have flung at their heads. I told them that the British army has only just escaped being whipped by a pack of farmers, that the flower of English manhood, unready because of these little clever people who sit at Westminster, has manured the wide stretches of the veldt, where their gravestones are meaningless. Will they take a lesson from this two-years' national disgrace? Will they organize the whole Empire by a form of compulsory service to meet the menace of the great Teuton machine which every day is being perfected for its inevitable use? No; I tell you, no. And yet, by God! there are a few men sitting in the House of Commons not yet so warped and twisted by the dishonesty of the party system that deep down in what remains of their souls they know that my stammering words are true. 'Compulsory service? Yes, that is the solution,' they say; 'but what kind of fools shall we be considered by our friends if we sacrifice our political careers for the sake of patriotism?' No, it's no use. Stop me ever from getting on my feet again. I am hurling my old body up against the brick wall of a political system that one of these days will place England under the feet of a determined, self-sacrificing, industrious and brutal enemy."

That little old man was Field-Marshal Earl Roberts of Kandahar.

* * *

Dinner was over; the servants had left. The thin smoke of cigars and cigarettes rose up to the gilt ceiling of the large, dignified room when the laughter and conversation of the men whose faces and figures formed the subject of caricatures in the English papers suddenly died away. The host, a bearded man with a high forehead and heavy bovine eyes, leaned forward. In his rather fine white hand he held a thick amber cigar-holder, which he used as a sort of baton to enforce his words.

"Gentlemen," he said in the peculiar guttural voice which was known and loved in many strange parts, "look out! I have asked you here on my return from Germany to say to you, look out! A colossus is stretching himself. Every great muscle of his arms is taut and hard. Every little cell of his great brain reverberates with two words only, 'Der Tag.' . . . . We live in a false security here. We are a democracy which tolerates a monarch. You, gentlemen, are our autocrats. Each one of you is the king of England. What are your majesties going to do? Are you going to continue to play Canute and hold up your hands to the waves and say, 'Back!'? Are you going to continue to sit within the apparently impregnable walls of your party system? Because, if so, the security of this kingdom and your little crowns is not marketable. There are no bidders. I say to you again, look out!"

That man was King Edward VII. of Great Britain and Ireland.

* * *

There was only one policeman outside that little, dull, unpretentious house in Downing Street in which much regrettable history has been made, and from which one generation after another has been misgoverned and misled by premiers and their satellites. On his chest were the ribbons of medals won in India and South Africa, and in his eyes there was the look of a man who fears that he is about to face unutterable disgrace.

He has watched one member after another of the British cabinet scamper up with white lips. From where he stands he can see the complicated system of wireless telegraphy on the roof of the Admiralty. He knows well, like every other man of the nation to which he belongs, that a message has been framed to be despatched from those wires to the great ships that lie waiting off the coast. He knows also that the hands of the army and navy are held by the grip of the party system, and that the agreements of his country with her allies may be broken, to her everlasting shame, by those frightened, panic-stricken men who have rushed up from their country houses to attend the cabinet meeting within.

There sat Mr. Asquith, the prime minister, with ashen face and hands shaking like a man with palsy. All round the table were seated the men who had trifled with their trust. Their teeth were chattering. They were face to face at last with the truth which they had dodged and refused to recognize.

"Why should we fight?" they stammered. "We are a peace-loving nation, unready for bloodshed. Let the others fly at one another's throats, and while they kill and devastate we will grow rich. Are we not a nation of shopkeepers?"

"Listen!" said Mr. Asquith.

From all parts of Great Britain and Ireland—yes, Ireland—there rose an ever-increasing rumble of passionate protest, like the breaking of huge waves upon rocks. Bugles seemed to ring out, and from every town and hamlet there appeared to rise up millions of hands. Near by a bell was tolling.

Mr. Asquith looked up and all round, catching the troubled eyes of his henchmen.

"Oh, my God!" he said, "our servants have become our masters. They demand that we shall fight. Gentlemen, the party system is dead."

* * *

The party system! The House of Commons is divided into two bodies. On one side of it sits the party in the majority, on the other side the party in the minority, and over them both the Irish. The House of Commons purports to represent a great country whose history gleams with the heroic results of individual effort. The constitution of all the men under the roof of that House is the same. Whether they call themselves Conservatives or Liberals, they are not there for reasons of patriotism. They have entered politics for the same reason that takes men to the stock-exchange and upon the stage—for money and for advertisement. On both sides there are men who own newspapers, run simply for the purpose of grinding their little axes, in which they may hurl sham invective at their fellow-conspirators and write columns of self-praise. On both sides

*In Century Magazine.

there are lawyers who have tacked on politics to their profession so that they may stand in the lime-light, pick up the plums, and manipulate commerce to their own benefit. On both sides there are bankers and publicans, journalists and company-promoters, city merchants and the poverty-stricken relatives of the great political leaders, who will obey orders, answer the party whip, and sell their souls for a mess of pottage. On both sides there are little creatures from the back alleys who have been educated to politics as a means of livelihood, and who are perfectly willing to assert that black is white or vice versa whenever they can gain by doing so. The majority are, ipso facto, the enemy of the minority, and the Irish hate them both; but the minority, majority, and Irish are all working together for their own ends. They may call themselves Conservatives, Unionists, Radicals, Liberals, Nationalists, Fenians, Anti-Vivisectionists, Little Englanders, or any one of the dozen meaningless names which have grown into the English language, but they remain mercenaries and parasites, the manipulators of a party system which is a cunningly built-up conspiracy to mislead the country, misrepresent its voters, and provide places for the incapable sons of peers and yearly incomes for specially chosen men whose integrity has been proved to be easily bought, and whose eloquence, like that of a criminal lawyer, is as ready to be used in defense as in prosecution.

In a word, the party system of British politics is the one corrupt thing in the constitution of that nation. The House of Commons has become the happy hunting-ground of a dozen great families whose members pass into it from time to time by the same right that men pass into the business firms of their fathers. They are all partners in a great swindle, and their clerks and henchmen, hired from the law, the universities, the factories, and the streets, vary only as their masters see fit. Those masters, nearly equally divided on both sides of the House, agree from time to time to take the reins of office, paying themselves large salaries, large pensions, giving places only to those men who have been most obsequious and most eagerly dishonest. They juggle with the votes of the country, with their tongues in their cheeks. They are past-masters in card-sharping and the three-card trick. There is not one man among them with the faintest gleam of imagination, patriotism, or understanding of the characteristics and spirit of the race whom they bluff by inheritance. Yes, there is one—the Mark Antony of the House of Commons, the little Celtic man whose name is Lloyd-George, who possesses the three gifts that go to the making of a great charlatan—a pair of wonderful eyes, a sense of impish humor, and that touch of exaltation which stirs men to hysteria. He is the Pied Piper of politics, the man whose little flute can draw from their dark places the laboring parties of the United Kingdom. He is the great democrat who has organized a bureaucracy more autocratic than anything in Russia. He is the king of charlatans.

England is a free country, a democracy which tolerates a monarch, and is governed by a royal family of hereditary politicians supported by a nation of slaves.

Let a young man enter Parliament big with a desire to get things done, imbued with honesty of purpose, honest enthusiasms, honest patriotism, and a great wish to devote his energies, abilities, and all his time to the amelioration of one or other of the evils which have been left coldly alone by the party system, and he goes into a mausoleum of broken lives over the portals of which is written the terrible legend, "Give up hope, all ye who enter here." The result of his temerity is inevitable. He has either immediately to sacrifice honesty to selfishness or to rush back into the world once more to breathe uncontaminated air and to hurl invective, unnoticed, uncared-for, at the men who year after year deliberately stand in the way of progress and with the utmost cunning lay stone after stone upon the great dam which holds back the waters of improvement and incloses in wonderful security the confidence-men who live upon the credulity of the British public.

The party system of Great Britain is responsible for the degeneracy of a great nation. It is responsible for the unemployment of its working-classes, for the tyranny of its trades-unions, for the sense of injustice which, but for Germany, would have seen insurrection in Ireland. Finally, it is responsible for the unforgivable devastation of Belgium and for all the bloodshed, for all the hideous waste of life, money, material, and for the chaos of civilization under which, in pitiful altitudes, the fathers of the next generation lie crumpled and dead.

Every widow, every orphan, every maimed man in Europe to-day; all those poor boys from Canada, Australia, and New Zealand; every Frenchman, Belgian, Indian, Russian, Italian, African; every man who has sprung to arms, left his civil work, his little patch, his quiet haven where the patter of children's feet has been the music of his life, has to thank the English party system for this war. Countries as crippled as their sons, who have crept back like whipped dogs to a kind of life, will for ten, twenty, maybe a hundred, years hence have to thank the English party system for this hideous, unnecessary, preventable war. If there is yet one spark of remorse in the little souls of the men who have sat so long at Westminster greedily taking their salaries for the non-performance of their duties, then the quiet lunatic asylums which stand among the silent poplars of English country-sides must soon be full. If not, if their long service to dishonesty has eaten into them, if they see no shame in having permitted their country to slip into unreadiness and inefficiency, these little, petty harpies, these hypocritical self-advertisers, may have the satisfaction of wallowing in a sort of triumphant pool of exaltation; may congratulate themselves on having achieved an act of incendiarism so frightful that the bloody glow of its flames lights up every corner of Europe.

Mr. Balfour, the theorist, the gentle, gentlemanlike university professor, upon whose gravestone will be carved the words, "Nothing have I ever achieved"; Mr. Asquith, his own worst enemy, whose famous, "Wait and see," will be forgotten and forgiven only when the beautiful towns of Belgium shall have risen once more; Mr. Winston Churchill, the inefficient hustler, who breaks, like a bull in a china shop, through the work of experts, and who will be remembered by posterity only for his comic hats; Sir Edward Grey, the imitation sphinx, who has never yet in all his political life understood the very rudiments of diplomacy; Lord Haldane, whose vanity is like that of the toad and whose credulity is no less than that of the bumpkin who goes to the race-course and falls an instant victim to the confidence-man, —these men, and all their satellites without one exception, have quietly, steadily, and persistently made it possible for German militarism, German chemistry, and German effrontery to cause England to be the one country on earth whose name can never be mentioned again throughout the ages without raising the bitter ire of her friends. Oh, my God! to think that the little old man, scarred and battered with the wars of his country, left alive surely by an all-pitying Diety so that his magic voice might sink into the hearts and brains of his countrymen to prevent the sacrilege of civilization, should have lived in vain! His warnings and his appeals, which stirred the English nation from coast to coast, were scoffed at or ignored by the English politicians. The monthly reports of the secret services, all proving the criminal folly of the policy of laisser-faire, have been docketed away. The facts which have been plain to all the world, and caused France to strengthen her army and cut the terrible figures, 1870, on every one of her bullets, have been scorned by the English politicians. Instead of taking advantage of the anxious readiness of the country to subscribe to a system of compulsory service, they have steadily weakened the army and would have scuttled the navy had not their rudimentary knowledge of the nation's temper told them that such an act would have brought about a revolution. They knew of Germany's settled intention of declaring war when armed to the teeth. They knew that the day was drawing ever nearer when the peace of Europe would be broken by the roar of artillery. Every conceivable piece of evidence that daily accumulated on their desks made that fact plain and unanswerable. How, then, did they intend to act when overtaken by the inevitable? Take one look at the journal subsidized by them and find the answer. Not caring for or appreciating the country's sense of honor and pride, they intended to break their treaties and stand aside. They were going to say: "Let them fight who care to; we are unready, unwarlike. We will provide the loans at a high rate of interest and the ammunition at a price." Therefore I cry out aloud the sentiments of all true Englishmen when I say that the English party system is responsible for the war; because, had we been able to place a great army in Belgium to resist the German assault, there would have been no war. It was only because Germany knew of England's unreadiness, and was in the counsels of England's politicians, that she sprang at Belgium's throat.

The mills of God grind slowly, yet they grind
exceedingly small.

The germ of suicide would grow and grow in the brain of the thinking man did he not passionately believe that God does not intend this war to be just a hideous fracas, a blood-drunken orgy. The day will come when the warring countries, flung at one another by the leading villians of greed and selfishness and dishonesty, will flick the blood out of their eyes and ask one another the meaning of it all. The maimed and broken of all sides will look to see, in compensation for their lost limbs, the improving hand of the Master upon the churned-up earth. Out of her ruins France will rise with prayer upon her lips; Belgium, with her arms bared for the rebuilding of her smashed cities; and Russia with tears in her heart and brotherhood in her hands. In what manner Germany will be touched who can say? As for England, she, like a creature miraculously risen from the operating-table, will look out on the future with humbler eyes and a thankful heart. The cancer of the party system will have been cut out forever.

Looking through the smoke, I can see the House of Commons occupied by a small committee of unpaid men—business men, honest men. They would shudder to be called politicians. Their ambition is to earn the title of patriots. They belong to no party. They are the servants of the nation. They will not govern the country; they will guide it. They will pursue the same principles and methods for the restoration of her commercial strength as are employed by a committee of liquidation appointed by the court of bankruptcy to a broken business concern. They will run Great Britain in the simple way in which a great railway company is run, and their shareholders, the nation, will be content to read their statements of progress and receive their dividends. Phoenix-like from the ruins there will have risen honest men, and there will be no comfortable corner on this earth for those outcasts who once gambled with a nation's soul for money.

Illuminating Glassware Supply as Affected by War Conditions

By J. F. Heffron

Very shortly after this greatest of all wars began a great many manufacturers on this continent discovered that their customary source of supply of essential and minor ingredients necessary for the production of their products had been cut off.

At first it was difficult to realize that the German and Austrian nations had, during the years of peace preceding the war, specialized in so many commodities which are in many instances absolutely necessary if certain manufacturers are to carry on their business of production.

Never before in the annals of history has the realization been forced upon the world as it is being forced upon us at the present time the extent to which nations have specialized in certain lines and how because of this specialization they have, in a sense, like individuals, become dependent upon each other for certain things.

The time the trade of nations was very limited in extent and when we never went outside the town, city, or country in which we lived to purchase those things which are required by civilized peoples, is from all present indications forever past.

This condition has come about because of the fact that applied science through its wonderful achievements has made the manufacture, the rapid and relatively cheap and efficient transportation of commodities over long distances, a simple and easy matter—and is also due to the fact that many groups of people in the world have specialized in one thing—and because of their inclination and ability they are specially able to produce cheaply and extensively certain commodities.

To properly appreciate the problem before us it will be necessary for us to note that the volume of commerce controlled by the Germanic powers prior to the war was fast approaching that of Britain herself. The merchant marine of the German Empire, like that of Britain, carried unimaginable quantities of material to all parts of the world.

It is now a matter of history, however, how the allied fleet, when war was declared, swept this growing enterprise of the enemy from the seas, and this, of course, is the primary cause of the difficulties which the manufacturers of this continent are now facing.

A short time after this stringency first appeared a number of large manufacturing concerns were forced to close down either wholly or partially. At the time this occurred the markets of the world had become badly demoralized because the declaration of hostilities and a number of these shut-downs were due, no doubt, to general business conditions then prevailing.

But it has since been ascertained that not a few concerns were forced to close down because of lack of certain raw materials. At present this situation has become very acute, and is being felt more widely each day.

It is not our intention, nor do we believe it possible, in this short article to even attempt to bring forward facts and instances to show just how the ramifications of this shortage have reached into almost every industry in the land.

It will be sufficient, we believe, to mention a few of the difficulties that have presented themselves in the manufacture of one commodity—namely, glassware. This will give us an idea of the difficulties the rest have to contend with. The writer is to some extent acquainted with the difficulties which have presented themselves to glassware manufacturers—i.e., electrical and lamp glassware, glassware of all kinds for illuminating purposes. We will therefore not go outside the limits of the problem now confronting manufacturers in this line.

A serious difficulty presents itself to manufacturers in this line because of their inability to secure potash. This is one of the commodities in which Germany has specialized, and practically the entire world's supply came from Germany before the war. This is an essential ingredient in the manufacture of a great deal of the glassware in use.

There are various other ingredients used in the manufacture of glassware which are difficult to secure, the demand in all cases being many times greater than the supply. In addition to potash, we might mention oxide of antimony, oxide of zinc, and oxide of manganese. Arsenic is also a minor ingredient. It might also be mentioned that each glass manufacturer uses chemicals which are secrets with him in the mixture of the glass batch. These, of course, I am unable to mention. But all of the above articles have doubled and tripled in price, and some of them are not procurable at any price.

Then, too, the war has presented another phase to this already difficult problem which is now being seriously felt by the glassware manufacturers. This is the tremendous demand for certain materials used in the manufacture of glass which are now also in great demand by the allies.

The principal material is soda-ash, which is a very important factor in glass-making. This particular material, made on this continent by several concerns, is now becoming very scarce indeed, the reason being that the allies have purchased almost every pound in sight. From this material caustic-soda is made, and from caustic-soda picric-acid is produced—picric-acid being the essential ingredient in high-explosive powder.

The price of these materials is continually advancing—some articles have advanced as much as ten times their normal price.

It has become necessary, therefore, with some manufacturers to discontinue entirely the manufacture of certain qualities of glass they have been in the habit of producing, simply because of the absolute lack of materials for producing it.

An Unprecedented Demand

A further problem then presents itself: this is the unprecedented demand by the people, not only of this continent, but of the world, for the product of the glass manufacturer.

Before the war commenced, huge quantities of glassware, and especially illuminating glassware, were imported from Germany by Canada and the United States. These imports being entirely cut off by the allies, the additional demand for goods manufactured here which before had been imported was immediately felt. These demands for supplying domestic use increased with leaps and bounds. But on top of this came the additional demands for unprecedented and undreamed-of quantities of glassware by countries formerly supplied with glass by Germany. Orders for quantities of material never before heard of in the glass business came flowing in. In a great many cases a price was not asked; contracts were willingly signed and all sorts of agreements were made with manufacturers if they would only supply the goods requested. Germany, until the outbreak of the war the centre of the world's supply of glassware, hemmed in on all sides by the Allies, ceased to be a factor in the business. The world's markets in this commodity moved to this continent, so that the glass manufacturers on this continent are now exporting glassware in quantities never before dreamed of to many parts of the world.

Salesmen were notified that they must not sell certain articles manufactured by the various companies they happened to be working for, or that certain articles could not be shipped for a number of months, or that certain other articles had been discontinued entirely. Additions were added to factories and plants, the wideawake concerns manufacturing this commodity provided increased capacity wherever possible.

In less than a year the glass manufacturing business on this continent has exceeded all preconceived notions of its possible expansion.

Both the foreign and domestic business in this and other lines is still growing. This becomes more and more noticeable as stocks of goods which had been drawn on up to this time are being exhausted. The latest development to be felt in connection with the export business is the embargo now being placed by different railroads on cars to haul export goods. Cars in some cases can only be had for shipment of goods intended for domestic use. If this inability of the railroads to handle freight increases, its effects will be seriously felt in many quarters.

The demand increases, while the materials that are necessary for the manufacturing of articles to supply the demand continually decrease in volume or advance enormously in price. The manufacturers are doing their best to cope with the situation by giving domestic orders every possible consideration and giving to the orders for export secondary consideration. The jobber and the dealer can help out also if he will wherever possible appreciate his needs as far ahead as possible.

Electrification of Harbor Terminals

For some three years the Montreal Harbor Commissioners have had under consideration the electrification of the harbor railway terminals, and during the past year steps have been taken towards this end. In the annual report, just issued, the Commissioners state:

"The increase in the railway traffic of the Port and the mileage of trackage in operation makes it important to proceed with the utmost despatch in establishing facilities which will not only retain Canadian trade, but which, by their superiority over those provided at competitive ports, will attract additional business.

"With this object in view the Commissioners have, during the past year, devoted much time and thought to a study of a scheme for the complete electrification of the harbor railway terminals, visiting and inspecting in the meantime the electric freight terminals of the New York Central, Pennsylvania, and New York, New Haven & Hartford Railroads at New York, Oak Point, New Rochelle, etc., where the application of electricity had proved successful in the movement of freight at the various terminals.

"It was also ascertained that, in addition to the primary object of overcoming the smoke nuisance, the application of electricity had proved that it had, among many others, the following advantages over steam for railroad terminal traction:—

"Economy in operation and maintenance; flexibility of control; availability for immediate service; fewer units required for equal service; elimination of corrosion of steel and galvanized iron by acid gases; fire danger reduced; and standby losses much lowered.

"As a result of this investigation, an expert electrical engineer has, for some time past, been engaged in studying on the ground the railway conditions of the port, and preparing a report as to designs, types and estimates, upon receipt of which it is proposed, should the report confirm the conclusions arrived at by the Commissioners, to proceed at once with the work of completely electrifying the Montreal Harbor terminals, upon the consummation of which Montreal will have the distinction of being the first port in the world possessing a complete system of electrified freight terminals."

The Kaministiquia Power Company

The Rapid Development of the Canadian Twin Cities Due Largely to Ample Supply of Dependable Power—Description of Latest Installation Work at Kakabeka Falls

By P. R. Farrow*

The Canadian twin cities of Fort William and Port Arthur, at the head of Lake Superior, occupy a strategical position in the commerce of Canada. During the seasons of navigation west-bound merchandise is carried largely by boat, on account of the low freight rates, and there transferred to rail, or stored for delivery during the succeeding winter months. East-bound grain, forest and mineral raw products are also transferred here, forming return cargo. The great bulk of the coal for the Middle West is brought up by boat during the summer from Buffalo and Cleveland, and transferred or stored, at immense electrically-operated coal docks.

At Port Arthur and Fort William are situated some of the largest and most modern coal docks on the continent. Upwards of 3,000,000 tons of coal are shipped through this port every year. The transfer facilities to handle this traffic must necessarily be of the very best, and electric power has here proven itself a most dependable and efficient servant. All the coal docks, of which there are five, are operated by electric power.

Grain Facilities

In the transfer and storage of grain these ports excel all other ports in the world. The storage capacity of the port is now over 45,000,000 bushels, and is being increased yearly. During the fall rush, grain is delivered day after day into the elevators at the rate of 2,000,000 bushels per day. It is then graded and transferred to boats for delivery at Georgian Bay, Lake Erie and the St. Lawrence ports.

Here again electric power performs a most important service, on account of its adaptability, efficiency, reliability and convenience. As new storage units are added to the elevator, the simple electric motor readily adapts itself to suit any location and meet any service, and yet can be centralized and controlled from one point.

On account of the location of these twin cities as a bulk-breaking and storage point for raw and finished products, it was obvious that they were destined to become large manufacturing and milling centres. The cities are now served by three transcontinental roads, and have a population of about 45,000.

The one other element necessary to complete the chain of facilities was introduced in 1906, when the Kaministiquia Power Company began delivery of electric power from their hydro-electric development at Kakabeka Falls. After nine years of operation this company can point to a record which for continuous and uninterrupted service has probably not been excelled by any other plant in Canada. Trouble, inconvenience or delay from ice, backwater or water shortage, is unknown, and from all causes the aggregate interruptions to the system have not exceeded twenty minutes in any one year. During the past year this record has been reduced to less than four minutes and the company have further plans and improvements under consideration by which they hope to reduce their service interruptions to the vanishing point.

The details of the electric power plant are covered in considerable detail below. The plant is located at Kakabeka Falls—a beautiful falls with a sheer drop of 110 feet, located some twenty miles northwest from Fort William, on the line of the Canadian Northern Railway. The water is brought overland for a distance of one and one-quarter miles in reinforced concrete aqueducts, of which three are now completed. At the brow of the hill, just above the power house, the aqueducts empty into a regulating reservoir or forebay, in which are located the recently installed automatic controlling gates for each of four steel penstocks, through which the water is carried to the power house turbines. The turbines operate under a net head of 180 feet. The power is generated at 4000 volts, transmitted at 25,000 volts to Fort William and Port Arthur, and there distributed at 25,000 volts and 2,200 volts.

The original installation was commenced in 1905, and in the fall of 1906 the first two units of 4,400 kv.a. each were completed and placed in operation. In 1911 the business of the company had expanded at such a rate as to justify the installation of a third unit. In 1913, taking advantage of the temporary trade depression, with its resultant low costs for equipment and installation of plant, the company commenced the installation of a third concrete aqueduct, and a fourth unit of 9,375 kv.a. This was completed and placed in operation in the fall of 1914.

While there has been a temporary falling off in manufacturing in the twin cities, as elsewhere, this has been largely counterbalanced by the manufacture of war munitions, and by the abnormally heavy grain movement. The 1915 grain crop exceeded all anticipations, and has been phenomenal in the history of the country. Ordinarily the bulk of the grain rush is over in December. It is estimated that it will keep all available rolling stock busy all winter, and all the railroads and boats busy all next summer, to get the grain out of the country before the next grain crop comes in. The railroads are the greatest distributors of the wealth of the country we have. This great movement of grain cannot but have a very beneficial and sustaining effect on the trade of the country throughout the coming year.

Summary

The following data covers the additions to the plant of the Kaministiquia Power Company, Limited, at Kakabeka Falls, during the period between June, 1913, and September, 1914, which consist of a reinforced concrete aqueduct, one and one-quarter miles long between the intake and forebay reservoirs; the installation of steel butterfly gates as head gates of the penstocks, in the forebay; the erection of a steel penstock, 740 feet long, eleven feet diameter, between the forebay and the power house, with a concrete covering; extensions to workshops and valve house; erection of a special battery house near the forebay to control the steel gates therein; erection of a 12,500 h.p turbine and 4,000 volt generator; five step-up transformers, with necessary switching and indicating switchboard apparatus; two storage batteries with their switchboards; the installation of an improved lighting system in the power house and various incidental work in connection with the above.

Aqueducts

The centres of the inside and outside of this pipe, which is an equivalent area to a 10-ft. diameter circle, are vertically offset one and one-half feet. The interior cross section of the pipe is that of a circle 10 ft. 6 in. diameter, with a segment cut from the bottom four feet from the centre, forming a flattened base. The bottom slab thus formed, is ten

* Power House Superintendent

inches thick and is carried out until a line sloping at eight degrees with the vertical approaches eight inches minimum to the interior. At the top the concrete is six inches thick and an arc with radius 6 ft. 1 in. meets the sloping sides and completes the section of the pipe.

Grade and Ground.—The formation of the surface upon which the pipe lies is very varied over its length of 6,500 feet, running from solid rock near the intake, through clay, boulders, swamp, quicksand, hardpan and gravel with boulders, to the forebay. For the first 500 feet from the intake, the pipe practically follows the river bank and at two places

Inner form in place, outer form and pouring platform in background.

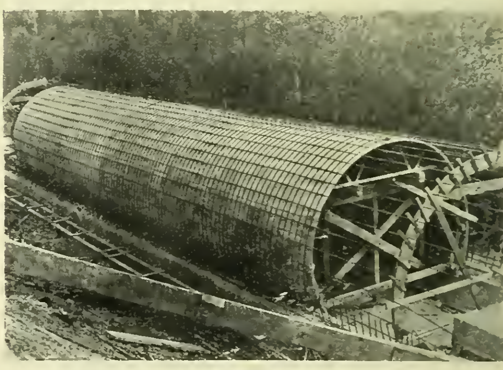
the bank had to be filled in with rock and a concrete retaining wall built on the bank to form a support for the base, one of these fills was 30 feet, maximum depth. At the intake the pipe runs below the level of the river bed and a retaining wall, to deflect ice and otherwise protect the pipe, was built up from rock from the aqueduct base level. A drain was also built from the intake to a point in the river 450 feet below to obtain the proper fall and to drain all aqueducts when necessary, for inspection. For 2,000 feet the aqueduct runs level from the intake over a rock bed, it then dips gradually to 4.5 feet below grade through a rock fill overlying clay and boulders for 1,000 feet, then for 900 feet it rises to 3.5 feet above the preceding level, passing through an excavation of hardpan and gravel; for the next 500 feet the level falls again through a fill over a quicksand. This portion of the grade was sheet-piled by double 2-inch planking driven four feet outside the base of the pipe and provided with drainage to take off water, but so arranged as to prevent the sand working out from under the base of the pipe. The pipe then passes over gravel, which was levelled for 900 feet, and into a deep cut of gravel and boulders, varying from six to nine feet deep and fourteen feet wide, which runs practically level to the forebay.

Concrete and Reinforcement.—The concrete aggregate consisted of one part of cement, two parts of washed sand, screened to pass through a ¼-in. sieve, and four parts of gravel screened between ¼-in. and 1-in. sieves. The cement, purchased on acceptance tests from the Canada Cement Company, was from one mill, and of a uniform quality, was required to pass the C. S. C. E. tests for Portland Cement, and to be of slow setting quality. The quantity of concrete used for the pipe amounted to 1.2 cu. yds. per lineal foot. The reinforcement was composed of one-half inch circular steel bars of standard specifications, spaced longitudinally from 12 in. to 15 in. apart and transversely from 5¼ in. to 6 in. apart, tied with No. 14 gauge annealed iron wire at all joints and lapped 12 ins. at ends of bars and firmly tied. No expansion joints were provided but it was hoped that sufficient hair cracks would develop to allow for contraction and prevent excessive leakage.

Forms and Centres.—The forms for moulding the pipe consisted of fifty-foot sections of steel framework, divided into three parts, running on wheels on special tracks along the pipe line, supporting a galvanized iron lined wood framework properly braced upon the steel frame, but collapsible by removing a few bolts. Over all was placed a wooden platform with central openings to allow the concrete to be deposited from carts directly into the form. The interior forms were wood, steel braced, and solid for the upper quarter section of the arc. To these were hinged side segments braced laterally when the forms were erected. The whole of the interior form was collapsible and was carried upon a track and a special carriage along the floor or bottom slab of the pipe, after it had been constructed. The forms for the bottom slab consisted merely of sides to support the concrete from the outside, lengthened to hold the transverse reinforcement in place, and a special interior form to bring the sides up 10 inches above the base before setting the upper forms.

Concrete Plant.—Two No. 2½ Smith concrete mixers, a 1/3 cu. yd. clam shell bucket, a two-stage, 25 h.p. centrifugal pump, one duplex pump, all electrically operated by three-phase, 550 volt alternating current, an electrically operated hoist, and a tower for washing and screening gravel and sand, formed the plant necessary to construct the aqueduct. A three-foot gauge railway, with eleven wood and steel contractors' dump cars was used to deliver material, and finally to cover the pipe, after completion, with three feet of earth covering as a protection from frost.

Method of Construction.—After grading and filling had been completed, in 1913, and allowed to settle all winter, the bottom slab, a simple slab 10 ins. thick, was laid after placing side forms. All reinforcement were bent at the works, from proper lengths of rod supplied, on a special bending machine. A centre form was placed and the sides brought up ten inches to form a support for the large forms



Transverse and Longitudinal reinforcing in concrete aqueduct—Kaministiquia Power Co., Kakabeka Falls.

of the superstructure. After the whole bottom slab had set for eighteen hours the forms were removed and the track laid for the upper forms, on the interior, directly upon the concrete slab and on the exterior upon a thin slab of concrete brought to the correct grade. The interior forms were then set for a distance of fifty feet, braced to the lower slab at the correct height and the longitudinal and transverse reinforcement applied and tied in place, with properly staggered and overlapped joints. The side and top form was then brought up, the sides cleaned and closed for concreting, set in place and braced on the lower section to prevent springing. Concrete was then placed on each side equally through small doors in the upper curve. When full to the level of the doors they were closed, and concrete poured from the top, through a four-foot opening, until full. The top was then finished off over the open section by trowels. The whole operation of concreting took from 2½ to 3 hours for each 50-ft. section. The forms were ready for removal twenty-one hours after the concreting was finished. Three sections of fifty feet of forms were built, with an extra interior section enabling, even under the most difficult circumstances, one hundred lineal feet of pipe to be completed per working day, after all preliminary work had been completed. The pipe was finished by plastering all defective work and applying three coats of cement wash to the interior surface.

Vents and Drains.—14-in. drain valves were placed at each end of, and at two low points along the length of, the aqueduct, serving to empty the pipe, when closed off at each end, for inspection. Wooden stop logs form a barrier both at the intake and forebay ends when it is necessary to inspect the interior. Air vents are placed at three high points and serve to discharge accumulations of air carried by the moving water and to admit air freely when the water level falls. These consist of 8-in. diameter pipes screwed into cast nipples attached to the reinforcement. The whole is surrounded by a wooden framework to protect from injury and prevent early freezing in winter. Artificial heat is applied in winter to keep the pipes free of ice. The drain valves are protected by concrete walls with a wooden housing at the top, and are operated by long handles from the level of the earth covering on top of the pipe; sufficient room is provided at the bottom of the concrete pit to remove the valve for repairs when necessary.

Materials.—The gravel and sand for the concrete was obtained from pits on the company's property and separated and washed in one operation by dumping the excavated material into chutes, where water carried it over properly adjusted screens. From thence the gravel and sand was carried to bunkers and the water and waste material allowed to settle, the remanant being used for covering the completed pipe.

A special covering of three feet of earth was placed

First completed section of aqueduct—Buggies used for conveying concrete from the mixers on pouring platform—Forebay in background.

over the pipe as soon as completed, to protect the concrete while setting, from the sun, and to prevent frost in the winter from penetrating the pipe. The cover has been seeded to grass to hold snow in the winter. The necessary forms were built at the work, a sawmill with a circular saw, planer and band saw being provided to make the necessary material.

The reinforcement was provided in proper lengths by the

Invert completed and track laid for inner forms. Outer forms being placed —Note reinforcing rods to join the invert to the superstructure.

mill, and bending machines in the field shaped all transverse bars.

Organization.—The whole work was in charge of Mr. Geo. Lewis, with an engineer for laying out the grades and levels, a general foreman, and a gang foreman on each section of the work; a timekeeper and storekeeper completed the staff. Inspection and testing was conducted by the engineer and writer, the company's superintendent.

Penstock Gates

Two heavy wooden flap gates, built of 10 in. x 10 in. timbers, having proved unsatisfactory owing to their great weight and difficulty in handling, a set of five steel gates, with 10-ft. diameter openings, were installed in front of the bellmouths leading to each penstock, each of which supplies its own generating unit with water through an iron pipe.

These gates, with their operating mechanism, weigh just over twenty tons each, and were supplied by Messrs. J. M. Voith, and erected under the supervision of their mechanic. The heaviest part of the shipment weighed 7½ tons and consisted of the 10-ft. diameter gate, which was shipped in one piece. The outer casing, in four parts, was bolted together in place and concreted solidly into the walls of the building and fastened with bolts into the vertical wall. Owing to the outbreak of the European war the operating mechanism was not received and temporary expedients have been adopted to open and close the gates.

It was the intention that the gates when normally open might be closed by an operator in the power house pressing a button or by an excessive increase in the velocity of water in the penstock. A storage battery placed near the forebay, in a specially designed house, supplies current to an electric motor mechanically connected to each gate. Switching equipment automatically starts the motor for closing the gate only when required; a clutch and a handwheel serves to open the gates. An attendant is necessary to fill the pipes in order to provide against over rapid filling for the penstocks.

Penstock No. 4

The dimensions of this steel pipe are: length 740 feet, diameter 11 ft., thickness of top plates ⅜ in., thickness of bottom plates 13/16 in. Two 7 ft. 6 in. diameter bellmouth pipes from the forebay wall, feed into the common 11 ft diameter pipe about 60 ft. from the forebay. The pipe then slopes at 23 degrees for 250 feet and changes to a slope of 9 degrees for 125 ft. and then forms a curve on a 262-ft. radius, 365 feet long, with large concrete bulkheads at each end to prevent movement. A sharp slope and a bend brings it to a nine-foot diameter butterfly valve which terminates

General View of the Kaministiquia Power Company's Hydro-electric Station at Kakabeka Falls—Shows Forebay and Spillway to lef

the penstock. A drain discharges the water into the power house tail race, when it becomes necessary to empty the pipe. The joints in the steel work consist of double riveted lap joints near the forebay, gradually changing to triple-riveted butt joints at the power house.

From the forebay to the commencement of the curve the pipe is carried on concrete saddles placed about 25 feet apart and two feet wide. Around the curve steel saddles are used, resting upon a steel base so that expansion or contraction may be absorbed by changes in the length of the curve.

Cover.—Over the penstock a concrete cover has been built with a clearance of 18 ins. between the pipe and steel work. Angle iron ribs, curved to radius and projecting into a light concrete wall foundation are spaced three feet apart by iron bars punched and riveted to them. These bars in turn serve to hold poultry netting and tar paper which forms a backing for the 1½-in. thick concrete covering, which was reinforced with triangle mesh wire. The covering was placed by a cement gun to the required thickness and is of the usual 1:2:4 mixture. It serves to protect the iron pipe against excessive temperature changes, and prevents the water on the interior freezing in winter time.

Forebay and Penstocks—No. 4, to left, 740 ft. long, 11 ft. diameter.

ks, Reinforced Concrete Power House and Tail Race—Kaministiquia River in Foreground and Transmission Line to the Right.

Doors are provided in the side so that inspection may be made at proper intervals to prevent rusting.

Messrs. John Inglis Company, of Toronto, provided and erected the penstock. All excavation and concrete work in connection with erecting saddles, bulkheads and foundations was done by the company. Shop and field inspection of the steel work was in the hands of the R. W. Hunt Inspection Company, of Montreal.

Valve House

Over the butterfly valve at the lower termination of the penstock, a concrete building with drains was constructed, the floor of which has been made into a workshop for repairs to machinery, etc. A small lathe and emery grinder and an electric drill have been furnished. This building has a concrete saw tooth roof, in two spans, which gives good lighting, although the building is on the north side of the power house proper, and lies so low that wall lighting is practically impossible. Light is also admitted to the power house from this building, through clear glass windows. In this same building is a water motor with gearing for operating the large butterfly valve of the penstock and turbine. It is reversible and controlled by hand wheels in the power house. The water supply to drive this motor is obtained from an independent source, making the whole installation reliable for use in emergency. The joint between the butterfly valve and turbine inlet pipe is a special type consisting of a groove on the interior of the pipe into which ½-in. lead packing is caulked. Short steel fillers on the outside, against which the flange bolts are drawn tight, leaves the lead to be forced into all small openings by the pressure of the water on the interior side and will also allow the large valve to be removed in the future, should any repairs become necessary.

Turbine

This unit, supplied by Messrs. J. M. Voith, is a twin spiral, inward flow, Francis type wheel with a maximum B.h.p. of 12,500. The supply pipe from the 9-ft. diameter inlet valve is a tapered steel pipe embedded in concrete and is furnished with a drain to take away leakage from the inlet valve, and empty the turbine when the latter is closed down. Water is distributed around the two cast iron wheel cases, with arm inspection covers, through balanced steel gates, the openings through the same being adjusted by the governor in accordance with the load on the unit. From the gates it passes to enamelled bronze runners attached to the steel shaft, which is directly coupled at one end of the generating unit. The water then discharges into a central pipe or draft tube gradually increasing in size until it reaches the tailrace. This draft tube is steel for seven feet and then concrete to the outlet and is curved to discharge the water horizontally. It is seven feet in diameter at the point of discharge from the turbine, and is rectangular in form at the point of discharge, being nine by sixteen feet. The surface was carefully smoothed to obtain proper discharge with a maximum efficiency in the turbine.

A relief valve 5 feet in diameter serves to discharge the water when the load is suddenly thrown off the unit, and prevents excessive rise in pressure in the penstock, or water hammer. This valve is kept closed normally by oil pressure from the governor pump, but open by means of a piston valve, which relieves the pressure when the governor gates close rapidly. The time and distance of opening and closing are capable of adjustment by means of dash-pots.

The governor is of the fly-ball and relay type, operated by oil pressure from a belt-driven rotary pump, at a pressure of 280 lbs. per square inch. It serves, by means of mechanical connections to a cylinder and piston, to keep the turbine gates at the proper opening to supply water for any load which may be applied to the turbine, and to keep the speed constant at all loads and within set limits under load variations. A relay valve connection from the fly balls, controlled through dashpots and a special regulating mechanism, admits and discharges oil from each side of the piston in the main cylinder as required, thus adjusting the cylinder and the gates as the load changes.

Foundations.—The foundations for such a heavy unit, which weighs nearly 400 tons, are necessarily very massive. The generator, situated nearest the tailrace end of the power house, is carried on a massive arch, 28 ft. span and semicircular, rising from the bottom of the excavation for the discharge water, 31 feet below the level of the power house floor and running 20 feet back from the wall of the building. The remaining 37 ft. width of the building is taken up with the various pits connected with the turbine inlets, outlets and drains. The excavation runs from 13 to 31 feet below floor level. An arch 10 ft. in diameter allows the penstock to enter the building at the front of the building.

The forms and centres for the arches, draft tubes, relief valve, etc., entailed much special work. Those for the curved draft tubes were built on wooden ribs of 2-in. planking spaced about 2 ft. apart and properly braced with ½-in. x 3-in. poplar strips nailed thereon to give the proper form to the tube. Openings with small clearances were left for parts of the machinery below floor level, which, after being placed and secured in position were grouted in place in the usual manner.

Generator

This machine, directly coupled to the turbine described, was built and installed by the Canadian General Electric Company, of Peterborough and Toronto. It is capable of generating 9,375 kv.a. at 257 r.p.m. and 4,000 volts, with a continuous overload capacity of 25 per cent. or, 50 per cent. for one hour. The total weight of the machine is 298,000 lbs., and the revolving field weighs 153,000 lbs. The armature is wound in two separate circuits entirely independent of each other, each connected to a bank of air blast transformers. The unit is of the horizontal shaft type; the shaft diameter being 13 inches.

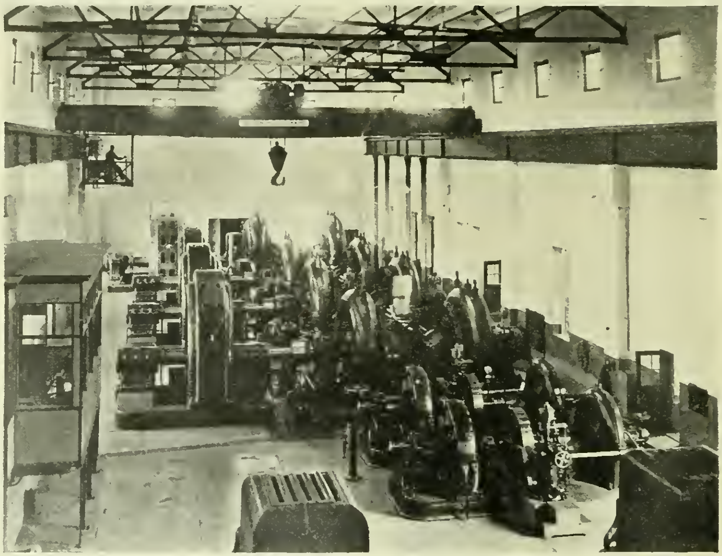
The field is supplied with direct current from exciters which were already installed, at 110 volts, and is regulated, for constant voltage at terminus of transmission lines, by means of a Tirrill regulator in the exciter circuit. The transformers are of the air blast type and consist of three single phase units installed over an air chamber, each of 1,475 kw. capacity. Interconnected between generator and transformers are selector switches, with connections to a common 4,000 volt busbar, which enables the generator to supply current to other banks of transformers in case of trouble.

Switchboard

The usual recording, indicating, and switching apparatus is installed in the generator circuits, being connected to the switchboard through current and potential transformers to eliminate high voltage on the switchboard. An ammeter is installed in one phase of each bank of three high tension transformers, to indicate the proper equalized loads upon each. The switching apparatus is installed in reinforced concrete compartment, with switches in front and current transformers and wiring at the back; the latter, for all high tension work at 25,000 volts, is bare No. 4-O copper on porcelain insulators. Over-load, time limit relays guard the transformers and generator against excessive short circuits. A motor controlled generator rheostat adjusts the field, with a control switch on the generator panel.

Battery

In view of the fluctuating voltage of the exciter circuit, due to operation of the Tirrill regulator, a small 80 amp. hour battery has been installed to connect to the control circuit of the switchboard and provide a few lights in the power house in case of short circuits or other trouble cutting the generator and exciter supply down. This is charged from a small motor generator set with a panel near the main switchboard, so that the usual attendant may operate it. The same set also serves to charge the battery situated at the forebay, through a special overhead line. Push buttons and indicating devices on one panel of the switchboard indicate the position of the butterfly gates at the forebay and control the closing of each gate. The power house lighting, which previously had been from unshaded carbon lamps in lines along the walls, was changed to ceiling tungsten lights with concentrating reflectors, with six 150 watt tungsten units in a space 28 ft. x 50 ft.; this gives a more even distribution of light and, although at a height from the floor of 32 ft., gives sufficient light for all ordinary work.



Interior of Power House showing 2 exciters, 3-5,000 h.p. direct connected units, and new 12,500 h.p. unit in background —Operating room to left, transformer gallery in foreground.

Staff

The entire work was carried out under the direction of Messrs. R. S. Kelsch, of Montreal, Consulting Engineer to the company, and W. L. Bird, manager. Mr. Geo. Lewis was construction superintendent for all concrete work. The writer was responsible for all preliminary engineering data on aqueduct, penstock, generator foundations, etc., and for designs for aqueduct forms, forebay battery house, valve house and workshop and details of all small work, with inspection of electrical equipment and hydraulic work.

Personals

Mr. T. Rodger has been appointed superintendent of telegraphs of the Grand Trunk system. He was formerly supervisor of plant.

Mr. P. T. Bowler, city electrician, New Westminster, has resigned. It is probable the position will be filled by his assistant, Mr. John Digby.

Mr. Frank Harris, publicity agent for the British Columbia Electric Railway Company, has resigned. We understand he will go into business on his own account.

Mr. Wilford Phillips, manager of the Winnipeg Electric Railway Company, has gone south on leave of absence, it is said, of several months on account of ill health. During Mr. Phillips' absence Mr. Henry Hartwell will be acting manager.

Mr. A. B. Smith, who recently retired from the position of manager of telegraphs of the Grand Trunk and Grand Trunk Pacific companies, was presented with a Victrola and a supply of records by the staff throughout the system. Mrs. Smith was presented with a bouquet of roses.

Mr. J. B. McCarthy has been appointed electrical engineer of the Canadian Copper Company and will be located at Copper Cliff, Ont. Mr. McCarthy is well known in Toronto, where he has been connected with the Canadian Westinghouse Company for several years. The work to be undertaken includes, we understand, supervision over the several generating plants of the Canadian Copper Company, as well as their transmission lines and the utilization of the current in mining operations.

Mr. Paul F. Sise, vice-president and general manager of the Northern Electric Company, has been appointed adjutant of the 148th, a battalion organized in Montreal by Lieut. Col. Magee for overseas service. Mr. Sise was formerly captain in the Victoria Rifles, and when the war broke out joined the Canadian Officers' Training Corps, which is affiliated with McGill University. Later, when the McGill Auxiliary Battalion was formed, Capt. Sise was in command of "D" Company, and afterwards of "A" Company, McGill Contingent, Canadian Officers' Training Corps. Considering the important executive position held by Capt. Sise, to say nothing of the responsibilities which such a position entails, it is impossible to underestimate the effect such a splendid example will have on his fellow Canadians. It typifies the calibre of the man and the loyal motives which are inducing our best citizens to answer the call of their country, and gives us certain confidences in the ultimate outcome of this great struggle.

Capt. P. F. Sise

Capt. Sise is only 36 years old. He was educated at Bishop's College School, Lennoxville, and at McGill University, from which he graduated with B.Sc. degree. He was one of the organizers of the University Club, Montreal, and is also a member of St. James Club and a Governor of the Western Hospital.

The many Canadian friends of Mr. John F. Ward will learn with regret that he is leaving the Northern Electric Company to become supply manager of the North-western Electric Equipment Company, of St. Paul, Minn. Mr. Ward has been district sales manager of the Northern Electric Company of Toronto for the past five years, during which time he has established himself as one of the most highly respected men in the electrical business. Among other activities, he has always been deeply interested in the Jovian Order. He is a past statesman, and is reigning Chiron in the 14th Jovian Congress. The members of his sales department presented him with a handsome club bag, well fitted up, on the occasion of his leaving the Northern Electric Company on February 1. Mr. Wood was also entertained at luncheon at the National Club by a number of his more intimate friends who took this opportunity of wishing him God-speed.

Mr. J. F. Ward

Mr. W. J. Bell, well known in the electrical construction field throughout Ontario, has just accepted a lieutenant's commission in the Royal Canadian Engineers and will immediately undertake a course of instruction in Ottawa. Mr. Bell was formerly with the Toronto Electric Light Company and later was foreman of construction for the Toronto Power Company in the erection of their second transmission line between Niagara Falls and Toronto. On the completion of this work he was engaged on high tension transmission line construction for the Hydro-electric Power Commission of Ontario and was afterwards with the Toronto Hydro-electric System. Latterly he has held the position of superintendent of the Cleveland Electric Illuminating Company, Cleveland, Ohio.

The Dealer and Contractor

A Code of Lighting Applicable to Factories, Mills and other work places—Valuable Information for Engineers, Central Stations and Electrical Contractors (Con.)

Section IX.

Control of Lamps and Arrangement of Switches

The control of lamps in factory and mill lighting is important in all cases, but specially so where a large number of lamps is used in preference to a small number for a given floor area. For example, where an overhead system of tungsten lamps of small size is used, a large number will, of course, be necessary for a given floor area, and in such cases the number of control circuits may at times seem excessive when planned out for sufficient flexibility of operation. Such circuits, however, in rendering the system more flexible, will be more than paid for by the saving in energy and maintenance due to the turning out of lamps not needed in certain sections of the factory or mill, provided the number of hours per day during which the lamps are used on the average is relatively large, and the differences in daylight intensities over the floor area is also relatively large.

Control Parallel to Windows.—The lamps most distant from the windows will usually be required at times when the natural light near the windows is entirely adequate, thus making it an advantage to arrange the groups of lamps in circuits parallel to the windows. The advantage of this method is further apparent when it is considered that if the lamps are controlled in rows perpendicular to the windows, all lamps in a row will necessarily be on at one time, while a portion only may be required.

Practical Case.—The foregoing statement may be developed into a definite proposition. Thus, to install a single switch may involve say $5.00 as its first cost. If ten lamps are to be controlled from a single switch, these ten lamps must obviously either all be turned off at a time or all turned on at a time. An additional switch at a cost of $5.00 will permit either half of these ten lamps being turned off, if not required at certain times when the remaining five are needed. This extra switch may or may not be an economy. Consider, for example, the case where these five lamps are of the 60-watt tungsten type, and that they are turned off by the extra switch on an average of one-half an hour per day while the others are needed, or vice versa. In a year's time, the energy saved at 1 cent per kilowatt-hour, will amount to perhaps 50 cents. At this rate it will require ten years for the energy saved to pay for the first cost of the extra switch. This would not be considered a distinct economy. If, however, the energy cost be greater, and more nearly the average under actual conditions, or if the number of hours per day during which a portion only of the lamps will not be used, be greater, then these values will be correspondingly modified.

Locating Switches and Controls.—In locating switches or controls in factory and mill aisles, care should be exercised to arrange them systematically, that is, on columns situated on the same side of the aisle and on the same relative side of each column. This plan materially simplifies the finding of switches or controls, by those responsible for turning on and off the lamps, and is particularly important where a given floor space is illuminated by a large number of small or medium sized lamps distributed uniformly over the ceiling area, a feature which is usually accompanied by the use of a relatively large number of switches or controls.

Section X.

Systematic Procedure Should be Followed in Changing a Poor Lighting System Over to an Improved Arrangement

When undertaking the change from an old to a new lighting system, the various forms of illumination which are adapted to factory and mill spaces should be studied, and an investigation made of the various types of gas and electric lamps on the market which are available for the purpose.

Time should be allowed for a study of the given locations to be lighted; for preparing the plans of procedure in the installation of the gas or electric lamps and auxiliaries; and for customary delays in the receipt of the necessary supplies and accessories to the work in hand. Altogether, therefore, work of this kind requires considerable time for its completion.

Using the Shop Force.—In large factories or mills, a wiring or gas fitting force is sometimes a part of the maintenance division. The work of the wiremen or fitters is likely to be heaviest in the winter due to the dark days. Where this condition exists, there is all the more reason to apportion out new work so as to accomplish it during the months of least wiring and piping repair activity, and further, at that time of the year when employees will be comparatively unaffected by the disturbances usually associated with a change from an old to a new lighting system through possible irregularities in the illumination service while the wiremen or fitters are at work.

Distribution of Expense.—Another feature different from the foregoing viewpoint, is in the distribution of the installation cost over a relatively long interval. If, for example, the system is desired for the approaching winter, the complete wiring or piping plans may be drawn up and blocked out into three, four or even more sections, thus spreading the expense over as many months.

Yearly Appropriation.—In some shops a given appropriation may be allotted each year for building equipment. From the standpoint of finance plans, it may thus be desirable to distribute outlays of this nature over the year, rather than to concentrate them at any one time. **An important consideration in this method of installing lamps, however, is to prepare in as far as possible the complete plans in advance, at least as regards given factory or mill sections, so as to insure a uniform and symmetrical installation as a whole when the component parts are finished.**

Section XI.

Reflectors and Their Effect on Efficiency

A reflector or shade is used in conjunction with a lamp for the purpose of reducing the glare otherwise caused by looking directly into the bare lamp, as well as for the purpose of redirecting the light most effectively to the work.

Reflectors and shades are now obtainable so designed as to be specially adapted to give sizes and types of the smaller and medium sized line of lamps, and hence care should be used to be sure that both reflectors and lamps are of the correct size in their relation to each other. This is of the utmost importance in securing uniform illumination for a given spacing distance and mounting height of the lamps. For a certain ratio between the spacing and the height of the lamps, a reflector can nearly always be selected which will furnish uniform illumination over the working surface. (These remarks concerning reflectors apply particularly to lamps of the tungsten type and to small gas units).

Function of Reflector.—Owing to the direction of the light from the lamp, nearly all types of lamps, in addition to the downward light, furnish some rays which go upwards and away in other directions from the objects to be illuminated, and are therefore relatively not useful. Furthermore, a bright source in the field of vision causes an involuntary contraction of the pupil of the eye, which is equivalent to a decrease in illumination in so far as the eye is concerned. Hence, while reflectors or shades may at first seem to reduce the amount of light in the upper part of the room, their use actually increases the amount of light in a downward useful direction, and improves the "seeing" due to the better conditions which surround the eyes. The economic function of the reflector, as contrasted with the easier conditions it affords the eyes, is to intercept the otherwise useless or comparatively useless rays which do not ordinarily reach the work, and to reflect them in a useful direction. In performing this function, there is a choice through the design of the reflector, in the manner of distributing the light so as to make the illumination on the floor space uniform with certain spacing distances and mounting heights as previously mentioned.

Avoiding Dark Spots.—With the use of lamps for which a large variety of reflectors is available, the proper reflector should therefore be chosen so as to give the desired distribution of light. In other cases, as in the use of the gas or electric arc lamps, where the globe or reflector is usually a fixed part of the lamp, care must be exercised to space the lamps at sufficiently close intervals to insure uniformity of the illumination, that is, a freedom from the relatively dark spaces which exist between lamps when spaced too far apart.

Light Interiors.—With a light ceiling, the reflection of that part of the light which passes through a glass reflector to the ceiling, and which is added to the light thrown downward from the under surface of the reflector, is a factor in building up the intensity of the illumination on the working surface. Great importance is therefore attached to light interior colors, especially on ceilings and the upper portions of walls, both in reinforcing the direct illumination, and in giving diffusion, which in turn adds to the amount of light received on the side of a piece of work. It should also be stated that the intensity of the light from bare overhead lamps when measured on the working surface may be increased by as much as sixty per cent. through the use of efficient reflectors. This is due to the utilization of the horizontal rays of light as previously stated, which predominate in the bare lamp, whereas the most effective light in factory and mill work is apt to be that which is directed downward.

Glass and Metal Reflectors Compared.—The question is sometimes raised as to the use of glass reflectors in connection with lamps for factory and mill lighting. This question is largely one of economy and maintenance, and it may be answered either in an off hand way or on a basis of practical experience with both types. In large installations of small units there has been an effort to establish the merits of glass and of metal reflectors, by equipping lamps in adjacent bays with glass reflectors in one case and with metal reflectors in the other. It has been found almost invariably that if the choice is left to the workmen and superintendents, glass reflectors will be given preference over metal, mainly on account of the added cheerfulness they produce. If, therefore, the first cost and maintenance expense of the glass reflectors is practically the same as with metal, then glass may be employed to advantage.

Reflector Efficiency.—Glass reflectors on the market are capable of producing an amount of illumination equal and even greater in some cases than that produced by the best metal reflectors, and even if the first cost is somewhat higher, the added advantage of glass as opposed to metal is usually sufficient to make the small difference in cost a negligible item. This factor is all the more noticeable when one considers that the reflector itself is a small part of the total cost connected with the wiring or piping of the lamp and its reflector.

Pierced metal reflectors are also available. These are designed with small openings at the upper portion of the metal, so that the reflector may give the same distribution characteristics as a given glass reflector, thus affording a suitable metal reflector for use where glass may be objectionable. Some of the advantages of the pierced metal reflector are that it is unbreakable and that accumulations of dust on the outer surface do not decrease the efficiency. It is also true that the light which passes through the openings in this reflector to the ceiling cannot be diminished by dust on the outer surface as in the case of glass reflectors.

Reflector Maintenance.—Regarding the maintenance of glass reflectors under rough factory and mill conditions, it may be stated that glass reflectors are used quite widely with almost a negligible increase due to breakage. Thus, out of the total maintenance cost in one representative installation, it was found that the charges were proportioned as follows:—

Renewals, cost of lamps (tungsten)	75 per cent.
Renewals, broken glass reflectors	3 per cent.
Labor, making renewals and changing reflectors for washing	16 per cent.
Labor, reflector washing	2 per cent.
Additional indirect charges	4 per cent.
Total	100 per cent.

Points to Consider.—Reflectors will not be classified here from the commercial standpoint, but the following items should be given consideration in the selection of the type of reflector for factory or mill use:—

1. Utilization efficiency: how much does the reflector contribute to the effective illumination on the work?
2. The effect in reducing glare.
3. Natural deterioration with age through accumulations of dust and dirt.
4. Ease in handling and uniformity of manufacture.
5. Physical strength and the absence of projections which may increase the breakage in case of glass reflectors.

A study of the various reflectors on the market with the aid of these items as a basis, will determine what reflectors are best adapted to given conditions. Regarding the third item in the foregoing list, it may be stated that under comparative tests in service, the accumulations of dust and dirt on glass reflectors do not seem to be any greater than the coating of dirt which accumulates on the inside of a metal reflector in the same length of time.

[Concluded in March 1 Issue]

Trade Publications

Graphic Meters—Bulletin No. 365, describing Type G. H. Graphic meters; issued by the Esterline Company, Indianapolis, Ind. The bulletin is well illustrated.

The Concentric Wiring Situation as it Affects the Electrical Contractor

By Terrell Croft*

It does not appear to be generally appreciated that the so-called "concentric" wiring systems are merely wiring systems having ground returns. It so happens that it is often convenient to arrange the grounded-return conductor as a concentric sheath around, but separated from, the conductor of the circuit which is insulated from ground. Hence the name "concentric." Considered in this light, there is nothing particularly new or novel about "concentric" wiring.

To the writer it appears as if the situation may be profitably considered from two view points:

First comes the general broad-gauge survey, that is, will ground return wiring systems, if generally adopted, be a good or a bad thing for the community in general? Will they, or will they not, increase fire hazard?

Second, the proposition may be viewed from a selfish standpoint, that is, what will be the effect upon my pocketbook and income as a contractor if ground-return wiring systems are generally adopted?

Examine some of the features relating to the first proposition given above. If concentric wiring is to be generally adopted, it is obvious that it must be.

(1) cheaper than the methods now in use, and

(2) safe from a fire hazard standpoint.

If it does not satisfy these two requirements it will not be used generally. It is usually conceded that concentric wiring is cheaper, for the service for which it is adapted, than any of the now accepted methods of wiring which can be applied under similar conditions. We do not now know just how much cheaper the concentric wiring will be, because this is a thing that can be determined only through extended experience. It appears, however, to be generally believed by those who have made a study of the situation that the concentric method of wiring will be enough cheaper than any of the existing methods to result in a very materially increased demand for house wiring and for electric light. The extensive application of ground-return wiring systems in houses occupied by the poorer classes of people in Europe appears to justify, in a measure at least, this opinion.

It is altogether probable, then, that concentric wiring, if adopted in this country, will extend to people who cannot now afford it the advantages of electric illumination, and, furthermore, will indirectly create an additional demand which does not now exist for electric wiring and for domestic electrical appliances of all sorts. In a general broad-gauge way, then, concentric wiring, if it can accomplish what its advocates claim for it, will be a good thing for the community in general.

A Matter of Insulation

As to the safety of ground-return wiring systems from a fire hazard standpoint; this appears to the writer to be largely a question of insulation. We all know that electric wiring systems with grounded returns will give satisfactory service if the "live" conductor is adequately insulated from the ground return. For example, consider the street railway systems which in our cities operate with a pressure of approximately 600 volts between line and ground. These now give wholly satisfactory service with the current being fed out over the trolley wire and returning via the earth. Experience and research has indicated the character of the insulation that must be interposed between the trolley wire and earth so that service will be satisfactory. Anyone will admit that the ground-return traction system is now a complete success from every standpoint. In some of the trunk line electric railway systems the pressures between the contact wire and earth are 1,500, 3,000 and even 11,000 volts, and yet these systems show entirely satisfactory performances because the live conductor is adequately insulated from the earth, which in each case forms the ground return.

Two overhead wire trolley systems were once used to a considerable extent, in which both the positive and the negative contact wires were insulated from ground and from each other, but these are now practically obsolete, because experience has shown that single contact wire systems with earth returns will, when properly laid out, give more satisfactory service than the two contact wire systems and they are more economical and simpler to install.

The writer ventures the prophecy that a similar evolution will occur with house wiring systems; that is, he anticipates that ultimately house wiring systems in general will have one live conductor insulated from ground and a continuous, positive grounded return, because wiring of this character will be cheaper and as safe and as satisfactory as the systems now in use, which involve two conductors insulated from ground.

It is, of course, appreciated that wiring for a traction system should not be compared directly with a house wiring system. However, the underlying principles are similar in both cases.

The Important Problems

The important problems are, then, in a ground return interior wiring system to:

(1) insulate the live conductor thoroughly from earth, and

(2) provide a continuous, rugged grounded return.

That these things can be accomplished there does not seem to be much doubt. It is believed, then, that the fire hazard will not be increased by properly designed concentric wiring.

Furthermore, we know from experience in Europe with ground return electric lighting wiring systems, and from our experience in this country with ground return electric railway systems, that a ground return system will, if properly designed and installed, give service as reliable as that afforded by systems having both of their conductors insulated from ground.

Now, to consider the situation from the selfish standpoint, every man in the industry will remember that many of the central stations groaned when the tungsten lamp was announced as a device that would give approximately three times as much light as the existing lamps with the same energy consumption. The central stations in many cases did all that they could to prevent the introduction of the tungsten lamp because they felt that their revenues would be decreased by 60 per cent. and that the result would be a receivership. Some of the central stations, however, looked at the situation from another point of view and did all they could to accelerate the use of the high efficiency lamps.

What has been the result?

The central stations are selling much more energy than they ever did and there is probably not one of them that would consider for an instant a proposition involving the substitution of the old carbon and metallized lamps for the tungsten lamps now in use. The tungsten lamp decreased the cost of electric light and enabled the central stations to secure customers who could not afford electric illumination at the cost involved with carbon lamps. The tungsten lamp has been a good thing for the contractor because more houses are being wired now than before its advent and more outlets are being placed in each house that is wired.

It is altogether likely that the concentric wiring system will, if it is adopted, have an effect on the industry somewhat similar to that which was due to the introduction of the tungsten lamp. As a general proposition, any economic ad-

* In National Electrical Contractor.

vance in any branch of work ultimately results to the advantage of that branch. It is likely that if concentric wiring is as cheap as its advocates claim it will be, that very much more wiring will be done than is being done at present and that there will be more outlets installed in every building that is wired.

The writer does not take much stock in the argument advanced from certain sources that concentric wiring will afford a great field for curbstone and high school boy "contractors." Much of the concentric wiring will, if it is adopted, probably be exposed, and it will require the manipulation of a skilled workman to afford a neat job.

It seems likely, then, that if concentric wiring is adopted that it will tend to give the contractor more work to do and that it will benefit him in about the same way that the tungsten lamp has benefited the central station.

To summarize, then, it is the writer's personal opinion that concentric wiring is bound to come, because it represents an economic advance, and it does not appear by any means to offer insulation or mechanical problems that cannot be, or have not been, solved. A suggestion to the contractor is, then, to keep posted and to be ready when the system is finally accepted by the National Board of Fire Underwriters.

In the meantime the contractor should, possibly in his own shop and always subject to the approval of the local fire inspection bureau, erect a ground return wiring installation or two in order to obtain some personal experience so that he will not have to depend wholly on hearsay and on the opinions of others as to the performance of the system. Let him acquire his information first hand. He can do this readily without using the so-called "concentric" wire. He can run his single live conductor in wrought iron conduit using the conduit system for the ground return.

Electric Piano Makers Organize

To further the commercial exploitation of the electrically-driven player-piano and the electrically-operated talking-machine, the National Electric Piano Makers' Organization Committee has been formed in New York City. The new body will hold its initial meeting in Room 903 of the Building of the Engineering Societies, No. 30 West 39th Street, Thursday, February 10. The principal piano and talking machine manufacturers that produce electrically-driven instruments and the manufacturers of small motors and other electrical apparatus entering into such instruments will compose the membership of the committee. A delegation of three members of the National Electric Light Association will attend the opening and subsequent meetings, to receive such suggestions and recommendations as may be made by the committee members for reference and report back to their association and to advise upon all questions of electrical technique that may arise. The purpose of the committee is set forth as "solely to work out the related commercial and technical problems of the electrically-driven musical instrument makers and the allied electric light and power and manufacturing interests, and to bring the former factor before the latter in the status of a producer of electrical current-consuming devices."

Pro Patria

Lieut. J. M. Thornton, of the Royal Engineers, who was killed in action at Frelinghien on January 19, has two brothers in Montreal, Kenneth Thornton, chief engineer of the Montreal Public Service Corporation, and David Thornton, treasurer of the St. Lawrence Flour Mills. He was the youngest son of the late Rev. Dr. Thornton, of London, Eng., and formerly of Montreal, and was an engineer by profession. He was formerly in the ranks of the London Scottish and took part with them in the great charge at Messines on October 31, 1914, being wounded. On recovering he was given a commission in the Royal Engineers and went to France last September.

Mr. Mack Lectures on "Condulets"

At a meeting of the Toronto Branch of the Ontario Electrical Contractors' Association, held in the association rooms on Wednesday evening, February 2, Mr. Ed. Mack, of the Crouse-Hinds Company of Canada delivered an address on his company's products. Mr. Mack illustrated his remarks from the very complete catalogues published by his company and also from an extensive line of samples of the Crouse-Hinds condulets. He described in detail the process of manufacture, pointing out the care taken at every stage in order to insure perfect workmanship so as to avoid difficulties when the material reaches the job. He also fully explained the original system of catalogue numbers adopted by his company, whereby a numeral is selected for each size from ½ in. to 6 in., pointing out where this system worked to good advantage when ordering condulets with a multiple of outlets, such as T or X. Mr. Mack also pointed out that in view of the fact that they carried at all times three separate and distinct stocks—two at different stages of manufacture and one of the completed article—they were in a position to fill any order from either of these stocks, stating that if the fittings required were not found in their completed stock it would only take a few hours to finish from the rough state and make delivery. Mr. Mack also explained that the keynote of his company's policy was "Service to the Trade," and they stood at all times ready to make delivery of any special fittings or special drilling of fittings or covers to meet any particular requirement.

Mr. Mack's address occupied about an hour and a half and was followed by the members with keen interest. Arrangements were made for a party to visit the Crouse-Hinds factory, at some date in the future, where, as Mr. Mack stated, they would be shown every step in the manufacturing process.

New Books

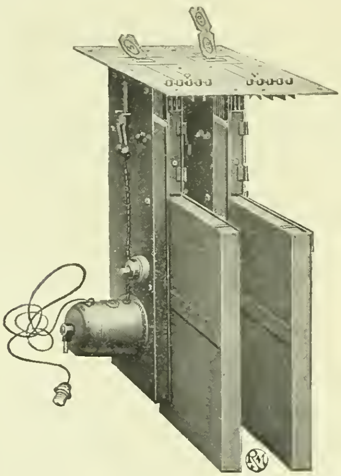
Electric Railway Engineering—by C. F. Harding, E. E., and D. D. Ewing, E. E., M. E. McGraw-Hill Book Company, Inc., New York, publishers; price $3; second edition, revised, enlarged, and re-set. This work is planned primarily for a senior elective course in a technical university, and so does not involve higher mathematics, and should be easily read by those who understand the fundamental principles of electrical engineering. The new edition contains an extra chapter, "Locomotive Train Haulage," and the other chapters have been considerably enlarged. Tabulated data representing actual operating conditions in railway practice have been increased by about fifty per cent., and another fifty illustrations have been added. 410 pages; size, about 6 by 9 inches; in the standard binding of the McGraw-Hill Book Company.

The Telephone and Telephone Exchanges—by J. E. Kingsbury, M.I.E.E., Longmans, Green & Company, London and New York, publishers; price $4.00 net. A history, in abreviated form, of the inventions and developments in the telephone field. The principal inventions have been described and the circumstances leading up to them; the developments resulting from them, and the influences bearing upon them, with such detail as the space permitted. Technical, commercial and political threads, as they compose the fabric of the telephone industry, are all interwoven in the record. An invaluable book for the telephone student. 540 pages, 6 in. by 9 in.; well illustrated.

What is New in Electrical Equipment

Electrically Operated Ticket Vender and Cash Register

The machine illustrated is made for selling tickets in motion picture theatres, amusement resorts, etc. In addition to passing the tickets out to the purchaser, it also registers the tickets sold. The machine ca be furnished to handle from one to four kinds of tickets. Five buttons are arranged opposite each class of tickets. By pressing No. 1 button, one ticket is ejected and registered by pressing No. 2 two tickets are ejected, and so on. By pressing one of the buttons by which either 1, 2, 3, 4 or 5 tickets are issued, it sets the motor in motion. This actuates the "spider" or a wheel with pins placed upon it at designated lengths, and this in turn forces the ticket strip through the slot or opening in the top plate of the machine. When one or more tickets are desired, as indicated by pressing one of the buttons above referred to, and the ticket passes through the slot at the top plate, the knife immediately cuts the ticket or tickets, at the same time automatically registering the number of the tickets issued, and after which operation



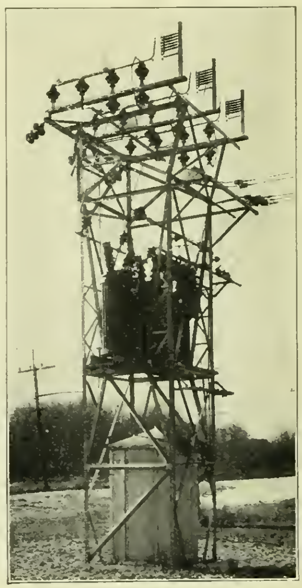
the machine returns to its normal position, and the current is cut off. The motor is connected with the ticket issuing mechanism by means of a series of gears. The motor has a rating of 1/50 horse-power and is made by the Robbins & Myers Company, Springfield Ohio. It is the series type and will operate either on direct or alternating current. The ticket selling machine is manufactured by the Automatic Ticket Selling and Cash Register Company, St. Louis, Mo.

That Spring House-Wiring Campaign

At the annual meeting of the board of directors of the Society for Electrical Development held in New York on January 24 it was decided to hold a 1916 Prosperity Week. This is the direct result of the universal evidence of the success of the big 1915 campaign. The coming year calls for an expenditure of $150,000, $50,000 of which is provided for the 1916 Electrical Week campaign. An appropriation was also made for use in a spring house-wiring campaign. Several leading electrical manufacturers have advanced the suggestion of a nation-wide house-wiring campaign, with this society as the central organization to handle the movement. Electrical interests everywhere have regular individual spring house-wiring campaigns, and it is thought that more effective results can be obtained if the manufacturers will work together in a centralized movement through the society's offices. Plans were also formulated for regular co-operative work by the society, with the object of bringing about more intensive work in communities where commercial development is slow, to which end it is suggested that a special committee be appointed to co-operate with the National Electric Light Association, the council of the Associated Manufacturers of Electrical Supplies, the National Electrical Contractors, the Electrical Supply Jobbers' Association, and the trade press. It was further decided to attempt a more effective co-operation with the Jovian Order.

Modern Outdoor Sub-Stations

Progress in high tension distribution made during the past four years has demonstrated the fact that it is no longer a question of whether outdoor sub-stations should be used, but rather how many can be advantageously installed in a given territory. The outdoor sub-station now occupies a very definite place in high tension distribution, and the general tendency is to employ the steel tower type. The sub-station illustrated herewith occupies a ground space of 6 ft. x 6 ft., and is designed for a maximum capacity of 150 kw. at 33,000 volts. The 3-pole switch is controlled by a locking



type handle which can be located either near the ground or approximately twelve feet above, as in this particular installation. A unique feature of this construction is in the use of a steel housing 4 ft. x 4 ft. x 7 ft., at the base of the tower. In this house is located the various metering equipments, distribution panels, feeder regulators, etc.—space also being provided for storage of spare parts. This equipment, which is shipped complete ready for installation, is manufactured by the Delta-Star Electric Company, Chicago.

Current News and Notes

Brantford, Ont.

The city of Brantford is making application to Parliament for authority to take over the Grand Valley Railway and operate it as part of the Brantford Municipal Railway System. It is also the intention to extend the road to the village of Cainsville and to place the whole system under the management of a commission.

Chatham, Ont.

The Chatham electric system are installed in their new offices, one of the finest suites of office rooms in the city.

Calgary, Alta.

According to the last annual report of the Province of Alberta, this province now owns and operates 165 telephone exchanges with 27,514 subscribers' stations. During the last year there was an increase of 1,565 rural subscribers. In addition to the Government system the city of Edmonton owns its own system with 8,650 subscribers, and there is a private company operating at Red Deer with 500 subscribers, making a total of over 36,000 subscribers' stations in the province.

Dashwood, Ont.

By-laws will be submitted on February 14 authorizing the expenditure of some $3,400 on a distribution plant in the village of Dashwood.

Dutton, Ont.

The Dunwich Rural Telephone Company are contemplating improvements to their telephone equipment in the spring.

Fort Frances, Ont.

The Ontario and Minnesota Power Company have been refused leave to appeal the assessment of $400,000 on property in Fort Frances. This decision would appear to be the final act in a strenuous fight which lasted for many years between the city and this company.

Galt, Ont.

The Lake Erie and Northern Railway Company has commenced the operation of electric cars on the Galt to Brantford line The general manager of this line is Mr. M. N Todd, also president of the Galt, Preston and Hespeler line. The rolling stock was supplied by the Preston Car and Coach Company. It is said that an hourly service will be put on between Galt and Brantford.

Granby, Que.

Operations will commence on the extension to Granby of the Montreal and Southern Counties Railway System some time during the month of March, according to a recently reported statement of Mr. W. B. Powell, general manager.

Halifax, N.S.

Dr. Geo. B. Cutten, president of Acadia University, recently addressed the Commercial Club of Halifax on the power available by the utilization of tide movements in the Bay of Fundy. Dr. Cutten estimated the amount of power at two million h.p.

Hensall, Ont.

The Hydro by-law was carried on January 24th by a good majority.

Hamilton, Ont.

The Bell Telephone Company have agreed to pay the city $3,000 for franchise rights during the coming year, which is to be considered as payment for the privilege of erecting its poles on the city right of way. The Bell Company have gradually discontinued their former practice of paying considerable sums for the privilege of operating in various cities throughout Ontario, Hamilton and Ottawa being the only two cities at present receiving any revenue from this company.

Holmesville, Ont.

The Goderich Township Telephone Company are reported to be planning to make improvements and extensions to their system in the early spring.

Halifax, N.S.

The Halifax Power Company have closed a contract with the council of the city of Halifax to supply municipal lighting for a period of twenty-five years at approximately $30,000 a year. The contract calls for lights within the next eighteen months. The new company will also provide light and power for domestic purposes and promise a reduction of at least 25 per cent. from existing rates. Up to the present time the Halifax Electric Tramway Company have had a monopoly of power supply in this city.

Inwood, Ont.

The Inwood village council are planning to make arrangements with the Hydro-electric Power Commission of Ontario for a supply of Niagara current.

Lethbridge, Alta.

The municipal street railway system of Lethbridge, Alta., showed a surplus of $3,677 for the year 1915 over all expenses.

London, Ont.

It is reported that the Bell Telephone Company are preparing plans and will commence work in the near future on placing a number of their lines underground in London, Ont.

The London Hydro Commissioners are planning to spend some $35,000 on line equipment, meters, etc.

Montreal, Que.

A. St. Jean & Company, electricians and dealers in electrical supplies, Montreal, Que., have registered.

Madawaska, Ont.

The Madawaska Telephone Association, Limited, have been granted a charter.

Moncton, N.B.

An interesting judgment has just been handed down by Judge Stewart in the county court by which the Prince Edward Island Telephone Company is required to pay damages to a Mr. H. Swan for cutting ornamental trees growing in the garden of Mr. Swan and overhanging the highway where the telephone lines were run.

Melbourne, Ont.

The Caradoc Ekfrid Telephone Company, Melbourne, Ont., are contemplating extensions and improvements to their telephone equipment this year.

Niagara Falls, Ont.

The Privy Council of England has decided in favor of Stamford Township and against the power companies at Niagara Falls in the matter of taxation for school purposes. This means that the revenue of the township will be largely increased from this source.

New Liskeard, Ont.

The electric light rates have been reduced from ten cents to eight cents per kilowatt hour, and the 25c. meter rental charge has been done away with.

North Vancouver, B.C.

Chief Findlay, of the Fire Department, North Vancouver, B.C., has recommended the installation of an alarm system consisting of thirty-five alarm boxes.

Ottawa, Ont.

The annual meeting of the shareholders of the Morrisburg and Ottawa Electric Railway Company was held at the head office of the company, Union Bank Building, Ottawa, on February 8.

Port Arthur, Ont.

Mr. M. M. Inglis, of Winnipeg, has been appointed manager of the Port Arthur Electric Railway system and entered upon his new duties on February 1st. Mr. Inglis was formerly superintendent of the electric light plant at Yorkton, Sask. He was educated at Sterling, Scotland, and before coming to Canada was on the staff of Johnson and Phillips, of London, and also for a time was with the Brush Electric Company at Loughboro.

Rainy River.

It is reported that the Clemenston Falls, near the mouth of the Rapid River, has been purchased by a number of Rainy River business men, and will be developed in connection with a pulp mill and box factory to be erected later.

Regina, Sask.

At the present session of the Saskatchewan Legislature a recommendation may be submitted calling for the appointment of a Provincial Commission to investigate the water powers of the northern half of the province. It has been suggested that the Commission be somewhat similar to the Hydro-electric Power Commission of Ontario.

Red Deer, Alta.

It is said that the council of the city of Red Deer will ask the Public Utilities Commission of the province for a reduction in the rates now charged by the Western General Electric Company. This company has a franchise which expires in 1929. Recently an unsuccessful attempt was made by the city to purchase the plant of the company.

Richmond, Ont.

The Malahide and Bayham Telephone Company are planning extensions to connect with the Aylmer and Tillsonburg system.

Semans, Sask.

The Semans Electric Light Company, Limited, have been incorporated.

Saskatoon, Sask.

As a result of the establishment of a soldiers' camp at the Exhibition grounds, daily average receipts of the electrical railway line have increased to $539, as compared with about $360 a year ago. This means that there is a profit of about $40 daily over all expenses and fixed charges.

Seaforth, Ont.

The McKillop Telephone Company, Seaforth, Ont., are planning improvements and extensions to their line system.

Southend, Ont.

The township council of Stamford township are considering the purchase of the electric plant of the Ontario Distributing Company and the erection of a sub-station, at a total cost of some $25,000. A by-law will be submitted in the near future.

South Porcupine, Ont.

The Tisdale township council have passed a by-law authorizing the purchase of an electrically driven fire pump to cost $4,370.

Toronto, Ont.

The annual report of the Toronto Railway Company shows gross earnings for the year 1915 as $5,694,136, a decrease of $432,960 from the previous year. Operating charges were 57.9 per cent. of gross, representing a slight decrease, and leaving the net earnings $2,243,524, only less than 1914 by $154,026. The total assets of the company are now placed at $19,932,856.

The city council have given the bill ratifying an agreement between the city and the Provincial Hydro Electric Commission re the construction of an electric railway from Toronto to London, its final reading.

The offices of the Hydro Electric Power Commission of Ontario have been moved from the Continental Life Building, Toronto, to their new building on University Avenue.

The township of Toronto will vote on February 12 on a by-law authorizing $345,355 for their part of the Hydro radial line to run between London and Toronto.

Vancouver, B.C.

The purchase is announced by the Consolidated Mining and Smelting Company of the West Kootenay Light and Power Company, which operates a number of hydro-electric plants in the neighborhood of Rossland, B.C.

On January 1, 1916, the B. C. E. R. Company discontinued the sale of the eight-for-25c. non-transfer tickets. It is stated that the competition from the jitneys in Vancouver is decreasing.

Winnipeg, Man.

According to the annual report of the Manitoba Government Telephones Department the total revenue for the past year was $1,769,589, against expenses of $1,328,545, leaving a net balance of $441,044. Interest charges to the amount of $418,502 have to be deducted from this amount, however, leaving a surplus of $22,542. The total revenue is a decrease compared with the previous year of $54,525 and the surplus is a decrease of $33,526. The balance sheet shows assets of $11,892,782. The number of urban exchange stations shows a reduction of 1,658 from the previous year, this number now standing at 24,880. This was partly offset by a gain in the number of rural stations from 11,993 to 12,272. The city of Winnipeg has 23,950 subscribers other than rural.

Electrical News
Generation, Transmission and Application of Electricity

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Defying the Protests of the Public

Still the Chief Intelligence Officer of the Canadian military organization—a German, with brothers fighting in the German army—continues to hold office.

Still men of German birth and close German relationships—and consequently close German sympathies—continue to hold important Canadian governmental positions.

Still certain aliens of Waterloo County continue to interfere at will with the prosecution of Canada's war, and continue to jibe at Canada's soldiers.

How long will our Ottawa Government defy the indignant protests of the electors? **WHY** is it necessary to defy these protests?

The British Empire, of which Canada is an important part, is in a death-grapple with Germany. There is no possible reason for doubting that this same Germany will, if she can, destroy the power of England. The destruction of British power almost inevitably means that Canada falls under the control of some other nation. Ultimately, if not immediately, that nation would be Germany—for, if Germany wins this war and cripples England, there will not be sufficient fighting power left to withstand her aggressions. Neither is there any doubt that in starting this war the ultimate ambition of the present German military authorities was to subdue the whole world.

This war has developed into a much bigger business than Germany dreamed when she willed it on Europe. She hoped to achieve her ambitions step by step, but the Allies have unexpectedly forced her hand and declared it a fight to a finish. Germany therefore fights to-day a fight for very existence—the fight of a hungry, maddened jungle-beast thwarted of its prey and driven to bay. To military Germany this war has now become a matter of life with power or death with shame.

Can we Canadians, as sane beings, fighting with such an opponent—clever, powerful, resourceful, unscrupulous, beastlike—can we, I urge, afford to take any chances? I don't say that any man of German blood in the employ of our Government is disloyal to Canada—I don't know. But I do say—it's possible. I do say that in the breasts of these men love of their native land would be merely human. I do say that, even with good intentions, these men of German extraction are more likely to be the medium through which important information might leak out. I am quite ready to admit that the vast majority of Canadian citizens of German extraction are entirely loyal to the British Empire, but I also say that Germany's methods in the conduct of this war justify us in keeping a watchful eye on the actions of even our closest friends who may have German blood in their veins.

The continuance of any men of German birth or close German connection in any position of trust in Canada is entirely indefensible. Remove them at once. Treat them with all courtesy, pay their salaries if you will, reinstate them when we've won the war, but now—remove them. **Make it as impossible for them to do us harm as if we believed them guilty of the desire.**

The value of Canada's exports for the month of January, 1916, was $85,000,000 as compared with $30,000,000 in January last year. Total exports for 10 months $630,000,000 against $385,000,000 a year ago.

And why should the loyal citizens of Waterloo County be singled out for the humiliations of the past few weeks? What is our Government afraid of? The loyal citizens of Waterloo County, of whatever nationality, can be depended upon to support any action that may be taken. Does our Government truckle to the opinion of the disloyal element?

I know that I express the sentiments of more than ninety-nine per cent. of the people of Canada in demanding that our Government, on the instant, remove these men from office in Ottawa or elsewhere, immediately provide adequate military protection for our public buildings, and immediately segregate any small element in our population which may give indication of German sympathies and in so doing may interfere in any possible way with recruiting or may hinder the progress of the war in the smallest measure whatsoever.

Rules and Regulations re Water Power Rentals

"The Rules and Regulations of the Province of British Columbia relating to Annual Rental Fees of Water Powers," was the subject of a paper by Mr. E. Davis, Water Rights branch, Department of Lands, Victoria, B. C., read at the meeting of the Canadian Society of Civil Engineers, Montreal, on Feb. 17. The purpose of the paper, said Mr. Davis, was to outline in a general way the methods which should be adopted by the Board of Investigation of the provincial Water Rights Branch in securing information which was necessary under the Water Act regulations for the appraisal and classification of the various water power plants of the province. Mr. Davis quoted the regulations on this point, the preliminary paragraph stating "the amount of the annual rental fee shall be based on the reasonable station output for the year, which shall be the Comptrollers estimate of the net amount of energy, expressed in horse power, available for transmission and utilisation by a reasonable and diligent use of the privilege. The said estimate shall be based on all data available for the preceding year, and shall be the continued product of the following factors, as derived from the said data." Having detailed the factors, the author said that the principle of a portion of the regulations relating to annual rentals was that the water power company should pay a fee to the province based on the "economic value of the site." No two sites were of the same value, as each power was peculiar to itself, whereas the market value for power was practically the same, hence to attempt to place the rentals to be paid by each on the same basis would probably mean that a tax which would be fair in one case would be unreasonable in another.

The rules and regulations which were in force in British Columbia prior to 13th January, 1914, required that the annual rentals be based on the quantity of water the holder of the record or license had the right to use. The question of the power actually developed and the amount of energy used was not taken into account. Under the present regulations those factors were considered, and consequently the annual rentals would vary in relation to the amount of power actually produced and to what was considered to be the value of the output to the user. The authority which was called upon to set the rates at which the rentals were to be charged was the Board of Investigation; it was a non-political body of four members, two lawyers and two engineers.

It should be the aim of every government which controlled the water of rivers and streams to try and bring about the develoment of every available site, as although at present there was no apparent shortage of coal, there could not be any doubt that it was a wilful waste that so much energy in the falls of our rivers was not utilised. If we did not make use of this falling water the useful work it was capable of doing was lost for ever.

Hydro-electric properties had not as a class returned to the investor swollen dividends as the value of water powers had been generally very largely over-estimated. A project required special consideration during the early years of its development; a surprisingly large number either failed to pay dividends or became bankrupt during the first decades of their existence. These failures might generally be attributed to one or more of the following causes: 1. Projects based on insufficient information as to the incidence of stream flow especially in the case of plants without storage, and lack of data as to correct flows with a consequent unexpected expense for auxiliary plants; 2, under-estimated development costs, especially in the matter of accessibility of sites, depth of foundation for dams, etc.; 3, failure to provide for the loss or expense entailed during the first few years in the building up of the power market; 4, over-estimating the economic value of the power development from the water as compared with fuel.

Mr. Davis then referred to the question of appraising each plant every five years and the conditions under which this appraisal should be made. He gave details of the various items which should be taken in account, and also the cost and appraisal of a supplementary fuel plant, further referring to the question of ascertaining the yearly cost per kilowatt hour of running a water power plant and its supplementary plant.

On the question of depreciation of plants in B. C. he quoted the following figures as giving the approximate useful life of water power apparatus: concrete structure, 50 years; steel line pipes, 30 to 50 years; building, 50 years; water wheels, 30 years; generators, 30 years; transmission line (steel towers) 50 years; transmission lines (wood poles) 15 years; telephone lines, 15 years; transformers and distribution stations, 14 years; conduits and cables, 18 years; steel flumes, 15 to 20 years; wood flumes, 10 years; wood stave pipe lines, 20 years.

The concluding portions of the paper dealt with estimates of the cost of oil, steam and gas engine plants in comparison with water power plants, in relation to the production of power, Mr. Davis stating that electric power plants using the oil engine as a motive power were becoming common in British Columbia, and the small water power plants, which were so numerous in the province, would likely find serious competition from this class of plant.

Electric Cooking Costs Less than Lighting

One of the most promising developments of the present time is the increasing use of electric ranges in our homes, and nowhere is this development more marked than at various points in Canada, where the rates are now so attractive as to make cooking by electricity decidedly more economical than with any other form of heat energy.

It is very generally argued that electricity at three cents will compete with gas at $1. Yet gas at $1, unless it is natural gas, is a rare product in Canada, where the prices range more generally from $1.25 to $1.75 per 1000 cubic feet. On the other hand, however, electric current costs very much less than three cents in many of our cities, towns, and municipalities, in very many cases averaging less than two cents, and in certain cases less than one and a half cents per kw. hour. Which all goes to show that if electric light consumers appreciated not only the advantages but also the cheapness of cooking by electricity our central stations would be flooded with orders for stoves and current that would swamp their construction department.

Of course, the one fly in the ointment is the cost of installation. We have been so near-sighted in this matter that we have allowed all our buildings, private and public, to be installed with electric wiring which is generally inadequate to meet the needs of the present day. Thus it is that the first operation when a demand is made by a private consumer for the installation of an electric range is the tearing out of the old wiring and its replacement by an installation of considerably greater capacity. This work often costs an amount comparable with the cost of the range itself, which doubling of the initial expenditure often is the determining point with the purchaser—deciding him against the purchase.

At many points in Canada, where the ultimate cost of current is down to one cent, or even less, the monthly bills have become a comparatively minor consideration. Thus, if we take the average consumption of one kw. per person per day, a family of five, which is about the average, will consume 155 kw. per month, which would cost at many points in the Dominion around $2.70. If we consider that the lighting bill alone, which this includes, would run from $1.20 to $1.50, this means that a family of five operates an electric range for one month for no more than the lighting of the home would cost by itself.

And not only have advances been made in the way of reductions in the cost of current. The operation of an electric range is coming to be recognized as worthy of a considerable amount of study and research. One of the best sources of information on this subject was a paper printed in our August 15 and September 1 issues, 1915, by Mr. P. W. Gumaer, who had made a very large number of experiments and, in this paper, described the findings of those experiments. Mr. Gumaer presented this paper before the American Society of Electrical Engineers, and in due course the discussion is now published, which we are reproducing herewith. Not the least noticeable item in connection with this discussion is the encouraging tone regarding the outlook of electric ranges at various points in the United States where the cost of electric current is very much greater than it is at many points in Canada.

Economic Use of Electric Ovens

Discussion on "Economic Operation of Electric Ovens," before the A. I. E. E. The original article was printed in the Electrical News of August 15, 1915.

Dwight F. Henderson: I think this paper has opened up a subject that will in the future be given a great deal of attention and study. The manufacturers spend a great deal of time in study and investigation and money in building efficient ovens, and then little attention is given to the operation of these ovens, ranges and other devices after they have been installed in the households. Our company in Spokane has been very active lately in pushing the sale of electric ranges and kindred devices. The greatest difficulty that our commercial men have found is in convincing the prospective users of this apparatus that the cost of operation is not going to be excessive. If this apparatus is used intelligently the cost in most cases is not excessive. We find that it closely approximates the cost of gas for a small family. I do not know how that would apply to a large family. I find, too, that the cost of heating water is the one great drawback with the electric ranges, if it is not done in some systematic manner. We have arranged a scheme for putting on a flat-rate water heater which has solved the problem as far as we are concerned, very nicely. We have developed a double snap switch interlocked so that when the range is turned on the water heater is off, and when the range is not in use the water heater is on. That gives an eighteen or twenty-hour use of the water heater and will give continuous hot water when connected to the ordinary water tank.

Ralph W. Pope: I can see the coming of the scientific domestic engineer when, as prophesied by the author of the paper, we can have a definite degree of heat indicated at which the food should be cooked, and also temperatures to which the oven should be heated, and any changes which may be necessary, may be brought about very readily. That appears to me a great advance.

There has been one serious drawback to the introduction of electrical apparatus in the kitchen, and that is the comparatively high initial price. It appears to me that that initial price might be made lower, when we consider that the revenue eventually is to be derived from the current consumed. Then, again, the higher cost of operation is not such a material objection. The cost is more than offset by convenience; frequently we pay more for cooking by gas than by coal, and still it is so advantageous, that the gas bill does not always trouble the kitchen. It is convenience we are looking for. As we all know, we have a great many conveniences which greatly increase the cost of living compared with our former more simple life.

S. N. Clarkson: The electric iron is quite a good revenue producer for the central station, and now that the manufacturers have given us satisfactory electric stoves, it opens up another and a much larger field for central station service to replace its competitors. The cooking load is a very desirable one because a great deal can be added to existing systems without appreciably increasing the demand, due to the diversity factor of the cooking load.

The human element enters into the cooking so greatly that it is impossible to give any accurate cost data to fit all cases. It would seem that with proper care in the operation of the stoves, a rate of 3 cents per kw.-hr. will about equal the cost with gas at 90 cents, and for rough computation, the current consumption of one kw-hr. per day per person is a fair average.

H. W. Flashman: I would ask the gentleman from Spokane if he will complete the discussion by telling us the rates of charge for gas and electricity. He stated he felt they broke even on electric cooking.

Dwight F. Henderson: Our rates for current are 8 cents for the first twenty kw.-hr., 6 cents for the next ten kw.-hr. and all in excess of that 3 cents per kw.-hr. Our stoves are put on the same meter which supplies the general lighting of the house. We figure that about the first thirty kw.-hr. will be used for lighting for an ordinary residence. That will leave most of the cooking to be done at the 3-cent rate, and our gas at Spokane is $1.40 per thousand feet, with certain discounts. I do not know just what the discounts are, but the convenience and other features of electric cooking offset the considerable difference in price between gas and the electric equipment. We have made approximately one hundred installations now, and our experience has been different from the report from St. Louis. The ranges for electric cooking, while they are not by any means perfected yet to the degree to which they will be, have met with general satisfaction. We have had only one or two cases where the installation was returned. The first cost has been a great handicap in the installation of electric cooking. We have to sell the average range laid down to us at from $65 to $90, and there is usually $15 to $20 expense incurred in wiring the house. We think that a large percentage of the people would be willing to stand the first cost if they were sure that the expense of operation would not be too high.

H. L. Wallau: Mention was made of the diversity factor of the cooking load. I do not happen to recall the figures, but quite a few experiments were made some years ago in Cleveland, and these figures were presented to the Association of Edison Illuminating Companies in the report of the Committee on Electric Cooking about two or three years ago. I merely bring this point up, so that if any of the gentlemen present desire to get some data on that diversity, they can look the matter up in the report.

I will add further that in Cleveland we found that the cost of cooking by electricity usually ranged from $1.50 to $2 a month per head, with current at 5 cents, and it was proportionately less than that with current at 3 cents. We had a 3-cent rate for what was known as the "four-hour load factor stove," that is, any stove the use of the connected load of which reached four hours a day, or more, received a 3-cent rate. If the use was less than four hours a day, the rate was 5 cents.

M. G. Lloyd: I am very glad to see going into our records some definite data on this subject. Most of the figures which have been available heretofore are of such an indefinite character or were obtained under conditions not very precisely stated, that it is hard to tell just where we stand on the subject of electric cooking. I think it is of great value to us to have these definite experiments available. One thing that is worthy of note in this connection is this: I think there is a very definite tendency in this country to recognize the advantage of cooking at low temperatures, so that more of the nutritive value of the food is retained, that is recognized as a desirable element. These tests indicate that cooking under the best engineering condition falls into line with that dietetic condition, that is to say, the most economical rate of temperature for cooking is the low temperature, at least in most of the cases specified.

In regard to the suggestions made by the author as to what is required, it may not be known to everyone that there are ranges on the market which meet some of these conditions, that is to say, the electric stove has already been combined in apparatus designed for the fireless cooker principle, and there are also ranges on the market which have been provided with automatic switches and time switches so the food can be put in the oven and the person in charge of the cooking go out of the house, and the cooking will go on for the proper time and at the proper temperature.

Cedars Rapids Electrical Development

Mr. R. M. Wilson Describes the Details of Installation and Operation of the Electrical Equipment, before the Can. Soc. C. E.—Nine Units of 10,000 kv.a., Each Already Running at Capacity with Load Factor over 90 per cent.

This paper, which is the third and final one on the Cedars Development, will treat of the general electrical design, construction, tests, costs and results of operation to date.

Before going into the general design a brief description of the present installation will be useful in following the details contained in the paper.

The generating plant consists of nine 10,000 kv.a., 6600 volt, 3 phase, 60 cycles, vertical water wheel driven units, and three 1,250 kv.a., 2300 volt, 3 phase vertical exciter units, with necessary switchboards and accessories. The excitation for the large units is obtained from individual motor generator sets of 150 kw. capacity, driven from the 1250 kv.a. exciter units. In order to provide proper voltage regulation on the main bus bars automatic voltage regulators have been installed on each unit, maintaining a steady voltage and preventing cross currents between the units. The main generator bus bars are not located in the power house, but have been installed in the same building as the step-up transformers for Massena and Montreal systems. The power house and transformer house are separated at present by a distance of approximately 800 feet, and are electrically connected by a system of feeder cables.

Size of Units

The design and layout of the generating and excitation system was the main point of consideration in the electrical layout, and had to be worked out in conjunction with the water wheel design. Mr. Smith has explained in his paper why the vertical type of unit was adopted. The next step was to determine the most appropriate size of unit, having in mind our contract obligations for the supply of energy, which are most onerous as regards continuity of service. Two sizes of units were considered, viz.: 15,000 kv.a. and 10,000 kv.a. The smaller capacity of unit was finally decided upon. Some of the principal reasons governing our decision were:

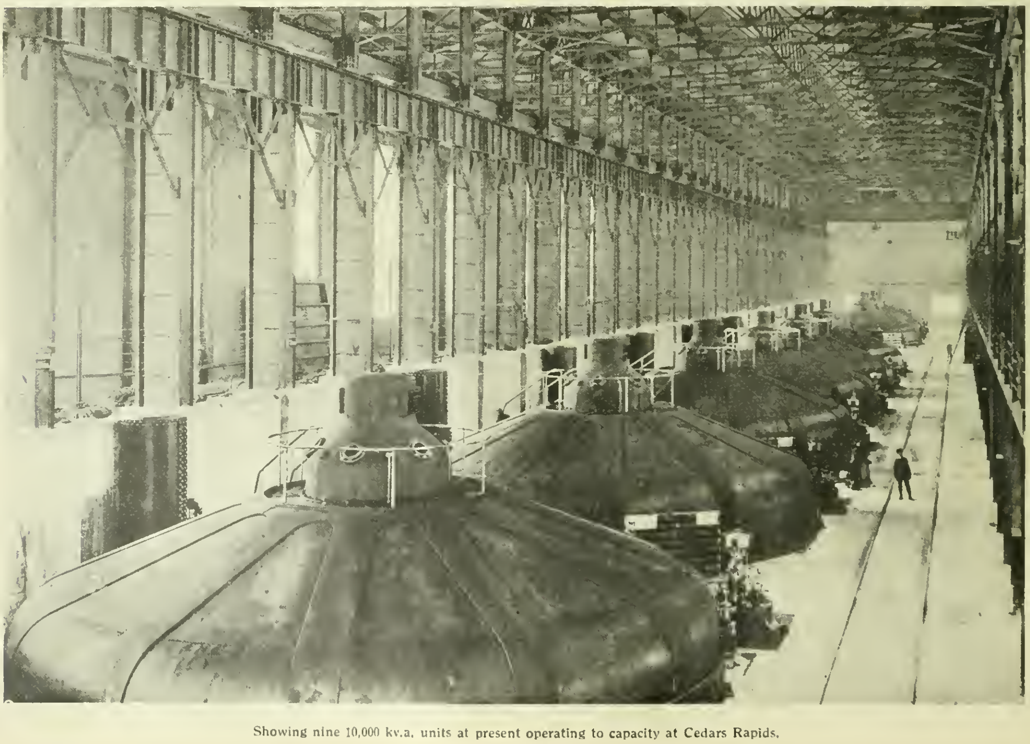
1 With units of 15,000 kv.a. size, too great a percentage of plant capacity would be put out of commission in the event of a failure of a single unit.

2. Units of this capacity and of vertical type had not been constructed and we did not feel justified in installing a unit which would be to a certain extent in the nature of an experiment.

3. The cost of other apparatus such as cranes, generator decks, bearings, etc., would have been materially increased as well as the cost of repairs in the event of failures, owing to the excessive weight of the larger size unit. As a matter of information the following comparative weights are given:

	10,000 kv.a. unit	15,000 kv.a. unit
Rotor	213,000 lbs.	425,000 lbs.
Stator	146,000 lbs	300,000 lbs.

When the size of the generating unit had been decided



Showing nine 10,000 kv.a. units at present operating to capacity at Cedars Rapids.

on, the design of the unit was discussed in detail with the manufacturing companies' engineers previous to our sending out specifications. One of the main objects of the discussion was to impress upon the designing engineers the importance of having the most economical ratio between the diameter of the unit and its height. The result was that the design which was finally adopted saved something like seven feet in the height of the power house over its entire length as well as keeping down the initial cost of the hydraulic installation.

As a matter of information the following are the most important points covered in the generator specifications upon which tenders were asked.

Generator Specifications

1. The generator to be of such design that the stator be divided into four sections, any one of which could be removed by raising the bridge frame carrying the thrust bearing and disconnecting the necessary armature coils. Our reasons for calling for this design was to permit of our having to rebuild only one-quarter of the stator in the event of the iron being damaged by short circuit in the armature winding.

2. The generator to be designed for 75 per cent. power factor and 25 per cent. overload for two hours, and the revolving element of such construction as to provide a braking curface with sufficient face to prevent undue heating. The air brakes having been furnished by the water wheel contractors, the frame of the stator had also to be designed to carry a load of 550,000 pounds.

3. The generators had to be designed to deliver their full rated capacity at a normal potential of 6600 volts, and all tests and guarantees were based on this voltage. The generator has also to carry full load rating in amperes at a voltage of 7200 volts for several hours without in any way sustaining damage.

4. The inherent regulation between zero load and full rated load to be:—

10,000 kv.a., 100 per cent. p.f., 14 per cent.
10,000 kv.a., 90 per cent. p.f., 24 per cent.
10,000 kv.a., 75 per cent. p.f., 27 per cent.

with field excitation for 10,000 kv.a., 75 per cent. p.f. The sustained short circuit current not to be more than three times full load current, and the instantaneous short circuit current not more than eight times full load current, and with these current conditions the generator was not to sustain any damage.

5. The generator to be of such design that the wave form will be as near a true sign wave as possible.

6. The temperature rise of the generator on continuous full load run at 75 per cent. power factor was not to exceed 45 degrees Centigrade at the end of a 48-hour run. This temperature refers to all parts of the generator except the collector rings, the temperature of which shall not exceed that of the generator frame or winding by more than 5 degrees Centigrade.

The temperature guarantees being based on a room temperature of 25 degrees C., and the method of measurement of the temperature being made by means of either exploring coils or thermometers, located at the hottest part of the machine.

In order to make absolutely certain that abnormal temperatures do not exist, the guarantees are for a period of two years. At expiration of the two years' guarantee, at the expense of the contractor, one coil from each of the four sections of the armature of any generator will be removed for the purpose of inspection, in order to demonstrate that the insulation on the armature coils has not been injured.

7. The efficiency guaranteed to be as follows:—

At 75 per cent. p. f.: 1¼ load, 95 per cent ; full load, 94.5 per cent.; ¾ load, 93.7 per cent ; ½ load, 91.7 per cent.

At 90 per cent. p. f.: 1¼ load, 95.8 per cent ; full load, 95.5 per cent.; ¾ load, 94.6 per cent.; ½ load, 92.8 per cent.

At 100 per cent. p. f.: 1¼ load, 96.4 per cent.; full load, 96.1 per cent.; ¾ load, 95.4 per cent ; ½ load, 93.5 per cent.

All losses are included in these efficiencies except bearing friction and windage, for which an allowance of 50 kw. has been provided for in the above figures.

8. The design of the generator is such that the ends of the armature coils are carefully braced preventing movement due to short circuits; also various parts of the coils in the slot are firmly held together preventing conductors spreading out.

9. The iron losses must not increase after two years' operation more than five per cent.

10. In order to provide proper ventilation, special care to be taken in the design of vanes and the methods of fastening same to rotating parts so as to avoid the danger of bolts or other fastenings becoming loose, due to vibration or short circuits. All vanes must be such that they will be housed in behind a smooth surface to prevent the operators from getting hurt by coming in contact with same.

The 10,000 kv.a. units, which were furnished and installed in accordance with our requirements, have met our most sanguine expectations. They contain many important features which have considerable to do with the splendid results obtained.

It may be of interest to note that the outside diameter of the stator is 37 ft. 4 ins., and the internal diameter of the stator is 31 ft. 11 ins., and that the unit is the largest in diameter which has been installed to date. The height of the stator frame from the floor line is only 33 inches. The armature iron is built up in such a manner as to give proper and efficient ventilation, insuring low temperature. The ventilation ducts are constructed with small eye beams spot welded to spacing punchings, which permits of at least twenty per cent. better air circulation than the old method previously used on large units. These units are the first ones installed with this system of ventilation.

The armature coils are insulated with a composite insulation mica next to the conductor and varnished cloth outside of the mica. The approximate thickness of insulation is 3/16 inches. A tinfoil tape, wound one-half lap, making a total thickness of .035 in., covers the varnished cloth It is wound very carefully to prevent the entrance of any air, particularly at the ends just outside of the slot. The tin foil covering is well grounded to the armature punchings. This construction equalizes the stress in the coil and prevents corona. The number of slots per pole per phase is one and one-half. The winding is what is commonly known as the barrel type.

The rotor consists of 136 poles and has a WR^2 equal to 31,000,000 lbs. at one foot radius.

The approximate net weights of the unit are as follows:— rotor, 213,000 lbs.; stator, 146,000 lbs.; misc., 32,000 lbs.

Determining the Temperature

It is now recognized that certain internal parts of the generator attain a much higher temperature than that indicated by thermometers placed on accessible parts, or than the average temperature indicated by the resistance rise of the entire winding.

In order to determine the actual temperature of the hottest parts of the winding, copper temperature coils of certain known resistance are placed so as to record the temperature in degrees centigrade on indicators placed on the switchboard.

In each generator six temperature coils are placed between the upper and lower armature coils at equal distances around the generator.

In providing the excitation for the large units we departed from the usual practice of installing large d.c. units water-wheel driven. In their place has been installed three a.c. 1250 kv.a., 2300 volt, three phase units excited by an 18 kw., d.c. generator on same shaft and turbine driven, also a bank of three 1000 kv.a. transformers which permits of one of the large units being used for excitation purposes in case of emergency.

These a.c. generators furnish the necessary energy for driving the individual motor generator sets for exciting the large units. Some of the reasons governing the adoption of this method of excitation are here given.

1. In case of trouble on an individual exciter set only one main unit would be affected.
2. All auxiliary machinery would be a.c. motor-driven with low operating costs.
3. It was easier to obtain proper automatic voltage control with individual generator exciter sets.
4. The investment in cables, switches, etc., for supplying individual sets for a.c. power lower than for d.c. power.
5. The cost of spare apparatus kept at a minimum.
6. In the event of emergency conditions one of the large units could be used.

The specifications for the 1250 kv.a. units are similar in nearly every detail to the large units.

To provide for proper voltage regulation, each generator has its individual exciter and regulator; the exciter or motor-generator set being connected to the main generator field through a remote controlled solenoid operated switch and a motor operated rheostat. Cross currents between generators operating in parallel are prevented by a current winding on the a.c. control magnet of the regulator; the phase of the current in the current winding being 90 degrees from the current in the potential winding. In other words, if the potential winding is connected across phase 1 and 3, the current winding is taken from phase 2.

Each regulator is equipped with a regulating rheostat which is placed in series with the a.c. control magnet. This rheostat has a resistance of 10 ohms total in thirty-six steps, each step changing the voltage held by the regulator approximately one-half volt on 110 volts normal.

With this system of control voltage variation can be obtained on the main units without effecting automatic regulation between the limits of 5800 volts and 7200 volts.

Ventilation

For the purpose of insuring proper ventilation of the main generators during the summer season it was thought advisable to install a suitable system of blowers, capable of furnishing to each generator pit 35,000 cubic feet of air per minute at one-half ounce pressure.

It was found after careful investigation that low speed fans were more efficient; also the initial cost was lower, as well as the operating costs.

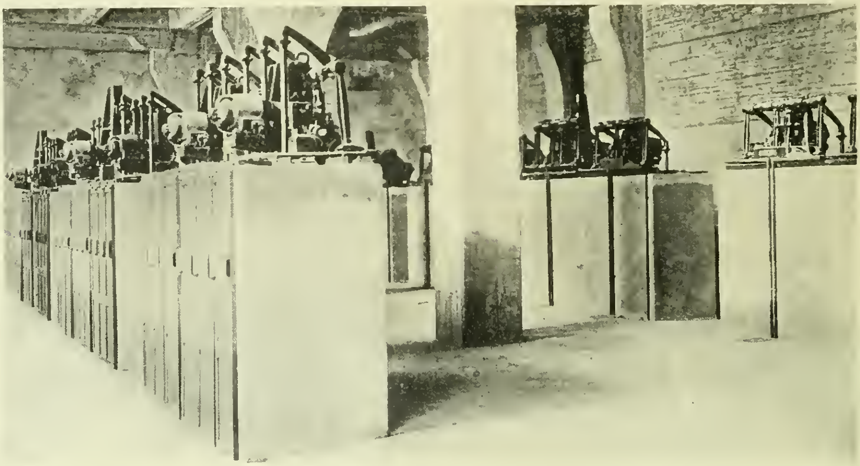
The system of fans found to be the most suitable for conditions at Cedars was one in which one motor would operate two fan units, each unit being known as a double Keith fan. Five sets of these units were installed and so arranged that the air supply to them could be obtained either from the tail-race or generator room. The installation of fans being so arranged as to provide a spare unit.

No air washing system was installed, as it was not found necessary, due to the location of the fans.

Each unit consists of two fans driven by a 60 h.p., 2200 volt, 3 phase motor. The combined air capacity of the unit is 105,000 cubic feet per minute at ¾ oz. pressure.

Switchboards and Low Tension Switchgear

In the design and layout of the most suitable system of switchboards and accessories, the following important point consistent with minimum initial cost and continuity of service. The double bus bar arrangement was finally adopted and designed in such a manner that a failure on any one section would not cripple the next unit. The double system of switches insures operation against interruptions due to failures, provides an easy means for constant inspection, and permits testing and meeting any load conditions being handled easily.



Oil Switches - Cedars Rapids Manufacturing and Power Co.

For the purpose of control, one main control and instrument board has been installed in the power house. This board controls the main generator circuits right up to the 6600 volt bus bars in the transformer house. In the same control room in the power house is installed the 2300 volt board for controlling the exciter units and auxiliary apparatus—all switching apparatus being remote control.

In the transformer house a control desk and instrument board have been installed for controlling the step-up transformers and out-going lines.

All switching apparatus and accessories have been installed in such a manner that extension to the plant can be made without in any way interfering with the operation of the present apparatus.

Each main generator is controlled by two switches, one located in the power house and the other in the transformer house. The switches are not automatic except when a reversal in power occurs, then the generator in trouble is immediately removed from the system.

It was thought advisable in the design of our switchgear and accessories to use a large factor of safety, and with this condition in mind all switches installed for the main

6600 volt units are standard 13,200 volt oil switches, and the current carrying capacity of same are fifty per cent. greater than the normal current output of the generators. The 2300 volt switch gear is for 7500 volt operation with a margin of safety in current carrying capacity of fifty per cent. more than normal requirements.

Switchboards and Switchgear

Some of the other important points in connection with the switchboards and switch gear are:—

All instrument panels are provided with testing studs so that standard instruments for check purposes can easily be installed.

Duplicate synchroscopes have been provided on both the 6600 volt and 2300 boards.

Control current for all switches furnished at 220 volts from motor generator set with an auxiliary storage battery.

All rheostats, switches, etc., remote electrically controlled.

All graphic meters on step-up transformers synchronized.

Complete system of signals electrically operated installed in power house, permitting switchboard operator handling any portion of the plant from control desk in operating room in power house.

All oil switches are electrically interlocked.

Signal lamps from all centre disconnecting switches mounted on control board in view of operator.

All bus bar insulators rigid and strong and spaced so as to prevent any distortion of bus bars under the most severe short circuit conditions.

Synchronizing of all main generators is done with switches in power house, so as to protect system against improper handling of main units.

The contact current densities used in the design of the switchgear was as follows:—65 amperes per sq. in. for clip contacts; 100 amperes per sq. in. for bolted terminals; 200 amperes per sq. in. for sweated terminals. All disconnecting switches locked type.

Four per cent. reactance coils based on the capacity of one generator installed between every group of three generators. With this protection and operating 18 units in multiple; which will be the complete installation of the plant, the maximum possible instantaneous short circuit current with an inherent reactance of the generators of 21 per cent. will not exceed 34½ times the capacity of one unit.

All generator panels are provided with the following instruments: a.c. ammeter; a.c. voltmeter; indicating polyphase wattmeter; recording polyphase wattmeter; indicating frequency wattmeter; power factor meter; d.c. field voltmeter; d.c. field ammeter; temperature indicator; signal system.

All bus bar and switch structures are of reinforced concrete. Reinforced concrete was adopted in place of brick for structures for the following reasons: (1) barrier work could be made thinner; (2) loading on floors much less; (3) easier to obtain greater clearances for live parts to ground in same space.

Cables

All cables used on the main generators operating at 6600 volts were installed for 13,200 volt operation. Cables used for 2300 volt operation were installed for 4400 volts.

It was considered that the increased cost due to the added installation was more than offset against failures. Lead covered, paper insulated cables were used in all places where they were subjected to moisture. All cables designed with cross sectional area of sufficient size to carry fifty per cent. over normal current continuously. All large single conductor cables on a.c. circuits have rope cores to minimize skin effect. In designing cables 1200 c.m. per ampere was generally used.

The most important part of the cable design was the size and kind to use on the main units connecting power house and transformer house.

The final adoption being four 3-conductor, 300,000 c.m. lead covered, paper insulated cables per unit.

Some of the reasons governing our decision were:—

1. Increase in apparent resistance of single conductor lead covered cables, carrying heavy currents at 60 cycles was found to be abnormally high.
2. The three conductor cable slightly cheaper in initial cost.
3. In the event of failure of one of the four cables partial service could be obtained during repairs.

Where the cable runs were comparatively short, single conductor cable was used to facilitate handling, and on account of the fact the outside diameter was less, thus taking up less room.

Conduit System

In connection with the conduit system, there were two main parts, interior conduit for control system, lighting and heating, and feeder conduits for carrying generator feeder cables in power house and between power house and transformer house.

The interior conduits were of galvanized iron pipe, the majority of which were embedded in concrete and the rest suspended from the ceilings of the galleries.

The feeder conduits, where permanent, as in the power house, are of vitrified clay, and where temporary, such as in the connection between power house and transformer house, fibre duct laid in concrete was used.

Battery Installation

To provide for auxiliary service for switch control and emergency lighting a storage battery has been installed having a capacity of 75 amperes for eight hours, 125 amperes for four hours and 315 amperes for one hour, with automatic switches, etc., to make the battery complete in every detail.

Lighting System

The main object in the layout of our lighting system was to get a good even illumination without shadows over every important part of the building. In general the plane of illumination was taken at 3 feet above floor level. The following intensities were adopted:—

Power house—generator room and gate house, 3 ft. candles; control room, 3½ ft. candles.

Transformer house—control room, 3 ft. candles; switch room, 1½ ft. candles; transformer chambers, 1 ft. candles.

The size of tungstens used in main part of power house was 500 watts, equipped with steel dome reflectors, distributed evenly over the roof girders, and in order to obtain the illumination desired 45 kw. of illumination was required. A similar method was adopted in the transformer house only smaller tungstens were used.

The amount of energy used for power house illumination per sq. ft. in the generator room and gate house is .63 watts. With this amount of energy the illumination obtained is perfect for operating conditions.

(To be continued.)

Rigaud vs North River Power Company

The Quebec Public Utilities Commission has passed judgment in the case of the Town of Rigaud against the North River Electric Company. It was complained that the company was in illegal possession of the streets, but the commission held that a franchise had been granted. The company had not, however, fulfilled its obligations in the matter of supplying light, and the commission granted a certain time for the necessary work to be done; an expert would then investigate the system and report. There was no obligation on the part of the company to supply power.

The Practical Value of Curves

The Application of Curves, Charts and Graphs to Facilitate the Analysis of Engineering Problems and Statistical Information

By F. H. Martin*

The talk this evening can hardly be termed a paper—it is more in the nature of a resume or collection of curves and diagrams that have been found helpful, especially in preliminary design work, and they are described in the hope that they may be of value to some of you.

It was the intention originally to analyse the mathematical side of the art of curve plotting, but mathematical discussions are usually rather dry, so this phase has been omitted and may be taken up later in the season if desired.

The talk this evening will be confined to the practical values of the curves which will be shown after a few introductory remarks:

Graphs are statements of results presented by means of diagrams, geometrical figures, or pictures to delineate or convey information in a vivid, forcible, and instructive manner; to put it tersely, it might be termed a picturization of facts.

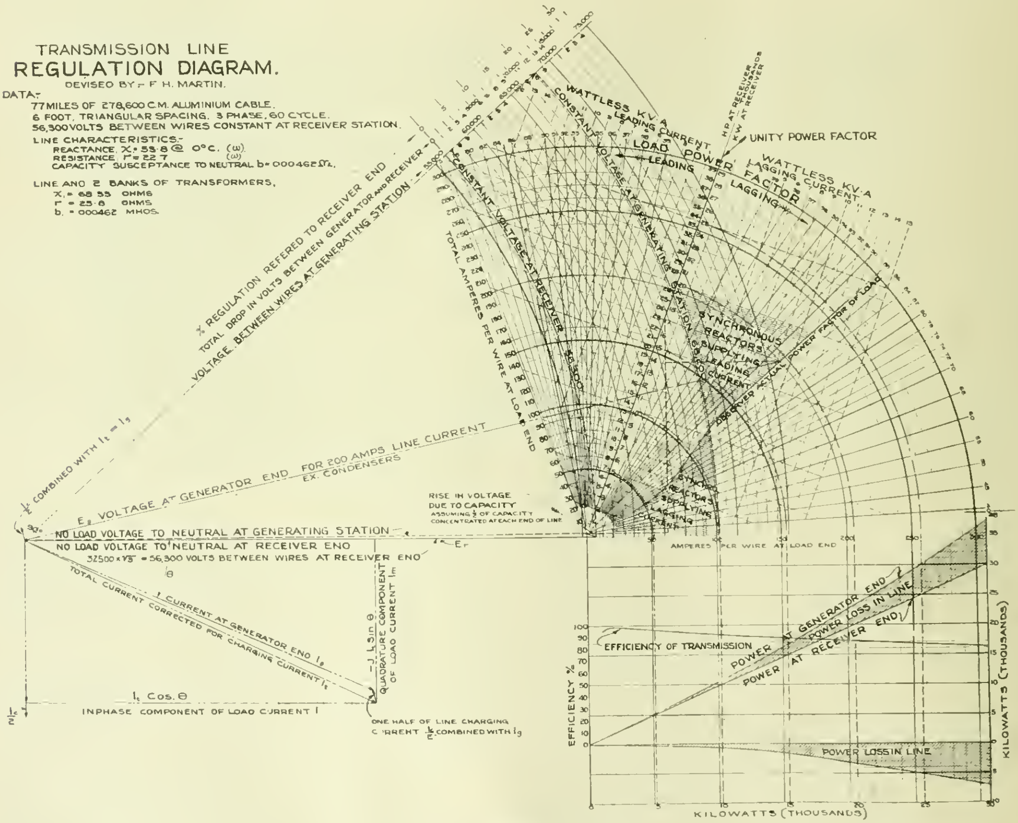
Charts are maps of results or facts, similar to, but slightly more complex, than graphs.

By reducing the value of facts to properly proportioned pictures or symbolic drawings, and arranging these geometrical diagrams in such a position that their relationship is apparent, their relative values, are instinctively appraised by the eye, and the lesson they are intended to teach, promptly and easily grasped.

Statistics are a collection of facts tabulated numerically, or, a group of facts brought out by collecting numbers; in other words, it is the science of measurements of the social organism.

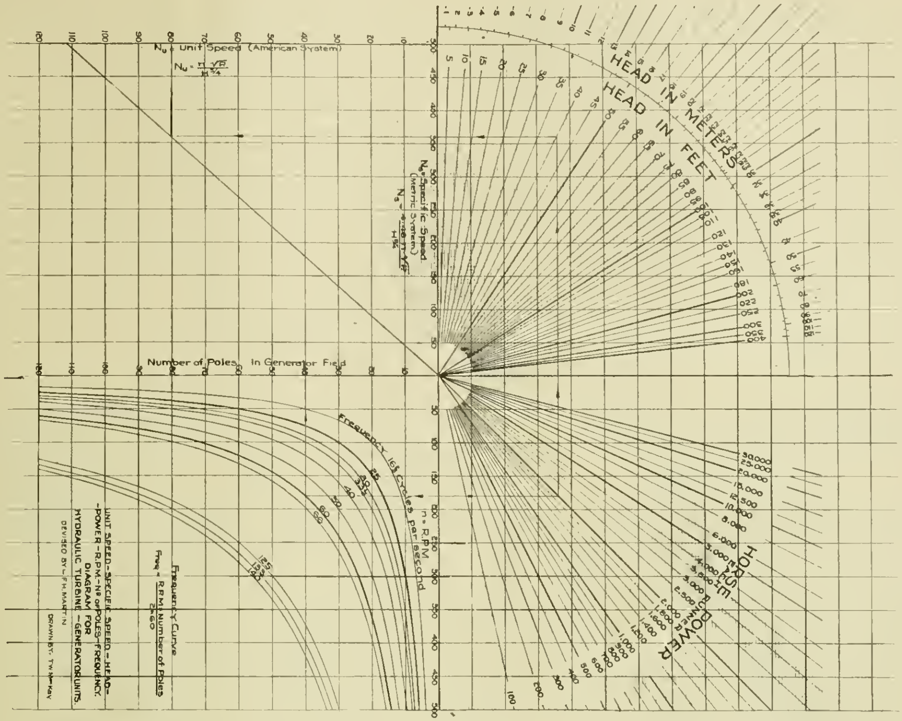
Each year thousands of dollars are spent in collecting all kinds of data, which is usually arranged in a tabulated form, and anyone who has ever had an occasion to analyze this enormous mass of information will have felt the need of a more coherent and concise means of arranging the same, in order to enable the average individual to recognize the salient features of these facts, and, to serve as a guide in making correct deductions therefrom, instead of accepting ready-made conclusions handed to him.

If the average citizen, and, especially the business man who usually dodges the simplest charts, obsessed with the



Transmission line regulation diagram.

* Designing Engineer, Winnipeg River Power Company, before the Electrical Section of the Manitoba Branch of the Canadian Society of Civil Engineers.



Unit speed—Specific speed—Head—Power—R.P.M.—No. of poles—Frequency diagram for hydraulic turbine—Generator units.

idea that they involve higher mathematics, or, some other mysterious agency, knew how to interpret charts and curves, it would be feasible to elucidate to him in effective form those facts, relating to broad social and public improvements, public-service operations, and international, state or municipal affairs.

To the ordinary person this does not seem to be a matter of great importance, and at first sight we cannot see its relationship to engineering, but when we consider that during the five years that the French engineers labored on the Panama Canal, they lost 22,189 men, while America has lost 5,000 in twice that time, and has also succeeded in transforming the region from one of the most deadly to one of the most healthy localities on this continent, due largely to the praiseworthy efforts of Surgeon-General Gorgas, who recognized how potent in the reductions of the cause of those losses are sanitary environments and the separation of the infected from the sound, we see how essential it is to standardize all the facts that would influence an engineering project in such a manner as to permit just comparison being made and then analyze the results graphically so that correct deductions can be made. Then there will no longer be any excuse for acting in ignorance since the curves will show exactly what is happening so that all conscientious workers for social, sanitary and other reforms will be able to discover at once the direction in which it is most desirable to concentrate attention.

The two principal methods of elementary statistics which ought to be understood by all students or officials who handle figures, and, which are easily within the grasp of all independent of mathematical training, but which are generally misunderstood, or ignored by the uninterested or uninitiated, are, the method of averages, and the method of diagrams, or the graphic method.

When we deal with large and complex masses of figures, we are unable to grasp them in their entirety, however clearly they may be tabulated. A list of figures, as for instance, the population of different cities, the wages of numerous individuals, etc., becomes less comprehensive as its length increases. A list of ten numbers can easily be grasped, of twenty, only with an effort, even by the highly skilled reader, while a series of figures for one hundred successive years leaves hardly any impression on the mind at all—we cannot see the wood for the trees—and we find that this also holds true in all fields of endeavor.

As civilization advances there is being brought to the attention of the average individual a constantly increasing volume of comparative figures and general data of a scientific, technical, and statistical nature. The graphical method permits the presentation of such figures and data with a great saving of time, and also with more clearness than would otherwise be obtained.

If simple and convenient standards can be found and made generally known, and adhered to, there will be possible a more universal use of graphic methods, with a consequent gain to mankind, because of the greater speed and accuracy with which complex information may be imparted and interpreted.

The graphic method is also used in solving problems in every branch of engineering (which otherwise would involve very complicated or laborious mathematical computation) by drawing vectors to scale, and estimating slopes and arears under curves. This method not only gives the student a mental picture of the operation, but compels him to think of the relation between the various quantities involved, instead of merely performing operation by fixed rules, and the principles so illustrated are more deeply impressed.

Much of the work of calculation done by engineers or designers is in the repeated application of a limited number of formulas to a variety of different conditions, which involves merely the substitution of different variables in identical equations. Any mechanical means for performing this operation expeditiously will not only lead to a saving of time and mental wear and tear, but will also minimize the chances of error. Such a device is the calculating chart, or monogram, and the increasing frequency with which it is employed in the more recent publications, is a good evidence of the growing recognition of its value.

Many excellent examples of these charts have appeared

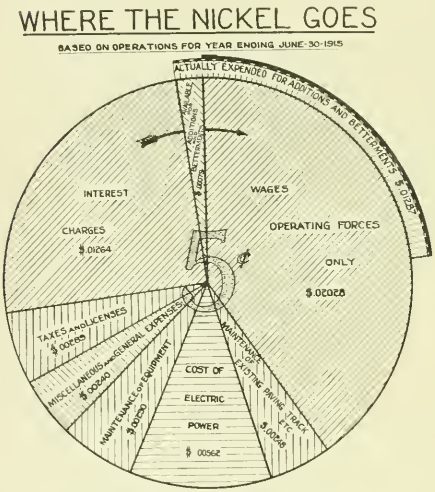


Diagram showing distribution of revenue.

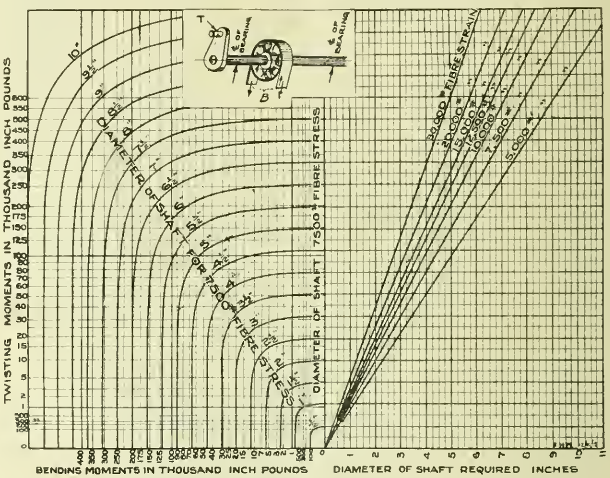


DIAGRAM OF STRENGTH OF ROUND SHAFTS, COMBINED TWISTING AND BENDING MOMENTS

of late years and are available for use, but it is evident that, to realize their full value as useful instruments, the engineer should have a sufficient acquaintance with their underlying principles to construct charts suited to his individual needs.

Some of the chart forms employed to-day have been known and used for many years, but it is only within recent times that any systematic study has been made of the subject as a whole, or any attempt to properly classify and correlate the different types.

In this work the French have been pioneers, and, it is to one of them, Maurice D'Ocagne, that we owe what is probably the most thorough and comprehensive text on the subject, his "traite de Nomographie." Soreau and others have also produced very creditable work on this subject.

Although books on Nomography have been published in many foreign languages, there does not appear to have been anything written on the subject in English, outside of a few scattered magazine articles, which have covered only restricted portions of the field.

Books in English on graphical calculus are by no means uncommon, but this is generally looked upon as something different from Nomography, although a strict line of demarcation between the two subjects would be somewhat difficult to trace.

Believing that this subject should be particularly useful to the practical engineer, who is often a trifle rusty in some parts of his mathematics, an effort has been made to simplify the mathematical treatment, and a series of problems has been worked out in detail, illustrating the application of all the chart forms herein explained.

It is thought that a study of these would afford a clearer insight into the methods employed, and a better understanding of the difficulties likely to be encountered, than would be possible from a purely theoretical analysis.

It will be observed that the corresponding metric dimensions have been added to the scales of some of the diagrams shown, this practically makes the charts international in character and like music, they may be arranged and interpreted in any language. This feature is greatly appreciated by engineering organizations whose scope is international and frequently saves considerable time in translating and converting from one system to the other.

The great advantage of the graphic method is that all of mankind's observations and calculations may be arranged or charted on co-ordinate paper, just as the hydrographer charts the position of the coasts, islands, rocks, channels, etc., on a chart, which is used to guide the mariner on his voyage, so the graphic method may be employed as a guide, especially for preliminary designs and estimates.

The prevailing tendency in engineering design is towards projects of greater magnitude containing a minimum number of units of maximum output, in making the initial layouts the approximate dimensions of the various apparatus must often be guessed at, and the uncertainty as to the exact requirements to be fulfilled by the work when completed is also a disadvantage, which cannot be escaped; but the more difficult it is to reach absolute correctness, the greater need we have of some guide which shall reduce the unavoidable guess-work to its lowest terms, and to save us from manifold hazards which result from not only guessing at facts, but at the effects of those facts.

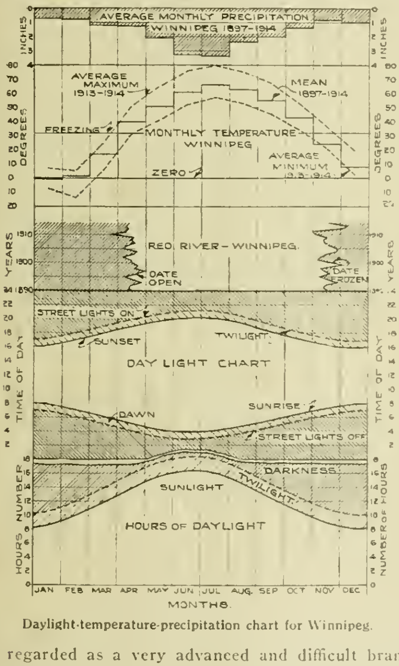
Whatever care we use we can never attempt with success to fix the exact point where economy ends and extravagance begins, but the graphic method helps us to establish certain narrow limits in either direction, somewhere within which lies the truth, and anywhere outside of which lies a certainty of error.

The final results must, of course, always be modified according to the results desired, conditions of working, the personal elements, etc., and accurate computations made for each particular case. The whole value of the charts shown this evening lies in their suggestive possibilities, as no attempt has been made to apply them to any specific case.

The continuation of this article, which will appear in a subsequent issue, covers the mathematical phase, starting from the simple geometric definition of a point in space moving in the shortest direction between two points generating a line, or one dimensional unit, movement of the line generating a plane or two dimensional unit, motion of the plane in a direction not contained within itself, generating a cube of three dimensions, and so on.

There will be explained more fully the two dimensional planes, containing the X and Y axis, which divides the plane into four quadrants, also positive and negative numbers, rectangular and polar co-ordinates, complex quantities involving the quadratic or square root of minus one quantities, which are so helpful in solving alternating current computations, and the equations for the straight line, circle, parabola, hyperbola and higher curves; graphical calculus; including integration and differentiation.

The graphical analysis of all of these gives a much clearer insight into their value, and allows the average individual to apply them daily to the solution of what would otherwise appear very complex problems. Until recent years



Daylight-temperature-precipitation chart for Winnipeg.

it was regarded as a very advanced and difficult branch of pure mathematics, its knowledge being the possession of a privileged few and especially endowed mathematicians.

The study of graphics is a common one, and no branch of mathematics knowledge has a more practical application. This is as it should be, for the fundamental ideas of graphics are common possessions.

New Books.

Kidder's Architects' and Builders' Pocket Book—a handbook for architects, structural engineers, builders, and draughtsmen, by the late Frank E. Kidder, C. E., Ph.D., Thomas Nolan, Editor-in-Chief; sixteenth edition; John Wiley & Sons, Inc., New York, publishers; price $5 net.

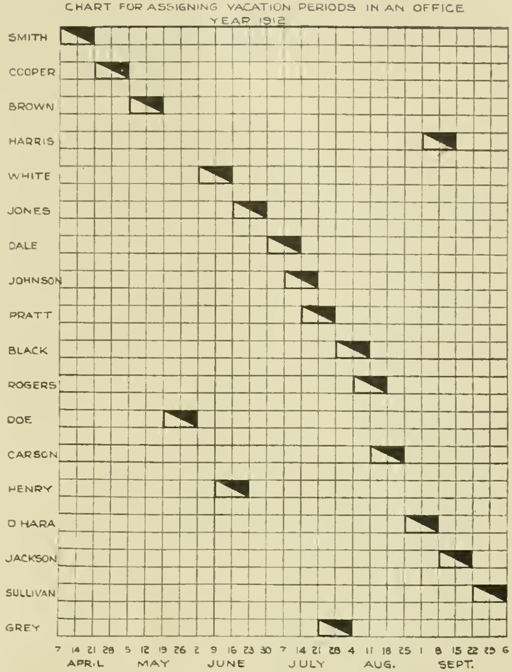


Chart for assigning vacation periods in an office.

The present edition is the result of an entire re-writing and resetting of the earlier editions. This book should prove particularly valuable as a reference, as its very broad scope may be gathered from the following brief review of the contents. Part I. deals with practical arithmetic, geometry, and trigonometry. Part II. deals with the strength of materials and the stability of structures, under the following chapter headings: (1) Explanation of terms used in architectural engineering; (2) Foundations; (3) Masonry walls, footings for light buildings, cements, and concretes; (4) Retaining-walls, and vault-walls; (5) Strength of brick, stone, mass-concrete, and masonry; (6) Forces and moments; (7) Stability of piers and buttresses; (8) The stability of masonry arches; (9) Reactions and bending moments for beams; (10) Properties of structural shapes, moment of inertia, moment of resistance, section-modulus, and radius of gyration; (11) Resistance to tension, properties of iron and steel; (12) Resistance to shear, riveted joints, pins and bolts; (13) Bearing-plates and bases for columns, beams and girders. Brackets on cast-iron columns; (14) Strength of columns, posts and struts; (15) Strength of beams and beam girders. Framing and connecting steel beams; (16) Strength of cast-iron lintels and wooden beams; (17) Strength of built-up, flitched and trussed wooden girders; (18) Stiffness of continuous girders; (20 Riveted steel plate and box girders; (21) Strength and stiffness of wooden floors; (22) Wooden mill and warehouse construction; (23) Fireproofing of buildings; (24) Reinforced-concrete construction; (25) Reinforced-concrete factory and mill construction; (26) Types of roof-trusses; (27) Stresses in roof-trusses; (28) Design and construction of roof-trusses; (29) Wind-bracing for tall buildings. Part II. contains useful information for architects, builders, and superintendents, under the following chapter headings: (1) Heating and ventilation, heat, fuel, gas and gas-piping; (3) Lighting and illumination of buildings; (4) Electric work for buildings; (5) Architectural acoustics; (6) Miscellaneous data. 1816 pages; flexible covers; well illustrated; 4½ by 7 ins.

Review of the Electric Vehicle Industry and Forecasts for the Coming Year

By A. Jackson Marshall*

The year 1915 saw many changes and improvements in the electric vehicle industry, all of which point to an unusually bright future both for the electric in the commercial field and as a passenger car. There has been no sudden, illusory spurts of popularity in the progress of the electric vehicle, rather it has been a gradual, steady growth, forming a good, strong foundation upon which to build up its ever-increasing business. Ever since the transportation world has recognized the value of the motor truck in the larger cities where there are opportunities of testing the various forms of trucks, that while the gasoline motor truck is especially adapted for long uninterrupted hauls, the electric vehicle is the desirable and economical vehicle for city and suburban work.

The Boston Institute of Technology, employing the best authorities in an unbiased study of transportation problems bears out this statement of the electric's adaptability to city traffic after four years of observation, and statistical study. Indeed, all we need do is to observe the large fleets of electrics in our city streets which have been adopted by our largest and most conservative business houses. The American Express Company has been a consistent buyer of all forms of electric trucks for the past seven years. It has now about 300 electrics in use in two cities alone, and the additions to its various fleets during the fall and winter of 1915-16 are practically all of the electric type. The Adams Express Company operates 326 electrics in two large cities and has just received the final shipment of an increase in one fleet of 42 electrics. The Ward Baking Company is now using 610 electric delivery wagons. The Jacob Ruppert Brewing Company has 145 electrics, many of which are five ton capacity units; the George Ehret Brewery 136; the New York Edison Company 130. A number of large fleets of electric coal trucks varying from the light 2-ton capacity to 5 and 6-ton trucks, are used in and around Boston, where they are operated 18 hours a day, hauling coal to the business houses and office buildings at night, thus avoiding the difficulty and delay of operating in the sections where traffic is more congested during the day. In the lighter class of delivery wagons the department stores have shown a strong preference for the electric. Gimbel Brothers operate 119; Lord & Taylor, B. Altman & Company, R. H. Macy & Company, Bonwit-Teller Company, Stern Brothers, the Tiffany Company, the Franklin Simon Company, all of New York, have adopted electric delivery service. In Chicago the Marshall Field Company operates no less than 230; Woodward and Lathrop, of Washington, Houghton & Dutton Company, of Boston, and the Bullock Company, of Los Angeles, are also representative department stores all using large fleets of electric vehicles. It is significant that in nearly every case where a concern has adopted the electric, large repeat orders have been the result, evincing a certain confidence in the substantial solidity of the electric vehicle for city and suburban transportation service.

While nearly all of the largest fleets of electric vehicles have been installed primarily through the efforts of the vehicle manufacturers, the electricity supply companies (central stations) of the country have exercised considerable influence in the promotion of the electric vehicle. However, there are comparatively few that appreciate the tremendous opportunities attending its further development. In New York City, for example, there is a minimum of something over $10,000,000 annually to be derived from the sale of current for electric vehicles in place of horses. Of 10,000,000 horses that are in use in the cities and towns of this country probably all could be successfully displaced by electric vehicles. This would mean an additional income to some six thousand electricity supply companies of about one million dollars. This is all the more significant when we consider that the combined income of all these Central Stations from all sources last year was approximately $450,000,000, of which but a very small percentage was derived from the sale of current for electric vehicle charging. Even if only a small fraction of the business in sight were obtained, it would represent a tremendous increase in the total incomes to the electricity supply companies.

That the horse and wagon is gradually being displaced by the light electric delivery wagon has been demonstrated by the very successful campaign recently carried on by a well-known manufacturer of vehicles of that type. Within its capacity rating the small 750-lb. electric delivery wagon costs less to operate than a single horse wagon and can perform a far greater amount of work. Where conditions are such as to demand mileage ranges of 30, 40 or 50 miles per day, the saving obtained by the use of this car may actually cover its cost in less than two years, and this after all other running expenses have been paid for. It costs less to keep this car in tires than it does to keep a single horse in shoes for the same work done. For equal service the cost of current at 5c. per kilowatt-hour amounts to but half the cost of hay and oats alone. In New York City more than fifty livery stables have expressed a willingness to store and wash this car for $10 a month. These same stables get from $27 to $30 a month for stabling and otherwise caring for a single horse and wagon, there is profit in the former and almost inevitable loss in the latter.

The Electric in Municipal Work

Another important development of the electric vehicle during the past year in a special field is its adoption for municipal service by many of our most progressive cities in one form or another. It is with considerable interest that fire chiefs throughout the country are watching the results and performances of electrically propelled fire trucks and engines in the cities where they have been adopted. This should prove an especially fertile field for the exploitation of the electric because of its inherent qualities of absolute dependability, its ease of operation, immediate response to driver's touch, and great simplicity of working parts, all of which are vastly important in operating fire apparatus. Philadelphia has adopted electrically propelled fire apparatus, and especially high commendation has been given it by the Fire Chiefs of the following cities, all of which have adopted the electric vehicle: Springfield, Mass.; Baltimore, Md.; Boston, Mass.; Akron, Ohio; Worcester, Mass.; Uniontown, Pa.; Camden, N. J.; Paterson, N. J.; Hartford, Conn., and several other cities too numerous to mention. A recent demonstration of electrically driven fire apparatus was held on the steep grades in and around Paterson, N. J., during November, at the time of its initial installation in that city. The tests showed the remarkable power of a combination chemical engine and hose wagon fully equipped with twenty lengths of hose and a crew of fourteen men weighing in all 18,320 lbs., and a second piece of apparatus consisting of 65-ft.

*Secretary Electric Vehicle Association of America.

aerial ladder carrying a crew of twenty-two men with total weight of 20,000 lbs. These two pieces negotiated a 18.23 per cent. grade, having an uneven cobble stone paving, in 1 minute, 13 seconds, starting at the foot of the hill from a dead stop. This hill had always been used as a test hill for every piece of apparatus used by the Paterson Fire Department, and the previous fastest time had been 1 minute, 40 seconds, made by a gasoline combination. It is interesting that these pieces of electrically driven apparatus made the run from Philadelphia to Paterson, approximately 125 miles, in fourteen hours elapsed time, including stops at Trenton, New Brunswick and Newark.

Electrics are now being used in large numbers for the collection of refuse in our cities, two of the most recent installations being in Boston, where two five-ton trucks have been purchased by the city, and in New York, where two gas-electric tractors are being used for the same purpose. Several cities of the south have adopted electrics for refuse collection, notably Miami, Fla., which has operated electric refuse vans for some time. Electric street sprinklers, snow plows, steam rollers, police patrol wagons, and ambulances, are all being gradually adopted by progressive municipalities, which recognize the economy of operating cost and efficiency of the modern electric commercial vehicle.

The very latest development, and one which will play an important part in further popularizing the passenger electric, is the electrically driven taxicab. The present gasoline taxicab service in many of our larger cities, and especially in New York, is inefficient, in many instances unsafe and costly to operate. An electric taxicab has been developed by a company in Detroit, where there is now a fleet of 47 in operation, which has all the exclusive refinement of a privately owned limousine in appearance, and is operated with far greater ease and safety than the very best of the gasoline taxicabs. Plans are now under way whereby a company will be formed to introduce electric taxicab service in New York and other large cities in this country. Mr. I. S. Scrimger, General Manager of the Detroit Taxicab & Transfer Company, has been in New York for several days demonstrating one of the electric taxicabs. Mr. Scrimger in relating the experience which his company has had with electrics in Detroit, states:

"The public in Detroit have taken very kindly to our electric equipment; so much so that we have had people wait from a half hour to three-quarters of an hour for an electric cab when we had gas cabs standing which they might have used. All of our cabs now in service are being operated 24 hours a day with two shifts of drivers; each man working 12 hours a day. To enable us to operate our cabs 24 hours a day we have had wayside charging boxes installed on the curb at the various hotels, and our cabs while standing idle are on charge. The Edison Illuminating Company, of Detroit, has co-operated with us in every way possible, and has given us power wherever it was possible to do so.

Electric Taxicabs

"We feel that we have constructed for our service a thoroughly up-to-date, practical electric taxicab. Some eight years' experience with the gasoline car taught us the weak points of the gas car and we have tried to overcome them with out new construction.

"Our cab has a 121-inch wheel base, and the interior of the cab body proper has a space about 68 inches long and about 50 inches wide, which you will see enables us to carry from four to five passengers very comfortably. Our experience taught us the limousine type of body was preferable to the landaulet type and could be operated with less expense. We are using pneumatic tires, and have already made a wonderful mileage showing with them."

The Battery Rental plan for commercial vehicles, which has been in existence for a number of years in Hartford, Conn., is just beginning to force recognition in other cities, and will, without doubt, become extensively employed throughout the country during the coming year. The aim of the Battery Rental System is to widen the scope of the electric truck, increase its mileage, and reduce the initial cost. The truck user buys a truck with chassis and body adapted to his particular requirements without the battery. The electricity supply companies or charging stations of the various cities where this system is used keep him supplied with charged batteries to run his truck. In other words, he buys from the electricity supply company not energy at so much per kilowatt-hour, but transportation service. He pays a flat charge for garaging and battery maintenance, depending on the size of his truck. In addition he pays so much per mile for the total mileage traveled as indicated by the odometer on the truck. When one set of batteries are nearly exhausted he receives a freshly charged set from the nearest charging station, taking from two to four minutes for the exchange, less time than it takes to refill a gasoline tank. This system is already in practical use in Hartford, Conn., Boston, Worcester, Baltimore, Salt Lake City, Fall River, Spokane and San Francisco, and as its success becomes recognized by other electricity supply companies, it will within a comparatively short time become practically universal, thus increasing the mileage radius of the electric truck and extending its usefulness to fields not always considered practical for the electric.

Battery Exchange System

The Battery Rental and Exchange System is also being developed successfully for the passenger car type. Coupled with this project will be a very substantial reduction in the price of electric vehicles. Already one large manufacturer of passenger electrics in Chicago is selling a vehicle minus batteries for nearly $1,000 less than last year, the purchaser renting the batteries from the various service stations throughout the city. In this way the user can estimate his maintenance costs without difficulty and he will know beforehand exactly what his operating expenses will be. In some figures recently compiled by this company it is shown that in the comparative costs of operating an electric and a gasoline car of the same valuation, the difference in upkeep expenses mounts as high as 185 per cent. in favor of the electric in cases where the owner employs a chauffeur to run his gas car. In instances where no chauffeur is employed the electric shows a saving of from 26 to 55 per cent. in operating costs over the gasoline type.

Other phenomenal price reductions in electric passenger vehicles have been due to quantity production and an unprecedented increase in sales. A decrease of $875 was announced by one company which has been carrying on an extensive sales campaign, and other manufacturers have offered reductions of from $300 to $800. All of this augurs well for future popularity of the electric, and already its recognition as the most satisfactory car for city and suburban use is evidenced in the greatly increased numbers which we see daily in the streets.

The past year has been marked by a number of successful long runs organized by several of the leading manufacturers. Fifteen hundred miles in fourteen days, using but a single charge of the batteries per day, was the record made by the Beardsley Electric Company, of Los Angeles, Cal. Recently a Detroit Electric made a run of 180 miles in less than ten hours, and the same make of car also accomplished a 375 mile run from Hartford to Washington in an actual running time of 21 hours. The trip cost $5.65, or less than 1½ cents per mile. A Waverley Electric made the trip from Buffalo to New York this fall in three days, and at the time of the Convention of the Electric Vehicle Association of America, at Cleveland, a Chicago Electric made a record run of 424 miles between Chicago and Cleveland in a running time of 28 hours. The Milburn Light Electric has been making some phenomenal long distance runs on the Pacific Coast, and has shown remarkably excellent hill climbing ability and mileage radius in the hilly sections around Portland, Oregon. One hundred and forty, and even one hundred and sixty miles on a single charge of the batteries has been accomplished by several different makes of electrics, showing that batteries are constantly being improved and their mileage capacity increased.

Manufacturers of electrics have begun to realize during the past year that there is a growing demand for electrics built along more masculine lines. This type of automobile has so long been recognized as the ideal car for a woman that they have lost sight of the fact that certain features of the electric have an especial appeal to business and professional men with whom destination on time is of vital importance. An electric is absolutely dependable, and in traffic congested streets it winds its way in and out more easily than any other type of car, saving time by stopping and starting in immediate response to the driver's touch. There are no blow-outs, no stalling of the engine, and no changing of gears to be reckoned with when every minute counts. Sturdy appearing roadsters, built on more masculine lines, have therefore been developed to meet popular demand, and the electric is fast establishing itself as a favorite with men for city and suburban use.

During the summer the new co-operative electric garage of the New York Electric Vehicle Association, located at Central Park West and 62nd Street, was thrown open to the public, and is housing its full quota of 100 electric passenger cars. The charging equipment of this electric garage, which is the largest in New York, is unusually complete, having facilities to charge from 100 to 200 cars per day and to care for the various sizes of batteries. Finely equipped electric garages are springing up in greater numbers all over the country, offering excellent facilities, and in some instances giving a unique parking service free of charge. The electric garages of Chicago offer a parking service in the Loop district which has proven a boon to shoppers and theatre patrons. Owing to the strict enforcement of the "half-hour law" for motor vehicles which prohibits a car from standing in any one place for more than a half hour, the owners of electrics who rarely employ a chauffeur were especially inconvenienced. Recognizing this, the electric garages organized the free parking service and the cars are brought to a centrally located garage by the owner and parked by a reliable and competent chauffeur who returns the car when needed again.

This is but one instance of the excellent service offered to users of electric vehicles, both commercial and passenger. Manufacturers, electricity supply companies, and electric garages are all co-operating to further electric vehicle development and to give the best service under all conditions to their patrons.

Montreal Talking to Vancouver

The Bell Telephone Company of Canada gave an interesting demonstration at the Ritz Carlton Hotel, Montreal, on Monday evening, February 14th. Through the co-operation of the American Telephone and Telegraph Company, Montreal was connected with Vancouver and about two hundred leading citizens of the Eastern Metropolis listened to conversations carried on with prominent men in Vancouver.

Lord Shaughnessy spoke to F. W. Peters, Supt. of the C. P. R. at Vancouver; Sir Frederic Williams-Taylor spoke to D. R. Clarke, of the Bank of Montreal in Vancouver; Alderman Leslie Boyd spoke to the Mayor of Vancouver, and President L. B. McFarlane, of the Bell Telephone Company, spoke to President Farrell, of the British Columbia Telephone Company.

Scene in the ballroom of the Ritz Carlton Hotel, Montreal, showing guests of the Bell Telephone Company listening to voices from far-away Vancouver. At the head table, reading from left to right, are: A. J. Dawes, Hugh Paton, R. B. Angus, Lord Shaughnessy, P. F. Sise, Jr., R. W. Hicks (New York), L. B. McFarlane, Sir Frederick Williams-Taylor, P. F. Sise, E. J. Chamberlain, F .W. Molson.

The circuit which was routed via Buffalo, Chicago, Omaha, Salt Lake City, Portland and Seattle, was 4,227 miles long—one of the longest over-land talking circuits ever arranged—and yet the transmission was excellent. Each of the guests was provided with a watch-case receiver, and besides following the conversations, each was enabled to listen to musical selections rendered at the Pacific end of the line as well as to the roar of the surf on the rocks outside San Francisco. Moving pictures were shown illustrating the building of the line and scenes in the various exchanges along the route.

A most interesting evening was brought to a close by the rendering of "God Save the King" in far away San Francisco, which had been connected with Montreal when the Vancouver conversations were ended. The listening guests in Montreal rose to their feet amid great enthusiasm as the familiar strains came clear and strong over the wire.

Overhead Ground Wires

Editor, Electrical News:—

What are the advantages and disadvantages of installing an overhead groundwire over six 960,000 circular mills aluminium feeder cables? The cables are run on poles a distance of 300 yards. The supply is 60 cycle, three phase, 600 volt, 2,000 h.p.

Small gap arresters are at present installed at each end of each feeder. These, however, have many times proved themselves not to be sufficient protection. The ground wires to same are of ample capacity and in each case lead directly to running water. Bends in the ground wires have been avoided as much as possible, and the length of wire varies between 15 ft. and 50 ft.

Choke coils are inserted on each feeder between arrester and apparatus to be protected.

The writer has been thinking of installing an overhead ground line running the full length of the feeder, cables, say 4 ft. higher than the feeders and grounding this line at every pole, the object being that any direct stroke or other charges will take the ground wire path in preference to the feeder lines.

There may be points which condemn this practice, with which the writer is not familiar, and he would, therefore, very much appreciate the views of other engineers who may possibly have tried this system.

Yours truly,

"Hydro Electric."

Personals

Mr. W. L. Bird, manager of the Kaministiquia Power Company, has been elected, by acclamation, president of the Fort William Board of Trade for the year 1916.

Mr. A. Grant, who recently returned to England on the voluntary liquidation of the Canadian British Insulated Company, Limited, of which he was manager, has been appointed manager for India of the British Insulated & Helsby Cables Limited, England.

Mr. E. S. Cook, formerly representing the Canadian Tungsten Lamp Company, Limited, in the province of Ontario, and late of the firm of Moncur & Cook, Hamilton, is again associated with the Canadian Tungsten Lamp Company, and will act in the capacity of district sales manager of the Ontario division, with office and warehouse at 166 King Street West, Toronto.

Mr. P. A. Macdonald, the recent appointee as Manitoba Public Utilities Commissioner, who succeeds Mr. H. A. Robson, K.C., was born in Gananoque, Ont., in 1857, and educated at Queen's University, graduating in 1876. Following his graduation he studied law in Toronto and began practising in Winnipeg in 1880. In 1888 he was appointed Master and Referee in the Court of King's Bench, which position he held until 1911, when he resigned to open an office for private practice. The new Commissioner thus brings to his work qualifications and experience which eminently fit him for the position. His many years of service as Referee and Master in the Court of King's Bench brought him in touch with law and business of various kinds. His appointment on numerous boards of arbitration—notably the labor dispute between the C. P. R. Company and its employees in 1908, of which board Mr. Macdonald was chairman—also shows a widely-recognized public appreciation of his sound judgment.

Commissioner Macdonald.

Commissioner Macdonald will be assisted in his work by an engineering staff, who will not only be at the service of the Commission in aiding investigations and settling technical disputes, but will also be available for the purpose of conferring with and advising upon the operation of telephone, gas, electric, and water supply systems, whether private or municipal, in any matters arising in the course of business. By the aid of these engineers the Commissioner will be relieved of the hearing of conferences between persons interested in purely technical matters, and will thus be relieved of certain burdens of office and left freer to devote his time to larger administrative work.

Mr. Malcolm M. Inglis, who has recently been appointed manager of the Port Arthur and Municipal Electric Railway, is a Scotchman, and was educated at the High School in Stirling and the Glasgow and West of Scotland Technical College. He commenced his practical career in 1901, with Mavor & Coulson, Limited, engineers and electricians, Glasgow, serving a regular apprenticeship in their various departments, and in addition completing two years in the designing department for electrical machinery. In 1908 he severed his connection with the Mavor & Coulson firm and accepted a staff appointment with Johnson & Phillips, Limited, London, England, as chief tester and outside erector, and in 1909 became assistant designer to Professor Kahn, of the Brush Electrical Engineering Company, Loughborough, England. In 1901 he accepted the position of chief electrical engineer to W. J. Craig & Sons at their Brynkinalt collieries, North Wales, which position he resigned in 1911 to come to Canada. From 1911 to 1915 Mr. Inglis was electrical engineer to the town of Yorkton, Sask., in charge of the electric light and power departments, during which time he acted as consultant supervisor of their new power house and Diesel electric plant, recently described by Mr. Inglis in the Electrical News. Mr. Inglis is an associate member of the Institution of Electric Engineers.

Mr. De Gaspe Beaubien, electrical engineer, of Montreal, has prepared plans for a hydro-electric development near St. Albans on the St. Anne's River, Portneuf County, P. Q. The project is for La Compagnie Hydraulique de Portneuf. It is proposed to instal machinery for a 500 horse power unit to be ultimately increased to 3,000 horse power. A dam has already been constructed, and the plans provide for a concrete power house, a 500 kw. generator direct connected to a vertical water wheel, flume, and the other necessary equipment. The head is 48 feet. The current is required for lighting and power purposes and it is proposed to distribute this in the adjoining districts. Tenders are now being called for the machinery.

Lieut. Reginald T. Smith

The many electrical friends of Reginald T. Smith will note with pleasure that he has been promoted to a lieutenancy in the Canadian Artillery. Lieut. Smith enlisted at the outbreak of the war as a gunner, and while in training at Valcartier was made sergeant. He went overseas with the first contingent, and served for a year at the front, taking part in every engagement from Neuve Chappelle to Loos. He is now in England.

Lieut. Smith formerly served three years with the Victoria Rifles, and later with the Westmount 21st Field Battery. He is a son of Mr. Henry Smith, of 96 Bellevue Avenue, Toronto, and a brother of Mr. Irving Smith, Electrical Apparatus and Specialties, Montreal. Lieut. Smith is well known in the electrical business ,and particularly throughout the North-West, where he represented the Canadian British Engineering Company as their Western traveller. At an earlier date he was with the R. E. T. Pringle Company. We congratulate Lieut. Smith on the good account he is giving of himself.

The Private Bills Committee of the Quebec Legislature have passed an amendment to the Montreal charter relating to the construction of underground conduits. This amendment empowers the Quebec Public Utilities Commission to allow, on the application of the Electrical Commission, a deviation from the types of construction previously authorised.

Electric Railways

1200 volt, direct current, third rail installation on English tramway—Track system of unique design

The Tramway and Railway World devotes some twenty-nine pages to a description of a recently equipped section of the Lancashire and Yorkshire Railway electrification, with direct current at 1200 volts. This same company have had experience with 3500-volt d.c. operation between Bury and Holcombe Brook, the difference being that the 3500-volt feed lines are overhead, while the 1200-volt feed is by third rail. previous practice in that it is a side-running contact instead of an over or under-running. This was determined as the result of 1200 volts necessitating more adequate protection. The form of the rail finally adopted is claimed to be admirable for guarding, and the small clearance available made this type preferable to the under-running type.

The live rail and its guarding, as also its relative position to the track rails, shown in Figs. 1 and 2, are the invention of Mr. J. A. F. Aspinall, the general manager of the company. It is very compact, lies close to the running rail, and gives a maximum of space to plate-layers and other

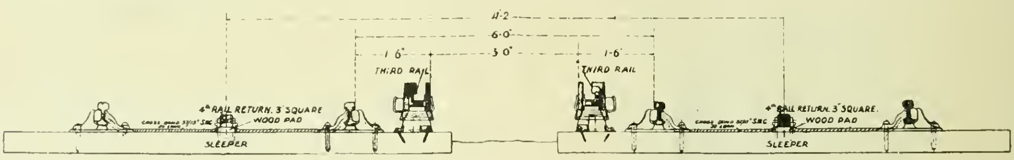


Fig. 1.—Cross section of permanent way tracks in relation to the structure.

Power is supplied by two 5000 kw. Dick Kerr turbo-alternator sets, 1500 r.p.m., and generating at 6600 volts, 25 cycle. At the sub-stations rotary converters are used.

The part of the line of chief interest is the track. Though the system adopted is the third or live rail, with track return, augmented by a fourth rail placed in the middle of the track, considerable variation has been made from workmen in the six feet where the rails are normally fixed. The guard is of Jarrah—adopted on account of its non-combustible qualities, and held in position by clips secured by ordinary chair keys.

A section of the rail has been designed so that its centre of gravity is well within the base line. The arrangement is such that a projection of the upper portion of the

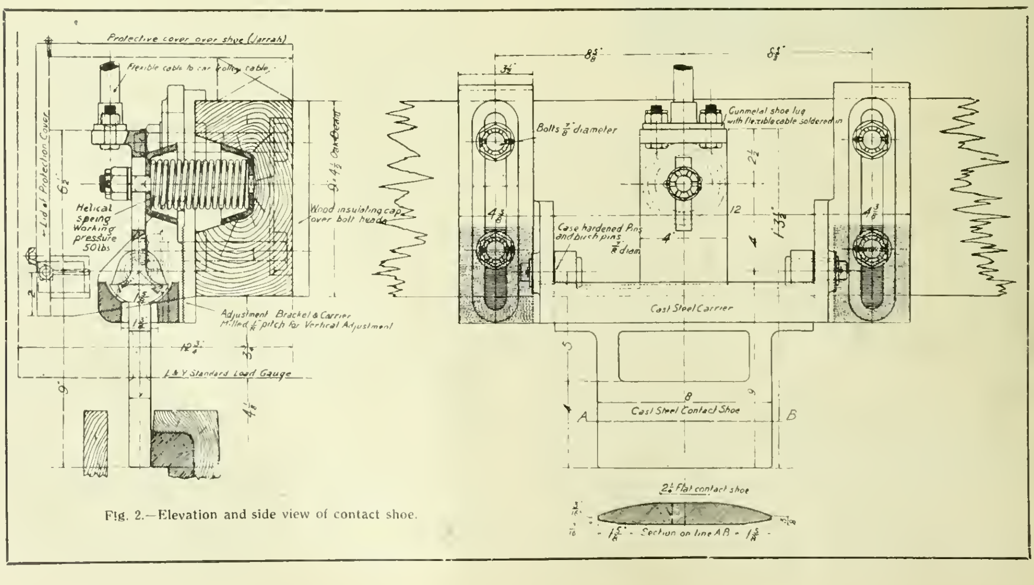


Fig. 2.—Elevation and side view of contact shoe.

insulator acts in conjunction with the guard as a key, which keeps the rail in position. The insulators on which the rail rests are kept in position by three small brackets on each. The rail does not rest directly on the porcelain insulator, there being a wooden packing inserted between to act as a buffer. The normal spacing of the insulators is approximately 12 feet. The live rail is anchored every hundred yards by a specially designed anchor insulator. These live rail insulators are of white porcelain completely vitrified

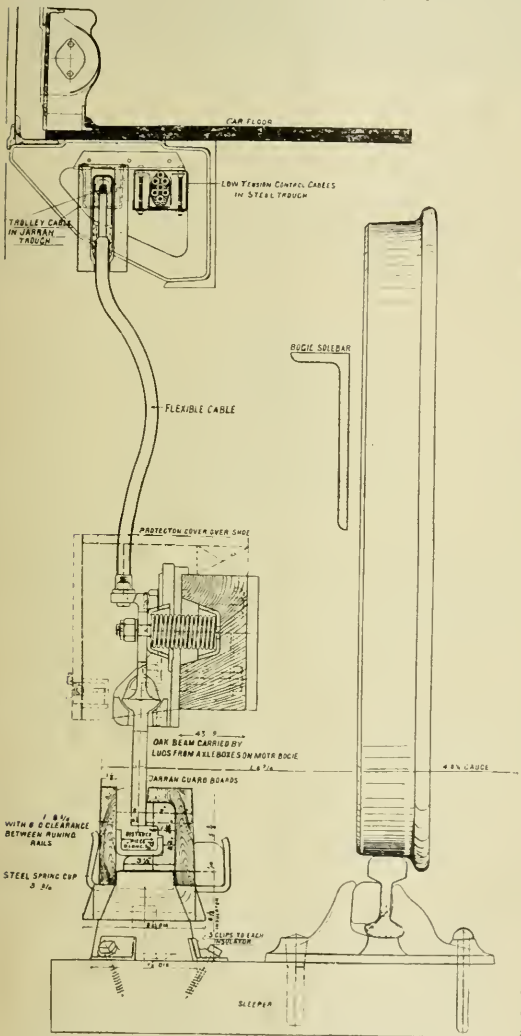


Fig. 3.—Cross section through conductor rail showing contact shoe and car trolley connection.

throughout and glazed all over, and are six and one-eighth inches high. The cross-sectional area of the rail is 8.35 square inches, and the weight 85 pounds per yard. The resistance of the rail ranges between 6.5 and 7 times that of copper of equal area. The rails are bonded with two bonds, each having an effective cross-sectional area of .4 sq. ins. The bonds are strip copper, flexible type.

The fourth or return rail is of square section with rounded corners, as shown in Fig. 1, with a cross-sectional area of 8.84 sq. ins., and weighing 88.5 pounds per yard. This section was adopted on account of the small surface exposed over a given volume of rail. This return rail rests on wooden pads one inch thick secured to the sleepers by iron dogs, and is anchored at intervals of 100 yards. There are two bonds per joint, having an effective cross-sectional area of .325 sq. ins. per bond. The fourth rail is also cross-bonded every 100 yards to the track rails, with cable bonds of 37/15 S. W. G. copper. The track rails are also bonded with cable bonds.

The track is fed from the sub-stations through short feeders which take the shortest course from the sub-stations to the track rail. No supplementary feeders are used. The live rail is divided up into sections, which are connected through section switches placed alongside the live rail and operated as ordinary hook switches.

The general arrangement of the shoe is shown in Fig. 2, and its connection of the trolley cable in Fig. 3.

Operating Methods

By E. M. Raver

Watching the Schedules

The public does not care so much about riding fast, as long as the car is running; as soon as the car stops the passenger begins to wonder why it stopped, and if it stands still a minute he begins to criticize the schedules. The good motorman watches traffic conditions and times the running of his car so as to prevent laying at end of line or on switches. And the good road officer or inspector watches the movements of motormen and conductors and encourages them to keep on the schedule, while the good superintendent watches the movements of both classes of operators to see that the maxim, "Cars make no money standing still," is adopted and followed as closely as possible.

Watching For Passengers

In cities of 40,000 to 60,000 where the 10 and 15-min. headway is more common than the more frequent headway, the good motorman and conductor will watch for the patron who is making reasonable effort to "get the car." Many a nickel is lost to the company because the motorman was not watching for patrons who were running for the car, and went on while the would-be passenger walks to town rather than wait for the next car. As a rule the latter does something else also; he "cusses" the company for keeping motormen and conductors who are so indifferent.

The good crew also watches for patrons who wish to transfer at junction points. Many times I have seen patrons leaving a car who desired to transfer to a car on another line, and when they were about half way to it the conductor, without looking around, gave the "go-ahead" signal and the car pulled away leaving them standing on the corner 10 or 15 min. to wait for the next car and voice their opinion of the company for tolerating such "bum" service. The good conductor always looks around just before starting his car at such places, and if passengers are making reasonable efforts to "get the car," they "get" it.

There is a vast difference in operating cars in cities of the sizes I have mentioned, and those of from 100,000 to 1,000,000. In the small city the patrons learn to know the men operating the cars and also the schedule on which the cars are operated. In cities of the larger class, cars are run at such frequency that patrons do not think anything of missing a car, as another is usually in sight, but in small places it is necessary to "watch" for passengers all the time and get them if possible.—Electric Traction.

The Dealer and Contractor

A Code of Lighting Applicable to Factories, Mills and other work places—Valuable Information for Engineers, Central Stations and Electrical Contractors (Con)

Section XII.

Side Light Important in Some Factory and Mill Operations

It has been customary in many cases to measure the effectiveness of illumination in terms of the vertically downward component of the light. This method has ignored the value of side components in relation to vertical surfaces and openings in the side of the work. It is sometimes more necessary to light the side of the machine or the side of a piece of work than the horizontal surface. If, then, in designing a factory or mill lighting system, the prime object is the production of the greatest amount of downward illumination, it may happen that the side component is so small that the sides of machinery or of work are inadequately lighted.

Two Ways to Secure Side Light.—Experience indicates that there are two general ways in which to secure adequate side lighting. One of these methods is to lower the lamps, and the other is to use broader distributing reflectors than are called for by the rules which consider uniformity of the downward illumination only. Side walls or other reflecting surfaces will modify the results. Thus, after the determination of a certain type of reflector for producing uniform vertically downward illumination, it may be found that more side light is necessary, and this extra side component may, as stated, usually be secured by selecting a somewhat more distributing reflector. Broader distributing reflectors are apt

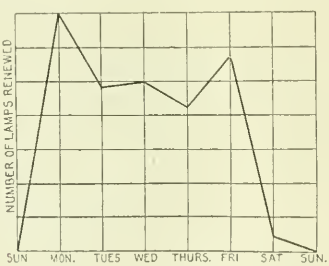


Fig. 12

to result in less downward illumination and will sometimes call for larger lamps than found necessary by preliminary calculations.

Practical Case.—As an illustration, in a certain lighting system a vertically downward intensity of about 3 foot-candles was deemed sufficient for the work involved. Measurements and observations showed that the side light was insufficient. In this particular installation it was found necessary to produce a vertically downward intensity of about 5 foot-candles on the average in order to secure an intensity of about 2 foot-candles on the side of the work, and also to use a somewhat broader distributing reflector than at first chosen. Two foot-candles on the sides of the work were sufficient in this where bench work and work in the vise on small machine parts were conducted.

Keeping the Lamps High.—It is recommended that the lamps be mounted near the ceiling in all reasonable cases where side light is necessary, and that the side light be increased, not by lowering the lamps, but through the medium of broader distributing reflectors and large lamps, if required.

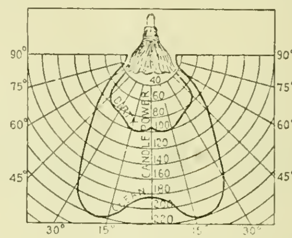


Fig. 13

This attitude is taken on account of the glare which results when lamps are mounted too close to the work, a feature most noticeable in the absence of a reflector or where glass reflectors are used.

Section XIII. Maintenance

The importance of system in the upkeep of natural and artificial lighting equipment may not appeal to every reader at the outset, but a consideration of the points involved will indicate that neglect of such work is apt to result in excessive losses of otherwise useful light.

Windows.—Factory and mill windows become covered in time with dirt, and produce greatly decreased values of natural light in consequence. These losses may easily be great enough to affect the workmen seriously, and to necessitate the use of artificial light at times when otherwise it would not be required. Dark surroundings also increase the likelihood of accidents. Regular window cleaning should therefore be a part of the routine of every factory and mill building or group of buildings.

Lamps.—Carbon filament, mercury-vapor, gas mantle and tungsten lamps burn out or break, globes and reflectors become soiled, and the various other items of deterioration take place so gradually that in many cases they are given no special concern in the practical economy of the shop. Moreover, it is hardly necessary to mention the fact that often lighting systems are allowed to deteriorate to an extreme point and nothing is done unless complaints come in from employees after the lighting facilities here and there throughout the shop have become so poor that work has to be discontinued temporarily. The losses of time from such circumstances, when added up throughout a year, are more than likely to exceed the expense of systematic attention to such maintenance items in advance.

Overhead System.—Furthermore, with modern methods where the lamps are usually mounted overhead rather than close to each machine, the importance of relieving the workmen from any care of the lamps and placing it in the hands of a maintenance department is even greater than has been the case in the past, particularly in large plants. To indicate the wisdom of a daily renewal of electric lamps, Fig. 12, has been worked up from the experiences in one large factory. In this factory all burned-out lamps are renewed each day except Saturday and Sunday, these renewals being based on a daily inspection of every lamp to ascertain whether or not it is in working condition.

Lamp Renewals.—A reference to the diagram shows that the renewals are considerably greater on Monday than on any other day of the week, this increase being due to renewals not given attention on the two preceding days. Obviously, therefore, a continued neglect of the inspection and renewal of these lamps would soon result not only in inferior lighting conditions, but to large losses of time for the employees, not to speak of the annoyance involved.

Reflector Cleaning.—The serious loss of light when globes and reflectors are allowed to go for long periods without cleaning, is shown in Fig. 13. This set of curves resulted from a test on a glass reflector used with a tungsten lamp. The one curve shows the value of the light given by the lamp at different angles when the lamp and reflector are clean, while the smaller curve shows the enormous reduction of light after the lamp and reflector has been in service for about four months without being cleaned.

In this particular case, which is a typical one, the loss of light at the end of the four month interval, amounted to about fifty per cent. The cost of electrical energy in this shop was such that the loss of light during the four months amounted to about 12 cents, while the total cost of taking down, washing and replacing this reflector amounted to about 3 cents. The economy of a fairly frequent attention to cleaning of such reflectors is at once apparent, even if the improved condition of the light in itself be ignored.

The examples just given, in the one case associated with the renewals of the lamps, in the other with the washing of the reflectors, will serve to illustrate the class of upkeep problems which are involved in shop lighting. The most forcible emphasis is applicable to the idea that system may properly be called a first step towards success in this line of maintenance work.

A Method of Inspection and Maintenance.—In one large factory a regularly developed method of inspection and renewals is employed. As an example, the method as applied to several thousand tungsten lamps, which are in service in the various buildings, will be described. All the lamps are inspected once per day, except Saturday and Sunday. A regular route is followed by the inspector, and all burned out lamps, broken switches, loose fuses, and similar items are noted. Careful observation is also made of reflectors which appear to need washing and any other points which might affect the efficiency of the system, after which a report is made up about noon and promptly sent to the maintenance department to permit all renewals and repairs to be made before night. In this manner the lamps are well maintained from day to day.

Marking Columns.—To facilitate this renewal work, it has been found advantageous to mark all columns through this shop. The inspector is thus enabled to indicate clearly the location of each burned out lamp and the renewal man to locate it without delay. It is helpful now and then in like manner to have the inspector note the unnecessary lamps found burning when artificial light is not required. If lamps are found burning at such times, a note sent to the head of the department calling attention to the matter is usually sufficient to remedy the difficulty.

Noting Soiled Reflectors.—As a check on a regular cleaning schedule, the inspector should note all reflectors in need of cleaning. The frequency of each cleaning will depend on the rate of deterioration due to the settlement of dirt on the surface of the glass or metal and also on the surface of lamps, and the fact should be kept in mind that the amount of dirt on a reflector is nearly always deceptive, that is, reflectors which have suffered a large deterioration in efficiency due to dirt often appear fairly clean, and for this reason it is best to increase the frequency of cleaning somewhat over that which seems sufficient from observation, particularly in view of the fact that tests indicate large reductions of light from apparently small accumulations of dust and dirt.

A Method of Washing.—In the factory just referred to, all reflectors are removed to a central washing point. Where the number of reflectors to be hauled is large, a truck is used. Often, however, where only a small number of reflectors is to be transported, small hand racks, devised for the purpose, are employed. When an installation is in need of washing, the scheme is to haul sufficient clean reflectors to the location in question. The soiled reflectors are then taken down and clean ones immediately put into place, after which the soiled reflectors are removed to the central washing point, washed and put into stock for the next location.

Section XIV.

Expert Assistance Suggested

The advantages of securing assistance in dealing with illumination is strongly emphasized. The points which come up for solution are complex and require, in many cases, the judgment of one who has had wide experience in the lighting field. In particular, anyone who undertakes to adopt any part or all of these suggestions will do well to secure the co-operation of a lighting expert capable of interpreting the legislative articles and of advising in a constructive manner.

Section XV.

Other Features of Eye Protection

Care is urged on the part of those responsible for the health and welfare of employees to see that adequate eye protection is afforded in all operations which are apt to cause injury to eyesight, if such protection is neglected. As typical of such other causes of danger to eyesight, are welding may be mentioned, where the operator, according to accepted practise, must wear a helmet serving as an eye shield as well as a shield for the face and head in general. **Protective glasses for this purpose should not be judged as to their protective properties by mere visual inspection. They should, however, be analyzed for their spectral transmission of invisible radiation.** Protective measures should also be taken to prevent onlookers from being unduly exposed to such eye dangers, by enclosing the welding operations with suitable partitions. These general remarks apply with equal force from the standpoint of those handling the operations to such other cases as the testing of arc lamps, inspection of hot metal and similar cases.

Section XVI.

Auxiliary Systems for Safety

The auxiliary system of lighting called for in Article XI. of the Code, is a safety first precaution which is insisted upon in a large proportion of the 1,200 buildings coming under the control of the Bureau of Water Supply, Gas and Electricity in New York City, particularly such buildings as are occupied by large numbers of people. The same precaution is now observed by the Bell Telephone Company's offices fairly generally throughout the country, also by a large number of private manufacturers and by local ordinances compelling all types of amusement places to take this precaution.

Electrical Inspectors for Province

Names Given Below of Inspectors of the Hydro-Comm. of Ontario with Towns under Jurisdiction of Each.—Information Frequently asked for by Contractors

No.	District.	Inspector.	Town in District
1.	Windsor	E. C. Weldrick	Walkerville, Ford, Gordon, Tecumseh, Sandwich, Essex, Obijway, Canard River, Maidstone, Amherstburg, Harrow, Kingsville, Cottam, Ruthven, Leamington, Wheatley, Stoney Point and Belle River.
2.	Chatham	W. H. Somers	Wallaceburg, Dresden, Comber, Tilbury, Blenheim, Ridgetown, Thamesville Bothwell, Glencoe.
3.	Sarnia	Mf. Wheeler	Courtright, Oil Springs, Wyoming, Thedford, Forest, Alvinston, Arkona, Petrolia, Brigden and Pt. Edward.
4.	St. Thomas	Geo. F. Howse	Aylmer, Dutton, Pt. Stanley, Tillsonburg, Springfield, Brownsville, Talbotsville, Corinth, Shedden, West Lorne, Rodney, Muncey Union.
5.	London	W. B. Legate	Lambeth, Deleware, Komoka, Mount Brydges, Strathroy, Ailsa Craig, Lucan, Byron, Thamesford, Westminster Gardens, Springbank, Broughdale, Thorndale, Dorchester, Belmont and Exeter.
6.	Woodstock	H. Webster	Beachville, Ingersoll, Embro, Ayr, Princeton and Drumbo.
7.	Brantford	W. H. Mowat	Paris, Burford, St. George, Lynden, and Plattsville.
8.	Hamilton	V. K. Stalford	Burlington, Port Nelson, Clappison Cor., Dundas, Aldershot, Waterdown, West Flamboro, Greensville, Grimsby, Beamsville, Bartonville, Ancaster, Chedoke, Winona, Stoney Creek, Grimsby Beach, Vineland, Freeman's Corner and North Grimsby.
9.	St. Catharines	A. T. Smith	Port Weller, Niagara-on-lake, Port Dalhousie, Grantham Twp., Thorold, Merritton, Allenburg, Vic., Louth Twp., Fonthill, Ridgeville, Fenwick, Electric Park, Port Colborne, Jordan, Jordan Station, Decow Falls.
10.	Toronto	H. F. Strickland (Chief Inspector H.E.P.C.)	Mt. Denis, Weston, Woodbridge, Lambton, Cooksville, Clarkson, Streetsville, Swansea, Mimico, New Toronto, Long Branch, Lorne Park, Port Credit, Agincourt.
11.	Guelph	Jas. M. Gass	Rockwood, Acton, Fergus, Elora and Elmira.
12.	Berlin	H. C. Fischer	Waterloo, Preston, Galt, Baden, Hespeler, Brealau and Bridgeport.
13	Stratford	Geo. F. Heideman	Shakespeare, New Hamburg, Clinton, Tavistock, St. Mary's, Mitchell, Sebringville, Seaforth, Egmondville, Goderich, Milverton.
14.	Aurora	R. R. Matson	Barrie, Allandale, Orillia, Coldwater, Waubaushene, Victoria Harbor, Port McNicoll, Midland, Penetang, Elmvale, Richmond Hill, Thornhill, Newmarket, Sutton, Roaches Pt., Orchard Beach, Keswick, Sharon and Queensville.
15.	Peterboro	H. A. Fife	Lindsay, Omemee, Millbrook, Hastings, Norwood, Havelock, Lakefield.
16.	Belleville	R. A. Thompson	Trenton, Brighton, Colborne, Cobourg, Cannifton, Corbyville, Madoc, Stirling, Hoard's Station, Campbellford, Frankford, Wellington, Picton, Marmora, Port Hope.
17.	Kingston	T. A. Hanley	Kingston Jct., Findlay, Tweed, Gananoque, Collins Bay, Napanee, Deseronto, Newburgh, Strathcona, Camden East, Yarker, Tamworth, Marlbank, Larkins, Stoco, Sydenham, Portsmouth, Barriefield.
18.	Simcoe	R. H. Crapper	Waterford, Pt. Dover, Jarvis, Hagersville, Caledonia, Delhi, Tillsonburg, Norwich, Otterville.
19.	Brockville	J. A. Johnston	Prescott, Cardinal, Iroquois, Morrisburg, Cornwall, Perth, Chesterville, Winchester, Kemptville, Merrickville, Smith Falls, Williamsburg, Westport, Aultsville, Farren's Point, Wales, Moulinette, Mille Roches, Lynedoch, Delta.
20.	Ottawa	Norman E. Bell	Almonte, Carleton Place, Egansville, Pembroke, Arnprior, Renfrew.
21.	Cobalt		
22.	Niagara Falls	C. E. Dilse	St. David's, Stamford, Port Robinson, Welland, Crowland, Bridgeburg, Ft. Erie, Ridgeway, Crystal Beach, Erie Beach, Crescent Beach, Thunder Bay or Prospect Bay.
23.	Palmerston	W. H. Croydon	Durham, Dundalk, Shelburne, Markdale, Flesherton, Mildmay, Chatsworth, Chesley, Hanover, Walkerton, Harriston, Listowel, Mt. Forest.
24.	Thunder Bay	W. S. Jaffray	Port Arthur and Fort William.
25.	Oshawa	W. F. Mitchell	Oshawa and Vicinity.
26.	Collingwood	E. J. Stapleton	Meaford, Thornbury, Stayner, Creemore, Clarksburg.
27.	Cannington	J. C. Burns	Beaverton, Sunderland, Uxbridge, Stouffville, Markham, Woodville and Brechin.
28.	Brampton	Geo. Ostrander	Brampton and Georgetown.
29.	Bobcaygeon	Sidney H. Cluxton	Bobcaygeon and surrounding Twp.

Cheap Wiring Becomes an Obstacle to Future Development

The Society for Electrical Development have just issued a little booklet entitled "Successful House Wiring Plans," which it is distributing in connection with a campaign to be known as "Wire your home" month, from March 15 to April 15, 1916. This booklet contains descriptions of the methods adopted by many of the central stations in the United States to induce citizens to have their houses wired for electric light.

So far as it goes this is an admirable scheme, but we hope the Society for Electrical Development will not overlook the fact that the house which is wired for electric lighting only is only half wired—perhaps not half.

They must also not overlook the fact that the installation of too small service wires is going to be an obstacle rather than an inducement in the way of further developments in the electrical industry, such as the more general use of household appliances, electric ranges, and—a little later—electric heating, will demand.

It may be that the men who are behind this movement of an aggressive house wiring campaign argue that the wiring of a house for electric lighting is the thin edge of the wedge which once started will be more easily driven home. It is not any too evident that this is the case. One of the biggest difficulties in the way of domestic electric cooking—the line along which development in the electrical industry is bound to take place, and the line along which the greatest development seems reasonable—is the necessity, in almost every case, of replacing the service wires by others that will carry a sufficient volume of current to supply the range. This adds so materially to the cost as to constitute an almost insurmountable difficulty. It is this difficulty central stations are struggling with at the present time. We believe, therefore, that the Society for Electrical Development and central stations in general will be well advised in considering this matter very carefully from the point of view of certain future developments. It is quite possible that a very large percentage of those who will avail themselves of a cheap wiring plan could not be induced to go a step farther and have it done as it ought to be done, but there will be an appreciable percentage of these people who, if the matter were placed before them in its proper light, would see it as a good business proposition to have their houses wired properly in the first instance. Let us never lose sight of the fact that we have passed the stage in the electrical industry when the cost of current is the biggest consideration. It is either the cost of the appliance itself or the cost of installing the appliance. Future developments must be along the line of removing these two obstacles, and we should lose no opportunity of working to that end.

Electric Radiators Heat Office Building While Being Moved

The Boston Elevated Railway Company, owners of a brick office building occupied by the Bay State Street Railway Company as headquarters of its electric freight business, recently moved the building about 150 feet to a new location, on Atlantic Avenue, Boston. During the process of moving, heating for the offices, which continued to be occupied without interruption, was provided by means of about 50 electric radiators, which were connected to the Elevated Company's circuits by means of temporary wiring. As the moving took place during mid-winter, the need of artificial heat presented a problem which could only be successfully met by the electric heating installation.

Program Five Months in Advance

The National Electrical Contractors' Association of the United States will meet in convention in New York City on July 17, 18, 19, 20, 21 and 22—five months in the future. Yet this enterprising association already has its programme planned and printed. It is also announced that in view of repeated requests arrangements have been made with the Hotel McAlpine whereby those manufacturers who are interested may obtain space to display such goods as they desire. It is believed that this proposition will prove attractive to many manufacturers. Further information regarding the convention may be obtained from Mr. George H. Duffield, 41 Martin Building, Utica, N. Y.

Haddin & Miles, Limited

It is announced that the name of the John Galt Engineering Company, Limited, has been changed to Haddin & Miles, Limited. The company have offices in Winnipeg and Calgary, the Winnipeg address being the Curry Building. They will specialize in the design and construction of waterworks, sewerage, sewage purification works, electric lighting and general municipal engineering. Mr. John Haddin, M. Can. Soc. C. E., A. M. I. C. E., well known throughout the Dominion in connection with his work in the John Galt Engineering Company, Limited, is the chief member of the firm

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Branston Violet Ray Apparatus

The Chas. A. Branston Company, 359 Yonge Street, Toronto, have issued catalogue No. 10, describing the Branston Violet Ray High Frequency apparatus. This company are the first to manufacture these goods in Canada and their products are the result of careful experiment and progress, which have resulted, it is claimed, in the most efficient and durable portable equipment of this nature on the market. The catalogue is well illustrated.

The city of Montreal has inscribed in appeal to the Quebec Public Utilities Commission the decision of the Montreal Electrical Commission of 1st June, 1915, with regard to the annual rentals and charges chargeable to the different companies for duct space provided for the various users in the civic underground system, Districts Nos. 1, 2, 2A and 3. Notice of the appeal has been given to the Montreal Light, Heat & Power Company, Montreal Public Service Corporation, Montreal Tramways Company, and the Dominion Gresham Guarantee and Casualty Company.

The Canadian Tungsten Lamp Company, Limited, Hamilton, Ont., announce the opening of a branch warehouse and office at 166 King Street West, Toronto. The company will carry a complete line of tungsten and carbon lamps in stock at the above address, and will transact their Ontario business through the Toronto branch, with Mr. E. S. Cook in charge.

Trade Publications

Lamp Guards—A folder is being distributed by Harvey Hubbell, Inc., describing, with illustrations, the economy of installing guards on lamps at unprotected points.

Private Telephone Systems—booklet issued by the Norton Telephone Company, 198 King Street West, Toronto, describing their various types of telephone systems and telephone instruments for private installations; illustrated.

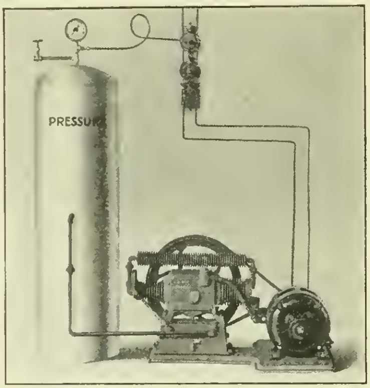
Deltabeston Wire—booklet by the D & W Fuse Company, describing, with illustrations, recent developments made by this company in the manufacture of fireproof wire. In this catalogue are listed and described asbestos covered wire for practically every kind of work and condition of service.

Hubbell Equipment—Bulletin No. 15-17, describing Hubbell direct threading shade holders, and Bulletin No. 15-15, describing side outlet current taps; by Harvey Hubbell, Inc., Bridgeport, Conn.

What is New in Electrical Equipment

Automatically Controlled Electric Driven Air Compressor Plant

The plant illustrated herewith has recently been developed by the United States Air Compressor Co., Cleveland, for garages, factories, air drill service, etc. The two stage compressor is belt connected to a ½ h.p. single phase or direct current motor made by The Robbins & Myers Co., Springfield. The tension is maintained on the belt by an automatic belt tightener. The cylinders of the compressor are opposed and are provided with rings to increase the heat radiating surface. The connection between the two cylinders is also similarly equipped. The outfit is self-oiling and it is necessary to replenish the oil about once in two months. Every working part runs in oil and no oil cups are used. The bearings are bronze with babbitt lin-



ing. All working parts are enclosed to keep out dust. There are no stuffing boxes to cause leakage or requiring repacking. The body is cast in one piece to insure alignment of the pistons. The valves are steel balls in bronze seats and each pump is equipped with a safety valve to prevent accident from too much pressure. The cylinders are 3 and 1½ inch by 3 inch stroke and the pump has a capacity of 5,000 cu. inches per minute. The shipping weight is 140 pounds and the floor space required is 14 x 24 inches. The outfit is supplied complete with 30 gallon seamless tank, automatic controller, gauge, valves, compressor d.c. or a.c. motor, oil trop, safety valve, automatic belt tightener and belt with all necessary piping as shown, all mounted on a large metal sub-base. In addition to the size shown, a larger outfit with a capacity of 15.000 cu. in. per minute can be furnished.

Cab Tyre Cable

The St. Helens patent cab tyre sheathed cable, recently introduced into Canada, is the product of a famous British firm, the St. Helens Cable and Rubber Company, Limited, Warrington, represented in Canada by J. D. Lachapelle and Company, 317 St. James Street, Montreal. Cab tyre sheathing is a rubber protection for all sizes of electric cables, and many strong claims are made for it. The company supply the sheathing and wires complete, and it is now in use by several of the largest companies in Canada. It is absolutely waterproof, resists the action of steam, oils, acids, etc., is flexible, will not kink, is light, easily repaired, not affected by vibration, if cut the cut does not extend, and will stand very rough usage. Its chief uses are: in manufacturing establishments, for portable tools, clusters; on railways, for signal, lighting, and tunnel cables, and train lighting; in generating stations, for battery rooms, portables, boiler houses, and service cables; for tramways, for wire and trolley feeds; for general wiring work, damp places and portables; and in all places where severe conditions are met with. In Great Britain it is used by the Admiralty. It is more expensive than the ordinary braided cable, but it is claimed that the life of the cab tyre sheathed cable is several times as long as that of the ordinary description, that it does not require any extensive repairing, and that it is in fact more economical than any cable not protected in the manner of the product of the St. Helens Company.

New Hubbell Socket

In addition to the Hubbell mogul porcelain sockets recently shown in these pages this company have just brought out another type of this socket fitted with a cast iron yoke tapped for ⅜ in., ½ in. or ¾ in. pipe or rod as desired. These are recommended for general outside illumination requiring a socket which can be threaded directly to the end of a solid arm or bracket. The design of the yoke permits

ample room for the conductors to be strung from the socket to the feed wires instead of drawing them through conduit or the supporting arm of the fixture. Conductors are easily attached to large head binding screws and lead through an opening in the top of the porcelain thence diverging to either side of the iron bracket for attachment to the feeder. New socket illustrated herewith.

Mogul Shurlok Sockets

For a long time the trade have demanded a mogul base socket from which it is impossible for an unauthorized person to remove the lamp, and this demand, it is claimed, has been met by Pass & Seymour, Inc. by their No. 597 Shurlok. This socket is fitted with the double shurlok

device which holds the lamp base rigidly without in any way distorting the base of the lamp; thus the lamp remains straight. The ease with which the lamp may be locked or removed by the proper person is the talking point in favor of the installation of these sockets wherever a high efficient unit is desired to be permanently located.

Current News and Notes

Fredericton, N.B.

The control of the Fredericton Gas Light Company has passed to the Maritime Corporation Trust Company of Halifax. The formal transfer was announced at the recent annual meeting of this company.

Kingston, Ont.

Power was delivered for the first time on February 16 to the Kingston Milling Company over the lines owned by Mr. J. M. Campbell, who has a power development plant at Kingston Mills.

Kirkland Lake, Ont.

It is reported that the Northern Ontario Light and Power Company will extend their lines from Cobalt to Kirkland Lake, some seventy miles, and that contracts have already been signed up to supply power at this latter point.

Mission City, B.C.

Mr. Hubert Sweeny, foreman of the Mission City Telephone Company, has enlisted for overseas service with the 131st Battalion at New Westminster.

Montreal, Que.

Mr. Arthur P. Scott died in the General Hospital, Montreal, on February 17, of pneumonia. Mr. Scott was a son of the Rev. Dr. E. Scott, and a graduate of McGill University in both arts and science. Among the University honors received by Mr. Scott were the Logan Gold Medal and the British Association Medal. Following his graduation he was engaged first as a demonstrator in the University, but later joined the staff of the Dominion Iron and Steel Company, and also spent three years with the Westinghouse Company at Pittsburgh. For the past year he had been with the Chicago Electric Furnace Company.

Ottawa, Ont.

It is announced that Capt. F. D. Burpee, superintendent of the Ottawa Electric Railway, will be Major of the 207th Battalion recently authorized to be recruited in Ottawa.

According to the annual statement of the Morrisburg and Ottawa Electric Railway Company, work will be commenced on the construction of this line in May of the present year. Mr. J. G. Kilt is president and managing director, and Mr. R. A. Bishop secretary-treasurer.

Perth, Ont.

The resignation of Mr. Evart Adams, superintendent of the Perth lighting system, has been accepted, and Mr. Carl Adams will be temporarily in charge. Mr. Evart Adams has enlisted for overseas service.

Petrolea, Ont.

The Canadian Westinghouse Company have been awarded a contract for transformers to be installed at Petrolea, Ont.

Orangeville, Ont.

The Clerk of the Dufferin County Council has been authorized to call for tenders for the re-wiring of the Court House and Registry Office.

Saskatoon, Sask.

The Western Lighting Agencies, Limited, have been incorporated.

The annual report of Commissioner Yorath, Saskatoon, shows that the net profit on the electric light and power department for the past year was $8,019. The street railway system showed a deficit of $30,973 as compared with $33,477 loss in 1914.

St. Marys, Ont.

The town council defeated the Hydro Radial by-law at its third reading. The vigorous opposition of Councillor Dale, who had obtained legal advice to the effect that the by-law was illegal, was largely responsible for the vote.

Toronto, Ont.

The Bedford Park Ratepayers' Association have requested the York Township Council to install Hydro lighting on Weyburn and Bedford Park Avenues.

The Ontario Legislature will approve the plans of the engineers of the Hydro-electric Power Commission of Ontario for a large power development in the Niagara Peninsula. It is said the immediate development will be 100,000 h.p., and there are visions of an ultimate capacity of 900,000 h.p.

Sir Adam Beck was tendered a complimentary banquet on February 15 in Toronto by the Hydro Radial Union of Municipalities.

Weyburn, Sask.

The council of Weyburn, Sask., has passed a by-law authorizing the expenditure of $35,000 in purchasing another generating unit.

Wingham, Ont.

Mr. E. Merkley is planning to install electric drive and lighting in his chopping mill.

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ADVERTISEMENTS

Orders for advertising should reach the office of publication not later than the 5th and 20th of the month. Changes in advertisements will be made whenever desired, without cost to the advertiser.

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Vol. 25 Toronto, March 15, 1916 No. 6

The War's Effects on Trade Policy of British Empire.

ONE of the most revolutionary results of the war, so far as the British Empire is concerned, will be the utter up-rooting of the old ideals of free trade which have been so great a factor in the political and industrial life of Great Britain. Already the chief exponents of free trade in Great Britain have thrown their former beliefs to the winds and come out definitely in favor of radical changes of fiscal policy, so as to enable the Empire, after the war, to maintain the objects for which it has been fighting and to make it impossible for Germany ever again to obtain that international industrial and commercial preponderance that has enabled her to plunge the world into war.

There is now no room for doubt that Great Britain will never again return to the position she occupied before the was as an isolated free trade nation. Her eyes have been opened to the danger of free trade so long as there are, among others, nations like Germany that will take advantage of it to increase their strength and preparedness for war. The rulers of England today are working out the details of this problem and getting ready for the changed conditions which will follow the war. Even now, these changes are to some extent in effect. By the time the war is over England will have much of the necessary machinery in operation, a good deal of the legislation worked out, and the public mind well prepared for the new fiscal policy.

In many ways these changes will work out to the advantage of Canada and the other overseas parts of the Empire. For Canadians the duty is to consider what this change will mean to us, and to see to how great an extent we can co-operate so as to produce, under the new conditions, the greatest advantage both to ourselves and to the Empire. The outstanding business features of the period following the war will be reconstruction and readjustment; reconstruction of the countries which have been devastated and readjustment of the business relationships and industrial activities which have been shattered by the war. A great deal of consideration has been given to the reconstruction problem. Readjustment of the business and industrial situation, however, has not been considered by the press in general to anything like the extent that it warrants.

* * *

In connection with Great Britain and Canada and to a large extent also in connection with the allied countries and Canada, the readjustment of business relationships will be of great and vital importance. No single country in the whole world will be in the same advantageous position as Canada. When the war is over, having borne her share of the struggle she will be favored by the allied countries whenever there is a possibility of conducting trade with her. In the markets of Great Britain and France this will be a great advantage to Canadian manufacturers. It will give them the whip hand in all transactions in which Canadian goods can stand any chance at all.

Even when one looks at this question in a broad and general way he cannot fail to be convinced that of all the countries in the world, the one which will develop most rapidly and most substantially after the war will be Canada. Our agricultural and manufacturing products are nearly all of a class that will be in demand in Great Britain, France, Belgium and other European countries. Our manufacturing and producing capacity will be strained to the utmost, and those who have foreseen the situation and placed their affairs in such shape as to take part in Canada's great expansion will reap a greater harvest of business prosperity than they ever dreamed of in the days before the war.

* * *

To put the matter in as brief and simple a form as possible, Canada will, more than ever before, be the Land of Promise and the Land of Fulfilment. Her plants will be running night and day, her merchants will be busy from morn till night. Her farmers will be able to sell at good prices everything that they produce, and this prosperity will attract to the shores of Canada a great tide of immigration. From all parts of the world people will set out for Canada to share in its expansion. The immigration from the United States to Canada which started on an extensive scale only a comparatively few years ago will be renewed and greatly increased. Moreover, from the United States we will then draw not only farmers in large numbers, but a far greater number of merchants and manufacturers than we formerly drew. Manufacturers in the United States will be quick to realize that, if they want to share in the trade of Great Britain and the allied countries to the fullest extent, they must establish plants in Canada so as to be entitled to the preferential treatment which Canada will then obtain.

* * *

These are no idle dreams dictated by desire and unfounded on fact. Anyone who reads what is appearing daily in the press of Great Britain regarding the fiscal problem, knows that these views are warranted by the trend of public opinion in Great Britain. Free trade has been killed. The Manchester Chamber of Commerce, the historic hot-bed of free trade has voted against it by 998 to 527. The greatest exponents of free trade in Great Britain have thrown it overboard. From now on, every man who thinks about the fiscal problem in the Old Country will think of it in terms of tariff protection. The working out of protection will involve many differences of opinion, but the great change has come about. The war has made protection the only logical policy for Great Britain. After the war, and to a considerable extent during the war, protective tariffs will come into effect and they will unquestionably include preferential treatment for the Overseas Dominions and reciprocity between the Allied Nations.

Overhead Ground Wires

The following suggestions are offered to "Hydro-Electric" in reply to his inquiry in our March 1 number re "Overhead Ground Wires." If the information contained in the inquiry had been more complete, more definite assistance could have been given.

Toronto, March 6, 1916.

Editor, Electrical News:

Re inquiry of "Hydroelectric" in Electrical News.

There is no objection to the installation of an overhead ground wire in the described installation as long as a secure construction can be made, which will exclude any possible chance of the ground wire breaking under the most severe weather conditions or getting into touch with the live wires, should whipping occur.

It must not be expected, however, that the ground wire will offer full protection against lightning. Practice has pretty well established the fact that the overhead ground wire is only able to minimize but not eliminate lightning troubles. How great the protecting quality actually is, has so far not been established.

Where the overhead ground wire can easily be installed and at a low cost, it is worth installing it. Its installation, however, is not always warranted where it involves a considerable expenditure.

Yours truly,
P. Ackerman.

Montreal, March 1, 1916.

Editor Electrical News:

I have noticed in the Electrical News of March 1st, a letter headed "Overhead ground wires" and am at a loss to understand the situation.

If I understand the letter aright a transmission extending only for 300 yards has been repeatedly struck by lightning, for the lightning protection is referred to as having "many times proved not to be sufficient."

The writer would not install either lightning protection or overhead ground wires on such a short transmission, believing that the expense and complication is not warranted by the risk. As, however, the writer states that the arrestors have acted many times, it would seem likely that the trouble was due to surges from some cause or other rather than lightning, such as by switching or possibly sudden shifts of load.

Yours truly,
Engineer.

Fort William, March 3, 1916.

Editor, Electrical News:

Re "Hydro-Electric" query, as to benefits of overhead ground wires. While we use overhead ground wires on our long distance transmission lines, and consider them beneficial, we have never found them necessary on our 2200 or 600 volt feeders.

I note H. E. uses 960,000 c.m. cable. Owing to the skin effect, and as a matter of efficiency, we practically limit the maximum size of our cables to, preferably, 1/0 B & S copper, or equivalent, or 2/0 at the outside.

Am inclined to think H. E. must have some inherent weakness in his equipment, the type of arrester or method of connection to ground. Avoid arcing grounds, or arresters in metal cases. Try arrester on each phase, each to a separate ground, on three consecutive poles. Make good connection to galvanized pipe, driven seven feet into moist ground. Salt, in and around each ground pipe, will improve ground, but decrease life of ground pipe.

Insert an ordinary transformer cut-out fused at 15 amperes in each ground wire, to interrupt dynamic current, until trouble located. Fuse should never blow if arrester working properly.

Yours truly,
W. L. Bird.

Winnipeg, March 6th, 1916.

Editor Electrical News:—

It is quite possible that the installation of a ground wire, as suggested, would be of some benefit. It is, of course, impossible to state what would be the best protection and what is the probable cause of the trouble complained of unless further information is given as to the location of the line and its exposure to atmospheric conditions. It may generally be stated that some gap-arrestors on a high power circuit and adjacent to the source of supply, are seldom satisfactory owing to their discharge capacity being altogether too small. I note that it is stated that the ground wire is of ample capacity and leads in each case directly to running water. From this it does not follow that the ground connection is satisfactory, as the resistance of water in different localities varies so much that it is quite possible that the fact of immersing the ground plate or wire in the water may give a very high resistance to ground.

A far better method of grounding would be to connect, if possible, to some system of water piping, or if this is not possible to install properly designed grounds which give ample surface.

It is also possible that some other type of arrestors might give better service. There can be no objection to installing a ground wire provided that it is mechanically sound and that the ground connections are properly made.

Yours truly,
J. G. Glassco.

Electric Power Co. Sells Out to Government

Hon. G. Howard Ferguson, Minister of Lands, Forests and Mines, has announced that an agreement has been signed with the Electric Power Company by which the Government buys outright the various water power and electric interests in the Trent Valley District, paying for them in Ontario Government 4 per cent. bonds to the amount of $8,350,000. It is understood that this system will be operated along lines similar to those followed in southwestern Ontario by the present Hydro-electric power commission of Ontario and that the eastern section of the province will now enjoy the privileges of light and power at cost as in the Niagara district.

Who are the true patriots in time of need—those who venerate the land, owning its wood, and stream and earth, and all they produce, or those who love their country, boasting not a foot of ground in all its wide domain?

Old Curosity Shop.

Vancouver's Development

By W. R. Bonnycastle

The physical and climatic advantages of Vancouver over the Eastern or Middle West cities are so well known that it is unnecessary to spend space or time in discussing these advantages. The disadvantages of Vancouver in the past have been its situation on the Pacific Coast, a small population of its own, and great mountain ranges between the city and the larger population on the other side. The consequence of these conditions has been to prevent Vancouver from being able to compete in the markets of the Middle West with the manufacturing cities of the East, in spite of the much greater distance of transportation from the eastern manufacturing centres.

There have been other reasons besides a limited market for the slow development of Vancouver as a manufacturing city.

Vancouver for some years has been a fools' paradise, and its population has included a lot of gamblers and speculators. Labor has been high-priced, inefficient and independent; capital has not been obtainable for legitimate development, but has been used for high finance and wildcat promotion; fair concessions and bonuses could not be obtained by prospective manufacturers, and the prices of sites and power have been exorbitant.

It is useless to dwell on the folly of the past—the live members of the population of Vancouver realize conditions and are adjusting themselves to meet the new demands, but, unfortunately, the live ones are only a very small proportion of the total population. Some of the electorate will ultimately see the new light; a large portion still dream of a returned prosperity, but are doing nothing to help push.

What Vancouver needs is new blood. Business men who can see not only the present necessities, but can look ahead and prepare for the time when Vancouver has become a large city. The time to meet the various problems which arise in the growth of a city is not when that problem is clamoring for solution and must be solved, but each problem should have been forseen and prepared for, as much as possible, years before.

City Needs New Blood

The old-timers in Vancouver have been too much in evidence; they have been sticking together and controlling the policy of the district and it is not reasonable to suppose that men growing up with a small town and knowing nothing of the problems of a large city would be able to look far ahead and provide for future expansion without grave mistakes.

The parting of the ways is here for Vancouver and the people must make their choice; even the most narrow-minded, ignorant, hide-bound policy cannot prevent Vancouver from growing, but it can seriously hamper its growth and prosperity and prevent it from taking its rightful place as one of the largest and most prosperous cities of Canada. An awakening of the people and a grasp of the problems which even now confront the future of the district is necessary—not ten or even five years hence but—now.

Several of the disadvantages which confronted the district have been reduced or have entirely disappeared. New railroads have lately been put into operation, opening up new districts and reducing the grades over the mountain ranges between Vancouver and the Middle West, so that competition with eastern cities might be successful throughout the prairie towns. The Panama Canal has brought Vancouver much closer to European and South American markets. The great industrial awakening of the far East has opened up a new field of great possibilities.

The mining and lumbering industries of British Columbia are still in their infancy. Foreign capital must be obtained to develop these industries, but the people of Vancouver can help to bring in this capital and develop industries to supply the necessary equipment, labor and material required for their operation.

There are other requirements, too, for a great manufacturing city, and one of the most important necessities is a large supply of cheap electric power. There is a fairly large supply of power available in Vancouver at present, but is this power cheap enough to encourage the establishment of manufacturing interests, to overcome the many advantages of a manufacturing point in the east near the centre of population with transportation facilities in every direction? It is not enough to offer power as cheap as it is in the East; it must be available in large quantities at a considerably cheaper rate. Electric power is one of the few commodities that is constantly growing cheaper.

The installation charges of the average plant, either for steam or water power, are growing less, while the efficiency of operation is growing greater. Consequently, the rates for electric service are being reduced all over the world.

Are Vancouver and vicinity getting their share in these reductions?

Lower Current Cost

New inventions and improvements are being made every day in electric appliances for heating and cooking. The efficiency of these appliances is steadily increasing and the cost decreasing. If a proper rate were obtainable for the electric energy necessary to operate these appliances every home in Vancouver could be so equipped that a considerable saving could be made in the present gas and coal bill and a degree of cleanliness and satisfaction obtained which is impossible under present circumstances.

Would Vancouver use more electric energy if the present rates were cut in half? Electric energy will some day be so cheap that it will be used as freely as water in your home. Will the people in Vancouver be the first or the last to realize these conditions?

The solving of the problem lies within the hands of the people of Vancouver and the surrounding municipalities. There is no city on this continent better situated for a large supply of cheap power. To-day the clouds are very black, but to-morrow or next day the sun will shine. Will the people of Vancouver prepare to-day to take advantage of the sunshine to-morrow, or will they wait until the sun is shining, thereby losing the first bright hours—the best part of the day?

There is several hundred thousand horse power of hydro-electric energy within a reasonable distance of Vancouver waiting to be developed, and with proper economy this power can be delivered to Vancouver and vicinity at a cost not to exceed $10 per horse power per annum. The construction cost of this power, delivered to a distributing station in Vancouver, would not exceed $75 per horse power of continuous power, which compares favorably with the construction cost of any other power development on the continent.

With a strong business administration and economical engineering the present rates for power and light could be cut in half as soon as the plants could be put in operation, and the rates could be further reduced as the demand for service increased and the power plants increased their capacity.

There are financial reasons why no new power company will enter Vancouver, but if the people of this district want a progressive policy in the supply of an unlimited quantity of cheap electric energy they must organize and act energetically to take advantage of their golden opportunity. There is said to be over twenty million dollars in the savings banks of Vancouver, and I know of no better investment for a portion of this money. An examination of the stocks of the various power companies of the world will, with very few exceptions, show a very healthy condition of affairs, and Mr. F. A. Vanderlip, President of the National City Bank of New York, says: "Four hundred millions a year, eight millions a week of fresh capital, can profitably be used in the development of the whole broad field of the electrical industry in the United States during the next five years."

Are the people of Vancouver going to allow one of the greatest of their natural resources to pass into the hands of private companies, as they surely will within the next few years?

The development of these water powers by private companies will, it is true, be of great assistance to the growth and prosperity of Vancouver, but not nearly as much so as if the people themselves should retain under their control the great powers which lie at their doorsteps.

Do not content yourselves by saying that Vancouver has no money at this time for such undertakings; there is plenty of money to be obtained, and now is the time to make a start so as to be ready when the demand comes. **Wake up, Vancouver!**

Electricity in a Modern Hotel

By Arthur J. Cantin

The Macdonald Hotel, the new Grand Trunk Pacific hotel at Edmonton, which was formally opened to the public on July 6, 1915, is quite the latest word in hotel equipment, being noted for its modern electrical fixtures and domestic appliances. The hotel management have installed their own generating system, and completely operate the hotel by electricity. With a connected load of nearly 350 h.p. in motors, and about 3,000 tungsten lamps ranging from 15 to 200 watts, the Macdonald Hotel represents an electrical load which would be attractive to any electrical service company. Typical load charts show the average maximum demand for energy for the entire establishment to be about 170 kw. The peak load occurs about 6 p.m. and the minimum load generally during the early morning hours, when the use of general lighting is a minimum and the demand on the various pumps is light. An average of the monthly reading of the totalizing watt-hour meter shows that the hotel uses approximately 40,000 kw.h. per month.

The hotel management could not see their way clear to connect the load to the municipal plant, on account of a city by-law by which no contract for lighting can be entered into for a period longer than one year, because of the uncertain valuation of the power rates. The hotel management therefore built their own generating plant.

There are four horizontal return tubular boilers of 150 h.p. operating under 125 lbs. pressure. These boilers were manufactured by the Goldie McCulloch Company, and are located in a boiler room in the basement, with the engines, generators and switchboard in a separate room. The prime movers consist of two 100-h.p., one 125-h.p., and one 75-h.p. Ideal engines manufactured by Goldie & McCulloch, with Ritis inertia regulators with a guaranteed variation of speed not to exceed two per cent. The engines are direct connected to Triumph Electric, three-wire, direct current 110-220 volt, 250 r.p.m. generators.

To secure a pleasing illumination effect in the lobbies, dining rooms, ball rooms, corridors and other public places, elaborate chandeliers and concealed lighting fixtures have been employed. An especially handsome effect has been obtained in the dining room by concealing lamps in reflectors behind frosted glass. In order to obtain long life in these lamps, 120-volt units are used on a 110-volt circuit. In addition to the general illumination of this room, portable lamps harmonizing with the decorative scheme of the room are placed on some of the tables.

In the main lobby, massive but graceful fixtures hung at various points diffuse light from one hundred 40-watt lamps, thus supplying a soft and even illumination which is supplemented in the alcoves by smaller diffusing units of similar design. Additional light for the clerks' desks and hotel register is afforded by small lamps. These lamps also prominently display signs directing patrons to the proper clerk to apply to for, "Information," "Rooms," etc.

Another type of hanging fixture has been used in the ball-room. The lamps in these fixtures supply but a part of the lighting for the room, the remainder coming from concealed units. Twenty-watt tungsten lamps are used in the wall candelabra fixtures.

There are about 30 electric motors in the building. To supply ice and artificial refrigeration, two motor-driven Linde Canadian refrigerating machines have been installed. They are ten-ton machines, and are operated alternately. There are twenty-three small refrigerators distributed in the kitchen, various dining rooms and the bar.

The control apparatus for the two refrigerating machines is grouped on a marble board. Leads enter and leave this panel board from the top, so that all live connections, rheostats and starters are concealed. There is also a small panel which controls the operation of the vacuum pumps working on the steam-heating system. These pumps produce a vacuum of 12 ins. to 14 ins. mercury column. Steam enters the heating system from the engine at about 1 pound pressure, but a by-pass is provided so that when the weather is cold live steam from the boiler may be admitted directly to the heating system. Two steam pumps lift water from the city mains to a tank situated on the top floor of the hotel. Water for house service is then fed by gravity to the various parts of the hotel. Washing, drying and ironing is performed electrically in the hotel's laundry.

The following is a list of the principal motors and the machines they operate:—

Machine	Motor		r.p.m.
1 6 Poll., 120-in., flat work ironer.	1—4 h.p.,	220 v.,	1870
1 body ironer	1—1½ h.p.	"	600
1 collar and cuff starcher	1—1/6 h.p.	"	1200
1 dry room	1— ½ h.p.	"	900
1 collar and cuff dampener	1—1/6 h.p.	"	100
1 collar and cuff ironer	1—2¾ h.p.	"	1100
1 finishing table	1—1/12 h.p.	"	1125
1 sleeve ironer	1— ¼ h.p.	"	600
1 sewing machine	1—1/7 h.p.	"	600
1 washing machine	1—2¾ h.p.	"	1000
2 washing machines	3—2 h.p.	"	1100
1 tumbler	1—2¾ h.p.	"	
2 30-in. extractors	2—5 h.p.	"	1200
1 20-in. starch extractor	1—1 h.p.	"	1200
1 drying tumbler	1—2 h.p.	"	1200
1 fan	1—2 h.p.	"	1000
1 coffee mill	1— ¼ h.p.	"	1650
1 sump pump	1—1¾ h.p.	"	1500
1 carbonating machine	1—1/8 h.p.	"	1800
1 knife cleaner	1—1 1/3 h.p.	"	2300

The main switchboard consists of eight panels of uniform size, 66 in. by 24 in., with sub-panels 24 in. by 24 in., or a total dimension of 16 ft. by 7½ ft. The material used is the best quality of slate, 2 inches in thickness, and painted with Egyptian lacquer to present a lasting black finish in harmony with the copper appliances mounted thereon and free from attacks of oil and dirt. The board rests on a six-inch channel iron base partly embedded in the cement floor, and is supported by a two-inch angle iron frame, supported from the wall by material of a like character. The board was designed with the view of locating the instruments and switches in the most natural position for the convenience of the operator. The instruments are on a level with the eye and the switches at the proper height for the average person. Beginning at the left, the first four panels are generator panels, connected to their respective generators according to their location. Following these are the 220-volt power panel, two 3-wire and two-wire lighting and 110-volt power panels. The last panel provides connection with the city power in case of accident to the hotel plant.

The circuit breakers on the generators are located between the generator and the main switch. A three-wire copper busbar is connected to all panels, with the main equalizer bus connected to all generator panels. The generator rheostats are mounted on angle iron frames firmly bracketed to the framework of the switchboard. All cables are run underground in conduits, and are carried from the conduit ends to their terminals on cleats. The intervening space between the floor and switchboard foundation is left open to permit the passage of cables leading to and from the board. Openings are provided in the pit wall to the rear of the meter board for the passage of cables in connection with the board.

The main elevator feeders run direct from the switchboard to the distributing board located in the penthouse close to the roof. The elevator and dumb waiters are of the Otis-Fensom type and consist of the following: two passenger elevators of the traction type, having a speed of 300 feet per minute, operated by a 25 h.p. motor; one service elevator operated by a 20 h.p. motor and one baggage elevator controlled by push buttons located near the baggage or trunk room.

An elaborate system of ventilation has been installed which continuously supplies pure air tempered to suit the prevailing atmospheric conditions and simultaneously removes impure and obnoxious odors. The main ventilating fans are located in the basement, fresh air being drawn in from the areaway through enormous air washers. Tempering coils have been distributed throughout the building. A central telephone exchange connects every room and department in the hotel through numerous trunk lines with the main exchange of the city. Extensive telegraphic accommodations have been provided. A signal system on every floor enables a guest to locate an attendant at all times. Fire alarm signals and fire escape indicators are located in the hallway of each floor.

Steel Conductors for Transmission Lines

By H. B. Dwight.

During the past year the price of copper has doubled. While the same wide fluctuation in price has occurred at other periods in recent years, the rapidity of the present increase forcibly suggests that changes in the methods of using copper conductors might be profitable at the present time or in the near future. Although steel cannot replace copper on transmission lines in the majority of applications, there are well-defined cases where steel conductors may be used with good economy. Accordingly, a short comparison is given in this article of the characteristics of steel and copper conductors for overhead electric power lines.

The chief characteristic of steel wire that must be taken into account when considering its advisability as an overhead electric conductor is that it has from 7 to 14 times as much resistance to alternating current as the same weight of copper, depending on the kind of steel and the current density. The choice between steel and copper depends on the ratio between the effective resistance of the two metals, the ratio of their cost, and upon mechanical characteristics such as the greater strength of steel.

In the past, even with copper at a low price, it has been found advisable to use steel conductors for overhead lines for two main classes of work. First, on account of their greater tensile strength, steel cables can be used for long spans of half a mile or more, where the use of copper would be impracticable. In certain cases, with comparatively heavy current, the steel cable has been used merely to support a copper conductor, but in many instances the steel cable has carried the current.

The other class of work is in branch lines to comparatively small isolated customers. It is not usual to employ in overhead work a smaller copper conductor than No. 6 B. & S. because a conductor of at least that size is required for mechanical strength. However, it frequently happens that as far as electrical reasons go, a smaller size than No. 6 copper would be sufficient to supply a certain load, and in such cases it has often proved profitable to use a steel conductor which would have just enough conductivity to carry the current, and would have ample mechanical strength.

Examples of cases where the above practice has been considered economical have been recently described. A No. 8 copper clad steel line about 10 miles long was built in the State of Washington to supply a 50 h.p. motor load at 6,600 volts. This line afterward carried 110 h.p. for some time, and was later changed to No. 6 copper in order to carry a still greater load. It is also stated that on the same system a considerable quantity of No. 8 iron wire for short tap-offs and lightly loaded branch lines on 6,600 volt circuits is used, without serious trouble resulting from voltage drop.*

In Minnesota a 40,000 volt branch line 20 miles long is being built with No. 4 galvanized steel cable. This will have only 7 per cent. drop at the estimated load of 400 kva., when calculated according to the data of Fig. 1. A No. 6 copper line would carry 2,500 kva. with the same drop, so that there is evidently a considerable margin for the use of steel conductors for small branch lines of a high voltage system of this kind.

In the above manner, a power company in its efforts to build up new loads can send out several inexpensive branch lines using steel conductors. Where these prove successful and the load grows, the lines may be re-wired with copper, possibly at lower than present prices. An alternative method of delivering an increased load would be to install an induction regulator to overcome the excessive voltage drop and voltage variation.

It is evident that when copper is unusually high in price, the opportunities for using steel conductors with profit are increased. In order to make an approximate determination whether steel conductors may be suitable for a given case, certain resistance and reactance data are given in Figs. 1 and 2.

This has been compiled from the results of tests published by the Bureau of Standards.† No attempt has been made to give the characteristics of all the kinds of iron and steel conductors which might be used. However, the grade of wire with the lowest resistance to direct current should not necessarily be chosen, for it sometimes happens that

*The Electrical World, p. 469, Aug. 28, 1915.

†Effective resistance and Inductance of Iron and Bimetallic Wires, by J. M. Miller, Scientific Paper No. 252, Bureau of Standards, Washington, D. C., August, 1915.

commercial steel wire, whose characteristics are given in Figs. 1 and 2, has a lower impedance to the comparatively heavy alternating currents used in power transmission, than a purer and more expensive grade of iron or steel designed for telephone and telegraph work.

The information in Figs. 1 and 2 is easily used. Since the impedance of the transmission line changes with the load, the resistance and reactance must be taken for the current to be considered. The reactance is made up of the internal reactance plus the external reactance. The latter may be obtained from ordinary transmission line tables. The calculations for voltage drop and power loss are then made in the same way as for copper transmission lines.

The higher price of copper may have already enabled steel to supersede copper for another class of work, namely, for bare conductors in direct current circuits. Certain grades of common commercial steel have a resistance to direct current circuits about 8 times that of a copper conductor of the same size, and therefore 7 times that of a copper conductor of the same weight (copper being more dense than steel). It follows that when the price per pound of steel cable is less than 1/7 that of copper, steel will be more economical with direct current, if the large size of the steel cable is not a disadvantage. But direct current conductors are nearly always covered with insulation, so that a small conductor is an advantage, and steel can only be considered for the rare cases where bare conductors are used for direct current, as possibly for feeders for interurban railroads.

For the main lines of alternating-current power systems, steel cables may not have an opening as yet, though it is nearer than would at first thought be supposed. For 25 cycles the d. c. resistance is increased about 30 per cent.,

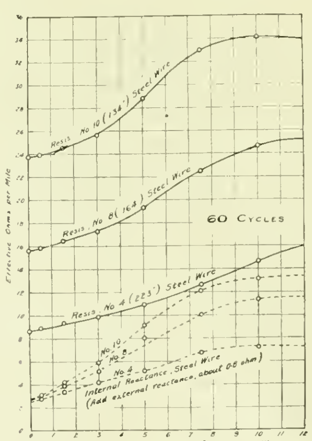


Fig. 1.—Resistance and Reactance of Steel Conductors at 60 cycles.

and for 60 cycles, as much as 100 per cent. with conductors less than about 50,000 c. m. and with average loads. If one assumes the usual limitation, that the line must be designed so that the steel cable can be replaced by a copper one when desired, steel will probably not be found as economical as copper, even for 25 cycles. However, if the line be specially designed for the permanent use of steel conductors, with higher voltage than would otherwise be used and with extra long spans to reduce the number of towers, it might prove to be a surprisingly close competitor of the usual type of copper transmission line.

Summary.—(1) The most common use of steel conductors is for lightly-loaded branches and extensions of transmission lines. Steel should be used with greater freedom in such work when copper is higher in price.

(2) When a certain load is to be transmitted, the voltage to be chosen should be higher if the conductors are of steel, than it normally would be if they were of copper.

(3) Long spans are possible with steel conductors, and economies can be made by reducing the number of towers and sometimes by shortening the distance of transmission.

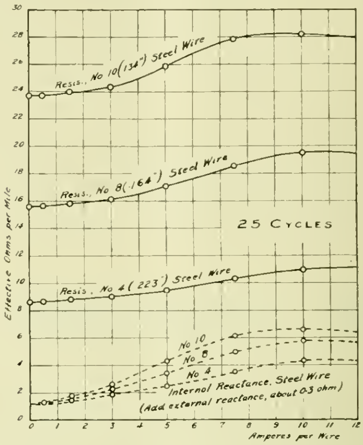


Fig. 2.—Resistance and Reactance of Steel Conductors at 25 cycles.

(4) Steel cables are better conductors for 25-cycle than for 60-cycle current.

(5) Steel cables are better conductors for direct than for alternating current. For bare direct-current conductors steel is more economical than copper when the price per pound of steel cable is less than 1/7 that of copper cable.

(6) In order that the economies to be obtained from the use of iron and steel conductors for power transmission may be taken advantage of more generally, the resistance and reactance of various grades and strandings of cables should be measured and published. Such information is very incomplete at present.

Winnipeg Jovians Present Prizes

At the regular luncheon of the Jovian Order held on March 1 the usual program was dispensed with, and instead, the prizes were presented to the successful players who took part in the recent Jovian Bonspiel. The Rev. J. B. Hindley presented the prizes.

The premier event was won by R. H. Howard whose rink included J. Pratt, third, E. J. Brown second, and J. R. Stienhoff lead.

Mr. Howard played off against J. F. S. Madden, of the Canadian General Electric Company. Mr. Madden is president of the Jovian Order and his rink included: F. E. Garrett, lead, F. W. Blythe, second, and J. B. Minns, third.

The league cup was won by James Bloomer, skip, who played against F. E. Filer, skip, in the final event.

A feature of the meeting was that about fifteen minutes was taken up with one minute speeches in which each unsuccessful skip showed exactly how he did not win the cup. This grand oratorical cup was won by R. H. Mainer.

There were 60 members and guests present.

Montreal's New Street Lighting System

Modern underground distribution system displacing dangerous street poles and wires. Inverted magnetites on special standards

An ornamental lighting system,—the cables for which are installed in the municipal conduits,—has lately been put into operation in Montreal. The streets lighted by the new system are St. Catherine Street, between Atwater and Papineau Avenue, a distance of 2¾ miles, Bleury Street and Park Avenue, between Craig Street and Pine Avenue, a distance of one mile. The system is now being extended down town to include Craig, St. James and Notre Dame Streets and Fortification Lane between Victoria Square and St. Lawrence Street, the square being included. The light is furnished by ornamental inverted magnetite 6.6 ampere arc lamps mounted on cast iron standards of special design.

On St. Catherine Street there are 141 of the new lamps, replacing 57 aerial arcs, while on Bleury Street and Park Avenue 41 of the new lamps replace 18 aerial arcs. These 182 lamps are divided into four circuits, so interconnected in pairs that should one circuit be interrupted some of the lamps on the end of the circuit can be thrown on the other circuit by changing the connection of the four point cut-outs in these lamps. The down-town system will have 91 new lamps to replace the 43 aerial arcs now in service. These 91 lamps will be divided into two circuits. The lamps are spaced at an average distance of 125 feet on alternate sides of the street, there being one standard at every intersection and two standards at important intersections and transfer points.

The cable carrying the current to the lamps is No. 6, twin-conductor, paper-insulated, lead-covered, 7500 volt cable, and is installed in a special duct of the Municipal Conduit System which loops in and out of each standard. The cut-outs are of the absolute type, and were especially designed to meet the requirements of the Light Department, having four accessible terminals. The location of faults in the cable is thus greatly facilitated, as all four conductors can be exposed in every standard. The leads from the cut-outs to the lamps are No. 6, single conductor, varnished cambric insulated and braided cable. The cables and leads were subjected to a factory test of 20,000 volts for 30 minutes and a test of 10,000 volts for 5 minutes after installation.

The cost of the erection now in operation was approximately $42,000—and the cost of the erection now being installed will be approximately $25,000.

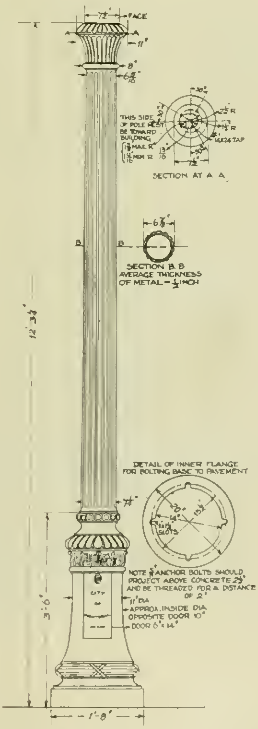
The contracts for the supply and installation of the standards, which included the construction of the concrete bases, were let to G. M. Gest, Limited, of Montreal, Winnipeg and Vancouver, for both sections. The contracts for the supply and installation of the lamps (the glassware for which was manufactured by the Jefferson Glass Company, Limited) were let to the Canadian General Electric Company for both sections, while the order for the supply and installation of the cable and cut-outs was given to the Eugene F. Phillips Electrical Works, Limited, for the system now in operation, and to the Northern Electric Company for the section at present being installed. The cut-outs are manufactured by the Northern Electric Company.

The current for the lamps is supplied by the Montreal Light, Heat & Power Company, under a ten years' contract, at $72.70 per annum per lamp, this price including the supply of station apparatus and the general care and maintenance of the whole system.

The putting into operation of the municipal conduits and the new lighting system on St. Catherine and Bleury Streets, and Park Avenue has enabled the city to remove a considerable part of the unsightly poles and overhead wires from these streets, and the remainder will be removed as soon as conditions permit. The clearing away of this aerial equipment, of which there was a great quantity, has greatly improved the appearance of the streets—especially when seen at night under the brilliant illumination of the new lights. The clean and uncongested appearance of St. Catherine Street as compared with that of former days is especially noticeable.

As soon as the Municipal Conduit System is extended over other districts the new lighting system will also be extended. The districts now under consideration are the section of the city bounded by Commissioners, Notre Dame, McGill and St. Lawrence Streets, and the district comprising St. Lawrence Boulevard from Craig Street to Sherbrooke Street. The work of preparing the estimates, plans and specifications for the new system and the general supervision of the installation was under the direct charge of Mr. Arthur Parent, superintendent of the Light Department, and Mr. P. S. Gregory, his assistant.

The removal of the poles and wires above referred to



Design of Montreal's new lighting standards.

was only possible owing to the construction of underground conduits. In the spring of 1913 tenders were first called by the Electrical Commission for the installation of the conduits. Contractors from many sections bid on this work, G. M. Gest, Limited, being the successful tenderers.

The first installation was made on St. Catherine Street from Guy Street to Papineau Avenue, conduit being placed in the sidewalks on both sides of the street with runs at each intersecting street, while at very important corners these runs were placed at each side of the intersecting street. Later in the same year the ducts were extended on St. Catherine Street from Guy Street to Atwater Avenue, and a system was also installed on Bleury Street from Craig to Sherbrooke Streets, on both sides of the streets, and on Park Avenue from Sherbrooke Street to Pine Avenue, but on the west side of the street only.

The following year the downtown section was constructed on Notre Dame, St. James and Craig Streets from St. Lawrence Boulevard to McGill Street and Victoria Square, including all intersecting streets within these limits, and Fortification Lane. G. M. Gest, Limited, made this installation, as well as that on the two preceding contracts, and in the meantime completed another contract on St. Lawrence Boulevard from Notre Dame, southward.

It was during the construction of the downtown section that the war started, and the work was ordered closed, but through the negotiations of G. M. Gest, Limited, with the city of Montreal, the former carried on their work successfully, thereby giving employment to many men.

In all the conduit contracts the same general type of construction has been used. Three and one-half square bore

15 duct run showing concrete encasement.

tile duct has been used for all light and power cables, excepting that for the services into the buildings, which are of 3½-in. fibre. The top ducts for the police and fire alarm signal wires, street lighting, Gresham Guarantee Company, are 3½-in. fibre, and are separated by a concrete fill from the balance of the system. The ducts are all enclosed in a three-inch concrete encasement, and graded to drain through the manholes at each end.

Main and service manholes are of concrete of octagonal shape, the 6 ft. x 8 ft. holes occurring at street intersections, with service holes 4 ft. x 6 ft. located between street corners, providing for services into all buildings. Each hole is drained through a trap and connected to the street sewer, thereby affording perfect drainage through the whole system. Ventilated covers are provided and these are of such design as to give sufficient strength without being unduly heavy.

Each of the operating power companies is provided with its own transformer manholes, which in general are about 10 ft. x 12 ft. with 8 ft. headroom. These are located in the side streets and are connected with the main manholes by fibre pipes. They have covers made in three sections of ample size to admit of transformers being placed. These holes are also of concrete and are connected to the sewer through a trap.

Owing to sub-surface conditions of many of the streets,

St. Catherine Street, Montreal.

it seemed at times almost impossible to place some of the intersecting runs and manholes, as the streets were already filled with the sewer, gas and water pipes on each side, the duct systems of the Montreal Light, Heat & Power Company, and the Bell Telephone Company. However, the past experience of the conduit contractors was of great service in overcoming these obstacles, and in no instance was it found impossible to make an installation as required.

The Bleury Street and Park Avenue section differed from that of the other streets in that a portion of the system was made jointly with the Bell Telephone Company, having separate ducts and manholes. These joint holes had a common wall, but with enough offset on each side to allow ducts to take care of the distribution in intersecting streets.

The telephone ducts are of multiple tile, and at all points are separated from the power ducts by at least six inches of concrete and gradually fanning out to reach the manholes. In addition to the power company having cables in the municipal ducts, the street lighting occupies a duct as also the fire alarm system. Ample space is provided so that future electrical needs can be taken care of without undue crowding.

It is the plan of the Electrical Commission to gradually extend the conduit system over the entire city of Montreal, removing all overhead wires and poles, thereby making Montreal entirely free from delay and danger to which it had been subjected in the past.

The Toronto & York Radial Railway Company have completed the electrification of their Schomberg line, which runs between Schomberg and Schomberg Junction. This work has been under construction for some months and according to recent announcements is now completed. For a number of years this branch has been operated as a steam road.

Cedars Rapids Electrical Development

Mr. R. M. Wilson Describes the Details of Installation and Operation of the Electrical Equipment, before the Can. Soc. C. E.—Nine Units of 10,000 kv.a., Each Already Running at Capacity with Load Factor over 90 per cent.

(Concluded from March 1)

Heating System

The heating system in power house and transformer house were designed for electric heating. The question of steam heat was gone into very carefully, but due to the nature of the load on the plant it was found that considerable heat would be obtained from the units themselves. This was one of the reasons for adopting electric heat as well as the high initial cost of the steam installation and the difficulty of getting cheap fuel.

It was found upon investigation that approximately 7,100,000 B.t.u.'s per hour were required in the coldest weather. This is equivalent to 2100 kw. per hour. Our load conditions on the plant at present provide in losses given off in heat 1100 kw. and in order to provide the balance of 1000 kw., a number of heaters were installed in suitable locations.

The number of heat units required for transformer house is 1,600,000 B.t.u.'s per hour, and is furnished from electric heaters consuming 500 kw. per hour.

The lighting and heating systems are provided with the necessary energy from transformer banks connected in delta, both power, light and heat are taken from the same transformers. The power and heat at 220 volts and the lighting at 110 volts.

Transformer House

The transformer house is a reinforced concrete structure built on the unit principle, and contains approximately 1,825 units; its size is 228 ft. long, 130 ft. wide, and 90 ft. high from basement floor to roof. In this building is installed a double system of 6600 volt generator busbars, with necessary oil switches, disconnecting switches, control panels, meters, etc.; also a double system of 110,000 and 66,000 high tension busbars, switches, etc., as well as the step-up transformers for the Massena and Montreal systems. The load per sq. ft. on all footing is 2,500 lbs. This loading may appear small, but owing to the nature of the soil on which the building rests it was not considered advisable to adopt a greater loading. The building is equipped with electric crane, turn-table and transfer table, for handling the apparatus quickly in case of repairs. There were several reasons for having the step-up transformers removed from the power house, principal among which was the desire not to have large quantities of oil in too close proximity to our generating apparatus. It permitted much easier construction arrangement in the exits for the transmission lines. There was also considerable saving effected in the rock excavation of the power house.

The tests carried out on the generating apparatus consisted of the following: efficiency, field characteristics, regulation, heat runs, over speed, high potential, oscillograph, test on Kingsbury bearings.

Efficiency

In making the tests to determine the efficiency of the unit a test was made to obtain the friction, windage and core losses by running the unit as a synchronous motor at the proper frequency and rated voltage. Owing to the design of the apparatus it was difficult to obtain steady enough readings on the instruments, and it therefore became necessary to determine the losses in question by another method. A method known as the "Decelleration Core Loss Test" was then employed, and a brief description of the results obtained by this test are as follows:

The unit under test is driven as a synchronous motor slightly above normal speed, having its fields excited with a constant current value. The driving force is then suddenly cut off and the unit allowed to decellerate. This process is gone through with different field current values, and finally one set of readings is taken with no field current. In the first series of tests the decelleration is due to the friction, windage and core loss, and in the final test the decelleration is due to friction and windage only.

Readings were taken at frequent intervals of speed and time and curves plotted for each value of field current having speeds as the ordinates and time as the abscissae. With the aid of these curves and the kinetic energy of the rotating parts a determination of the core loss, friction and windage losses is easily made.

To get the load loss a decelleration test is made with the armature leads short circuited and the field excited so as to create full load current to circulate through the armature windings. The decelleration curve is plotted under these conditions and the loss calculated in accordance with formula.

The friction windage losses as determined contained losses due to wheel and generator as they are direct connected. In order to divide up the losses between wheel and generator they were calculated in proportion to their respective weights.

When making tests for efficiency all water was drained out of turbine casing and manhole in draft tube opened to prevent turbine becoming air bound.

Field Characteristics

The field characteristics at different power-factors were determined by means of the no-load saturation and the short circuit impedance curve. It being assumed that the voltage generated under short circuit conditions was entirely consumed by the synchronous impedance and armature copper loss. With this assumption the normal volts were calculated for different values of load, and the corresponding values of field current on the no-load saturation curve was taken as the correct field current for that particular load.

The regulation was taken as the drop in voltage expressed as a percentage of no-load volts.

The values of terminal volts under different loads and power factors were taken from the same calculation that figured in the field characteristics and curves plotted having terminal volts as ordinates and loads as abscissae.

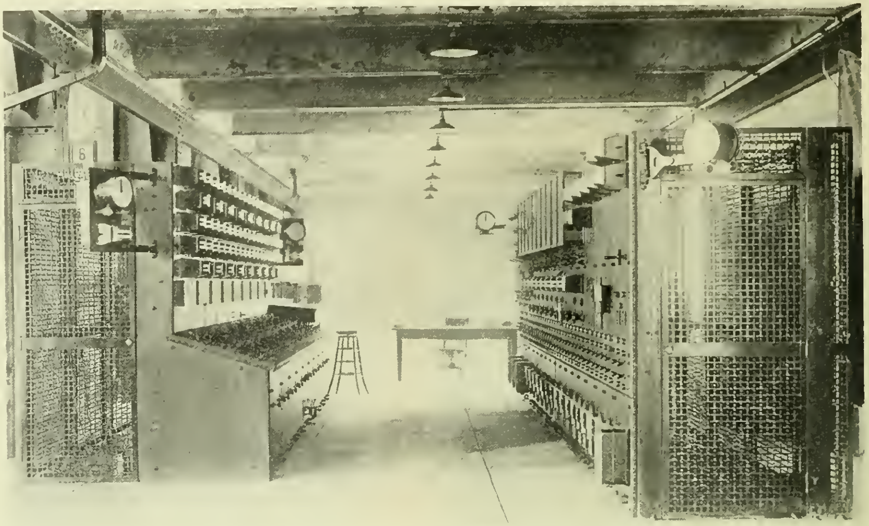
A line was drawn from the point on the baseline corresponding to 10,000 kv.a. cutting each of the curves. Where this line cut the curves the value of terminal volts were noted and regulation calculated.

Heat runs were made with various power factors and loads with different degrees of ventilation. The temperatures were indicated by the temperature coils installed in the units, and the air temperature surrounding the unit under test was determined from the average of several thermometers placed at different locations around the unit.

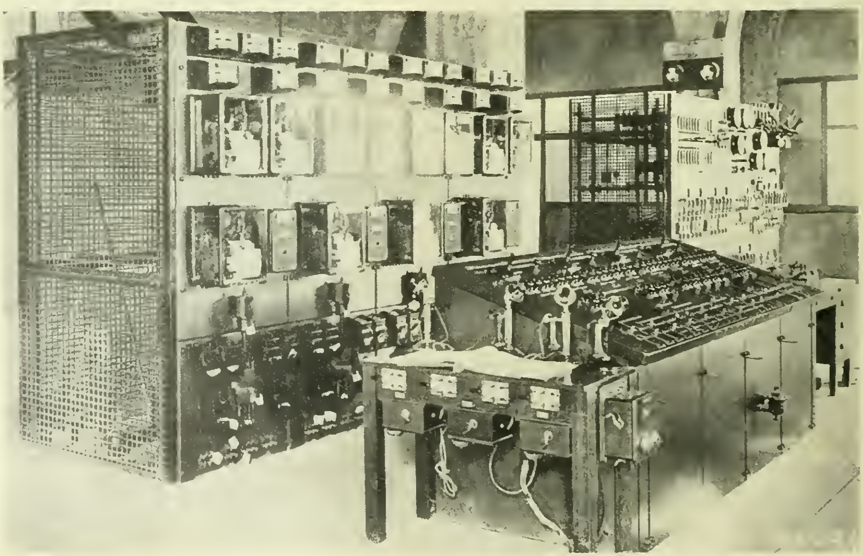
The over speed test was made by throwing the water wheel gates wide open and unit allowed to rotate without load or brake.

A high potential test of 15,000 volts was made on armature windings, and 2200 volts on field coils for one minute.

Oscillograph tests were made under all conditions of short circuits, including single phase and three phase, as well



Power House Switchboard—Cedars Rapids Manufacturing and Power Co.



Transformer House Switchboard—Cedars Rapids Manufacturing and Power Co.

as tests for wave form under different power factor conditions.

One interesting test was made by short circuit under normal load. It was performed as follows:—the unit was loaded by means of a water rheostat, located in the gate house, and the unit short circuited by means of a special oil switch.

At the moment of short circuit the field current jumped from 305 amperes to 500 amperes, and the armature current to approximately eight times normal current, the speed of the unit raising from 56 r.p.m. to 66 r.p.m., then back to 53 r.p.m., and finally settled down to 56 r.p.m. The wheel gate opening as a result went through a large variation, causing considerable water surge in the gate house.

Test on Kingsbury Thrust Bearing

Size of Machines Tested—10,000 kv.a. machine, main unit; and 1,250 kv.a. machine, exciter unit.

Object of test—A complete series of tests were run in order to determine: (1) friction losses in bearing at normal speed; (2) temperature rise of oil in thrust bearing casing with oil supply shut off for 30 minutes; (3) bearing brought to rest without application of brakes; (4) bearing running at 10 r.p.m. for one hour.

Preparation before test—Before the above tests were run care was taken to supply the proper amount of oil to the bearing, namely, 15 gallons per minute to the main unit and 5 gallons per minute to the exciter unit; also all oil meters and thermometers were calibrated.

Description of Tests

(1) Friction Loss—The oil supply to the bearing in gallons per minute and the temperature of the oil in the inlet and outlet pipes was measured. These measurements were then corrected according to the above calibration results and the net supply of oil delivered and the rise of temperature determined.

(2) Oil supply shut off for 30 minutes—This consisted of measuring the rise in temperature of the oil in the thrust bearing casing over a period of 30 minutes. A recording thermometer was used.

(3) Stopping without brakes—Guide vanes were closed and unit allowed to slow down. Observations taken of time and manner in which unit comes to rest. Special notice taken of the number of r.p.m. at which unit commences to vibrate before coming to rest.

(4) Low speed test—Unit brought up to normal speed and then allowed to slow down to about 10 r.p.m., this low speed being maintained for approximately one hour. Measurements were taken of oil supply in gallons per minute and the rise of temperature in the oil.

Resume

The friction loss in the bearing at normal speed was in every case found to be less than guaranteed (12 h.p.) the highest friction loss being 10.25 h.p. for main unit No. 8.

The units can undoubtedly run for several hours without oil supply, as far as the thrust bearing is concerned. The maximum rise in temperature of the oil was 4.1 deg. C., and in most cases not more than about 3 degs.

Test No. 3, stopping without brakes, is the most severe condition this type of bearing can be put under. The critical speed seems to be about 5 r.p.m. At this speed the oil film breaks down and the unit commences to vibrate. If the vibration starts before the speed gets down to 5 r.p.m., it usually means that one can look for trouble when starting up next time.

Test No. 4 was usually run after test 3, that is, after the unit was shut down without the application of brakes. The unit was brought up to full speed and kept there for a few minutes. If the temperature rose the unit was immediately shut down and the shoes and the runner inspected. If temperature was normal the speed was slowly reduced down as close to 10 r.p.m. as possible, and kept there for one hour. No trouble was experienced when running this test at 10 r.p.m.; the trouble always occurred when starting up.

The slow speed test for the exciter units was run between 18 and 30 r.p.m., as it was found impossible to keep the unit running at 10 r.p.m.

Mr. R. M. Wilson

Radiation Losses

In order to get the total heat generated in the thrust bearing, losses due to radiation must be added to losses specified in the above table. By looking through the recording thermometer charts for the main units it was possible to pick out a number of occasions when units had been shut down. Curves were then plotted giving the drop in the oil temperature per hour. From these curves new curves were plotted giving the radiation losses in horsepower. These losses were found to be fairly constant for the first three or four hours after the unit was shut down and then slightly decreased. The maximum radiation loss was 0.9 h.p., the minimum 0.3 h.p., giving an average of 0.6 h.p. 400 U. S. gallons of oil was assumed in the housing.

Total Horse Power Loss, Etc.

Total loads on bearing, pounds	550,000
Area of shoes, square inches	1,690
Unit pressure per square inch, pounds	325
Revolutions per minute	56
Mean surface speed, feet per minute	715
Frictional loss in bearing h.p.	8.6
Co-efficient of friction	0.00072

Reactance Coils

It has been stated that reactance coils have been installed in the bus bars for limiting the current at times of short circuit. In order to fully appreciate their value the following may be useful, the data furnished being for full plant capacity, Fig. 1.

Generator reactance equals 21 per cent.; bus reactance equals 4 per cent., based on capacity of one generator. The most severe short can exist when it takes place in section "C" or "D."

Three generators in section "A" have a combined reactance of 7 per cent., and will give 14.29 times normal current on dead short circuit on bus in section "A."

A short in section "B."—The reactance in the bus com-

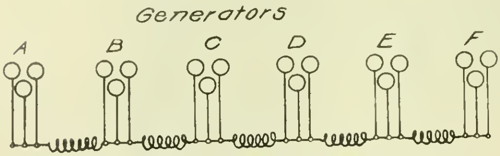


Fig. 1.—Reactance coils between bus-bars.

bines with the reactance of the generators and section "A" will deliver to section "B" $100/(7+4) = 9.11$ times normal current. Section "B" delivers 14.29 times normal current, making 23.4 times normal current.

A short in section "C."—The equivalent reactance of sections "A" and "B" with bus reactance is $100/23.4 = 4.28$ per cent. This can also be obtained by combining reactance of "B" with "A" and bus reactance $= \dfrac{1}{1/11 + 1/7} = 4.28$ per cent. 4.28 per cent. + 4 per cent. bus reactance = 8.28 per cent. $100/8.28 = 12.1$ times normal current flow from sections "B" to "C."

By the same method sections "D," "E" and "F" supply 12.85 times normal current to section "C" and the two generators not affected supply 9.5 times normal current, making a total of 12.1 plus 12.85 plus 9.5 equals 34.45 times normal current most severe short circuit.

Costs

The following summary contains the costs of the electrical installation for the first development of 100,000 h.p.

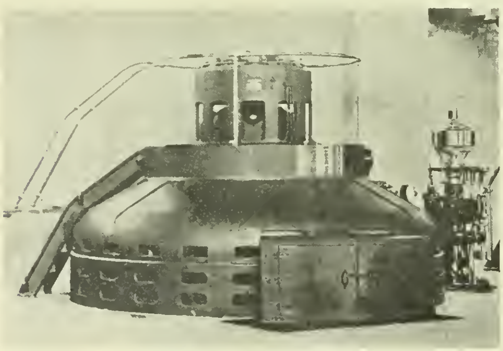


Fig. 2.—One of the exciter units.

These costs include engineering, supervision and interest during construction:

	Per Kw.
Generators, exciters and blower equipment	$10.04
Switchboards and H. T. switch gear	2.18
Switch cells and bus structures	.26
Control cables and conduits	.54
Main cables and ducts in P.H. and T.H	.23
Feeder cables, ducts and trestle	1.40
Auxiliary power cables and conduits	.28
Auxiliary transformers	.22
Auxiliary switchboards	.37
Storage battery installation	.11
Lighting system	.19
Heating system	.19
Miscellaneous	.24
	$16.25

The total cost of the transformer house, including crane, turntable, transfer truck, etc., was $3.02 per kw.; the cost per cu. ft. was 9 8/10 cents; the cost per sq. ft. of floor, 25 1/10 cents; number of sq. ft. of floor per kw., 1.2.

It might be of interest to note the following:—

225,000 ft. galvanized conduit was used for control lighting and heating circuits.

54,000 ft. 4-in. fibre duct used for main cables.

23,000 ft. 3½-in. square bore tile duct was used.

277 cubic yards of reinforced concrete for switch cells and bus-bar structures at an average cost of $58.70 per cu. yd.

The following were the contractors for the various apparatus:—Generators, exciters, switchboards, General Electric Company; cables, Northern Electric Company; blower equipment, Sheldons, Limited, Galt, Ont.; auxiliary transformers, Canadian Westinghouse Company; conduit installation, G. M. Gest; cranes, Whiting Foundry Company; storage battery

Fig. 3.—Section of high tension room.

equipment, Hart Accumulator Company; lighting and heating switchboards, Monarch Electric Company.

Operation

The plant was first placed in commercial operation on December 27th, 1914. Since this date the load has been gradually built up, until at the present time the plant is operating at its maximum output with a daily load factor of over ninety per cent.

During the present year's operation everything has worked out smoothly, and very little trouble has been experienced.

The number of men forming the complete operating staff for power house and transformer house is 24 in three shifts of 8 men, each working on an eight-hour shift, with one operating superintendent.

The excellent results obtained in operation to date are in no small degree due to our superintendent, Mr. W. G. Hullett.

Mr. Smith, in his paper, has given the personnel of the staff engaged on the Cedars Development, and in concluding this paper I desire to express my thanks to my associates who have assisted me in its preparation, particularly Mr. A. Gall, Mr. Svenningson, Mr. Alex. Wilson and Mr. George Hawley.

In the Public Eye

A budget of comment presented in the interest of public welfare, independent of party politics and with malice toward no one.

I wonder what Premier Hearst and his friends think now of J. R. Fallis, and at the same time I would like to know whether Sir Robert Borden has seen the handwriting upon the wall. Fallis is the man who used to represent Peel county, Ontario, in the local legislature. The Davidson Commission showed him up in connection with profits he is said to have made in purchasing horses for the Government. Many a man has disappeared from public life for dealings of this kind, but Fallis did not see it this way; neither did Premier Hearst. Fallis simply resigned and sought vindication by the re-election route. Peel county electors took a different view of it, however, and turned Fallis' former majority of 627 into a Liberal majority of over 300; a turn over of about 1,000 votes. They have given the first public reply to profiteering methods.

Fallis' defeat is a lesson for Fallis, and a pretty clear announcement of the downfall of any others who follow his ideals. If Fallis had made his commission honestly on the horse deals he should have kept it. Handing it over for a patriotic purpose and then seeking re-election was too much for independent Conservatives to stomach. They simply felt that a member of the Government, in his own interest even, should keep his skirts clear, and they went out and voted against Fallis.

When will political leaders in Canada realize that honesty is the best policy and that clean Government would remain in power indefinitely? That is what I have been trying hard to hammer in, but the task grows more and more difficult, and the Government, instead of taking my good intentions at their face value, has been misconstruing them and classing me with its enemies. If Sir Robert Borden would rise above party politics he would realize that behind these criticisms there lies the best friend the Government could have—the independent citizen who would gladly see him measure up to the stature of a clean and a great political leader.

If Sir Robert Borden fails to see the Peel result in the light of a warning closely related to the Shell Committee situation, he ought at least to recognize it as a public assurance that the people will stand behind him if he tries to stamp out the profiteering business. The defeat of Fallis cannot be taken as a Conservative defeat or as a Liberal victory. It is an announcement of the public temper about profiteering and what it means to any party which fails to stamp it out.

Here is the opinion of a strong Conservative paper (The Montreal Star) on the events in Peel County:—

The electors of Peel County, Ont., are worthy of public congratulations and universal gratitude from the entire people of Canada.

* * *

When Colonel J. Wesley Allison gave evidence some time ago before the Davidson Commission he stated that he "was not the agent of any company which sold pistols to the Government" and did not profit "in any way, directly or indirectly," by such sale. Major General Sir Sam Hughes, however, now classes him as his special confidential agent in securing munition supplies in the United States, and in cutting down war combine prices charged there. The latest evidence about this special confidential agent was read before the commission a few days ago. Samuel M. Stone, vice-president of the Colt Patent Fire Arms Company of Hartford, Conn., tells of an order for 5,000 pistols given to the company, after a conference between the chairman of the company's board, Colonel Allison, and General Hughes at Moira, N. Y. He states that the Canadian Government paid $18.50 for each pistol, while the U. S. Government has for years been able to buy them for $14.50, and that dealers could buy them nearly 20 per cent. cheaper. Mr. Stone adds that the company gave Col. Allison a "present," a very small one indeed considering his services, but a "present" for all that, and that he "would not like to consider Colonel Allison one of our regular staff."

At present Colonel Allison is in Florida for his health. When he comes back we are told he will be called upon to give more information. Perhaps we will then get at the facts—learn how much he got for a "present" and just what he considered his duties to be, as Major-General Sir Sam Hughes' special confidential agent for keeping down war combine prices. Perhaps too, we shall be given an inside account of the conference at Moira between Colonel Allison, General Hughes and the chairman of the Colt Company's Board.

* * *

And, by the way, it is decidedly encouraging to note the evidences of independence being shown in our western provinces. In Manitoba and Saskatchewan the honest electors are beginning to make themselves heard. In British Columbia, two ministers in one week is a fine record against the "corrupt combination," as Sir Hibbert Tupper puts it. Sir Hibbert's active participation in this campaign is all the more significant when we recall that the name Tupper has stood for many years in Canada for staunch Conservatism and rugged honesty.

The handwriting on the wall is becoming crowded. Does Sir Robert Borden still persist in closing his eyes to it?

—SEARCHLIGHT.

Electrical Contractors Losing Two Good Men

The Ontario Electrical Contractors' Association are losing, through resignation, two of their most useful and energetic officers—Mr. J. W. Commeford, president, and Mr. R. D. Earle, secretary. Becoming effective, as they do, almost simultaneously, it is impossible that this organization should not feel the loss somewhat keenly, but it is fortunate that there are on the executive able men who are willing, under the circumstances, to step in and give their services that the trade my not suffer. We understand the offices have already been filled by Mr. G. D. Earle, who has consented to act as president, and Mr. M. Soules, of Oshawa, who takes the office of secretary-treasurer. Under the management of these new officers the members of the Association may rest assured their interests will be carefully safeguarded.

Mr. Commeford, we understand, has been appointed to an important Government position which would conflict with the duties he was performing for the Association, and so has been reluctantly obliged to relinquish office at a time when everything was going along smoothly and vigorously. Mr. Earle leaves to serve his country in Lieut.-Col. Sharp's Battalion, the 116th, and is now stationed at Oshawa. If Mr. Earle is as good a soldier as he was a secretary, and we have no doubt on that point, the 116th is to be congratulated that he threw in his lot with them.

The Dealer and Contractor

Legislation and the Electrical Contractor

By Paul H. Jaehnig

In view of the great interest now being taken in the Ontario License Bill which it is proposed to introduce at the present session of the local House, the following paper will be of keen interest to the electrical contractors of the province. There does not seem to be any doubt, either in the minds of the contractors themselves or of the legislators who have made a study of this question, that a certain amount of legal protection is necessary, not only in the interests of the contractor, but equally in the interests of the general public. This matter is very nicely brought out in the following paper:—

The need of legislation for the electrical contractor has been apparent for some time in the industry; a need to correct well known abuses and weaknesses in the trade, to make untenable the position of the incompetent contractor, and make restrictions in the interests of public safety.

Legislation as it affects the electrical contractor may be divided into two classes—(a) corrective, which is intended to overcome abuses and weaknesses which are apparent, and (b) protective, which makes impossible the incompetent and ignorant contractor, assures protection to the public of life and property, and establishes the responsibility of the electrical contractor for his work.

One of the abuses most frequently met with is the matter of sub-contracts. You, as an electrical contractor, know from your own experiences how you are apparently taken into confidence by the general contractor and led to believe you are the favored son; that if you can reduce your bid just a little you are "it," and you delude yourself with the prospects of a fat sub-contract, only to wake up and find that you had been played against by your competitors or fellow contractors, and the other fellow, who was a more reckless gambler than you, got the contract. This procedure, which is common throughout our country, simply diverts the profits on the job from the electrical contractor, to whom they rightfully belong, to the general contractor, who did not earn them. This explains why you never hear of an electrical contractor retiring from business after he has accumulated a competence, as that time never comes; but you probably all know of several general contractors who are now enjoying their hearts desire.

This abuse can be, and has been, partly corrected by proper legislation, which provides for the segretion of the electrical work from the general building contract, and which must be let as separate contract. Such laws applying to public work are now in force in three or four States and are working to the decided advantage of the electrical contractor. If these laws could be applied to private work as well there would be some hope of the electrical contractor attaining the status of the general contractor. Speaking seriously, this same condition may be brought about on private work if the electrical contractor will co-operate to that end.

Before the Virginia Electrical Contractors' Association.

The architects, I believe, would welcome such a plan, provided the electrical contractor could satisfy them of their competency and responsibility and thus gain their confidence.

Legislation which provides protection to the public as well as the electrical contractor is highly desirable. You all realize that you are at a decided disadvantage in trying to compete with those in the industry, who, through lack of knowledge of the correct principles, lack of experience and a disregard of the safety of the work, secure the work largely because they do not know how to intelligently estimate the cost. His sole aim is, therefore, the immediate profit, and all principles are sacrificed to this end. This condition works to the decided disadvantage of the responsible contractor, as it tends to discredit the electrical contracting business and also keeps him from securing work to which he is justly entitled by virtue of his knowledge, experience and desire to elevate the business in general.

The responsibility of the electrical contractor for all of his work should be definitely established. It should be practicable to identify the responsible party as well as to specify how and by whom electric work should be done. There should also be a suitable penalty or fine for failure to comply with these requirements.

Adequate License Laws

Such conditions can only be met and corrected by adequate license laws which at the same time will afford the greatest measure of protection to the public. Such laws, if carefully drawn, enacted and wisely administered, will not only dignify the business, but greatly improve the status of the electrical contractor.

In considering the desirable provisions of a license law, it is well to take advantage of the experience of the states and cities having legislation in force. It is essential to know the experience of others to profit thereby. With these experiences at your command, together with copies of existing laws and ordinances, it is not such a difficult task to secure the much needed legislation in all communities.

While your association can render this service in connection with legislation in your locality, do not think for one moment that all you have to do is frame and present the bill and the thing is done. Legislatures and councils are unknown quantities, which must be taken into consideration. Earnest, whole-hearted effort on the part of every individual interested, together with hard, persistent work, are absolutely necessary to bring the matter to a successful conclusion.

The results will more than justify the cost. If your first effort is not rewarded by satisfactory results, do not give up; keep on trying; it is worth while. Laws are useless unless rigidly enforced. In order to obtain the full benefits of the law it is essential that a rigid enforcement be insisted upon. This requires not only officials with power to enforce the laws, but also the co-operation of the responsible contractors. You owe it to yourself and your business to see that laws affecting your business are strictly enforced, so that you are all on the same footing and no one has an advantage over the other fellow.

In considering legislation it would seem that the best protection for both the public and the contractor requires an examination of the applicant before a properly constituted examining board as to knowledge, experience and ability to undertake the installation of electrical work in accordance with modern standards of safety. The law should also establish responsibility for installations, making it a misdemeanor to do irresponsible work. The law should penalize by fine or imprisonment, or both; it should revoke a license for cause.

Laws should be framed carefully in order to secure mutual benefits and protection. The benefits of a good license law accrue not only to the public, but to the contractor, the workman, the supply dealer and, in fact, to all interested in the industry.

If the old saying, "The workman is worthy of his hire," is true, so is equally true the new saying, "The electrical contractor is worthy of a fair profit on his work."

When you stop to consider the status of the electrical contractor as compared with the workman it seems, in many cases, the workman has the advantage. He has but one commodity o sell, namely, labor, with no capital invested, and no risk involved, yet his returns are sure.

The electrical contractor, on the other hand, is required to invest more or less capital, buy and sell quantities of material, assume a risk on every contract he undertakes, assume responsibility for all the work he does, and, in general, takes chances on his work being completed somewhere near his estimate.

For all of this his returns are, at best, problematical. If things go smoothly he may have a small profit to show for all his efforts and responsibility; if they go otherwise, he has the doubtful pleasure of computing the losses in his business.

It is time the electrical contractor came into his own, as he certainly is entitled to a profit commensurate with the capital invested and the risk involved.

Best Business Getting Methods

The National Electrical Contractor recently offered three prizes, 1st, 2nd and 3rd, for the best business getting ideas sent in that could be published. These suggestions had to be of a practical nature so that contractors or dealers could apply the methods advocated to their businesses and make money. The following contribution was awarded first prize. It has reference to the policy followed by an electric supply company in connection with Electrical Prosperity Week:

Electrical Prosperity Week Cash Dividends

It could not help but succeed, but none of us anticipated such gratifying results as obtained from our campaign during Electrical Prosperity Week.

It was all very well to take advantage of the many good suggestions and material furnished by the Society for Electrical Development, and we enclosed fliers in each envelope, used stickers galore, posters in our windows and throughout the store and banners on the machines, but what we wanted was to identify our store in the prospective customer's mind.

Our newspaper advertisements stated that we would give three cash prizes of $25.00, $10.00 and $5.00 for the three best essays on the comforts, conveniences and economy of using electrical appliances in the home. Suggestive cuts of useful devices were arranged to run with the copy. Of course we had an attractive window display, all articles being plainly priced. The great number of replies, not only from the city, but throughout the State, was conclusive proof of the interest shown and the appreciation, particularly of the women writers on the good points and advantages of Domestic Electricity, was a revelation.

We wrote each contestant, giving the names and addresses of the winners. Enclosed in each letter went a small bulletin with cuts and prices of standard electrical household appliances. We are still receiving results in the way of sales.

Our motor department advertised a free inspection of motors during Electrical Prosperity Week to any concern who would just call us up. In a great number of cases we were able to make valuable suggestions, and unquestionably this feature was a factor in securing new and promising customers.

We are still cashing in and receiving dividend results from our prosperity week.

Cheap Wiring

Editor Electrical News:

Your article "Cheap Wiring Becomes an Obstacle to Future Development" in the last issue of the Electrical News is timely. Surely the electrical business has been exploited enough along bargain-counter, cut-rate lines! With all the cheap current, cheap lamps, cheap fixtures, cheap irons, toasters, etc., ad lib., what chance is there that the public will ever learn to take quality into consideration?

There is, no doubt, a lot to be laid at the door of the cheap contractor, but low-priced campaigns play into the hands of the cheap manufacturer and jobber just as well as the cheap contractor. They are not in the true interests of the public, nor, in the last analysis, in the interests of any one—central station, manufacturer, jobber, or contractor. Should not the public be given a chance to educate themselves up to an appreciation of the essentials which are vital to the elimination of fire and shock hazard—that is, insulation, copper, and workmanship?

If the Electrical Development Society want a big job, is not that a big enough one, and which would in the end benefit everybody—except perhaps the cheap "guy"?

It is a pity, too, that our "Hydro" seems to lend itself to the low-price campaign policy—which, by the way, is not carried into its inspection department. This brings up the point covered in your January 15 number in the article entitled "Divorce the Inspection Department," where you point out the iniquitous policy of having the Inspection Bureau subsidiary to the Commission. The fact of this tendency of the Hydro to ignore the education of the public along the lines of quality—the lines essential to public safety—is another strong argument in favor of there being an independent inspection bureau. Added to this there is the political, and other, discrimination, which in itself, one would think, would be sufficiently convincing.

Yours very truly,

11 Sorauren Ave., Thomas Jackson.

Toronto. March 9, 1916.

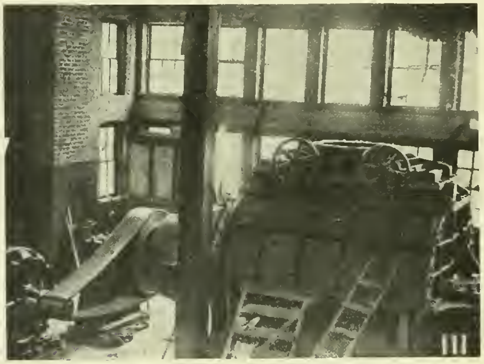
Mr. R. H. Mainer Answers Call of Duty

R. H. Mainer, well known throughout the Canadian electrical fraternity, and past vice-president and general manager of the Mainer Electric Company, Limited, Winnipeg, Man., has resigned his position with that company, the resignation taking effect on March 1. Mr. Mainer feels it his duty at the present time to go into active service and has attached himself to one of the regiments being formed in the city of Winnipeg. Anyone who knows the very large amount of business this company has been handling and the prominent position it has achieved in the electrical trade will appreciate the sacrifice Mr. Mainer is making. We trust his reentry into the Canadian electrical business will not be long delayed.

What is New in Electrical Equipment

Renold Silent Driving Chains

A particularly interesting arrangement in the driving of Roots blowers from electric motors in a large Canadian plant has just come to our attention. There are four of these blowers, which require from 150 h.p. to 300 h.p. to operate them. By adopting the Renold Silent Chain Drive, instead of the leather belts previously used, it has been possible to place the motors quite close to the driving shafts. It is stated that due to the great saving of space thus obtained the management were able to arrange the four units in less space than was originally occupied by the three which were belt driven. It will be noted from the illustrations herewith how



A 150.h.p. Renold Chain Drive on double-ended Blower.

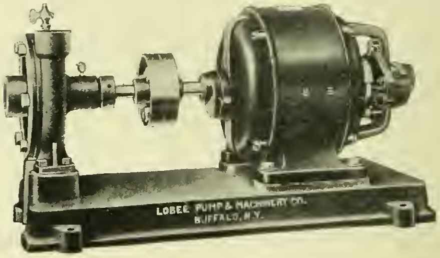
smoothly the chain runs in each case. This is partly due to the characteristics of the chain and also to the special spring boss used on the driving wheel, which absorbs all the fluctuations of the load before they reach the motor. The result is that the motor is relieved of practically all the shock inseparable from the driving of large blowers by spur gears, etc. At the same time, the wear on the bearings of both shafts is reduced to a minimum, due to the fact that no initial tension is required in the chain, owing to the very positive nature of the drive.

These Renold drives, on the continuous operation of which the whole plant is dependent, have been running, we are advised, for over two years, day and night, and are giving every satisfaction.

The motors are of the squirrel-cage induction type with full load speeds of 570, 490 and 430 r.p.m., according to their horse power. The 200 h.p. and 300 h.p. motors are furnished with outboard bearings, while the 150 h.p. motors are equipped with merely the two bearings for the reason mentioned above. We are indebted to Messrs. Jones & Glassco, Montreal, for the illustrations shown.

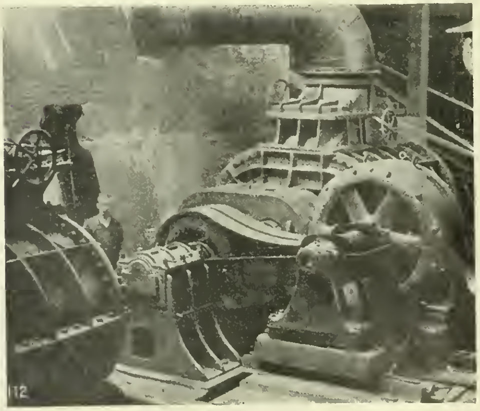
The Lobee Pump

A compact centrifugal pumping outfit shown in the accompanying illustration is manufactured by the Lobee Pump & Machinery Company, of Buffalo, N. Y. This is a small iron centrifugal pump fitted with bronze runners to resist the chemical action of the water. It has a 1½-inch suction inlet, a 1-inch discharge outlet, and a capacity of 25 gallons

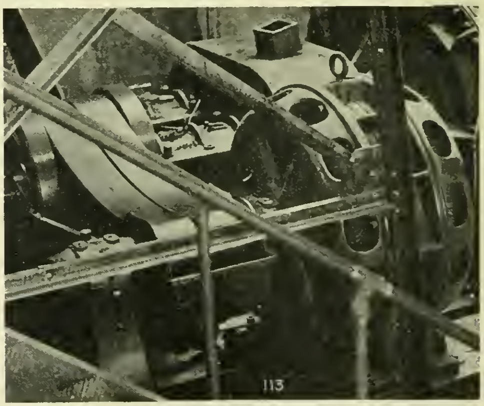


per minute against a head of 35 feet. When pumping against this head a Westinghouse 1 h.p. motor is used. The pump is designed for heads up to 90 feet, but of course, in such cases, requires correspondingly larger motors. The pump is designed for use on buildings where the pressure is low or for the circulation of brine in coolers, and for other purposes of a similar nature.

A portion of the hydro-electric development of the Laurentide Power Company, Limited, Grand'Mere, P. Q., is now in operation, current being delivered to the Shawinigan Water and Power Company over a new transmission line from Grand'Mere to Shawinigan Falls.



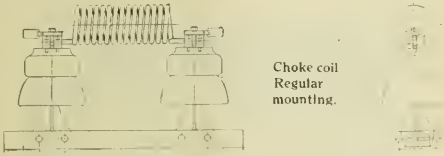
300-h.p. Renold Chain driving a No. 9½ Roots Blower.



200-h.p. Renold Chain Drive (top half of gearcase removed).

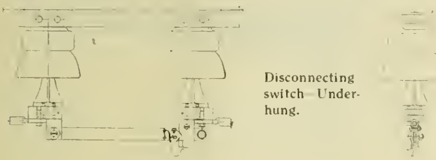
Choke Coils and Disconnecting Switches

The choke coils, disconnecting switches and fittings illustrated herewith are typical of the new and more complete line of such apparatus recently brought out by the Electric Service Supplies Company, and shown in a new edition of their catalog on Garton-Daniels Lightning Arresters. The fittings which accompany this line are all of new design and



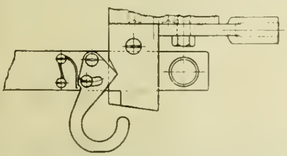
Choke coil Regular mounting.

noteworthy. Garton-Daniels choke coils and disconnecting switches are made for both regular and underhung mounting for voltages up to 35,000 and for all standard ampere capacities. They are made with a base of channel iron, either 3 or 4 inch, depending on size of coil or switch. Iron pins are riveted into this channel, and insulators cemented to these pins support iron caps, which in turn support the terminal blocks, terminals and coil or switch proper. All



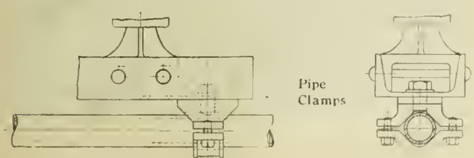
Disconnecting switch Underhung.

channel bases are drilled with 9/16 inch holes in each end and may be so mounted on any flat supporting member by bolts or lags. It is claimed that these coils and switches are very rugged in construction and possess great electrical and mechanical strength. The switches are designed for disconnecting and controlling high voltage lines, branch feeders, etc., as well as for lightning arrester disconnecting



Switch Lock.

switches to disconnect arresters from the line for the purpose of inspection, repair, etc. The manufacturers claim that these choke coils and disconnecting switches as well as the fittings are so designed that, when used in conjunction with Garton-Daniels lightning arresters maximum protection may be expected. The line of fittings referred to consist of malleable iron pipe clamps for mounting switches or coils on either parallel or transverse piping; disconnecting



Pipe Clamps

switch locks for use particularly on underhung types as assurance against any tendency for the blade to be blown open; disconnecting switch stops which when installed prevent the blade being opened beyond a given angle; switch blade operating attachment which provides an extra large hole in the switch blade to facilitate the quick opening of the switch in an emergency, and disconnecting switch hooks of lengths from 4 to 12 feet to operate the switches.

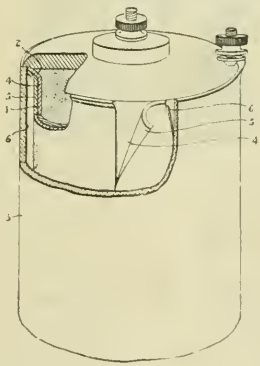
Pyrene for Electric Fires

The Ontario May-Oatway Fire Alarms, Limited, 92 Adelaide Street West, Toronto, are asking special attention of electrical men to their Pyrene fire extinguisher, which, it is claimed, is particularly adapted for extinguishing electric arcs or any form of fire associated with electric machinery. The extinguisher consists of a liquid which evaporates to a heavy gas at a temperature of 200 degs. Fahrenheit. It is a fair

electric insulator itself and does not cause any deterioration in the insulating properties of electric dynamos or motors. The device in which Pyrene is used is a double-acting pump of one quart capacity, and weighs complete only 6 lbs. In size it is 3 ins. in diameter and 14 ins. long. For the liquid it is claimed that it will not deteriorate with age, that it will not freeze above 60 degs. F. below zero, and that it contains nothing that will stain or injure any fabric. Particular attention is drawn to the convenient size and light weight, one quart of this extinguishing material being contained in a vessel which will fit easily into a man's coat pocket.

New Water and Weather Proof Batteries

The principal objections to dry batteries are the difficulties encountered incident to atmospheric and temperature influences upon them. To overcome such difficulties the Canadian Carbon Company has succeeded in insulating the active part of the battery, namely, the zinc electrode, in such manner as to minimize the retarding effect upon the electrolyte, due to low temperature, and to restrain the violent chemical action caused by extremely high temperature. It is well known that dry batteries decrease in efficiency through age and it is mostly due to the excitation caused



Perspective view of cell.

by the transference of energy between the negative and positive poles, this being principally due to superflous moisture in the atmosphere effecting the zinc container.

The Canadian Carbon Company have provided a novel formation of the cell and arranged for a covering thereon, whereby the cell is insulated against the effect of changes in atmospheric conditions. It will be noted on the illustration showing a sectional perspective view of the cell, that the zinc cup is formed with an outwardly flaring upper edge. This flaring edge engages the upper edge of the outside container and as the inner member is spaced centrally within the outer container, a surrounding dead air space is provided for. The cell itself is being coated with a special adhesive varnish which is impervious to moisture, thus forming an insulating coating. A jacket formed of a sheet of asbestos or some similar heat insulating material is placed around the zinc container, while the varnish coat is still sticky, thus providing a protecting covering which is a poor conductor of heat, consequently the cell retains a comparatively uniform temperature, outside changes of temperature effecting it but slowly. The electrolytic paste and the depolarizing compound inside of the cell are also protected to a very great extent against atmospheric changes.

The outer carton is made up with a water resisting material or is lined with paraffin or coated inside with some other waterproof material. When the cell is now placed within the external cover the top is sealed so that the sealingwax extends over the top of the flanged zinc container, effectively closing the air space surrounding the cell and consequently forming an insulating jacket very effective against

changes in temperature. The seal extending beyond the top edge of the inner container effectively secures the outer carton to the cell and this forms a unit from which the outer carton cannot be removed and replaced in a fraudulent manner.

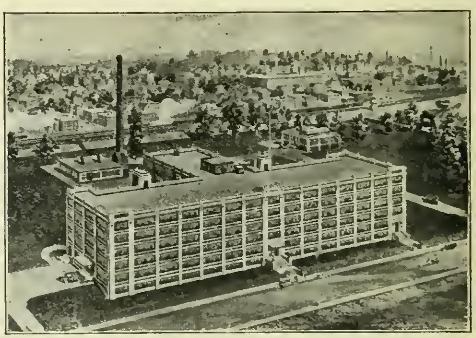
Estate Stove Company

The illustration herewith represents a type of range now being placed on the market by the Estate Stove Company, of Hamilton, Ohio. The conservation-of-heat principle, which has been so successfully applied in the manufacture of fireless cookers, is the foundation of the efficiency of the bake-oven of the Estate electric range. The walls of the oven are two inches thick and so thoroughly insulated that radiation of heat is reduced to a minimum. The oven door is just as heavily insulated as the walls. It is claimed that the temperature inside the oven may be 500 degrees while the outside of the wall is not more than 50 degrees above the room temperature; this means that a kitchen may be kept practically as cool as any other room in the house. To show the temperature of the oven a mercurial thermometer is installed in the oven door. Heating plates are installed in the top and bottom of the oven, these plates being controlled by a single three-heat switch. The heating plates are of the enclosed, iron-clad type, which give complete protection to the heating coils and afford a perfectly smooth surface for contact with the cooking vessels. All heating

plates are supplied with three-heat switches. The illustration is only one of a large number of designs manufactured by this company.

Holtzer-Cabot New Factory

On February 22nd the Holtzer-Cabot Electric Company opened their new and handsome plant to the inspection of their customers and friends, when large numbers of interested guests were conducted through the building. This structure is the most modern type of a reinforced concrete, flat slab, mushroom column building, 300 feet long with a depth of 60 feet, and containing one ell 90 x 60 feet. New



ells may be added as the growth of the business demands or new floors may be added on the top. The floor area of the factory comprises 148,000 square feet, representing six storeys. The land area is over four acres. The company have moved most of their effects into the new plant, but the old plant in Brookline is still retained for the manufacture of certain products.

Current News and Notes

Brantford, Ont.

A very favorable report was presented by the Commissioners of the Brantford Municipal Railway System at their recent annual meeting. A small deficit was the result of the year's operations but the Commissioners stated that the surplus of profits for January were sufficient to wipe out the deficit of the previous year. They are also confident that the day of deficits has passed.

Campbellford, Ont.

The local municipal plant which has been supplying a certain amount of power to the Seymour Power Company interests in Campbellford will continue to do so for another ten years, according to a recent contract renewal between the company and the municipality.

Emerson, Man.

The town council, Emerson, Man., are considering the installation of an electric lighting plant.

Fort William.

The January gross earnings of the Kaministiquia Power Company were $30,745, as compared with $27,656 a year ago. The first three months' gross of the company's fiscal year is $99,658, as compared with $84,974 in 1915.

Halifax, N. S.

The Bay of Fundy Tide Power Company, Limited, has been incorporated with a capital stock of $50,000 and head office Wolfville, N. S.

Kenton, Man.

Best & Kerr, electricians, Kenton, Man., have registered.

London, Ont.

The London Public Utilities Commission will confer with the Commissioner of Industries and General Manager Buchanan on the advisability of installing a municipal telephone system under the management of the local hydro electric commission.

The Utility Electric Mnufacturing Company, Limited, has been incorporated; capital $40,000; head office London, Ontario.

Montreal, Que.

The contract between the Quebec Railway, Light and Power Company and the town of Levis for the street lighting has been renewed for a period of ten years. The contract is for 370 lamps of 60 candle power. The company will also supply current for lighting for the residents at a rate of 7 cents per kilowatt hour, for bills of not less than 75 cents per month.

The "Wednesday Electrical Luncheon" at Cooper's Restaurant, Montreal, has proved a great success, the attendance being on one occasion as high as ninety, although the average is less than this. The proceedings are of an informal character, the luncheons fulfilling the principal object of making men in all branches of the electrical industry better acquainted.

On Thursday, January 13th, the Electrical Section of the Board held a luncheon meeting in the Assembly Room. A full attendance of the entire membership of the section listened to a very interesting talk by Mr. Burnett, of the Sunbeam Lamp Company, on the subject of "The Making of Electrical Lamps," his remarks being illustrated by an exhibit showing lamps in the various stages of manufacture. Mr. C. H. Wilson, Chairman of the Section, presided.

Ottawa, Ont.

Hydro Radial interests from various points in south western Ontario opposed the application of Mackenzie & Mann interests when they appeared in Ottawa recently for an extension of their radial franchises in the Niagara Peninsula.

Portneuf, Que.

The Portneuf Hydro Electric Company, Portneuf, Que., are calling tenders for an electric plant, the ultimate capacity of which is to be 3,000 h.p.

Peterboro, Ont.

The Utilities Commission of the city of Peterboro is authorized to negotiate with the Otonabee Power Company for the purchase of their transmission lines in that city where they do not parallel the Hydro system.

Regina, Sask.

New provincial regulations respecting the construction and maintenance of electric plants have been printed and are being distributed throughout the provice of Saskatchewan.

Sarnia, Ont.

The city council are considering the installation of an extensive street illumination system. The Ontario Hydro Commission's engineers recommend the use of six hundred 100 watt lights and seventy ornamental standards attached to the railway poles, carrying one 1,000 c.p. unit each. The estimated cost of operation is placed at $45 per lamp for the larger unit and $15 for the smaller one per annum.

St. Johns, Nfld.

An electrically operated copper smelter has just been placed in operation in St. Johns, and will operate under the name of the Hydro-Electric Smelting Company, in which Mr. W. A. Mackay is largely interested.

Vancouver, B. C.

Smith's Electrical Company, Limited, has been incorporated "to carry on business, either wholesale or retail, for all sorts of electrical fixtures, supplies and apparatus, and other furnishings of an electrical nature; to carry on the business of electrical engineers or contractors, etc." Capital $10,000; head office Vancouver, B. C.

Winnipeg, Man.

The annual report of the Winnipeg Electric Railway Company for the year 1915 shows earnings of $1,331,737, compared with $1,769,114 in 1914, the decrease in earnings being attributed to general depression and the active competition of the jitney. The directors state, however, that they anticipate increased earnings in the coming year as December and January compared favorably with a similar period in any previous year.

The British North American Hydro-electric Power Company of Manitoba will ask for incorporation as a $5,000,000 organization at the present session of the Manitoba Legislature. It is understood the plans of the company include the construction of a transmission line from Winnipeg to Brandon and possibly farther west, with branch lines north and south to supply such points as Minnedosa, Dauphin, Deloraine, Killarney, and so on. The company propose to purchase power from the municipal system operated by the city of Winnipeg.

Personals

Mr. R. D. Earle, secretary since its organization of the Ontario Electrical Contractors' Association, has resigned that position to attach himself to the 116th battalion, at present located in Oshawa.

Mr. J. D. McArthur, the well-known railway contractor, has been appointed to the Board of the Winnipeg Electric Railway Company. Mr. McArthur takes the place of the late Sir William Whyte.

Mr. J. W. Commeford, who has so acceptably filled the office of president of the Ontario Electrical Contractors' Association since its organization, has resigned to accept an important government position.

Mr. P. D. Ross has been appointed by the provincial Hydro-electric commission as their representative on the Ottawa Hydro-electric commission. The other two members are Mr. J. A. Ellis, ex-M. P. P., and the Mayor of Ottawa.

Mr. A. P. Ross, district chief of the Windsor section of the Bell Telephone Company, headquarters at Chatham, has resigned to take an officer's training course in London, Ontario. Mr. Ross was presented with a handsome wrist-watch by the staff of the Chatham local branch.

Mr. Ernest Lane, who has been acting local manager for the West Kootenay Light and Power Company for some time, has assumed a similar position at Trail, where the smelting and refining plant of the Consolidated Mining and Smelting Company is situated. Mr. Lane was formerly chief electrician at the Granby smelter, Grand Forks.

Mr. Thomas Henry, chief engineer of the Interurban Electric Company, has resigned that position and associated himself with the sales department of the Toronto Electric Light Company. Mr. Henry was the guest of honor at a banquet given by the staff and employes of his old company at which he was presented with a gold watch and a flattering address.

Renfrew Electric & Mfg. Co.

The Renfrew Electric and Manufacturing Company have recently engaged as their superintendent Mr. George W. Nock, M.E., E.E., of New York. Mr. Nock was formerly chief mechanical engineer for the Westinghouse Electric Company of Pittsburgh, Pa., and was for three years assistant superintendent of the General Electric Company at Pittsfield, Mass. Latterly his headquarters have been in New York, where he has carried on business as a consulting mechanical and electrical engineer. Mr. Nock has had a very wide experience and has travelled extensively over the North American Continent and Europe, doing electrical research work. The Renfrew Electric Company are to be congratulated on securing a man of Mr. Nock's experience and ability at a time like the present, when Canada is going ahead so rapidly in electrical manufacturing lines.

Owing to a fire which completely destroyed their former premises at 19-21 Richmond Street West, Weiss and Biheller (Canada) Limited, have taken new offices at 115 Bay Street, Toronto.

The Canadian sales of Pass & Seymour, Inc., will be conducted by Mr. Geo. L. Hatheway, from their Boston office, of which he is in charge. This office is located at 158 Purchase Street, and all communications will receive prompt attention from this address.

Electrical News
Generation, Transmission and Application of Electricity

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Orders for advertising should reach the office of publication not later than the 5th and 20th of the month. Changes in advertisements will be made whenever desired, without cost to the advertiser.

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Vol. 25 Toronto, April 1, 1916 No. 7

Keep the Home Fires Burning

The all-important work of the British Empire to-day is a vigorous, systematic, well-organized prosecution of our war. This applies equally to Canada, as the most important colony of the Empire. Yet Lord Shaughnessy says he is not satisfied of the wisdom of raising a half-million men at the present time and by the present methods.

Now, people are apt to listen when Lord Shaughnessy talks. Some way or other we Canadians have got into the habit of believing in this big man who does things. So, when he makes a public statement (which isn't often) we have felt that it carries the weight of a tremendously wide and ripe experience backed by sound common sense. If there is any one outstanding figure in this Dominion to whom the word "can't" is a stranger, it is surely Lord Shaughnessy. He is Canada's big man—big through hard work, undoubted ability, unconquerable determination, unlimited confidence in Canada and in Canada's resources.

And now along comes Lord Shaughnessy's statement that he is not satisfied of the wisdom of raising half a million men in Canada for military service under the present system. The press is saying, and some of our politicians—mere opportunists by comparison—that Lord Shaughnessy is all wrong.

Are two soldiers poorly equipped and badly trained of more value on the fighting line than one properly equipped and sufficiently trained? If so, Lord Shaughnessy is wrong. Are two soldiers without munitions better than one with plenty? If so, Lord Shaughnessy is wrong. Is a half million soldiers, weakly supported by a country of crippled industries, better than half that number vigorously backed by the money and the ample products of a country whose industries are healthy, vigorous and thoroughly organized? If so, then Lord Shaughnessy is wrong.

But, we believe Lord Shaughnessy is right. Is it not possible, indeed is it not apparent, that undue pressure is being brought to bear to take our valuable men from their regular avocations before they are actually needed? We have many men ready for overseas who have not been called. Why not, at least, divide their time, meanwhile, between industrial and military work? We have actually reached the point where our wheels of commerce are beginning to slow up for lack of man-power—much of which, apparently, is going to waste right around us every day. On all hands we hear the industrial cry for more men. "We can't get sufficient men to fill our orders," they are all saying. And if this is true to-day, what will it be like in another six months or a year, if recruiting goes on under the present haphazard auspices? The answer is all too plain. Our factories will be crippled, our farms will be depleted, our industries of every kind—the backbone of our strength, whether in peace or war—will be driven to the wall.

We shall have a big, unwieldy fighting machine without any "punch."

We believe Lord Shaughnessy is right, and we believe just as strongly that present recruiting methods are wrong. It is a system that no man defends, a system that no one approves. It evidently exists simply because it existed, and because our Government is so conservative, so unbusinesslike, so evidently unwilling (whether incapable or not, we cannot say) of taking a man's grasp of a man's job. Under the present system of recruiting, the men who answer the call of duty are of course the men who recognize their duty. They are thus the men who count for most at home—the men who can least be spared—the men whose removal causes the biggest rift in our industrial life.

* * *

And our Government sits quietly by. Young men with no ties and no responsibilities, and in many cases occupying positions from which they could readily be spared, stand back and allow the ranks to be filled by our artisans, our captains of industry and our professional men. It is this the Government is defending. It is this also Lord Shaughnessy, no doubt, has in mind when he criticizes.

Of course we are going to win this war—why shouldn't we? We are immensely richer both in men and money. But are our enemies going to force us to use all our men and all our money just because we are badly organized? It begins to look that way. Will it then be a victory in which we can take pride in after years—a victory of mere weight of men and superior wealth? Will it even be a victory which we can follow up to advantage? Are we going to allow Germany to issue from this war, as she entered it, the best-organized nation in the world? Will we be ready to meet her competition? Or are we actually going to be too weak from lack of present organization to count in the commercial war that is only just beginning, and which will be fiercer and more prolonged by many times than the present war of men?

* * *

What Canada cries out for to-day is organization—for war, present and future. What business man goes on year after year, for example, without taking an inventory? Yet our Government takes no inventory, knows nothing about the stock in hand. Is this business? What Canada needs most urgently at the moment is an inventory of her man resources—the capacity, the responsibilities, the experience, the fitness for this or that work, the ties—of every one of her citizens. Next we need an organization that can say to each man, "Your place is—there." What Canada needs is, if you like, moral conscription, which does not curtail the liberties of the citizen in any way, but simply points out in an authoritative way the path of duty. No one would oppose it; few would fail to answer such a call. It would mean the highest conservation of all our resources. It would mean preparedness, not only for this year and next, but for the years which follow. It would mean winning this war without the feeling that Germany, even though crushed, will laugh up her sleeve at the tremendous sacrifices she has forced us to make and at the exhausted condition she has left us in.

Lord Shaughnessy is right when he warns us against impairing our industrial strength. It is a vitally important question—scarcely less important than the war itself, because the two are so closely inter-related. Whatever the outcome of this struggle may be, if we come out of it badly organized, industrially weak, bereft of our most useful men, overcrowded with slackers and incapables, even when we reach Berlin—we've lost.

High Priced Gasoline the Electric's Opportunity

Little by little the electric range has been overcoming the lead of its strongest competitor, the gas stove, until it now stands, in many localities, in undisputed possession of the cooking field as regards both efficiency and cost of operation. And now, just appearing over the horizon, comes the electric automobile. Like the electric range, the two big obstacles have been the initial cost and the popular fallacy that electricity is too slow. The cost of ranges has gradually been reduced, and their speed has been improved, until they now compare favorably with their best competitors. Cost of operation is no longer a bugbear—it has become an asset. So with the gas car—a little more slowly, but just as surely, the electric is taking its place. It is being cheapened in first cost; it is improving its speed; for some time it has cost less to operate and maintain.

Generally speaking, the trend of prices of the things that enter into our daily needs has been upwards, without any cessation, during the past few years. The one big outstanding exception is the cost of electric current. At many points in Canada rates are anywhere from 10 to 20 per cent. of what they were ten years ago. It is not infrequent that a rate of less than one cent is obtainable by the householder. Still lower rates are available for power, especially at off-peak load. The small cost of electricity has become almost as wonderful as electricity itself.

The electric automobile has had an uphill fight with its gas competitor. Sentiment has been a considerable factor in this competition. The gas car is faster, and has a wider range of operations. The popular idea with regard to high speed is, we believe, entirely wrong, but it is, nevertheless, difficult to overcome. A few years, no doubt, will teach the average motorist the folly of maintaining a 60 h.p. motor for a fifteen to twenty mile rate of speed when a half or third as much power will do the work. The average gas car actually travels no faster than an electric around the city streets. We believe it is inevitable that when the thirst for high speed which seems to have taken possession of the modern motorist has been satisfied he will come to recognize that the electric car is fast enough for all reasonable and sane purposes.

And now comes a real boost for the electric in the rapidly-increasing price of gasoline. The lower cost of operating the electric car has always been a talking point, and now it is more than that—it's an unanswerable argument. The difference should now be sufficient to convince, where formerly it served only to interest. For example, we are just in receipt of figures covering the operation of a five-ton commercial gasoline truck which, operating under usual conditions, made three and a half miles on a gallon of gasoline. Assuming 15 cents for gas, this would represent a cost of about 4 cents per mile, and if the truck operated thirty-five miles a day gasoline would figure out $1.40. Compared with this, figures for the operation of a five-ton truck by electricity show the cost of operation four and one-tenth cents per mile, or $1.43 for the thirty-five miles. These figures are pretty close, though the advantage is with the electric on account of lower maintenance. But suppose we figure gasoline at 40 cents—then the cost per mile of operating the gas truck becomes 11 cents. and the total cost $3.85. Thus the use of the electric represents a saving per day of $2.42, which in 300 days amounts to $726.

It would certainly appear that the present moment is opportune for central station men to look very carefully into this question of electric vehicle load. The charging of electric vehicle batteries can be attended to entirely at off-peak hours. This means that in a hydro-electric plant the revenue obtainable from the vehicle load is pure velvet; and even with a steam plant it is almost entirely so. We reproduce a very interesting curve on another page in this issue showing the value of the electric vehicle load in filling up the valleys of the central station curve. This curve represents the load in a city of 100,000 where a hundred commercial electric vehicles have been installed. It is worthy the attention of every supply station in the Dominion.

Ontario Hydro to Have Government Audit

For the first time since the Hydro-Electric Power Commission of Ontario have been in existence, a Government audit of the operations of the Commission has been made. This is contained in a report recently issued by Mr. James Clancy, provincial auditor, in which he criticizes in somewhat severe terms the attitude of the Commission in assuming authority not conferred upon them by the Hydro Electric Act. The Audit shows that while the province has authorized to the end of 1915 an expenditure of $13,169,000, the Commission have actually expended $17,359,000, or an excess over the amount authorized by the province of slightly over four million dollars.

It is not suggested that this money has been misused in any way, but Hon. T. W. McGarry has introduced a Bill enlarging the powers of the Commission. At the same time Mr. McGarry took occasion to explain that the extra monies had been used chiefly to finance smaller municipalities, which were under obligation to repay these sums over a fixed term of years. The Commission had thought well to adopt this policy of advancing money to municipalities. The present amendment to the Act would merely legalize this course in future.

From the brief discussion in the House over this matter it would appear that the Hydro-Electric Commission have left themselves open to a charge of arbitrary dealing in this case. Mr. McGarry practically admitted that the Government auditor had been unable to obtain the necessary information from the Commission's auditing department to make a complete audit of accounts until the present year, when the Government had insisted that these figures be placed at their disposal.

Electrical Precipitations

A paper, illustrated with lantern slides, on the "Electrical Precipitation of Solids from Gases" was read by Mr. Linn Bradley, of the Research Corporation, New York, before the electrical section of the Canadian Society of Civil Engineers, held in the Engineering Building, McGill University, Montreal, on March 16. Mr. Bradley gave a history of the experiments made on this subject, which commenced in 1837 in England. He remarked upon the importance of the losses by gases, which in later years, owing to commercial developments, had stimulated researches, and had resulted in new methods of cleaning. The manufacture of high tension equipment had been a very important factor in electrical precipitation, which was obtained in its simplest form by two sets of electrodes, one for discharging and the other for collecting. In high tension work one problem was to eliminate corona, while in electrical precipitations a problem was to produce corona, negative corona being more effective than positive corona. In the early days a much lower voltage was used than is now the practice; 75,000 v. to 90,000 v. were now used, and experiments had been made with voltages up to 500,000. Insulation difficulties and the costs made the extremely high voltages impossible at present.

Electrical precipitation was used for three main purposes; 1, in which the principal object was to collect dust and gases; 2, where nuisances had to be eliminated; and, 3, where it was desired to improve the plant and to lower the cost. Mr. Bradley dealt in detail with such of these purposes, describing plants where gold and silver; tin, lead, copper, etc., were controlled from gases and dust, by means of the electrical processes. In some instances the saving amounted to thousands of dollars per annum. Under the head of abating nuisances, the operations were directed to do away with sulphuric acid and other acid mists, dust from sand blasting, slate dust, and black smoke. Speaking on the third portion of his subject, Mr. Bradley enumerated instances where large sums had been saved by saving tar from illuminating gas, economies in blast furnaces by saving the gas, securing zinc oxide, etc.

Holding Company for Montreal Power Companies

Although not officially confirmed, there are reports of an impending amalgamation between the Montreal Light, Heat and Power Company and the Cedars Rapids Manufacturing and Power Company. The two concerns are now to a large extent interlaced so far as direction and working are concerned. Directors of the Power Company are on the board of the Cedars Rapids Company, while Mr. R. M. Wilson, the electrical engineer of the Power Company, was responsible for the electrical design of the Cedars Rapids plant and is operating engineer of the plant. Moreover, the latter company is under contract to supply the Power Company with a large amount of current. It is understood that the merger will be effected by an exchange of shares on the basis of three shares for one in the case of the Power Company and one for one in the case of Cedars Rapids.

The Civic Investment and Industrial Company is the name of a new concern, just incorporated, through which the deal, it is stated, will be effected. This company has a capital of only $100,000, but wide powers are taken which will enable it to increase the capital. The company may amalgamate and consolidate with any company whose assets or shares it may acquire, and "may exercise its borrowing power or increase its capital, and may carry on the business of any such company on terms approved of by shareholders representing a majority of the shares of both companies, and set out in a notarial deed to be deposited in the office of the provincial secretary, and for that purpose the amalgamated company shall enjoy and may exercise the charter powers of both companies, under the name of either, and shall assume their obligations." Power is also taken to invest its capital in the stocks, bonds, or debentures of any corporation having for its object the exploitation of telephones or tramways, or the supplying of heat, water, light or power within the Province of Quebec.

The Bedford Mills Electric Company are reported as planning to install a 60 kw. dynamo to be water wheel driven.

Overhead Ground Wires

Toronto, Ont., March 13, 1916.

Editor, Electrical News:—

Regarding overhead ground wires for 300 yards, 600 volt transmission in "Hydro-Electric's" letter in your March 1st issue, it is impossible to express a final opinion in a case like this without going thoroughly into the local conditions. The following information and suggestions, however, may be helpful:

Present lightning arresters may not be suitable.

Lightning arrester grounds may not be satisfactory.

If the running water is pure it may form a very poor ground.

The best ground would be connection to a water supply system. If this cannot be secured the next best scheme is a ground formed by piping driven into permanently wet ground. Salt brine occasionally poured into the earth around pipe may improve a poor ground.

In many cases overhead ground wires have provided very effective protection against lightning. In this case the line is so short that it would not be an expensive experiment and would possibly be beneficial.

A 3/8-inch galvanized stranded steel cable suspended 4 ft. above line wires could be easily installed at small cost. If it is substantially supported, so that there is no chance of its coming down and grounding the line wires, there is no disadvantage in its use. The overhead stranded cable should be grounded at every pole. Two or three overhead grounded cables might be more effective than one cable.

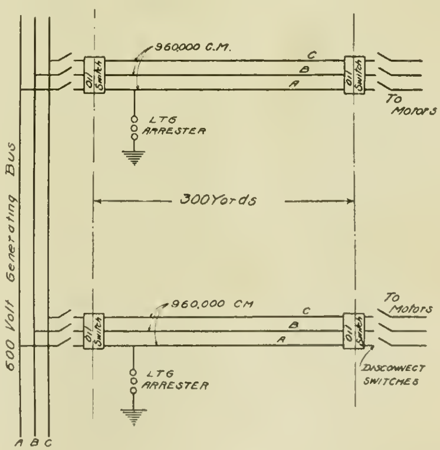
Trusting that the above notes may be of assistance to your correspondent,

Yours very truly,
"Electra."

Winnipeg, March 15, 1916.

Editor Electrical News:—

"I would recommend placing lightning arresters on only one leg of each three phase circuit, making sure to connect to corresponding legs, as per enclosed diagram. This scheme has the advantage of allowing discharges to ground without causing a short through the arresters, and will give equally



good protection. Choke coils give no protection against lightning, their use being to limit the amount of current in case of short circuit. Do not approve of ground wires over transmission line."

Yours truly,
R. H. LONG,
Elec. Supt. W. E. R. Co.

Vancouver, B.C., March 6th, 1916.

Editor, Electrical News:—

To protect overhead cables from the effect of atmospheric electricity, the most effective thing to do is to surround them with a complete network of grounded wire, so as to put them, in effect, in the same position with reference to atmospheric changes as if they were underground.

Just how much or how little screening of this nature is necessary depends upon the location and arrangement of the cables. For low voltage circuits, where the cables are not spread far apart, one grounded wire about four or five feet above the circuit may be sufficient, but if the atmospheric conditions are severe, and the line a very important one, it may be well worth while to put up three overhead wires, spread out to occupy a rather wider space horizontally, than the circuit.

The ground wires should be grounded at every possible point, that is to say, at every pole.

Yours truly,

R. F. Hayward.

Battery Charging and Load Factor

Trucking and delivering is done by day. Let these trucking and delivery vehicles be "electric" and they can be worked by day and charged by night. Charged by night when that station of yours is running way down on the low spots, but with the interest charges humming right along at full speed. Glance at the curve and observe the night valley. The shaded portion indicates how much a modern electric vehicle load would tend to fill up this valley.

The diagram shown, by courtesy of the General Vehicle Company, Long Island, N. Y., is an actual curve taken from a central station in a manufacturing city of 100,000. In addition to this city population, about 25,000 people in the suburbs are served. The vehicle load as shown is made up of 100 commercial electrics distributed by sizes as follows:—

40	1,000 pound
24	2,000 pound
12	4,000 pound
12	7,000 pound
12	10,000 pound

It will be observed that this is but one vehicle to each 1,000 inhabitants, and does not include any pleasure cars.

Consider what this load means in kilowatt hours. The original load on this station was 41,500 kw.h. This vehicle load of 2,557 kw.h. added to the present output raised the load factor from 59.6 per cent. to 63.2 per cent., an increase of 3.6 per cent. What other load do you get that is as favorable as this? Suppose your rate is 3½c. per kw.h., then this vehicle load would mean a revenue of about $27,000 for a 300-day year, or an income greater than would be obtained from 500 residences. Furthermore, the residence load would require additional investment coming, as it does, on the peak, while the charging load, with its valley characteristics, would require no new generating equipment.

Operating Expenses Seven Per Cent. of Gross

The first annual report of the Cedars Rapids Manufacturing and Power Company for the year ending December 31, 1915, is a decidedly favorable one, showing earnings of almost three per cent. on the capital stock issued. The gross revenue for the year is placed at $685,593, and operating expenses at $48,295. That is, the ratio of operation to gross revenue is approximately seven per cent.—the lowest, we believe, that has ever been recorded by a hydro-electric company. The assets of the company are placed at slightly over twenty million dollars.

The Beckwith township council are planning to build some twenty miles of telephone line during the summer of 1916.

New York a Gilded Tragedy

(Sydney Brooks in North American Review)

To come from England to Manhattan Island, from a country strung up as never before in its annals to the heroic pitch, full of the spirit of sacrifice and endurance and in daily touch with the grimmest facts of life and death—to come from such a country and to land in New York is to make a change indeed. For New York, always a feverish and pleasure-loving city, is to-day simply drunk with money. Even during the height of the steel boom of twelve or thirteen years ago, when every train from the west seemed to bring fresh carloads of brand new millionaires, the metropolis was not so openly reeling with dollars as it is at this moment, when the gayest "season" of its history is drawing to a close.

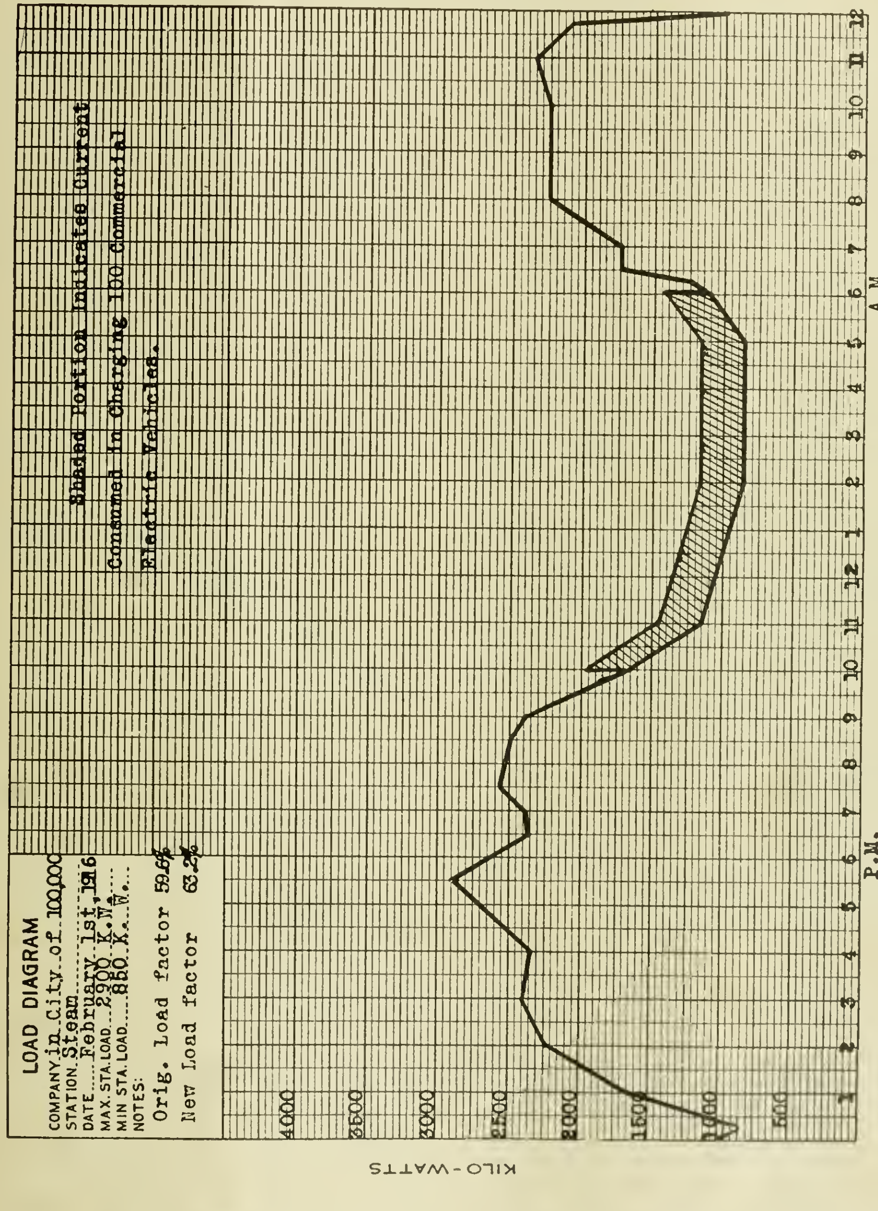
It almost appals an Englishman to find there in full swing the old rotten life that we in England have put completely behind us. And it appals him still more to reflect that a bare two years ago he was leading, if one allows for the extra intensity that New York throws into all its activities, very much the same life himself. One despairs of ever being able to convey to one's American friends how completely the war and its conditions and consequences has become not merely a part of, or a side issue to, but literally the whole British existence. They are so dominant, have so utterly swallowed up everything else, that no other form of life, least of all the trivial carelessness of peace, seems normal or even credible.

I catch myself in New York, if I enter a lighted room, instinctively reaching out to draw down the blinds lest a Zeppelin raider should note the glare; and of all the sights that crowd in upon me, that of multitudes of young men who are not in khaki strikes me as the strangest and the most repellent. It may be one more proof of our demented state, but it is the bare fact that not for anything would we in England change places with you in America or part with the waste and misery of the war to receive in return the "blessings" of such a peace as yours. Stay-at-home Americans simply cannot enter into or even conceive the atmosphere of the belligerent nations in this struggle; and conversely, so long as it lasts, a visitor from any one of the countries at war will continue to be shocked by the atmosphere of America as something unnatural to the point of being grotesque.

In New York the fact and the vastness of this chasm of sentiment assail the visitor with the sharp finality of a bayonet thrust. Louvain and Rheims are among the stricken victims of the war, but New York is its supreme and gilded tragedy, and has, I fear, neither the sense nor the soul to know it. Americans must by now have heard of the English charwoman whose husband was at the front and who was drawing her weekly separation allowance. She was asked what she thought of the war.

"What!" she replied. "A pound a week and no 'usband! Why, it's 'eaven! It's too good to last!"

There is something in New York's attitude towards the war which reminds one of this simple soul.



Filling up the valleys with electric vehicles—shaded portion indicates battery load.

Regulation of Transmission Lines

The Application of Synchronous Condensers—Favorable Results of Operation on the Winnipeg Municipal System

By F. H. Farmer, and E. V. Caton*

The subject of line regulation through the use of synchronous condensers is one which is claiming a considerable amount of attention at the present time, and the introduction of capacity into a transmission line or feeder circuit in the form of synchronous motors is, in many cases, attended with such valuable results that the writers have thought this would be an interesting subject for discussion. This paper has particular reference to the installation recently made at the terminal station of the city of Winnipeg's system, and the installation may be regarded as typical of the general case where it is desired to correct the power factor of a load by means of the introduction of synchronous condensers at the far end of the line.

The writers wish to draw attention to the excellent paper by Prof. L. A. Herdt and Mr. E. J. Burr read before the Canadian Society of Civil Engineers in March, 1915 entitled "Constant Voltage Operation of the High Voltage Transmission System," which treats with the city of Winnipeg's installation, and they have no desire to trespass on the ground which Prof. Herdt and his associate have so ably covered. They propose, rather, to bring out the salient points in connection with the effect of power factor on the regulation of a transmission line, and to indicate the way in which these effects can be utilized so as to control line drop. The installation itself will be described in rather more detail than has been possible within the scope of Prof. Herdt's paper, and some further information will be presented as to results obtained in actual operation. It is not proposed to deal with the mathematical analysis of lines in connection with synchronous motors, and those wishing to go more fully into this phase are referred to the above paper and also one by Mr. H. B. Dwight, read before the Canadian Society of Civil Engineers in 1913, in which the subject is fully covered. There are also available for reference many articles in the technical journals and other publications dealing with this phase of the subject. It is interesting to note that in this case line regulation is to some extent a by-product. The main consideration was to increase the capacity of the lines to meet the growing load, and this could be done either by putting up additional transmission lines, or else by increasing the capacity of existing lines—which was limited by consideration of voltage regulation. It was found that by adding synchronous condensers to increase the power factor the regulation would be so far improved as to greatly increase the available line capacity.

The installation of new transmission lines is, of course, a very costly undertaking, and in this case the cost of synchronous condensers with their necessary equipment was only a fraction of the cost of additional transmission lines to produce the same increase of line capacity. This method of increasing line capacity is a feature which is now being very generally recognized, and is bound to have an important bearing not only where it is required to increase the load on an existing transmission line, but also upon the design of new lines. It means that instead of the inductive drop in a line imposing a comparatively low limit upon its capacity, the inductive drop can be eliminated. From this it will naturally follow that the spacing of cables on the towers may be increased, if desired, without hurting the regulation at the receiving end, and also heavier copper may be used, thus reducing ohmic losses in the line. It is a matter of common knowledge that on an ordinary transmission line there is very little object in increasing the size of copper beyond a certain point, because the total drop being compounded of ohmic and inductive drop is scarcely influenced at all by a decrease in line resistance. (See Fig. 1). From an operating standpoint a system of this kind has the very important advantage that it admits of regulation at the receiving end instead of only at the power house. In the case of a long transmission line where the drop at full load is considerable, and depends upon both load conditions and power factor conditions, it is a difficult matter for the station operator to maintain the bus-bar voltage at the receiver end at the right point at all times. The operator at the receiving end is conversant with load conditions at all times, and if instead of communicating with the power house, he has the voltage control in his own hands he can readily adjust

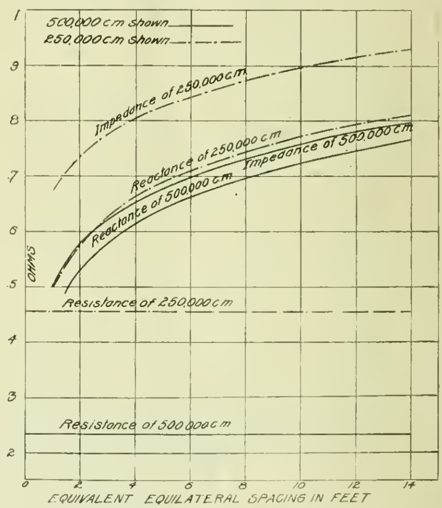


Fig 1—Curve showing resistance, reactance and impedance per mile of line for 250,000 and 500,000 c. m. Copper at 60 cycles.

the voltage so as to exactly meet load conditions. The use of synchronous condensers at the receiving station provides such a means of regulation by simply varying the power factor of the load.

In passing it may be of interest to note that while the term "synchronous condenser" is in general use as applying to the use of synchronous motors for the purpose of power factor correction, it is only correct when the motor is supplying a leading current. Since it is often necessary to supply lagging current to obtain the necessary regulation the term "synchronous reactors" has been suggested as the more correct term to apply. The term "phase compensators" has also been used, but it is liable to lead to confusion, as this term is applied to an apparatus sometimes used in connection with large wound rotor induction motors to improve their individual power factor. Throughout this paper the term "synchronous condenser" will be used as applying to

* Before Winnipeg Branch C. S. C. E.

synchronous motors running without mechanical load and supplying the necessary wattless leading or lagging current required for power factor correction. Having indicated in a general way the advantage which may be gained from the use of synchronous condensers, we will now consider the problem of drop in alternating current transmission lines, and the effect of imposing a synchronous condenser load on the system.

Line Regulation of Synchronous Motors

The regulation (or variation in voltage between no load and the required load) under various conditions of load is, in practically all long distance transmission lines, the factor which limits the amount of power which can be transmitted over any line. For this reason anything which tends to reduce the voltage drop under load conditions, that is, improve the regulation, will increase the amount of power which it is practicable to transmit over a given line, and is therefore much to be desired.

In ordinary d.c. transmission lines, the only variable for a given line, which causes a drop in voltage, is the current, the drop being given by the simple Ohm's Law:

$$E = IR$$

where E equals voltage drop, I equals current, R equals resistance of line in ohms. With alternating current, however, we find an entirely different set of conditions, as in addition to the simple IR drop we have the drop due to the self induction of the line which is given by PLI, where $P = 2\pi \times$ frequency, L = self induction of the circuit in henrys, I = current. To obtain the total drop it is necessary to add these two values together vectorially when we obtain the formula:

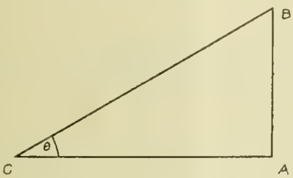


Fig. 2

$$E = I\sqrt{(R^2 + P^2 L^2)}$$

the value $\sqrt{(R^2 + P^2 L^2)}$ being known as the impedance of the circuit. The above, however, only holds good for a non-inductive load on a transmission line, and it is necessary to make other corrections when the load is inductive.

As is well known, any alternating current can be split up into two components at right angles to each other; these two components being known as the power or in-phase and the wattless or out-of-phase components; the angle between the power component and total current being the angle of phase difference, the cosine of this angle being what is known as the power-factor of the circuit. This is shown graphically in Fig. 2. In this figure BC is the total current; AC the power component; AB the wattless component; and θ the angle of phase difference.

By inspection it can be seen that the following relations obtain: $AC = BC \cos\theta$; $AB = BC \sin\theta$, and

$$\text{Ratio} = \frac{\text{Wattless current}}{\text{Power current}} = \frac{AB}{AC} = \tan\theta.$$

It is thus seen that the actual power of the current is proportional to the length AC and that any increase in the angle θ with AC remaining constant, i.e., constant power, will increase BC and BA, or in other words, the total current will increase with an increase of θ without any increase in the power. Since the total current in a circuit may be resolved into its two components, the in-phase and the out phase respectively, it follows that the total voltage in a circuit may be similarly resolved and the triangle in Fig. 2 may equally well represent a triangle of voltage as of current.

Fig. 3 shows the simple diagram for the graphical determination of the voltage drop in an a.c. circuit for varying conditions of load and power factor, and is the simple well-known Mershon diagram. In this figure E_r = voltage at receiver end; E_s = voltage at supply end; I = current at receiver end; θ = angle of phase difference at receiver end.

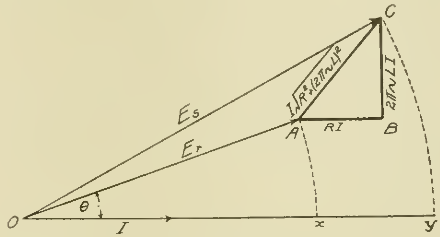


Fig. 3

The triangle ABC is the triangle of voltage drop and is identical to the triangle shown in Fig. 2. AB is the drop due to the resistance of the line, BC is the drop due to the reactance of the line, and AC is the total impedance drop. The total drop is equal to xy measured on the same scale as E_r and is the difference between the length of the vectors E_s and E_r.

Fig. 4 shows this same diagram further extended. In this figure the triangle ABC has each of its individual components resolved into their "in-phase" and "out-phase" components, with reference to voltage at the receiver end.

That is—AB is resolved into two components: BD (resistance drop of out of phase current) and AD (resistance drop of in-phase current). BC is resolved into two components: EC (reactance drop of out of phase current) and EB (reactance drop of in-phase current).

The total xy equals AD + DF + FG

$$= IR\cos\theta + IX\sin\theta + E_s(1 - \cos\alpha)$$

Where α is the angle of phase difference between voltage

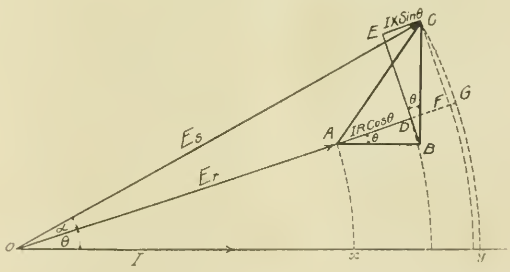


Fig. 4

at transmitting end and voltage at receiving end. This angle is usually so small that the last expression may be neglected, thus giving a convenient approximate result,

$$\text{drop} = IR\cos\theta + IX\sin\theta.$$

From the above it will be noted that the total drop now depends upon four factors: (1) the current = I; (2) resistance = R; (3) reactance = X; (4) angle of phase difference θ or power factor.

Since R and X are fixed for any line the only way in which the drop may be altered is by alteration of either the current or the power factor. Since an increase in the current will obviously increase the drop by lengthening both AB and BC and therefore xy, it will be seen that to improve the regulation without decreasing the power we must decrease the angle θ, thereby making the angle between AC and E_r less obtuse and so reducing xy. In other words, we must improve the power factor.

Methods of improving the power factor are well known, the most popular being to encourage the installation of synchronous motors instead of induction motors, and by encouraging the individual consumer, by means of bonuses or penalties in the form of rate adjustment, to maintain his power factor as high as possible. This method, although tending to improve the general power factor of the load, fails, in so far as it does not leave the control of the power factor of the load in the supply company's hands.

For this reason it had recently been found advisable in some cases for the supply company to instal large synchronous motors running light and, by means of their field control, to control the power-factor of the system on which they operate.

Although the fact, that by the control of the field current the current taken by a synchronous motor may be made to vary in both quantity and phase displacement, is well known, it might be advisable to briefly explain how this happens.

This is shown by simple vectors in Fig. 5. In the case (a) the machine is supposed to be excited to below its normal value. Then applied voltage = OE_s; generated motor voltage = OE_b and lags slightly behind the true opposition value by an angle = ϕ which depends upon the mechanical load on the machine and is constant for constant loads. This is actually the angle of displacement of a pole from the centre of polarity of the armature winding at any instant, due to the torque imposed by a mechanical load tending to

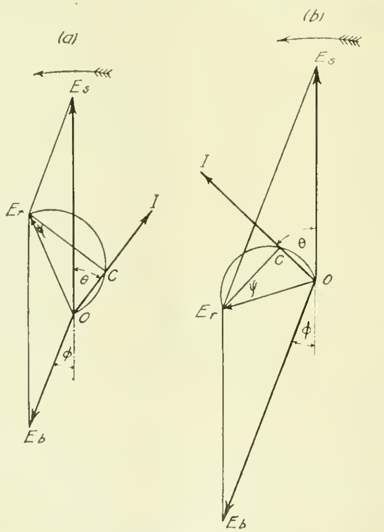


Fig. 5

pull the machine out of step. The resultant of OE_s and OE_b is OE_r and this is the voltage available for forcing current through the winding. Now OE_r may be resolved into its two components OC, the in-phase voltage and CE_r, the out-phase, the angle ψ being such that

$$\tan \psi = \frac{\text{Resistance of motor armature}}{\text{Reactance of motor armature}}$$

The current will thus be along the line OC and will in this case lag the impressed voltage E_s. Its value will be equal to E_r/z when z = impedance of the windings.

In case (b) the excitation is increased above the normal and the resultant OE_r is obtained, and the current OI, which in this case leads the impressed e.m.f., the angle ψ being a constant for any one machine.

We thus see that by varying the excitation of a synchronous motor we obtain various values of current and that above a certain value of excitation these currents lead the

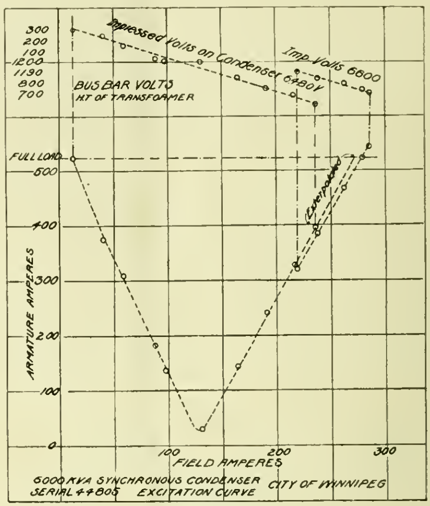


Fig. 6

impressed e.m.f. and below the value lag the impressed e.m.f This is shown in the well-known V curve of synchronous motors, Fig. 6.

(Continued in April 15 Issue)

Great Lakes Power Company

It is understood that a company capitalized at $2,000,000 has been formed to take over the present power interests of the Algoma Steel Corporation and that the water rights held by this latter company will be developed.

It is publicly announced that the Great Lakes Power Company, Limited, representing financial interests in Chicago and Boston, have signed an agreement with the Algoma Steel Corporation to take over the street car and ferry business of this corporation as well as their power interests, both developed and undeveloped. The new company had a bond issue of $2,200,000.

The present water power development of the Algoma Steel Corporation is in the neighbourhood of 15,000 horsepower, and it is understood to be the intention of the new company to overhaul this plant and double its capacity at a cost in the neighbourhood of two million dollars. The 30,000 h.p. will be utilized by the Lake Superior Paper Company, the Algoma Steel Corporation, and for light and power for various industries at the Soo. It is understood that negotiations are already under way to induce new industries to locate at this point, where, it is claimed, low power rates will be a special inducement.

The American Telephone and Telegraph Company's annual statement shows an increase in gross earnings of approximately $14,000,000 over the previous year, the amount being $240,000,000. Net earnings were $41,117,487, of which the dividend requirements take $29,100,000.

Fire Alarm and Police Telegraph System

Mr. F. A. Cambridge, City Electrician, Winnipeg, describes the situation in that City, before the local branch of the C.S.C.E.

From humble beginnings a system has been evolved that today presents facilities to the public for giving an alarm in the transmission of a signal and in the calling out of the fire apparatus. This has meant not only a tremendous amount of work on the part of manufacturers in the design of apparatus but considerable engineering talent has been expended on the transmission circuit from the old house top wiring to a modern system such as is installed today in any of the large cities.

As far as Winnipeg is concerned the present fire alarm system is the outgrowth of a system installed a considerable time before the advent of the telephone and which consisted of a few alarm boxes connected to bare iron wire circuits mostly supported on roofs of buildings and connected to a fire station and the old pumping plant at Armstrongs Point and supplied with current furnished by gravity cells. On the advent of the telephone an arrangement was made by the council whereby the Bell Telephone Co., undertook to place the wires on its poles and to operate the system. No improvement was made in the character of the circuits, storage cells were however substituted for gravity cells.

The system was at this time operated on what is known as the automatic principle in which a given number of "breaks" originating in the circuit are repeated upon one or more additional circuits by means of what is termed an "automatic repeater." The city in 1902 decided against entering into a renewal of the expiring contract with the Bell Telephone Co., and decided to construct a new system and take over the operation. A system was built and ultimately a considerable number of improvements were introduced—such as the use of insulated wire for the street lines,—subdividing the circuits, modern switchboards, protection features at the central office and the operation of the system "manually" instead of automatically, trained operators being on duty at all hours.

The rapid growth of the city however brought about not only a corresponding extension of the fire alarm system but with the corresponding growth of the electric light railway and power system of the Winnipeg Electric Railway Co., followed by the duplicating of that company's system by the rival municipal system, elements of danger were introduced that called for drastic and thorough treatment if the efficiency of the fire department and the safety of the public were to be held paramount. In other words a thoroughly modern and efficient system had to be designed, constructed and financed.

Functions Defined

The electrical department functions were ultimately defined by the city council in relation to services as follows: to have charge of the construction, operation and maintenance, of the fire alarm system and to have charge of the construction, and maintenance of the police telegraph system. While this is not a thoroughly ideal plan for the reason that a common staff of operators, trained to operate both systems would be preferable to two distinct sets of men under two different authorities, the present arrangement however is sufficiently idealistic to secure the maximum efficiency in construction and maintenance of the underground and overhead systems which after all are the largest items.

The problem of financing was the first that required attention and considerable preparation had to be made before any actual advance could be made. Hitherto any appropriations made for the fire alarm system were taken from the ordinary tax levy. Now the council naturally are always desirous that the taxation rate should be as low as possible, hence it is difficult to obtain in any one year sufficient funds from that source to warrant the laying down of any expensive piece of work—moreover one council cannot bind its successors to continue to appropriate funds for a given object. The situation first of all necessitated an application to the Provincial Legislature for increased borrowing powers so that the council could, without a vote of the people, issue long term debentures for the purpose of financing the outlay contemplated. This is the basis of the legislative powers now in force and enabled the city to finance the matter in the most economical manner. Appropriations were provided in the stock issue from time to time until the system's requirements were met. The police telegraph system was also financed in a similar manner. The financial obstacles being surmounted plans for the system took place. These involved four fundamentals without which no system of this character can be termed "modern."

First, the central office equipment must be housed in a fireproof building conveniently located in relation to the centre of underground cable area. Second, underground conduit runs must be secured sufficient to at least comply with the underground wiring law and if rendered possible by financial appropriations, extend beyond the limits of the area specified in that law. Third, a cable and wiring system must be evolved capable of providing satisfactory telephonic as well as telegraphic service, with, in the case of the police alarm system, an alternating current power supply for the flash lamp and bell systems. Fourth, a modern receiving-transmitting, and power system at the central office with modern receiving facilities at each fire hall, police station, and pump house, for receiving and recording messages transmitted.

Continuity of Service

Now there should be in laying out a system of this kind one cardinal point borne in mind, and that is, to secure as far as is humanly possible absolute continuity of service. In any other public service shut downs are regrettable and may occasion loss but in these services the lives and property of citizens may be sacrificed through the failure of the lines of communication between the citizen or fire or police officer at the alarm box, and the fire or police force at the various stations. However thoroughly the fire department is equipped, and in this connection Winnipeg is well to the fore in comparison with other cities, we must get our alarm in to the fire department with the highest degree of speed, and the lowest degree of possibility of error or interruption.

The fundamental idea being continuity of service it was decided to run trunk lines from the central office to as many fire and police stations as could be reached underground constituting these local distribution centres. With our generous provision of underground ducts this was subsequently carried out so that use is made of six fire stations and two police substations as distribution centres.

At each fire station the cables are brought into a terminal cabinet in basement where facilities are provided for testing and for manipulation of circuits into groups. In police signal work it is desirable to keep the number of boxes per circuit down to ten or twelve to avoid clashing, but on fire alarm work good practice permits of twenty to twenty-five boxes per circuit.

In the Winnipeg system the fire alarm box circuits except those in the centre of the city, radiate from the district fire stations and while the above rule is observed on the circuits proper these are really further subdivided into groups of circuits at the distributing points thus allowing in case of trouble of cutting out a faulty branch circuit and maintaining service on the balance of lines on that group while trouble is being hunted on faulty branch. From the district fire stations the fire and police alarm wires are carried out underground to cable terminal poles located at various distances in different districts dependent upon amount of underground ducts available.

At the terminal poles substantial cable terminal boxes are placed in which each wire is separately fused at three amperes with an enclosed fuse designed for 2000 volt service, and also connected to a vacuum lightning arrester. The police wires are then carried out to the aerial cables which are all composed of two No. 16 B. & S. wire for the series lines and two twisted pairs No. 19 (one pair in reserve) for the telephone lines all saturated paper insulation and a 3/32 in. lead sheath. The fire alarm signal circuits to the remaining fire stations are in every case carried from the underground cable terminals in 10 conductor aerial cables.

The Seven Call Box

The police signal boxes are of the type known as the seven call box. There are two distinct circuits brought to each box. One the signal or telegraph circuit, and the other a telephone circuit. Included in the signal circuit and within the box is an electro mechanical mechanism actuated either by turning a key in a special keyhole in the outer door or (after opening the outer door) by pulling a lever, either operation automatically transmits a number of impulses giving the number of the box and the patrol wagon signal. As this is the most urgent signal no other act is necessary to turn this in than that recited. There is also a movable pointer, normally set at waggon position and automatically returning to that position after having been used at any other position, by means of which it is possible to transmit automatically a fire or ambulance call or the patrolmen's report signals three of which are separately designated. There is also wired into this circuit but not exposed to the patrolman, a single stroke bell enabling the officer to know whether the line is already in use; a telegraph key for inspectors trouble signals and automatic cut-outs that operate upon the closing of the outer door. The telephone instrument is an ordinary common battery—bridging set, the transmitter being mounted on the inner door. There are 158 signal boxes on the circuits at present; 85 of which are mounted on poles and 73 on iron pedestals.

Switchboard Equipment

The main line switchboard for the police system is made up of five sections and is arranged for handling 24 series telegraph box circuits, and six substation circuits. There is also a telephone terminal board for fifty circuits. All lines are protected by vacuum type lightning arresters sensitive high tension fuses, choke coils and emergency air gap arresters are also used for protection. Each telegraph circuit is then taken through a centre zero milliampere meter and two line relays and also through various switches for testing and other purposes, a telegraph key and an adjustable resistance.

There are also provided on each panel a line test circuit with centre zero volt meter specially calibrated for accurate ground testing purposes. On the centre panel on this board is mounted the manual transmitter used by the operator to repeat the emergency signals received on the box lines to the various substations. It is also possible by manipulation of box circuit switches to send out by means of the transmitter, code signals on the flash and bell system. The various lines are taken from the above to a three panel storage battery switchboard upon which are mounted a full line of instruments switches, and upon the rear a standard mercury arc rectifier, its supply at 220 volts being connected to either the lines of the Winnipeg Electric Railway or the city system. All the above switchboards are of impregnated black marble mounted on angle iron frames.

The entire equipment of time stamps as well as secondary clocks of both fire and police systems are electrically actuated by a master clock on the police system so that a uniform time system is insured not only in the central office but throughout the system.

Illuminated Signals

An ingenious system of illuminated signals has been worked out in this system whereby on the transmission of an "emergency" signal a red lamp on the register affected is automatically switched on and the number of the circuit on the board is illuminated. There is also a series of illuminated signal discs on the various switchboards to remind operators to restore switches to normal positions and to automatically warn operators of trouble on lines. As the telephone is largely used as a medium of communication between department officials and constables a fully equipped central energy switchboard is provided having lines to all offices in police headquarters and to all signal boxes.

Incoming alarms are in every case recorded on punching registers, and all outgoing alarms are likewise recorded on registers on both fast and slow time circuits. The individual box circuit records are not time stamped but a master register common to all box circuits is actuated and the record is time stamped as likewise in the records of the outgoing signals. These stamps are actuated by the master clock. In addition to sending the alarm out on the fast time circuits every alarm is also repeated on the slow time circuits so that all stations receive the alarm over two separate circuits. There are two reasons for this; first to gain time and second to guard against error or failure to receive alarms.

In the fast time service the speed of the signal is only limited by the speed of the box (and they are speeded up to the maximum) and the registers on which the alarm is recorded in the fire stations. This speed is however far too high to actuate the large gongs which are electro-mechanically driven; therefore the speed of the other circuits has to be adapted to them. Moreover in case a register record was not absolutely intelligible to a fireman or a pump house attendant we have the second alarm following immediately behind the first, recorded upon the large single stroke gong that any novice can count. It is further to be noticed that means must be provided so, that these large gongs shall not be sounded unnecessarily, for instance any superfluous sounding of these at night not only wakens men who, are not required to turn out, but at the same time opens all the stable doors and turns on all fire station lights resulting in needless disturbance and loss of sleep.

Fast Time Service

Unlike the ordinary branch exchange, the branch lines on this board cannot be cut through to central telephone exchange, the branch lines being used for fire department business only. In addition to the regular telephone service provided as mentioned above the department has private lines to pumping plants so that fire department officers may through the medium of police signal box phones communicate with engineers of pumping plants, etc. This plan is especially useful when using the high pressure water service. It will also be possible shortly to obtain phone connection with the fire alarm operators by switching in a portable set into a jack in a fire alarm box.

Because the city council has cut the wage of the electrical workers employed by the city of New Westminster to $4.10 a day, the men went out on strike.

Electric Railways

Modern Methods in Street Railway Track Construction—Concrete Base the Only Permanent Form

By R. K. Compton*

Importance of Construction.—One of the most difficult problems which a municipal engineer faces in street improvement of today is the premanency of the street railway track construction. On this point hinges the durability and integrity of that portion of the pavement immediately in the railway area and adjacent thereto. Even in outlying suburban sections, pavements on streets where railway tracks exist are more difficult to construct and maintain than on streets where no tracks exist. The situation is intensified when similar streets are to be improved in heavy traffic sections of busy cities.

Early History.—The speaker takes the liberty of introducing into this subject his experience in the City of Baltimore, where this matter has been given most careful attention, both by the municipal authorities and the street railway officials. In collecting data on this subject from the principal cities of this country we find that other cities have passed through similar experiences. Some fifteen years ago it was the practice of street railway companies to lay the ties directly on the original earth foundation of the street, tamping up with whatever local material was convenient. Consequently track structures had absolutely no stability other than that given by the natural earth foundation existing in the street, so that within a few months after the street was improved and opened to traffic the rails would vibrate under the movement of cars and heavy trucks, with the result that cracks would develop in the paving adjacent to and for several feet on either side of the rails, causing rapid disintegration of the paving, particularly in the case of sheet asphalt. If the pavement were of stone or vitrified block, cracks would develop and the paving blocks would soon begin to "work" and loosen up. Within twelve months the paving in the railway area would be in such condition as to seriously impair the usefulness of the street. This disintegration did not confine itself to the railway area, but would gradually encroach upon the city area.

The next development in this construction was the installation of gravel ballast. This was somewhat of an improvement over the original construction, the only difference being that the development of cracks and disintegration was somewhat postponed. Gravel, being round and smooth, would shift under the strain of passing traffic, with results most damaging to the paving.

The crushed stone ballast was then used. On suburban streets with light car and vehicular traffic this was a decided improvement, and in some instances the results obtained, both as to track construction and maintenance of paving, were most desirable. Care, however, had to be taken by the track gangs to see that most careful tamping was done. The rock ballast construction, however, in heavy traffic downtown streets, did not give the results desired, so that in the past few years many cities have been installing a concrete slab, from 6 to 8 ins. in depth, under the ties, then brought up and completely enveloping the ties in concrete, and the concrete foundation for the paving installed on top of this.

Right here it may be well to note the following list of cities which have used or are using concrete as a foundation for track construction, in whole or in part. Most municipalities do not use it exclusively, but use concrete in the heavy traffic sections, and rock ballast in the suburban sections where car and vehicular traffic is light, or where the paving of streets may not be regarded as permanent on account of the surrounding property being undeveloped. This information was obtained in 1913 and 1914 through correspondence with municipal officials in the respective cities. These cities are as follows: New Orleans, La., Chicago, Ill., Buffalo, N. Y., St. Louis, Mo., Norfolk, Va., Boston, Mass., Detroit, Mich., New York (Brooklyn), Cleveland, O., Nashville, Tenn., Memphis, Tenn., Springfield, Mo., Birmingham, Ala., Dayton, O., Cincinnati, O., Baltimore, Md.

It is a fact that traction engineers as a rule object to concrete under the ties, claiming three distinct disadvantages:

Objections of Traction Officials.—First, that concrete under the ties makes the track construction entirely too rigid, and that rock ballast gives equally good results and overcomes this rigidity in that it allows a certain amount of resiliency, and that such resiliency is necessary, otherwise undue wear will take place on the rails from passing cars, and that rigid track construction is hard on the equipment.

Second, that in case of reconstruction the railway company is put to an unnecessary expense removing the concrete so as to replace defective or disintegrated ties with new ones.

Statistics show that there is no real ground for the first objection, and even if there were, this can be overcome by keeping the conceрte base an inch or so low and bedding the ties in a thin bed of loamy sand on top of the concrete slab. Care should be taken, however, to bring the concrete up on the ends of the ties so as to confine the sand and prevent its shifting.

Replacing Ties

The second objection can be overruled by the fact that in replacing worn-out or disintegrated ties, the railway company does not have to remove any more concrete than it would otherwise remove were the pavement only on a concrete foundation of the usual thickness, as will be hereafter shown by the method of construction followed by the City of Baltimore. Furthermore, statistics compiled by the Board of Supervising Engineers in the City of Chicago, who have been giving this matter most thorough study for the past eight years, show that sound yellow pine ties, thoroughly embedded in concrete, are almost indestructible.

Another and third objection made by the traction officials

* Chairman and Consulting Engineer, Paving Commission, Baltimore, before American Good Roads Congress, Pittsburgh.

is that the car lines have to be diverted, either by means of laying a third and temporary track on the street to be improved, or if the street is so narrow as to prohibit this, there has to be an entire re-routing of the cars, causing by either method serious inconvenience to the public and disorganization of the car company's traffic schedule. This claim can also be overruled by a method which the speaker will outline to you later, as followed by the City of Baltimore.

The experience of all municipal engineers along this line has probably been the same.

Baltimore Work.—Owing to the flat refusal of the traction authorities to install permanent construction, many of us have had to resort to legislative bodies for relief. In the beginning of the year 1914 the situation in the City of Baltimore was thoroughly studied, both by the municipal engineers and the traction officials, with the result that the State Legislature of Maryland was appealed to by the municipality and a law was passed putting the character of foundation under the ties of the several street railway companies and steam railroads under the jurisdiction of the Paving Commission, with power to decide whether such foundation should be of plain ballast or concrete. The commission decided that in heavy traffic downtown streets concrete construction, 6 ins. thick, under and around the ties, was necessary, but that in the outlying suburban section where the traffic was light and street development more or less of an uncertainty, awaiting property development, rock ballast could be used.

The traction officials were informed that they could install the ties immediately on top of the concrete or install a cushion between the top of the concrete and the bottom of the ties. They chose the former.

It may be interesting to note here that in the downtown business section of Baltimore the streets are exceedingly narrow, not over 40 ft. in width between curbs, and there is no room for a temporary third track. Furthermore, the gauge is of odd dimension, namely 5 ft. 4½ ins., so that the track area takes up more space than in most cities. It was also impossible, owing to congestion, to divert the cars to other streets. In order, therefore, to meet this, the third objection of the traction officials, it became necessary to install the concrete without interruption to car traffic. It was at first thought that this could be done by blocking up the tracks an inch or so above the exact grade, installing the concrete, allowing it to set and lowering the tracks to the proper and exact grade. The conclusion was reached, however, that this would not only be very expensive, but hardly feasible, so that it was then determined to pursue the penetration method. This was done by bringing the tracks to the exact grade and ballasting with crushed stone from 1½ to 2½ ins. in size, free of dust and small particles, and tamping the same thoroughly as in ballasting ordinary track, care being taken to thoroughly tamp the ballast and make the same carry the strain of passing cars, then applying a thin cement grout.

In improving streets containing railway tracks the forces of the railway company and that of the paving contractor have to work in conjunction. The railway area is first graded out to the subgrade of the paving by the paving contractor. The railway company then takes charge and grades out to a point 6 ins. below the bottom of the ties. New rails and ties are then installed where necessary, together with any new special work. The ballast, of the size and depth previously noted, is then placed and thoroughly tamped under the ties and up to a point 2 ins. above the bottom of the ties, the rails brought to the proper grade and line, and when the entire construction is "tight" the penetration begins.

The grouting mixture is composed of 1 part cement to 2 parts sand, and is about the consistency of thin cream. The operation is readily done without interruption to car traffic by the use of a small continuous mixer (known as the Coltrin mixer) placed just outside of and parallel with the railway tracks, with a flexible chute, in two sections, to convey the grout from the mixer to the ballast. Starting on the down-grade end and working up-grade, the thin grout is penetrated into the stone ballast, which, as previously noted, has already been securely tamped and made to carry the strain of the passing cars. As already noted, the chute is flexible and in two sections. When a car comes along the first section is thrown out of service and the second section is lowered to the ballast at about the ends of the ties and the mixer kept in service. After the car passes the first section is thrown back in service.

It is true that during this operation some movement occasionally occurs in the tracks, but there is a city inspector on the work at all times who hunts for and locates loose ties and they are immediately tamped up with green concrete.

The natural supposition is that sufficient movement of the ties and track would occur to injure the concrete while setting, but this is not true if the work is carefully handled and executed. On one street in Baltimore this work was successfully handled with five different lines of cars passing up and down the street with but 20 seconds headway at times during the day; while on another piece of work it was successfully installed with eleven different lines of cars passing over the special work with less than 20 seconds headway at short intervals during the day. The resultant mixture is about 1 of cement, 2 of sand and 5½ of stone, with the concrete very dense, as the ballast has been thoroughly tamped and voids reduced to a minimum.

This ends the work of the railway company, as after this section of concrete is installed, the paving contractor again takes charge, installing the concrete base for the pavement immediately on top of the railway base, and then the paving.

Bond Between Slab and Base

As a rule, there is no bond between the paving slab installed by the railway company and the paving base installed by the paving contractor, because generally the former is several blocks ahead of the latter, and in the meantime the concrete slab has set. This therefore overrules the second claim of the traction officials, and the penetration method pursued meets the third claim.

One of the principal points gained by this form of construction is that it shows up very clearly every weak place during the progress of the work. All loose or poorly tamped ties are made apparent by the bubbling or oozing up of the grout as a car passes over. Failures in finished pavement are avoided by immediately tamping such ties, which in many cases would otherwise have been overlooked. It has been found by careful cuts made in the finished work that this grout when properly applied penetrates the ballast to the subgrade, forming excellent concrete, and insures solid track construction, free from vibration, upon which the life of any pavement in the railway area depends.

From records kept and compiled by the Paving Commission it has been found that the total extra cost of this construction over plain ballast, including labor and material, is about 52 cts. per lin. ft. of single track.

In the last two years about 10 miles (single track) of such construction has been installed in the City of Baltimore by this process, in the busiest streets of the city, and car traffic interfered with to such a limited extent that you hear no complaint whatever from the traveling public during the course of the work. Included in the 10 miles of single track will be found all classes of paving within the railway area—sheet asphalt, wood block, granite block, vitrified block and scoria block.

Type of Pavement.—It has been suggested that this subject could properly include a discussion as to the type of pavement between and adjacent to the rails which has been found most satisfactory. The most satisfactory type of pavement in the railway tracks on heavy traffic streets is granite block, with a cement filler. Excellent results have been obtained in Baltimore with the recut granite. The old blocks are from 8 to 14 ins. in length. The 8-in. blocks are re-headed, while the 14-in. ones are split, making altogether, blocks smaller and much more uniform in size than the standard new block. The result is a very uniform, even surface, an excellent pavement for track areas.

On streets which may be half business and half residential, or in the retail districts, vitrified blocks should be used.

All block pavements should be laid on a cement-sand cushion.

On strictly residential streets of very light traffic sheet asphalt has been used, but the speaker rather deplores the use of this material within the track areas.

The block pavements are usually laid between the extreme outer rails, including the dummy, with two rows of liners on the outside of each outer rail. Selected granite block, on a mortar bed, is most desirable as liners on heavy traffic streets. On streets of lighter traffic and residential streets, wood block, 4½ ins. deep, thoroughly embedded in the concrete and on a mortar bed, give most excellent results as liners and an excellent finish to the street, particularly where sheet asphalt is laid from the rails to the gutters.

In order to cheapen the cost of track paving our policy the latter part of last year was to install sheet asphalt in the dummy strip, where there is very little traffic, and which will give good results if the track work is stable. We will follow this policy almost exclusively this year, as a modification of our former standard, where asphalt is used between the rails and curb.

Track Details.—The rails are usually of the Trilby type, 105 lbs. to the yard, 7 ins. deep, with a slight bevel on the outer paving edge. With this rail, and the use of steel tie plates and screw spikes, tierods may be eliminated, and by the elimination of the rods better results from a paving point of view are obtained. Tierods are a nuisance in track paving, causing a great amount of cutting if a block pavement is used, and usually have to be placed below the center of the rail in case sheet asphalt is used in order to have them in the concrete instead of in the binder.

Comparison of Mixing and Penetration Methods.—Good construction could unquestionably be obtained by the rerouting of the cars, either by means of a third track and cross-overs or by diverting the cars to other streets, thereby allowing the concrete to be placed by the ordinary mixing method and at the same time allowing time for the concrete slab to set before car traffic is again restored. While this method is a safer way, it is much more expensive than the penetration method. Unquestionably excellent results have been obtained by the latter method such as has been described, its attractiveness being that it is cheaper as to first cost, owing, principally, to the economical manner in which the materials can be handled, and it overcomes the principal objection of traction officials, namely interruption to car traffic, which is of course a serious objection.

In order to obtain good results with the penetration method, every detail must be carefully looked after by the inspectors, such as the quality and size of the stone composing the ballast, the tamping, and the mixing and placing of the grout. Frequent test holes should be cut in order to see that thorough penetration is secured, and wherever possible the penetration should be started at the down-grade end of a block and proceeded with up-grade.

Conclusions.—Under the old system of earth foundation or ballast, failures and troubles were numerous. Under the new system of concrete under the ties, installed as has been described, the percentage of trouble is infinitesimal, the principal defects being at crossings and around special work. It proves conclusively that for strictly up-to-date permanent construction, both for the street railway system and the pavement, the ties should be laid on a concrete base, from 6 to 8 ins. in thickness, and completely enveloped in the same.

Taking the Public Into Your Confidence

The Twin City Rapid Transit Company, one of the largest electric railway systems in the world, periodically advertises to the public the general policy of the company regarding their endeavors to serve their patrons in a satisfactory manner. The following is an example. It was published as a Christmas message, though its wording is suitable to any season:—

"It is the intention of the Twin City Lines to serve the communities they reach in the best possible way by furnishing first class dependable electric car service at all times; smooth tracks, clean, comfortable, well-lighted, ventilated and heated cars, manned by civil-spoken, courteous, considerate employees who shall be watchful of the passenger's safety and comfort first, last and all the time.

"We welcome constructive criticism with an open mind and endeavor to remedy defects in our service whenever they are brought to our attention. We do not wish to impose any arbitrary or unjust regulations upon our patrons, but, on the other hand, we hope they will recognize that it is necessary to adopt some rigid rules, but this is always with the idea of being reasonable and just to both the company and its passengers.

"Our conductors deal with more persons every day than the average man encounters in many weeks. In all weathers and at all hours, they meet every fashion of folk, the well and the sick, the pleasant and disagreeable, the worst and the best. Do they fail sometimes? Very probably. They are only men after all, with their own individual characters. But when they do fail, they have broken the rule, the reasonable rule for which we stand. If a man is unfit, sooner or later he is dismissed from our employ. We keep only the best of them in our service and we want all of them to be efficient in their duties as well as civil and courteous in their manners.

"In the same way that the manager of a large store or hotel does not know how his employees are treating customers or guests unless the employees are reported, so it is with us, although the store or hotel manager has the great advantage over us in usually having all his employees beneath one roof and under his own observation.

"When it is considered that we carry an average of nearly 700,000 passengers every day in the year (a number equivalent to the population of Minneapolis, St. Paul, Stillwater, and the suburbs of these cities), each passenger representing a separate business transaction, and that we operate approximately 1,000 cars over 440 miles of track, each car in charge of two men, and far away from close supervision, would it not be surprising if all those men were conducting themselves exactly as we expect them to, and waiting on each of those 700,000 customers as they should be waited upon, and as we desire that they should be served?

"We prize very highly the good-will of the people of the Twin Cities, as it is constantly being shown us, and we wish to assure them, in return, that we will strive harder than ever during the year to come to merit their friendliness and confidence."

The London Street Railway Company are planning to double track a section on Dundas Street East during the early summer.

The Dealer and Contractor

Good Light is One of the Best Investments an Employer of Labor Can Make

By J. F. Heffron

Manufacturers throughout the country, in constantly increasing numbers, realize that a very considerable proportion of our industrial accidents are due to poor lighting. The illuminating engineer had knowledge of this relation years ago and has constantly endeavored to draw the manufacturers attention to it, but only of late have his efforts in this direction received any measure of the attention that is undoubtedly their just due. There still remains, however, much to be done in the way of enlightenment of the manufacturer in this connection, but the new field has been opened, and with proper attention and the right line of argument when approaching a prospective customer, the enterprising and progressive electrical contractor will find considerable new business in this field, which heretofore, he has, in most cases, overlooked.

Every factory, shop or mill, is equipped with a lighting installation of some kind. Upon investigation, it will be found that most of these installations are far below the standard now considered necessary. Many manufacturers are difficult to approach on this subject; they do not realize that they have any problem to solve, and so it is difficult to make them realize that the solution may mean a cutting down of waste, and, as such, money in their pockets. It is necessary therefore to arouse the interest of your prospect, so that he may give consideration to the problem you desire to lay before him.

A good opening for your wedge can often be secured by pointing out to the party you are interviewing the fact that years ago it was considered unnecessary to protect the employee by the installation of safety devices which are now considered an absolutely essential part of industrial equipment, and which are in many cases even required by law for the protection of the employee. The employer has also of his own volition installed safety devices, which years ago were considered unnecessary, because he realizes that he can in this way protect himself from payment of damages arising out of possible injuries to his employees—for instance, the installation of guards around cog-wheels and other dangerous moving parts of machinery. If it can be shown that good light also plays an important part in the evidence of possible accidents, you can be sure of gaining your prospect's attention, and very often you are able to land a contract, which could not be obtained by other methods.

It is a well known fact, that industrial accidents increase in direct ratio to gloom and darkness, that the greatest number of accidents in industrial establishments occur during the months of December and January, the months having the least daylight. It has been shown by illuminating engineers, that the number of accidents caused is twice as high in the winter months as in the summer months. It is of course during the winter months that artificial light must be depended on to a greater extent than in the summer months.

Mr. R. E. Simpson in a paper presented at the ninth annual convention of the Illuminating Engineering Society, Washington, D. C., tells how the conclusion was reached some years ago, by many of the largest coal mine operators, that undoubtedly the darkness of a coal mine, broken only by the feeble light of a miner's lamp, is in great measure responsible for many coal mine accidents. It is worth our while to note, that the introduction of electrical power for haulage purposes has provided the coal operators with an efficient means of lighting the more important switching points in the mines. The use of steel and concrete for roof support, and the application of white-wash to the roof and sides at the turn-outs, switching points, and shaft bottoms, materially increase the illumination, we are told, and, as a result, the motorman can see, easily and surely, that switches are properly set and that no standing cars block his way, which of course enables him to avoid derailments and collisions. Other employees, at these points, which are the busiest parts of the mine, can also perform their duties much more efficiently and safely because of the better illumination.

In the Illustrated World, Chicago, Dec. 1915, John A. White tells us that according to a United States Senate report on a large steel plant, during a period of five years, in all its various departments, the accidents at night outnumbered those of the day, in some cases by as much as one hundred per cent. Undoubtedly other factors must here also be taken into consideration, yet unquestionably this tremendous discrepancy between day and night accidents can be due in large measure only to the difference in degree of illumination.

We know that from the view point of every-day good health, a building flooded with sunlight is much more desirable to work in than a place which is dark and gloomy. Leaving out of the question the possibility of disease-germs, the workman can no more be happy and contented in a gloomy place than the housewife in a gloomy kitchen. Good illumination means less irritability, better nerves and, as a result, a surer, steadier hand in directing dangerous machinery, greater staying power, and an ability to turn out a greater amount of work in a day.

Light and Health Go Together

We have heard on various occasions how eye strain frequently results from poor illumination. This is due as often to harsh glaring light as to poor or insufficient light. The Society for the Conservation of Vision, New York City, numbering among its members some of the most illustrious names on the continent both medically and otherwise, have found, as a result of their investigations into the matter of poor light and its effect on the eye, especially among school children and factory employees, that much harm is undoubtedly caused by factors entering into the matter of poor lighting, which factors are in themselves so subtle that their effect is frequently unnoticed or not realized until too late and the eye has been impaired beyond repair.

Mr. White in the article mentioned, tells us that it appears rather odd that in all the agitation for safety-devices around machinery, the importance of lighting has not been sufficiently emphasized or insisted upon; very often where proper precautions have been taken to illuminate the machinery, little heed has been given to lighting the floor space of the passages. A man cannot come from a glare of light and step into semi-gloom without having his eyes so dazzled that for the moment he is blinded. Employees temporarily blinded in this manner are frequently injured by stumbling over boxes or other obstacles that have been placed on the floor.

A typical case of poor passage lighting and its result, is mentioned in Mr. Simpson's article already noted. He tells us of a certain shop having widely spaced lighting units and supporting columns, one of which cast a shadow which hid a flat two inch metal bar lying at an angle across the passage-way on the floor. When one of the front wheels of a truck encountered the bar, the truck axle, swerving sharply to the right, jerked the handle out of the laborer's hand and struck the right foot of a workman standing at the side to let the truck pass. The blow broke one of the small bones in his foot. The sudden stopping of the truck also caused one of the heavy pipes on it to roll off, the truck handle acted as a skid, guided the pipe against the workman's left leg, breaking both bones below the knee. It is evident, Mr. Simpson tells us, that neither man saw the bar of iron on the floor, a fact which is easily understood when one considers that the floor and the bar were both dark-colored, and further obliterated by the shadow. It is fair to assume that had adequate light been provided, one of the workmen would have seen the bar and would have removed it instead of attempting to pull a heavy truck over it.

Mr. Simpson tells us further of a paper mill employee, who, while feeding a conveyor with small pieces of pulp wood, noticed that the chute at the other end of the conveyor had become clogged. No light was provided at the chute, but the man, after stopping the conveyor, attempted to clear the way. While thus engaged a block of wood slipped out and, falling, broke his ankle. There was no occasion for any of the workmen to use this part of the mill unless the conveyor or the material caused trouble. This, however, was just the time light was needed and none had been provided.

Reducing Cost of Doing Business

The amount of money required to maintain proper lighting units, affording ample illumination in both cases just cited, would have been negligible compared with the amount of the claim paid the injured workmen. It is a fact that such units could have been kept burning day and night for a number of years and still the owner would have realized a handsome profit. Undoubtedly also the employees would have been saved from injury and its attendant troubles.

Mr. Simpson mentions other incidents of like nature, which are especially interesting to us, in that, the accidents resulting are directly traceable to poor lighting. In the first one, we find that an employee missing his footing, fell into a tank containing hot water and acid, and was fatally burned. In this case a number of tanks were placed close together, with narrow walks between them at the top. Guard rails and light were not provided. In another instance, we are told how the lack of light in a hold of a vessel was, without a doubt the cause of a crushed foot. A workman was piling pig iron there, in the semi-darkness, the open hatch, far above, admitting so little light that he could not see the pile was uneven. While he was still at work the pile toppled over and he was injured. Almost exactly similar was the accident which crushed a workman's shoulder, because he could not see in the ill-light of the ship's bottom that a hook he had fastened into a bale of cotton was insecure. After the bale had been hoisted part way out of the hatch the hook slipped and the bale fell on the workman badly injuring his shoulder and back.

A case wherein light had been provided but was poorly located, is illustrated by the accident which occurred causing serious injuries to a workman running a machine with four saws on one shaft. The saws were well guarded but the drop light was so badly arranged that one of the guards cast a deceiving shadow. The workman thought he was placing his hand on the guard, but instead he placed it on the shadow, and as a result was badly injured. This was purely a case of improper lighting, and as it appears that the workman arranged the light himself, it points out the hazard in the practice of permitting workmen to adjust lighting units to suit their own convenience, instead of having them placed by a lighting engineer who has studied the safety problem carefully.

The records of workmen's compensation and accident insurance companies, we are told by Mr. Simpson, offer a fruitful field for study of accidents, particularly when special attention is given to details in the investigations. The Travelers Insurance Company in the United States has over 200 men who are specialists in accident prevention work. A record is kept of all industrial accidents happening in the factories, shops, and mills, carrying insurance with the Travelers; all important ones are investigated by the inspectors, who ascertain the conditions prevailing at the time the accidents occur. The reports of these men are of great interest in the relation they bear to causation and prevention of industrial accidents. It is found that very often the lighting question plays an important part. Figures compiled from these sources indicate that one half a million avoidable accidents occur each year in the United States, of which number it is estimated that about one quarter are due directly or indirectly to poor lighting facilities. The number above mentioned is merely approximate, but returns from actual accidents investigated bear out the approximation very well indeed. Actual accidents investigated during a period of one year, and listed as avoidable, are given as being 91,000 in number. The Travelers Insurance Company's record show that 23.8 per cent., were due, directly or indirectly to lack of proper illumination.

Twenty-four Per Cent. of All Accidents

We are told that **a further analysis of the records show that 10 per cent. of the total number of industrial accidents for the year were due primarily to inadequate illumination, and in the remaining 13.8 per cent., the lack of proper lighting facilities was a contributory cause.**

Mr. D. R. Wilson, special inspector in the Factory Service in Great Britain made an investigation of lighting conditions in British textile industries and in foundries during the years 1911 and 1912 but in his reports there is not contained sufficient data to enable one to ascertain the percentage of accidents due to the inadequate lighting conditions described. But it is interesting to learn that Great Britain and other European countries are giving this matter serious consideration. Their action in giving attention to this problem helps to assure us that it is indeed a grave and serious one.

The conditions existing in the greater number of our industries are without doubt inexcusable whether we look at them from the point of view of the workman or of the employer. From Mr. White's article we learn that it is roughly estimated that the cost of injuries to workmen amounts within a year to a quarter of a billion dollars; half of which accidents are preventable. Think of this enormous loss to manufacturers. And still more should we try to realize what these accidents cause in misery and suffering, perhaps for life, to the workmen and their families.

It was the custom a few years ago for many plants, both large and small, to shorten the working-day during the mid winter months because proper illumination was lacking. But manufacturers have since realized that this is very short-sighted business policy. And each day in greater numbers are they also realizing that it is short-sighted policy to compel employees to work under any but the best possible conditions that can be provided.

Essentials in Industrial Lighting

Mr. White points out some of the principal things that should be borne in mind, and that should be given special attention when considering the matter of securing good light in an industrial plant. He first draws our attention to the manner in which manufacturers are giving this matter careful thought by constructing buildings in a manner entirely different from that followed a few years ago. As a result we find their construction has been radically changed until they are now almost as well lighted as the photographer's studio, brick and concrete walls seeming hardly to exist, the sides being a mass of glass. He tells us that:

> "Four factors may be taken into consideration with regard to the proper illumination of industrial plants. The first is the question of how best to introduce daylight into a building; the second concerns the use of artificial illumination; the third, employment of methods for properly diffusing light; and lastly, the question of selecting the right sort of artificial illuminant, and so protecting it as to avoid fires and explosions."

He mentions further how the realization of these new problems have brought into existence and created a demand for the illuminating engineer. He points out also, how the casualty companies, who, for a special premium take over the legal hazard involved in the employing of men in factories, and who for this reason are held responsible for all preventable accidents to employees, greet the rise of this new profession with enthusiasm.

We find in summing up the entire matter, that many employers and manufacturers now find good illumination a profitable investment. A great many of them, it is true also, have either not had the facts in the case pointed out to them, or only realize their need in a dim and incomplete way, because these facts have not been presented to them in a proper and convincing manner. If this is properly done by the man engaged in selling and installing good light, and if the electrical contractor who feels that he is incapable of doing this will call upon,—for instance—the different large illuminating glass manufacturers for the assistance of their staff of illuminating engineers, who extend their services in this connection gratis, these engineers will assist him in conveying this knowledge to the manufacturer, and as a result a much larger field, and undoubtedly a profitable one, will be opened to the contractor, who will then not find it necessary, as did Alexander, to sigh for more worlds to conquer.

New Dual Power Automobile—An Economical Combination of Gasoline Engine and Electric Motor

After two years of experimenting and engineering, coupled with months of severe road tests, one of the oldest and most conservative of electric vehicle manufacturers is about to place on the market a dual-power electric car, the most recent development of its kind. The principle of the new car, it is reported, is entirely novel, combining the best features of the gasoline car with those of the electric. Anyone familiar with an electric vehicle knows that if the battery could be charged every few miles or every time it needed it, or if it could be continuously charged, a battery only half as large would be necessary. Suppose then that half the battery has been discharged, and in its place has been installed a small gasoline engine and dynamo to charge the remaining battery. The next obvious step is to eliminate the dynamo and to use the vehicle motor driven by the engine as a dynamo. Thus the engine and motor dynamo are placed on the same driving shaft with only a magnetic clutch between them, the controllers arranged so that the car may be driven by either the engine or the motor, and the engine when driving the car also drives the dynamo and charges the battery.

From the point of view of the gasoline car, the modern automobile already has as part of its equipment a small storage battery and a dynamo motor which charges the battery and starts the engine. Suppose then that the dynamo motor is increased in size until it is large enough to run the car, and also suppose the storage battery correspondingly enlarged. The gasoline engine could then be made very much smaller because it would not be used for starting and accelerating—the things that are responsible for all the excess power requirement in the regular gasoline car. The control mechanism of this car exactly resembles the control mechanism of a gasoline car. It consists in its visible parts of a sector with two finger levers mounted above the steering wheel. The outer lever is the electrical controller, and the inner one controls the gasoline engine. The outer lever works directly through a rod in the steering shaft, on an electrical rheostat controller which governs all the necessary electrical connections. The inner lever also has one electrical function; as soon as it is moved up from the neutral or dead position it actuates the magnetic clutch and connects the motor and engine.

The motor turns over the engine and starts it in the usual gas car manner. As soon as the engine is running at speed it turns the motor into a generator and charges the battery, the engine at the same time driving the car. However, when both levers are up, the engine and motor together drive the car giving sufficient power and speed for any occasion. The motor can drive the car alone, while the engine is still. The engine, however, cannot drive the car without also running the motor-dynamo and charging the battery. Coasting either down hill or on the level charges the battery.

Assuming the car to be standing still, the driver moves the outer or electrical finger lever, and the car starts as a pure electric, motor driven from the batteries. It quickly attains 15 or 20 miles an hour, or whatever the desired speed may be. The driver may then continue to drive electrically or he may move the inner lever, and so start his engine. Both motor and engine are now driving the car. If road conditions are severe, or there is hill climbing to do, the dual may be continued, otherwise the driver next moves the outer or electrical lever back to neutral. The engine is now driving the car and running the motor as a generator charging the battery. If the driver wishes to stop, he presses on the single foot lever which operates the brake. If the motor is driving, the first movement of the foot lever shuts off the current; in any case, it short circuits the motor through a resistance making a magnetic brake. Further movement of the brake lever acts on a regular band brake on the rear wheels and stops the car. If desired, the action of the car may be largely controlled with the foot lever. There is, of course, no clutch lever, because there is no clutch in the ordinary sense of the word, and as there are no gears, there is no lever corresponding to the gear shift lever on a gas car. Even the braking for most stops is amply provided for by the reverse magnetic effect of the short circuited motor when the finger lever is moved back. Reverse, which is purely electrical, is operated with a short heel lever just back of the driver's foot. It simply reverses the electrical motor without changing any shaft or gear connection.

Every gasoline car operator knows that only a small portion of the high power of his engine is used in simply driving the car. Even the big heavy car with the 60 horse power engine uses not over 10 horse power for straight driving. The rest is merely on hand for emergencies, and the excessive demands for starting and accelerating. However, the consumption of gasoline naturally corresponds to the size of the engine, and not to the amount of power that is actually used. It is reported that the test models which have been driven into the country for hundreds of miles in all sorts of weather and road conditions, have been making about thirty miles per gallon of gasoline while running on the engine alone and at the same time charging the battery for an additional fifteen miles on the same gallon, thus making a possible mileage of 45 on one gallon of gasoline—a most remarkable showing. This extraordinary economy seems almost incredible, but it will be understood by anyone who is familiar with the regular gas car's extravagance.

This duel-power electric can attain a speed of 40 miles per hour on the dual drive, or can maintain a speed of 20 miles per hour when run as a pure electric. Another feature claimed to be a distinct advantage, is the ability to set the speed at a certain rate, say thirty miles per hour, and immediately as the car "picks up," it will maintain this speed until the driver wishes to change it.

Electrical Contractors' Convention and Show in Massey Hall, Toronto, June 6, 7, 8.

Plans have now been finally arranged for the annual convention of the Electrical Dealers and Contractors Association of Ontario, which will be held in the basement of Massey Hall on Tuesday, Wednesday and Thursday, June 6, 7 and 8, 1916. At the same time the Association are putting on a big electric show, which is, in reality, the first electrical show ever attempted in Canada. Present indications are that the space will be very quickly taken up as manufacturers and dealers will appreciate the value of displaying their products for three days right in the view of the contractor delegates who will attend this convention from every city and town in Ontario, as well as from many points in our other provinces.

When we say that this is really the first electrical show that has ever been put on in Canada we do not overlook the efforts that have been made from time to time to interest the electrical trade in cosmopolitan shows of various kinds. In this particular show, however, nothing outside of purely electrical equipment will be allowed on exhibition. The intention is to interest only those people who are interested in electrical matters. For this reason it is all the more important that every section of the trade should stand behind this exhibition so as to make it a marked success.

We believe that no electrical contractor can afford to miss the opportunity of being present at this convention and exhibition any more than any manufacturer or dealer can afford to overlook the advantages of meeting these contractors. We understand that many interesting and special features will be shown including models of ideal construction work under different conditions, samples of concentric wiring, about which there has been very much discussion recently, and other matters of equal interest and importance. A number of recent devices just ready to place on the market will be shown for the first time.

Keep the dates in mind—Tuesday, Wednesday, Thursday, June 6, 7 and 8. The location is an ideal one—Massey Hall, corner Yonge and Shuter Streets, in the very heart of the city. A copy of the announcement being sent out by the secretary of the show convention is shown on the next page.

Toronto Hydro Extending Underground Work

The Toronto Hydro-Electric Commissioners are calling tenders for a quantity of underground conduit work. The work of the Commission for the present year also includes considerable extension and construction work on a number of sub-stations.

Personals

Lieut. Alec Wilson, distribution engineer, Montreal Light, Heat and Power Company, is taking a course at Halifax to qualify for a captaincy in the Victoria Rifles, Montreal

Mr. H. R. Mallison, of the Nova Scotia Tramways and Power Company, recently delivered an address on the development of the water power at Gaspereaux before the Rotary Club of Halifax, N. S.

Mr. Ernest V. Pannell, Assoc. Mem. I. E. E., recently prepared a paper on Continuous Current Railway Motors, which was presented before the Institution of Electrical Engineers, and is now published in pamphlet form.

Mr. R. L. Wilson, manager of the Railway Division of the Westinghouse Electric & Mfg. Company, East Pittsburgh works, has been appointed assistant general superintendent, looking directly after trades apprentices, employment, working conditions and other matters of a similar nature.

Mr. J. E. Richards, general auditor of the London and Port Stanley Railway system, has been appointed manager and treasurer of the road, succeeding F. T. Leversuch. Mr. Richards was formerly with the Chatham, Wallaceburg and Lake Erie Electric Railway.

Mr. L. V. Webber, sales manager of the Metropolitan Engineering Company of Canada, has resigned his connection with that company to become Montreal manager for the Jefferson Glass Company of Canada. Mr. Webber is one of the best known men in the Canadian electrical trade, where he made the acquaintance of practically every central station

Mr. L. V. Webber

man in the Dominion in the early days through his intimate associations with, and active work in the Canadian Electric Association. At that time he was with the Toronto Electric Light Company where he was head of the meter department for a number of years. The Montreal showrooms and Mr. Webber's offices are in the Royal Trust Building.

The Shawinigan Water and Power Company is now delivering power to its subsidiary, the Public Service Corporation, Quebec, over a new transmission line from Shawinigan It will be remembered that the Shawinigan Company acquired a controlling interest in the Dorchester Electric Company, and incorporated a new company with the name of the Public Service Corporation. The steam plant of the Dorchester concern is being used as an auxiliary.

The Electrical Dealers and Contractors Association of Ontario

will hold a

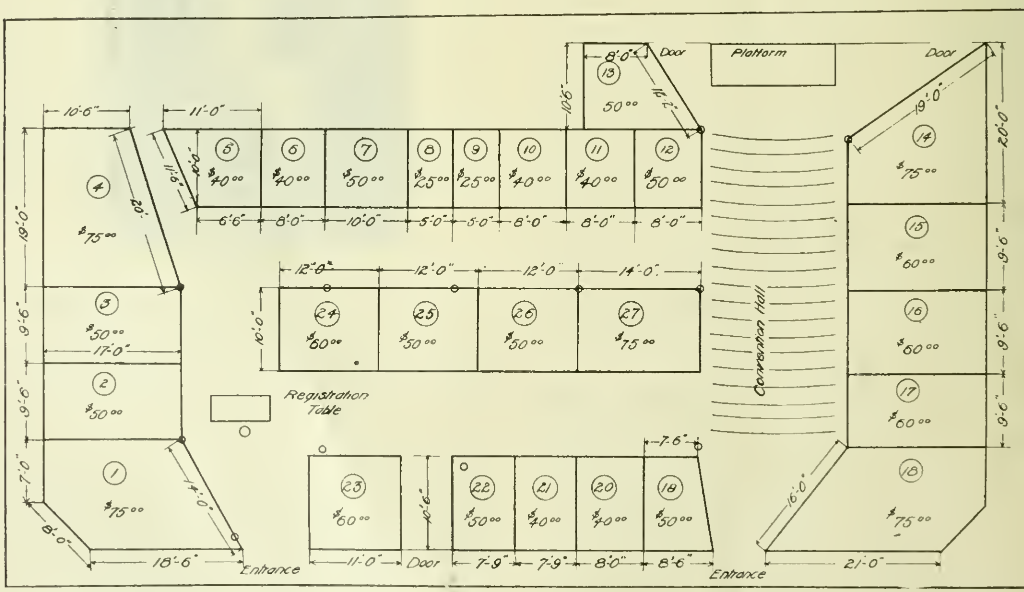
Public Electric Show

in connection with their Second Annual Convention at Massey Hall, Toronto, on June 6-7-8, 1916

The Electric Show will be open to the trade, only, from 9 a. m. to 4 p. m. daily; the general public will be admitted from 4.30 to 11 p. m.

The band of the Queen's Own Rifles will be in attendance each evening from 7.30 to 10.30.

Complete information may be obtained from the Secretary of the Show Committee, Mr. E. A. Drury, 45 Moutray Street, Toronto. Telephone Parkdale 4413.



Plan of Massey Hall basement, Yonge and Shuter Sts., Toronto, where Electric Show will be held.

What is New in Electrical Equipment

Three new Hubbell reflectors have just been placed on the market. They are classified as Focusing, Distributing and Intensive. Fig. 1 illustrates the focusing type for 60 watt lamps. Fig. 2 illustrates the distributing type for

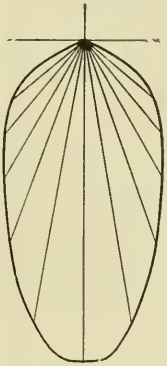


Fig. 1—Focusing Type Reflector with corresponding Distribution Curve.

100 watt lamps. Fig. 3 illustrates the intensive type for 100 watt lamps.

The focusing type is recommended for localized illumination of high intensity over a small area. The smaller units are particularly adapted for bench work where small articles are assembled or where vises are used. The dis-

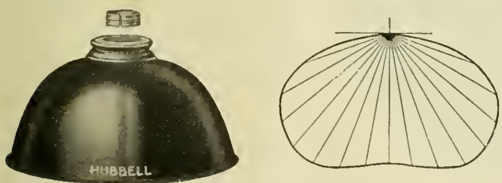


Fig. 2—Distributing Type and Distribution Curve.

tributing type, as its name implies, is intended for general illumination in factories or warehouses. Intensive reflectors are primarily designed for the lighting of large areas though they may be used to advantage in illuminating a group of machines by centrally suspending them from drop cords, thus reducing the distance between the unit and the floor and intensifying the light within the required area.

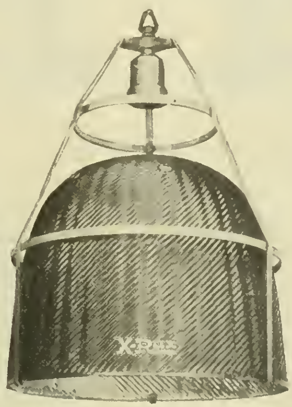
All of these reflectors are equipped with the standard

Fig. 3—Intensive Type and Distribution Curve.

Hubbell contractile collar holder making the use of a separate shade holder unnecessary. These reflectors are made of a sturdy, uniformly spun steel, finished green outside and aluminum inside. Various types are available for use with lamps ranging in capacity from 10 to 100 watts.

Jumbo X-Ray Reflector

The Jumbo is a big reflector designed for big type "C" lamps, and it is one of the latest additions to the direct lighting line of reflectors manufactured by the National X-Ray Reflector Company, Chicago. This reflector was designed to illuminate interiors of considerable height and floor area, such as erecting shops, armories, coliseums, etc. A general shape was selected for this reflector that would give



the desired distribution of light and incidentally conceal the brilliant filament of the light source. The reflector itself is 16½ inches in diameter and 13⅜ inches high. It can be used with 500, 750, or 1,000-watt type C lamps. The special holder which is supplied with it has an adjustable feature which makes it possible to obtain two or three degrees of spread to the light from this unit.

Robbins & Myers New Line of Desk and Oscillating Fans

For the 1916 season the Robbins & Myers Company have brought out a complete new line of desk and oscillating fans in the drawn steel frame construction. In this line two new sizes have been developed—the six-inch desk fan and the nine-inch oscillator. All sizes except the six and nine inch are furnished with six blades, regularly. The six-inch size has four blades and the nine-inch size has five blades. The advantages claimed for six blades over four blades is lower speed for a given volume of air, with less air hum. The steel shells of this new line are made from extra heavy metal—3/32 in. in thickness. The bronze bearings are pressed into cast iron hubs which are attached to the steel frames by screws. This permits the bushings to be replaced easily and quickly without dismantling the fan or destroying the alignment. The oscillating mechanism is the gear type the same as is used in Robbins & Myers cast iron frame fans.

The six-inch desk fan, Fig. 1, has a universal a.c. d.c. motor, and will operate on direct current of any voltage from 100 to 120 volts and on alternating current of any frequency from 25 to 60 cycles, and any voltage from 100 to 120 volts. As it is small and light it can be carried by the traveler in his hand bag, and as it will operate on the majority of commercial circuits, he can use it in almost any hotel. A switch in the base provides two speeds. The base is provided with a felt pad to prevent the fan from marring any surface upon which it is placed. The base and motor are handsomely finished in gloss black enamel and the blades are polished brass. The motor is large in proportion to the blade diameter and the fan will give a good breeze. Ten feet of cord and separable plug are supplied with the fan.

The nine-inch oscillator fan, Fig. 2, has five blades, and is an excellent type for all household services. It is made

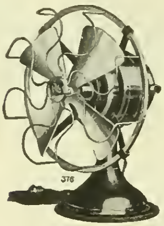


Fig. 1—Six Inch Desk Fan.

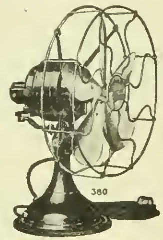


Fig. 2—Nine Inch Desk Fan.

for alternating current, Model 26, and direct current Model 27. The gear type oscillating mechanism is the same as is used in the larger fans. The motor is the series type and the speeds for direct current and alternating current are the same. A three-speed switch is provided. The fan is provided with a felt pad on the base and is equipped with ten feet of cord and a separable plug. In addition to the 110 and 220 volt types, the direct current fans can be furnished in low voltages for operation from storage batteries.

The twelve and sixteen-inch desk fans have blades in both types. The motor is the induction type in the alternating current model. This fan has a three-speed switch. The twelve and sixteen-inch oscillator is supplied with either a.c. or d.c. motor. The fan has an induction type motor and no centrifugal or automatic starting switch is required. It is regularly furnished with six blades in both the twelve and sixteen-inch sizes.

The Packard Electric Co.

The Packard Electric Co. Limited, have recently engaged as their chief engineer Mr. Frank T. Wyman, formerly chief engineer of the Pittsburgh Transformer Co. Mr. Wyman is a graduate of the University of Vermont. After graduation he taught electrical engineering in the Drexel Institute, Philadelphia, for two years, and in the University of Pittsburgh for two years. He has been with the Pittsburgh Transformer Co. for the past seven years, the last four as chief engineer. The Packard Electric Co. are to be congratulated in securing a man of Mr. Wyman's experience and ability.

From the Dufferin "Post"

Mr. Wm. Stewart is a moving picture man and ventriloquist, who hails from Toronto, and says he has been touring this country giving concerts for the past eighteen years. In operating his picture machine he connected his lantern leads onto the electric mains of the Cataract Electric Company, Limited, in the towns of Erin and Alton, which resulted in the Electric Company laying a charge for the theft of electricity. The case was heard by Magistrates Limebeer and Harris, of Caledon, at that village last week, and owing to many complications developing which caused the case to be postponed the plaintiff was able to settle the difficulty by giving the Electric Company a guarantee he would keep off their lines in the future and pay the cost, which was accepted. In addition to a large number of spectators in the court room were several picture men from the surrounding towns.

Trade Publications

Watch the Way the Wind Blows—booklet issued by the Westinghouse Electric and Manufacturing Company, Pittsburgh, illustrating and describing their various types of electric fans.

Lightning Arresters—new catalogue by the Electric Service Supplies Company, describing Garton-Daniels lightning arresters, with illustrations. This catalogue supersedes all similar catalogues and bulletins previously issued; well illustrated.

Sherarduct—booklet by the National Metal Moulding Company, Pittsburgh, describing Sherarduct rigid steel conduit. The booklet explains that this conduit is rust-proof and acid-proof, and illustrates a number of large buildings where it has been installed exclusively.

Electric Radiators—folder issued by the Lee Electric Radiator Company, Chicago, describing a little 300-watt radiator suitable for electric cars. This radiator is operated off the battery, and, it is claimed, involves no additional expense where this battery is charged according to a monthly rate.

Fans—booklets No. 1083 and 1084, by Robbins & Myers Company, Springfield, Ohio, describing respectively cast-iron frame and drawn steel frame fans for a.c. and d.c. circuits. The R. & M. Company are also distributing a folder for dealers which gives a number of interesting publicity suggestions for newspaper and other advertisements.

Westinghouse Publications—The A B C of Automobile Battery Charging, describing the Westinghouse Cooper-Hewitt Rectifier Charging Outfit. Bulletin 3763; describing Westinghouse No. 532-B railway motor. Leaflet 3823; commutating-pole rotary converters. Leaflet 3818; type C push-button stations. Catalogue 3002; describing type CW slip-ring induction motors for constant and varying-speed continuous duty service and No. 1 of Vol. 3 "Data Exchange."

The Electric Vehicle Association will affiliate with the National Electric Light Association and will be known in future as the Electric Vehicle Section of the National Electric Light Association. The Electric Vehicle Association was formed in 1910 and has grown so rapidly that its present membership is approximately 1,200. This figure may be taken as indicative, within rough limits, of the growth of the electric vehicle industry during that period.

Apparently "Electric Week" is to be made an annual affair in the United States as it is now announced that a nation-wide campaign similar to that carried out last year in connection with Electrical Prosperity Week will be undertaken under the name "America's Electrical Week" culminating in a series of displays and demonstrations during the week December 2-9, 1916. As was the case in last year's campaign the Society for Electrical Development, 29 West 39th Street, New York City, is conducting the campaign.

Fraser & Chalmers of Canada Limited, Montreal, have recently been awarded the contract by the City of Regina, covering the delivery and erection of a 300 h.p. steam turbine direct connected to two centrifugal pumps having a total capacity of seven million Imperial gallons per twenty-four hours.

Current News and Notes

Arnprior, Ont.

The McNab Telephone Company have been granted a charter.

Belle River, Ont.

The Rochester Telephone Company are planning to extend their trunk line from Pleasant Park to Belle River.

Blenheim, Ont.

The Blenheim and South Kent Telephone Company are planning line extensions.

Calgary, Alta.

Contracts to the amount of $9,773 were recently awarded the Canadian Westinghouse Company for electrical apparatus.

Castleton, Ont.

The Cramahe Municipal Telephone Company propose building a system during the summer.

Edmonton, Alta.

The city council are extending their electric transmission and telephone lines to the town of Beverly.

Grand Valley, Ont.

A by-law authorizing the expenditure of $11,000 for an electric distributing system was recently carried by the electors.

Guelph, Ont.

The annual report of the Guelph Radial Railway System recently submitted by A. H. Foster, manager, shows gross earnings of $45,143. This is a slight decrease over the previous year, but still sufficient to pay the annual dividend of 6 per cent.

Halifax, N. S.

The city council have adopted the recommendation of the Board of Control of the city of Halifax that the draft agreement for the lighting of the city streets by the Halifax Power Company for twenty-five years be ratified.

London, Ont.

The Board of Commissioners are considering the installation of a municipal lighting system along the west London breakwater.

Mount Forest, Ont.

The Mount Forest, Wellington & Grey Telephone Company are planning to extend their lines from Pike Lake to Gleneden.

Port Arthur, Ont.

Mr. Richard Fox, for many years superintendent of the electric light system in Port Arthur, died recently at his home in this city.

Portneuf, Que.

The Portneuf Hydro Electric Company have awarded the contract for water turbine equipment to the William Hamilton Company, Peterborough. De Gaspe Beaubein, Montreal, is engineer in charge of this installation.

St. John, N. B.

The St. John Street Railway carried 7,782,979 passengers last year. Much of this increase in car travel was due to the extension of the railway tracks to East St. John and Glen Falls and to the completion of connection at the Reversing Falls.

Toronto, Ont.

The annual statement of the Canadian General Electric Company for the year ending December 31, 1915, showed gross profits of $1,219,513, compared with $914,528 the previous year The unusually large sum of $416,222 is set aside for depreciation of buildings, machinery, patterns, etc., leaving a net profit of $764,378. After payment of the regular 7 per cent. dividend there is a surplus of $66,356. One of the most interesting items in the report is "Interest on loans," which this year amounts to only $38,912, as compared with $190,957 a year ago.

Vancouver, B. C.

The B. C. Telephone Company have decided to erect a long-distance copper circuit between New Denver, Kaslo and Nelson. A certain amount of line work will also be put up between Nelson, Rossland and Penticton.

Weyburn, Sask.

A by-law was submitted to the electors on March 27 authorizing the expenditure of some $35,000 on the installation of a 500 kw. turbo-generator unit.

Yamachiche, Que.

The Brunelle Furnace and Boiler Company are considering the installation of motor drive for a quantity of their machinery.

Power Company Will Appeal

Judgment has just been rendered in the Supreme Court by Mr. Justice Maclennan awarding the Nova Scotia Construction Company the sum of $175,332 for work done under various contracts in connection with the power company's hydraulic development at St. Timothy. It is stated by the power company's attorneys that an appeal against this judgment will be entered.

Employees Honor Memory of Geo. Westinghouse

The Veteran Employees' Association of the Westinghouse Electric & Manufacturing Company, at its Third Annual Banquet, held Saturday evening, January 29th, in the Fort Pitt Hotel, Pittsburgh, presented to the company a handsome bronze memorial tablet of the late George Westinghouse, founder of the numerous industries bearing his name.

Electrical News

Generation, Transmission and Application of Electricity

Published Semi-Monthly By

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Orders for advertising should reach the office of publication not later than the 5th and 20th of the month. Changes in advertisements will be made whenever desired, without cost to the advertiser.

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Vol. 25 **Toronto, April 15, 1916** **No. 8**

An Amendment (?) to the Railway Act

> **Notwithstanding anything in this Act or any other Act of the Legislative Assembly of the Province of Ontario, or any custom or usage to the contrary in cities of over 200,000 inhabitants, every electric railway company or street railway company operating a railway therein shall furnish free transportation over all the lines so operated by the said companies, for all officers, non-commissioned officers and privates of His Majesty's regular Army or Navy, including those in course of training.**

This is the text of an amendment to the Ontario Railway Act which Mr. Irish asks His Majesty, by and with the advice and consent of the Legislative Assembly of the Province of Ontario, to enact at the present session.

Some way or other we don't believe His Majesty will do it. His Majesty is British—not German. That being the case we cannot conceive of his consenting to any act which is so manifestly unreasonable and unfair. Some way or other we do not believe the Legislative Assembly will ever go so far as to make the mistake of asking His Majesty to do such a thing.

Mr. Irish evidently is unfortunate in the choice of his amendments. His recent attempt to help out the liquor interests was stillborn, though even among the most ardent supporters of the proposed liquor legislation there are many who will admit the justice of the arguments in favor of compensation. Mr. Irish's bill, however, had to be sacrificed on the altar of public opinion. Now, having learned his lesson, he has resolved to make no more such mistakes. This time, knowing the present antagonistic attitude of a large percentage of the electors towards the Toronto Railway Company (against which the amendment is, of course, directly aimed) he no doubt feels safe in counting on public opinion to back him in treating this corporation with as little consideration as if they were a lot of criminals.

But we believe again Mr. Irish has miscalculated. Many citizens of Toronto may have no love for the Toronto Street Railway Company, may feel that in more than one stand-up fight the company has got the better of the city—but that is an entirely different thing from deliberately hitting below the belt as this amendment aims to do. It is entirely a question of the company's charter rights—not what the company ought to do, or might do if it were so philanthropically inclined—though, for the matter of that, what right has this company to give the soldiers free rides any more than the Hydro or the T. E. L. have to give them free light, or some other group of citizens to give them free meals, someone else clothes, someone else cigarettes, etc. It is an amendment without one shred of justice or common sense to commend it.

Should We Stop Recruiting in Ontario?

To the Britisher, to the Canadian, there is something repulsive about the word "conscription." Voluntary service has been so long recognized throughout the British Empire as the ideal form of military law that we do not take kindly to the thought of being compelled to shoulder arms. But in the face of what is happening in Canada, if we look right at the facts we cannot but feel that there is much to be said in favor of conscription.

What is the situation in Ontario? Recruiting has been carried on to such an extent and in such a haphazard manner that our industries are crippled, production is at low ebb, labor for the factory unobtainable, and contracts which rightly belong to us are going to the United States. Ontario is suffering as the result of her activity in recruiting, a statement which cannot be made of certain other provinces of the Dominion. Conscription would remedy this inequality.

This war is a business and should be conducted in a business-like way. Have we not recruited beyond the requirements? If we have not, why are battalions which were in camp at Niagara last year preparing to return there this summer? The time necessary to train a soldier is surely not a satisfactory answer—and all the time our industries crying for men.

Sir Robert Borden offered to send 500,000 men if required, but it would seem that the Minister of Militia's call for the second 250,000 has not yet been justified.

If we are recruiting more men than are required, it means loss to the country and to the Empire. Every man's time should, in this crisis, be employed where it will be most effective.

The scarcity of labor is serious. The suggestion has been made that women take the place of men in the banks and offices and other business places, and that the men thus replaced who do not join the colors go to the farms. Yet, in the face of this situation, we find the Government appropriating $100,000 for a campaign in the daily newspapers to encourage increased production and thrift on the farm, where the supply of labor is already totally inadequate.

There are grave economic problems before us. Can they be satisfactorily worked out under the present system of recruiting? What are the opinions of our readers?

Special Contractors' Number of E. N.

The electrical contractors of the province of Ontario have shown an entirely commendable confidence in the immediate future of the electrical business in announcing so early the date of their convention and in prosecuting so vigorously their campaign for a real Electric Show which is to be held in connection with the convention. That the Show Committee is meeting with splendid success is gratifying assurance that their confidence was not misplaced. It is very possible that a much more pretentious program could have been carried forward with equal success, but we understand it was the feeling of the association members generally that it would be better policy to make haste slowly. At present writing, however, it looks as if the annual Electric Show has now established itself, and we look to see it grow in size and representative value year by year.

The Electrical News from the inception of this organization has been only too pleased to render every assistance in its power to further the aims of the contractor members. This (1) because we had faith in the personnel of the association and of its officers, and (2) because we had long been convinced of the necessity of such an association to round out the organization of the Ontario electrical trade. At no distant date we hope to see similar associations in every province of the Dominion—British Columbia is the last to fall into line—and, a little later, perhaps, a Dominion-wide association, with possibly the provinces as branches; or, the Dominion association may be merely executive, composed of elected delegates from each province. The main thing, however, is that we have started. It is quite worth while to be on the way even if we are not quite sure where we are going. There is a lot of missionary work to be done yet and, as we see it at the moment, these provincial associations are doing splendid missionary work.

So, let us keep the ball rolling along. The Electrical News wants to do its share and we believe we can best serve the interests of the contractors, as well as the manufacturers and jobbers, by getting out a Special Contractors' Number on June 1. No pains will be spared to make this issue interesting and useful to the electrical contractors of Canada. If we succeed in arousing them to take a deeper interest in one another and to realize that by **working together** many of the present unsatisfactory conditions may be removed, we shall consider ourselves amply repaid.

And now, **everybody**, let us get behind and boost for a Big and Successful Convention and an Electric Show that will be talked about till next year this time. The officers of the Association can be depended upon to do their share but the **real** success must depend on the rank and file. That means **you**. Don't wait for the other fellow to do all the work and show all the enthusiasm. Get your shoulder to the wheel.

Rangers Carry Two-and-a-Half Pound Telephone

A portable telephone, made of aluminum and weighing 2½ pounds, the invention of a forest officer, R. B. Adams, of Missoula, Montana, will be part of the regular equipment of patrolmen on the National Forests the coming field season. This instrument is regarded as a great improvement over the set formerly used, which weighed ten pounds.

It is said that a field man equipped with this telephone, a few yards of light emergency wire, and a short piece of heavy wire to make the ground connection can cut in anywhere along the more than 20,000 miles of Forest Service telephone lines and get in touch with the headquarters of a supervisor or district ranger. To talk, one end of the emergency wire is thrown over the telephone line, the two ends are connected to the portable instrument, and the instrument is connected to the ground wire, the end of which must be thrust into the damp earth or in water. Contact with the line wire is made possible by removal of the insulation from a few inches of the emergency wire.

The Adams instrument does not ring the bell of the receiving telephone, but instead causes a screeching sound from a small megaphone-shaped apparatus descriptively known as a "howler." This instrument is installed at the ranger station telephone and is said to give effective notice that some one is on the wire. If the field man needs to talk with some one elsewhere on the line, the ranger station instrument can be used to ring up the person wanted, when the conversation can be carried on.

Forest officers say that these portable phones are especially valuable in reporting fires and other emergencies with the least possible delay, and also in sending instructions to field men and keeping the district rangers informed as to the progress of work going on in the field, thus supplementing the regular telephone sets installed at lookout points, ranger stations, and at convenient intervals along Forest Service roads and trails.

Hydro-Electric Smelting Company

A syndicate backed by Newfoundland capital and organized by Mr. W. A. MacKay, has been formed and incorporated at St. John's with a capital of $100,000.00. It is called the Hydro-Electric Smelting Co., Ltd. This Company has taken over property at Little Bay, known as the Little Bay Mines, and have installed an electric smelter of the Wile type, at St. John's with a capacity of ten tons per day. This smelter is situated on the property of the Reid Newfoundland Co. near tidewater, the current being purchased from this company, who have a generating plant twelve miles from the city.

It is proposed with this plant to treat galenas, coppers and other valuable ores from different parts of the island, with a view to encouraging individual claim holders to work their properties until such a time as a permanent supply of about 200 tons per day will be available, when the company will erect a concentrating plant and smelter to handle this quantity at some convenient point in Green Bay, where there are numerous deposits of ores at tidewater.

The property at Little Bay consists of a square mile owned outright. This property has been idle for the past two decades. It had been worked very extensively by an English Company and in 1881 shipped 22,000 tons of ore, averaging 10 per cent. copper. At that time the company did not find it remunerative to ship any ores under the above percentage, consequently there are dumps, estimated to contain 500,000 tons, on the property, running from 2 to 7 per cent. copper. There is also a lake on the property with an estimated capacity of 26 million gallons which is rich in copper being leached from the mines and dumps. Tin scrap deposited in this lake precipitates copper very rapidly, as, in three to four weeks, when taken from the water it assays from 32 to 35 per cent. copper.

The company has acquired a water power from the Newfoundland Government, and contemplates erecting a hydro-electric plant for the concentration of these dumps, and for electric smelting on the spot. Mr. P. L. Simpson, Pittsburgh, is consulting engineer and chemist of the company.

Copper mining in Newfoundland has not been vigorously exploited during the past twenty years, when several mines were closed down owing to the extremely low price then existing. Newfoundland was once the sixth copper producing country of the world.

It is reported that the Madoc Mining Company will construct a hydro-electric development plant at Big Stoney Rapids to operate their Goudreau mines.

Electric Vehicle Day at N. E. L. A.

An important feature of the forthcoming convention of the National Electric Light Association at the Congress Hotel, Chicago, May 22nd to 26th, will be Electric Vehicle Day under the auspices of the Electric Vehicle Section of that organization. A partial list of papers arranged for presentation on Electric Vehicle Day at the convention follows:

"Central Station Assistance in Promoting Electric Vehicle Use," by W. P. Kennedy, Consulting Transportation Engineer, 1790 Broadway, New York City.

"Exchange Battery Systems" by P. D. Wagoner, President, General Vehicle Co., Long Island City, N. Y.

"Passenger Vehicle Problems and Activities" by E. P. Chalfant, Eastern Representative, Anderson Electric Car Co, 2 Columbus Circle, N. Y. C.

"Greater Garage Service" by Harry Salvat, Proprietor, Fashion Auto Garage, 51st St. and Cottage Grove Ave., Chicago, Ill.

"The relation of tires to Electric Vehicle Efficiency" by S. V. Norton, Manager Truck Tire Sales Dept. B. F. Goodrich Co., Akron, Ohio.

"Electric Truck Troubles and How to Minimize Them" by F. E. Whitney, General Manager, Commercial Truck Co. of America, 27th and Brown Streets, Philadelphia, Pa.

"Industrial Truck Applications" by G. W. Squires, Jr., Sales Manager, General Vehicle Co., Long Island City, N. Y.

Recovery in Industrial Life

The annual report of the Canadian Westinghouse Company, head offices Hamilton, Ont., shows net earnings for the year 1915 amounting to $860,628.00; property and plant account takes $150,000 and $261,285 is carried forward. The total surplus of the company is now $1,823,775 and the total assets $8,330,757. Regarding business conditions the annual report has this to say:

"The industrial life of Canada during the year just closed experienced a remarkable recovery from the suspended activity of the preceding year. Many plants which had with difficulty kept together an irreducible minimum of their operating organization found themselves early in 1915 strained to their utmost capacity under night and day operation. In addition, numerous new industries have been brought into being, the changed conditions in these respects being the direct result of large purchases in Canada by the British and Allied Governments of various supplies and munitions of war."

Montreal's Electrical Luncheons

At the Wednesday Electrical Luncheon, held in Montreal, on April 5, Mr. W. H. Camp, of the C. P. R. telegraphs, mentioned that during a sleet storm in the Sudbury district the copper wires were broken; in adjoining districts the storm did not affect the wires, and the superintendent of the Sudbury section suggested that the cause of the breaks was disintegration due to the flames from roasting minerals. Mr. Camp requested information on this point from any of those present. Mr. W. J. Winter, of the Bell Telephone Company, stated that the company had had considerable trouble with their wires, of phosphor bronze, in that district; they crystalized owing to the fumes, and had to be laid in conduit. The company also found that copper wires in Montreal subjected to fumes from locomotives had a comparatively short life. Mr. A. C. Towne told of his experience with copper wire in round houses stating that the fumes eat away the wire, leaving a mere filament.

The Ottawa Electric Railway Company have supplied a gun crew of ten men for the 51st Battalion, C. E. F., Kingston.

Meter Testing Board in the City of Edmonton

By Stanley Clothier and Arthur J. Cantin

Like many other western cities, the City of Edmonton had a phenomenal growth during the boom years of 1911 to 1914, and many of the departments were re-modelled several times during this period. In three years the electric light warehouse was moved three times to larger quarters, and each time an opportunity was given to remodel the meter testing board.

The present board has been in operation since June. 1915, and a description, together with a schematic diagram of connections, may prove interesting and useful to readers of the Electrical News. Each time the test-board was remodelled an effort was made to improve and simplify it, not

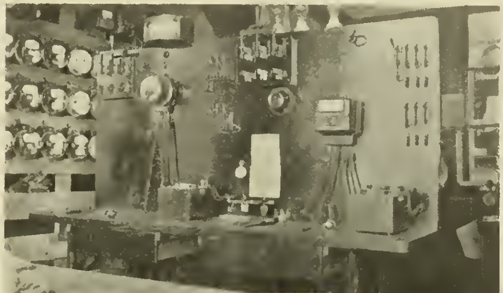


Fig. 1

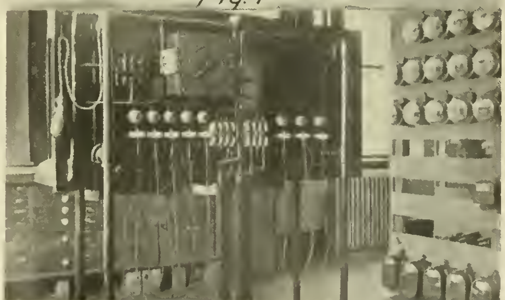


Fig. 2

forgetting that safety first is an essential, both for the person operating, and for the meters themselves.

The board, as can be seen from Fig. 1 is a double board, each half being entirely independent, so that two men can work at the same time without interfering with one another. The left side is used for single-phase, two-wire meters only, it having a simple connection as shown in the sketch. The right side is more fully equipped, and is used for single-phase two and three-wire meters, also for polyphase 110, 220 and 440 volt meters, and any power factor desired.

The supply is taken from the regular 220 volt three phase power mains. The voltage fluctuation is perhaps greater on the power mains than on the lighting mains, but by the use of a Rotating Standard ordinary voltage fluctuations are not noticed. The phase shifter was supplied by the States Co. and is indispensable where a large number of polyphase meters are repaired and tested, making possible an accurate power factor adjustment. It also acts as a potential transformer and delivers 110, 220, and 440 volts.

The three pole double-throw switch is one of the main

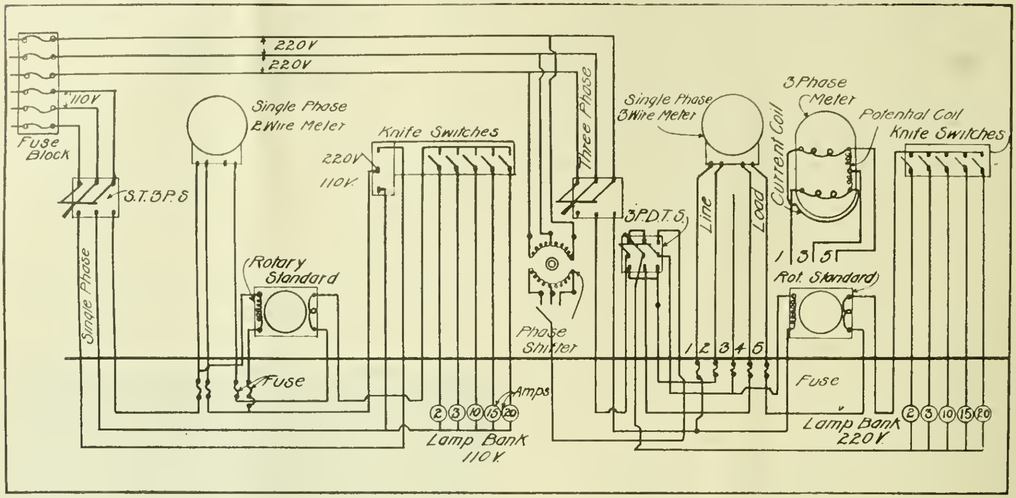


Fig. 3—Schematic diagram of connections, Edmonton meter test-board.

features of the board and the throwing over of this switch is the only action needed to change from two-wire to three wire. The switch is seen in Fig. 2 close to the phase shifter. When in the upper position the board is ready for two wire and polyphase meters, and only leads 1, 3 and 5 are alive, making accidental short circuit impossible. When in the lower position leads 1, 2, 4, and 5 are used, and the line voltage is put on the shunt terminals of the Rotating Standard.

The rheostat used on this side of the board is made of 32 c.p, carbon filament 220 volt lamps. This lamp bank is located in the basement immediately below, where the light and heat are out of the way.

The cost of the board as it now stands, not including the Rotating Standard, is less than $100.00 and is complete enough to serve all the requirements of a department the size of Edmonton.

It may be stated that the 220 volt lead was selected after careful consideration. Extra switching gear could have been provided to give a 110 volt load when testing 110 volt meters, but with the present arrangement there is no danger of burning out lamps, as might be possible with 110 volt lamp load and the current consumption is really a small item.

About 500 meters are handled per month on the test board with an average of 30 kw.h.

The meter leads are made of No. 14 flexible heater cord and will carry 40 amps. without overheating. Spring connections are fitted on the leads so that they can be inserted in the meter terminals without the use of a screw driver. The board is made of 2 in. fir plank mounted on a frame of 2 in. iron pipe. A portable lamp is provided and is useful for examination of meters. On top of the board are three test lamps connected to either 220 or 440 volt and used for detecting ground or open circuit.

To Buy Out Chambers Plant

The Board of Trade of the town of Truro recently unanimously adopted the following resolution:—"Resolved that the Truro Board of Trade is of the opinion that the Town of Truro should purchase the Chambers Electric Light & Power Company, Limited, undertaking and franchise, provided a satisfactory purchase price can be arranged, with a view to extending the same and operating an Electric Light & Power Plant as a public utility for the town."

To Confer on Underground Plans

With a view to an amicable arrangement, the Quebec Public Utilities Commission asked the Montreal Electrical Commissioners and the power and other companies to confer on the subject of agreeing on a mutually satisfactory system of manholes for the underground conduit system. The Public Utilities Commission have, on several occasions, heard evidence and arguments by the companies which object to the single system of manholes, and since then the law has been amended giving the commission authority to approve the use of common manholes for low and high tension wires. The Commission, in a communication to the various parties, state that "the whole question resolves itself into whether there should be separate or common manholes, and upon this question the interested parties seem to be thoroughly divided in their views. The ultimate cost of the work will have to be borne by the interested companies, and with this common interest it seems to us not impossible that they should so far reconcile their differences as to agree upon a conduit system reasonably safe without costing undue outlay. We appreciate the fact that the proper officers of the companies interested are the best persons to determine what their requirements are, and how far they can be modified to obtain agreement upon a system that can be fairly used by all. We therefore propose to give these companies an opportunity to get together and solve the matter for themselves if they can. The only observation we would offer is that it may be quite necessary at certain places to have separate manholes, without establishing any general rule, and that it is quite obvious, to a greater extent, that a system of common manholes is reasonably safe and much more economical."

The various companies and the Electrical Commissioners are therefore requested to meet and see if an agreement cannot be arrived at to eliminate separate manholes as much as possible, and get on with a system that will be reasonably safe and avoid unnecessary expense. Any agreements are to be filed and, failing agreements, written submissions are to be made showing what the parties contend for in the way of joint or separate manholes. These submissions will come before the Commission and the Railway Board.

Electric Supplies, (H. Norman Howlett and H. Miller), Montreal, Que., have registered.

Regulation of Transmission Lines

The Application of Synchronous Condensers—Favorable Results of Operation on the Winnipeg Municipal System (Con.)

By F. H. Farmer and E. V. Caton

We have already seen that any alternating current may be resolved into two components—its in-phase component given by $I \cos \theta$ and its out of phase component given by $I \sin \theta$. Now from the simple diagram as shown in Fig. 2, we note that by reducing the out-of-phase component the power factor may be increased, and it is obvious that by supplying to the circuit a current equal in value to the out-of-phase component, but 180 degs. different in phase, the wattless component may be eliminated and the power factor brought to unity. That is, loading the circuit with a leading current equal to the out-of- phase component $AB = I \sin \theta$ the power factor may be made unity.

To find the kv.a. of synchronous motor required to raise the power factor of a given load to another power factor it is only necessary to supply a leading current equal to the difference of the wattless component in the two cases.

Thus, to raise 100 kw. at 80 per cent. power factor to 100 per cent. power factor,

kv.a. = 125

Therefore watt component $= 125 \cos \theta = 125 \times .8 = 100$ kw., and wattless component $= 125 \sin \theta = 125 \times .6 = 75$ kv.a., or to bring up the power factor of a load to 100 kw. at 80 per cent. power factor to unity power factor would require a synchronous motor capacity of 75 kv.a. leading.

Another method of calculation may be used in that ratio

$$\frac{\text{wattless}}{\text{power}} = \tan \theta.$$ Therefore wattless component $= 100 \tan \theta = 75$ kv.a. A simple diagram for the performance of this calculation is given in Fig. 7.

It is thus seen that the power factor, and therefore the regulation of a line may be controlled by the use of synchronous motors and the practical application of this is found where the voltage at the power house is kept constant and the power-factor of the load varied to give the required voltage at the receiver end. During light load the synchronous motor is made to give a lagging current and thus decrease the power factor and increase the drop, and on heavy loads the synchronous motor is made to give a leading current, thus increasing the power factor and decreasing the drop. By suitable adjustment of the synchronous motor excitation the power house voltage may be held constant over a wide range of load and the voltage at the receiver end adjusted to the load conditions. It will be noted that this method of control differs essentially from the method more generally in use up to the present time, viz., adjusting the synchronous load to maintain the power factor as high as possible, in that, during light load periods it will be necessary to decrease the power-factor of the load considerably to obtain the required voltage at the receiver end without lowering the power-house voltage.

This method of operation may be open to objections on the score of efficiency when the power is supplied by a steam plant, but in the case of an hydro-electric plant supplying power over a long line has obvious advantages.

The question may be asked what is the limit to which this method of line regulation may be applied. In the case of the ordinary transmission line as at present designed the theoretical limit of constant voltage regulation is so much larger than the load for which the line is designed that it is of little importance, the efficiency being the limiting value. In the case of lines having conductors of large size, however, since the efficiency is high, right up to the theoretical limit of constant voltage regulation, it becomes of importance. In practice the theoretical limit is felt with very heavy lines by a rapid increase in the condenser capacity required as this limit is approached.

At the time it was decided to instal synchronous condensers, the city of Winnipeg's plant consisted of five 3,000 kw. generators and three additional 5,000 kw. sets were being installed, making the total normal capacity of the station

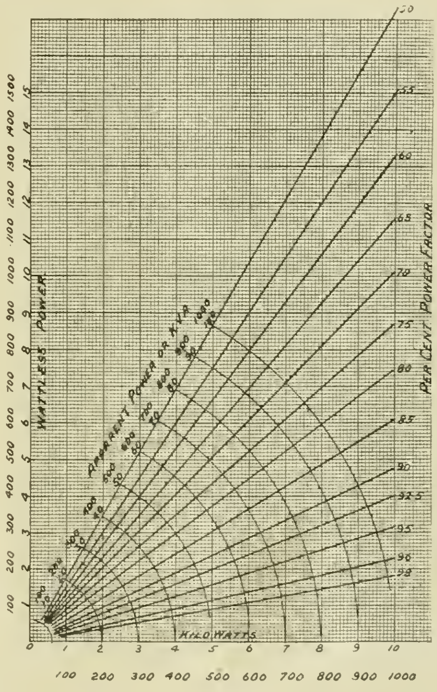


Fig 7

equal to 30,000 kw. without considering the overload capacity of the machines. The design of the plant is such that an ultimate capacity of 81,600 kw. may be installed. The present transmission line consists of two circuits carried on one set of steel towers. The particulars of the line are as follows: length, 77 miles; frequency, 60 cycles; cables, 278,600 c.m. aluminum; average conductivity, 61.15 per cent.; overall diam., .653 in.; wires carried at corners of an equilateral triangle of 6 ft. sides; resistance per wire at 0 degs. C., 22.7 ohms; reactance per wire, 53.8 ohms; capacity susceptance per wire to neutral, .000462. The lines were designed for a maximum load of 11,250 kw. each. The present right of way will allow another set of towers with two more lines to be installed. It will thus be seen that under the then existing conditions the maximum capacity of the existing right of way was 45,000 kw.

The load in 1913 had risen to over 14,000 kw. and with this increasing rapidly it was necessary to provide additional line capacity. Various methods were discussed, viz., the building of an additional line and the increasing of the present line voltage. After full consideration, and particularly in view of the expense involved in either of the above schemes, the installation of synchronous condensers at the terminal station was decided upon . The various schemes considered and the final decision are fully gone into in the paper by Prof. Herdt, to which reference is made. It may be noted in passing that the power-factor of the load at that time varied from about 78 per cent. on light load to 88 per cent. on full load.

Equipment

At the city of Winnipeg's terminal station the electrical energy transmitted from Point du Bois at 60,000 volts is transformed to 12,000 volts on bus-bars, at which voltage it is transmitted to the various sub-stations of the system and to the city pumping system to the north. The condensers are arranged to operate from the 12,000 volt busbars, and so maintain the load on the power transformers at the desired power-factor. The bus-bars are in duplicate, main and auxiliary, and feeders may be supplied from either set. Both sets are also cut into two sections, No. 1 and No. 2, tied together by tie switches, and the two condensers operate respectively from main bus No. 1 and main bus No. 2. There did not seem to be any particular advantage to be gained by duplicating switching arrangement so as to operate from auxiliary buses as well as main buses.

The transformers, condensers and other equipment are housed in an annex to the terminal station which is arranged so as to admit of extension when it becomes necessary to add still more condenser capacity. On a gallery above the transformers are placed the oil switches controlling the machines. An overhead crane is provided to facilitate the handling of the machinery, and the transformers are on rails so as to render them easily removable if necessary. The building is well lighted by five large windows, and arrangements are made for ample ventilation as described below.

The transformers are rated 6,300 kv.a. capacity, with primary 12,000 volts, and secondary 6,600 volts. They are star-connected on both high tension and low tension, with suitable taps on the high tension side to take care of changes in bus-bar voltage, and with three sets of terminals brought out on the low tension side, giving 1,150 volts, 3,300 volts and 6,600 volts respectively. The first two are for starting purposes only. The transformers are water cooled, and of the usual shell type of construction.

The two condensers are each 6,000 kv.a. capacity, at 0 degs. leading power-factor, 6,600 volts, 60 cycles, 600 r.p.m. This rating is a maximum rating and is based on a temperature rise of 50 degs. C. at continuous full load. On account of the high speed they do not occupy much floor space, the bedplate being only 12 ft. 1 in. by 9 ft. 6 in. The construction of the stator follows standard methods and has large air ducts for ventilation. The end bell is solid so as to constrain the air to be forced past the armature winding. The rotor, which is a solid steel casting, has interior ventilating ducts through which air can circulate into the inner part of the machine. Fan blades are attached to the rotor near the centre to force the air into these ducts and blades are also attached near the periphery which produces a powerful draft inside the housing.

The machines have to dissipate the heat losses on a capacity of 6,000 kv.a., and since they are of comparatively small dimensions, owing to the high speed, it will be seen that the air must be passed through rapidly to dissipate the heat generated. Each machine passes about twenty thousand cubic feet of air per minute, and in order to prevent the air in the room becoming too hot a disc fan has been placed in the wall as high as possible. The air enters the building through a large door communicating with an open craneway, and it therefore is as cool as outside conditions will admit. Under these conditions even with the hottest summer weather the circulating air is kept reasonably cool. In the tips of the poles is inserted a damping winding which consists of a number of bars inserted in slots in the faces of the pole pieces, these being connected by copper straps on either side of the rotor. The function of this winding is to make the machine self starting and acts in the same way as the short-circuited winding of an ordinary induction motor. It further has a powerful damping effect opposing any tendency of the machine to hunt backwards and forwards off the synchronous position. The exciter, which is of 40 kw. capacity, is direct connected on the rotor shaft.

It is essential in a machine of this sort whose capacity is a considerable percentage of the capacity of the whole system, that the starting should make as little line disturbance as possible. There is considerable friction in a journal when a shaft is just starting up and before the oil film has formed between the shaft and bearing surface, and in order to eliminate this effect when starting up the machines an electrically-driven plunger pump supplies oil through ports in the bottom of the bearings, thus actually lifting the shaft from direct contact with the bearing and allowing it to float on a film of oil under pressure. The oil gauges on this pump show that a pressure of about 600 to 900 pounds per square inch is necessary to lift the rotor, after which the pressure remains constant, the oil flowing away over the surface of the bearing. When the machine is well under way and the oil rings in the bearings are supplying the necessary lubrication, the pump is shut down and the valves closed.

To determine the extent to which the starting effort is improved by the use of oil pumped into the bearings, a test was made recently on one of these machines at the station. A lever was attached to the shaft, and a pull exerted at a measured distance from the centre at right angles to the lever, the force applied being measured on a dynamometer. After the machine has been at rest for twelve hours, and the bearings were consequently pretty dry, the turning moment necessary to start the rotor was 4650 foot pounds. On starting up the oil pumps, with the pressure held steady at 600 pounds per square inch, the turning moment necessary to start the rotor was 104 foot pounds only, or about 2 per cent. of the former.

Minimum Line Disturbance

A consideration of the theory of starting characterization of self-starting synchronous motors is not within the scope of this paper; but in actual practice the ability of a condenser to start up with a minimum line disturbance is a most important consideration, especially when the units are large in comparison with the total line capacity. The point is, therefore, discussed briefly. The actual initial starting torque will vary with the position of the field poles relative to the armature coils from a maximum to a minimum, depending on whether the field poles are directly between, or directly central with the armature poles. If the motor fields be short-circuited at starting an induced current will flow through them in quadrature with the impressed voltage which will have a powerful demagnetizing effect on the stator and result in a decrease of torque. If, however, the fields are left open an induced voltage may be set up high enough to cause a breakdown of the field winding. It is usual to short-circuit the field through a resistance when starting, except in special cases where high torque is necessary. After the motor has started up its speed will rise until it reaches synchronous speed, and locks itself in, the pole pieces on the rotor assuming a definite polarity induced by the polarity of the stator winding. This may or may not be the polarity for which the fields are connected to the exciter. If it is opposite polarity, then on applying a field current the poles will be demagnetized, and a heavy current will flow into the armature stator owing to the rotor having to slip one pole to come into synchronism: this is the cause of the heavy kick frequently noticed on closing the field switch of a synchronous motor. This may be obviated by closing the field circuit with a very weak field current, which ensures that the polarity will be correct. Then, as the field current is increased, the machine remains in step, and the field may be adjusted to the most desirable point for switching full voltage onto the stator. The theory of self-starting synchronous motors is fully dealt with by Fecheimer, Vol. XXXI, Part 1, A.I.E.E., and by Newbury, Vol. XXXII, Part 2, A.I.E.E.

In starting the machines under discussion, a voltage of 1,150 volts is first applied to the terminals, and this brings it up to synchronous speed in 80 seconds under normal conditions. During this process the field switch is open, and a field discharge resistance is inserted in the machine field by means of auxiliary contacts on the field switches, thereby obviating any high induced voltage in the field winding. The voltage is next raised to 3,300 volts, and after the machine steadies down a weak field current is applied. The machine is then in synchronism, and as the field strength is increased the current taken decreases its lag and later becomes a leading current. At a certain point of field strength which has been found by experiment to give the best results as regards minimum disturbance of the line, the voltage is changed from 3,300 volts to 6,600 volts, when the machine is fully on the line. The process of starting up is indicated by the chart shown herewith, which shows an actual case. In this instance the machine was on the line in 3 mins. 15 secs. from the time of closing the first switch.

The Control System

The control system is quite interesting since all starting and manipulation of the machines is done by remote electrical control from the switchboard gallery, which is in the main building of the terminal station, and therefore out of sight of the condensers. The oil switches controlling the transformers are operated in the usual way. There are three 3-pole oil switches connected to the 1,150, 3,300 and 6,600 volt taps respectively of each transformer. It is essential that these should be so arranged that it is impossible to close one oil switch in before the preceding one has fallen out, otherwise part of the transformer winding would be short circuited. The double throw controllers are used with the three oil switches. The first position of No. 1 controller closes the 1,150 volt switches. The second position of No. 1 controller operates the trip coil of the 1,150 volt switch and at the same time energizes the closing coil at the 3,300 volt switch. The closing current for this switch has to pass through a small pilot switch on the 1,150 switch which is only closed when that switch opens, and thus the closing of the 3,300 volt switch does not commence until the 1,150 volt switch is open. The first position of No. 2 controller opens the 3,300 volt switch and closes the 6,600 volt switch through a similar interlock which prevents the switch closing until the 3,300 volt switch is open. The second position of No. 2 controller simply trips the 6,600 volt switch. Bulls-eye lamps on the control panel, adjacent to the control switches, indicates which switch is closed at any time.

The main field rheostats and field switches are placed in the machine room, and these are also operated electrically from the control board. Each machine is supplied with the following instruments, which are mounted on an instrument board behind the switchboard: voltmeter on 12,000 volt bus; ammeter on 12,000 volt side of transformers with plugs, to be read on each phase; wattless kv.a. meter; field ammeter; exciter voltmeter. In the case of the voltmeters, only one meter is used for the two machines, with voltage plugs to connect up to either as required. The wattless kv.a. meter is an interesting application of the polyphase wattmeters. It is a centre zero wattmeter free to move in either direction from the zero point. The voltage windings are interchanged, The effect of this connection is plainly to put the voltage in quadrature with the current, so the meter will register wattless kv.a. in one direction if the current is lagging and in the other direction if the current is leading. The value of such a meter is quite evident. It affords an immediate indication of the amount of reactive kv.a. the machine is imposing on the system and whether this is lagging or leading.

Voltage Regulation

The method of line control by varying the fields of condensers and thus changing the power-factor must not be confused with the maintenance of high power-factor. When the load is light a condition may arise and in fact does arise, where we will actually impose a lagging current on the system and so increase the voltage drop in the line. Supposing that it is desired to maintain a constant voltage at the terminal station with a constant voltage at the power house. There will be a certain load condition that will give the required drop without any aid from the condensers. If the load falls below this point voltage at the receiving end will tend to rise, but can be kept at the required point by introducing the necessary amount of lagging current—or by weakening the field of a synchronous condenser or reactor. If the load increases beyond this point the voltage at the receiving end will tend to drop but can be maintained by introducing the proper amount of leading current, that is, by strengthening the field of the condenser. The voltage can be maintained absolutely by proper manipulation of the condenser field strength. This at once suggests the use of a voltage regulator of the Tirrill type, operating upon the exciter, and such a system as this is in use at Winnipeg and in several other places.

The old type of Tirrill regulator is only capable of taking care of a field variation of 2 to 1 usually 140 to 70 volts, and while this is entirely satisfactory for generator regulation, it does not meet synchronous condenser conditions where there is a very wide variation of field strength. In the case of the machines under consideration, the field at 6,000 kv.a. lagging is 12 amperes, and at 6,000 kv.a. leading is 280 amperes, requiring a similar ratio of voltage variation so as to operate without moving the main rheostat. The way in which the excitation varies with the load is well illustrated by the saturation or V curve for the machine. (See Fig. 6). A newer development of voltage regulator is not limited to the 2 to 1 voltage range, but is able to operate over a very wide range, and is therefore particularly applicable for use with synchronous condensers. The regulator uses the same basic principle of short circuiting the exciter rheostat rapidly for short intervals of time, thereby holding the exciter voltage at some point intermediate between the "all in" and the "all out" rheostat position, but the method by which this result is obtained is essentially different from the older regulator. One important difference is that the control magnet, as well as the vibrating magnet, are both operated from alternating current derived from potential transformers, and thus the operation is unaffected by low values of the exciter voltage. It is not within the scope of this paper to describe in full the details of this regulator.

Rheostat in Series

There is in series with the potential winding of the main control magnets a rheostat whereby the potential across the winding can be varied by a small percentage. This admits of setting the regulator to hold voltages at a slightly higher or lower point according to load condition, and this operation is readily done by a rheostat hand wheel on the face of the bench board. An equalizing rheostat is used in series with the main exciter rheostat and the regulator short circuits the main rheostat only. The position of the equalizing rheostat sets the upper limit to which the voltage on the exciter can rise when the regulator contacts are closed, and the correct action of the regulator depends to a great extent on the proper setting of both main and equalizing rheostats. Both these rheostats, as well as voltage adjusting rheostat, are situated close to the bench board and are operated by hand wheels on the face of the bench board.

In actual operation the regulator takes care of voltage changes in a very satisfactory manner. A sudden change of load causes a momentary swing in voltage which is immediately corrected. An entirely automatic system of voltage regulation is thus obtained, and since the regulation is effected through the raising of the power-factor as heavy loads come on, the old limits to the line capacity are removed and it is possible to very greatly increase the load which can be carried on each transmission line.

Operation

The present method of operation is to run one machine constantly, the other machine being run during the peak load period. The power house voltage is maintained practically constant during the day and the operator at the terminal station regulates the voltage to suit the load conditions, entirely independent of the power house operator. On starting up the machine the only attention necessary is to have a man start up the oil pressure pump for the bearings, after which the whole control is in the hands of the operator on the main control board. During the time of peak load which comes on in the evening the voltage at the terminal station is raised by means of the voltage regulating rheostat on the regulator from 12,000 to about 12,500, and this is gradually reduced as load conditions necessitate.

The regulator is always in use except during lightning storms, when it is usual to disconnect it and do the regulating by hand. The nature of the load is such that hand regulation is fairly satisfactory. This would seem to be good operating practice from the fact that in the event of a flashover on the line, due to lightning, the regulators attempt to hold up the voltage. It is probable that this will tend to prolong the arc unduly, and that it is better practice to allow the voltage to take a dip, which will generally result in the arc clearing itself. When starting up one machine it is very desirable to have the other machine on the regulator, as this reduces the line disturbance to a minimum. The addition of the condensers to the terminal station equipment has not necessitated any increase in the operating force required to operate the station.

Results Obtained in Practice

The results actually obtained under operating conditions are in every way satisfactory. Chief among these is the greatly increased line capacity. Even if we neglect the increased capacity of the line obtained with the use of the condensers, the improvement and convenience of this method of regulation is of great value to the operating department, as there is no necessity for continual telephonic communication between the operators at each end of the line to adjust the voltage. Further, the regulation throughout the whole system is greatly improved, and the flywheel effect of the motors has a beneficial effect. Owing to the improved regulation the arrester gaps may be more closely set, thus affording better protection.

The condenser equipment was put into operation in October, 1914, and has therefore handled load conditions through one complete yearly cycle, and the performance fully justifies the decision of Prof. Herdt and the engineers associated with him as to this method of overcoming lack of line capacity. While the writers have dealt mainly with this individual case, the system is evidently one with a wide range of usefulness under different conditions, and no doubt in the future we shall see the principle more generally recognized as a factor in overcoming the difficulties inherent in the design of long distance transmission lines, as well as setting a new and higher limit upon the capacity of existing lines.

Driver's Speed Increased by Using Efficient Motor Equipment

By A. Jackson Marshall*

A proprietor of a large laundry which now operates 26 electric vehicles stated to a representative of the Electric Vehicle Association of America, that one of the most noticeable things in the change from horse drawn to electric vehicles, was the increased efficiency of the drivers themselves.

"With one exception, all of our drivers welcomed the change and, due to the very simple operation of electrics, they experienced no difficulty in learning to drive them in a remarkably short time. The exception of whom I speak was a driver who had been with us longer than the others and he was very skeptical about the new equipment. A couple of weeks after he had been driving one of the new electrics, I asked him if he wanted to go back to the old method. He just grinned and said, "Nothin' doin'."

"Of course the appearance of immaculate cleanliness which our whole delivery outfit now has, is a very great asset to a laundry. Our drivers wear white uniforms during the summer months and we find that the good appearance of our delivery fleet is the best advertiser we can have. Any woman will place greater confidence in a laundry whose delivery men give a favorable impression in their fresh, clean uniforms, than one whose drivers always carry with them the disagreeable odor of horses and stables, or are begrimed with dirt and grease and are saturated with the penetrating smell of gasoline.

"Another point is the effect which the increase in the speed and efficiency of the new equipment over the old has upon the drivers. Unconsciously they speed up their work and show a very noticeable increase in 'pep'."

There is a certain psychological effect upon the operator of an efficient motor delivery equipment that spurs him on to more speed in his end of the delivery work. The efficiency germ unconsciously gets into his system and he sees himself accomplishing many times more work than he did with the slow horse and wagon. It has been observed by the Electric Vehicle Association that when a man is driving a horse-drawn vehicle he recognizes that the horse means comparatively slow transportation and he falls into the mental habit of doing everything in connection with his work slowly. He excuses himself by thinking or saying that he is easy on the horses and that he must treat his animals in a humane manner. The psychology of the thing works both ways. With delivery equipment that is slow, the driver becomes slow and plodding. On the other hand, if a driver is given a delivery equipment with which speed is easily maintained, it reflects on his own manner of working and he becomes a faster, better worker. The improvement in the attitude of the driver to his work when delivery with good dependable electrics, is a valuable asset to any business trying to solve the delivery and transportation problem.

The Court of Appeal has upheld the claim of the municipality of North Vancouver for power to expropriate the electric distributing system within their borders. This is part of the system of the British Columbia Electric Railway Company.

*Secretary Electric Vehicle Section N. E. L. A.

City of Kamloops Hydro-Electric Plant

Detailed Description of Engineering and Economic Features of Power Generating and Pumping Systems of this Growing Western Centre

By H. K. Dutcher, M. Can. Soc. C. E.

It is the purpose of this paper to refer to some of the engineering and economic features in connection with the design and construction of the Municipal power plant and pumping systems of the city of Kamloops, which have been recently completed and placed in service.

These systems include a steam turbine power plant and pumping system, a new reservoir and a hydro-electric power plant and sub-station.

The steam power plant and pumping system, together with the sub-station of the hydro-electric plant are included in the one building, and located near the eastern limits of the city, while the generating station of the hydro-electric plant is located on the Barriere River, which flows into the North Thompson, the distance of this plant from Kamloops being about forty miles almost due north.

To properly appreciate the relation of these systems one to the other and their importance in the general scheme upon which the plans of development were based, it is necessary to refer to some of the economic conditions affecting the growth of the city and the development of the surrounding districts.

The city of Kamloops is located on the main line of the Canadian Pacific Railway at the junction of the North and South Thompson Rivers, and for some years it has maintained the normal growth of a railway divisional point, and centre of a considerable ranching district. Very little attention has been paid to mixed farming in this district, due partly to the fact that most of the settlers were cattle ranchers, and also to the limited supply of water available from the streams for gravity irrigation systems.

When the richness of the lands in the "Dry Belt" had been more thoroughly appreciated, greater efforts were then made towards intensive cultivation, and many of the lands were divided into small areas for fruit trees, but as the precipitation on the district varies from ten to fifteen inches per year, the dependence upon limited sources for gravity irrigation systems, imparted a certain feeling of timidity with respect to the planting of crops and intensive farming. Consequently Kamloops has been obliged to import butter, eggs and other farming products which should have been supplied locally.

This condition would tend to affect the cost of living and the discouragement of much desired local industries, but when the plans of the Canadian Northern Railway included a route from Vancouver to Edmonton by way of Kamloops and the North Thompson River, the location of the city as a centre of some importance for future growth was more fully realized. Therefore, when the increasing demand for power, both for the municipal electric light and power service and for the pumping plant, was rapidly passing beyond the capacity of the old steam plant, it was decided to investigate the possibilities for an ample supply of cheaper power, with particular regard to hydro electric development, in order that, if possible, electric power might be available to irrigate by pumping, the rich lands along the North and South Thompson Rivers.

During the course of examination of the several streams available for power within practical range of the city, there appeared to be some prospect that a company holding the power rights on the Adams River might develop power from this source, in which case the lands along the South Thompson River would be looked after.

Attention was directed, therefore, mainly to an examination of the streams flowing into the North Thompson River, and of these the Barriere River appeared to answer the requirements for power development most satisfactorily, especially in view of the two large lakes available for storage, the heavy grade of the stream and the convenience of the transmission line passing down the valley of the North Thompson through comparatively open country with a prospect of a power market along the entire route.

It was estimated, however, that winter conditions of the Barriere River would affect the operation of the hydro-electric plant for probably an average of six weeks per year, and in view of the importance of the prospective power loads it was considered advisable to plan the auxiliary steam plant system with a capacity equal to the hydro-electric plant, and to estimate the period of operation of the steam plant both as an auxiliary and reserve system for an average of six hours per day throughout the year, and the estimated cost of the combined system was, therefore, based on this condition.

The capacity of the old plant was about 500 h.p. and included three 150 h.p. return tubular boilers, two tandem compound steam engines, one belt connected and the other direct connected to generators, and for the waterworks service there were two steam-driven plunger pumps, one with capacity of 1,000 gallons per minute and the other 700 gallons per minute. Both pumps, however, were in poor condition and were continually breaking down.

Moreover, it was impossible to keep a reserve supply of water in the reservoir for fire protection, as the capacity of this reservoir was only 150,000 gallons, and during the summer months the demand for water in the city exceeded ten times this amount.

The water for the city system was pumped in from a well located under the power house which was fed by two intake pipe lines carried out into the river about 100 feet, and the rapid growth of the city along the river above the location of the intake created a danger to the sanitary conditions of the water supply which required immediate attention.

After some study of these different factors affecting the immediate and future requirements, the city finally decided to proceed upon the following scheme of construction:—

(a) The development of a hydro-electric power plant on the Barriere River with a capacity of at least 5,000 h.p., of which the first installation would provide for 2,000 h.p.

(b) The construction of a new steam plant and pumping station in the city, the steam plant to provide for either oil or coal fuel, and to have the first installation up to 2,000 h.p. capacity. The pumping plant to include two motor-driven centrifugal pumps to deliver 1,200 Imperial gallons per minute each, and one steam turbine pump of equal capacity.

(c) The construction of a covered concrete reservoir of 1,500,000 gallon capacity but designed for an extension to 3,000,000 gallons by the construction of a second section.

Barriere Hydro-Electric Power System

Barriere River

The Barriere River rises in the mountains near Adams Lake, flows in a westerly direction for a course of about thirty-two miles and empties into the North Thompson River at a point about forty miles north of Kamloops.

On the main branch there is the North Barriere Lake, which is located about nineteen miles from the mouth of the river and receives the flow of numerous streams from the mountains. It has an elevation of over 2,100 feet above sea level, and an area at low water of 1,200 acres with excellent conditions for storage of 30,000 acre feet of water by the construction of a dam at the outlet.

At the distance of eight miles from the outlet of the North Lake the main branch is joined by the east branch, which empties from the East Barriere Lake, located about four miles from the forks and having almost the same elevation above sea level and an area of about 1,500 acres.

The total drainage area of the Barriere River is about 230 square miles, with an average precipitation of probably about 35 inches. The mean flow during a normal year would be about 550 cubic feet per second with extremes of about 3,600 cubic feet per second as a maximum in the early summer period, and 220 cubic feet per second in the low water season of the winter months.

Of the total flow about 80 per cent. comes from the North Barriere Lake, and with the provision of storage for 30,000 acre feet in the East Lake, there should be no difficulty in maintaining a flow of from 300 to 350 cubic feet per second for power development.

Power Development

As the elevation of the North Lake is about 2,100 feet above sea level and the elevation at the outlet of the river is about 1,150 feet, there is therefore an average grade of about 50 feet per mile. The plan of power development provided for the location of a generating plant at a point about five miles up from the mouth of the river.

For a distance of about 3½ miles above the site of the generating station the grade of the river averages 65 feet per mile, and a suitable site for an intake dam was located to give an effective head of 192 feet at the generating station by 17,800 feet of flume system.

While the plans provide for the ultimate development of 5,000 h.p. from the present intake, the first installation provides for 2,000 h.p. by two 1,000 h.p. units, which, with the installation of 2,000 h.p. in the auxiliary steam plant would give the city a maximum of 4,000 h.p. to start with.

The location of the generating station of the Barriere hydro-electric plant was made, however, with the view to the abandonment of the present intake when the demand for power exceeds the economical maximum capacity of the combined Barriere and steam plant systems as developed, and the development of from 15,000 h.p. to 20,000 h.p. by constructing about ten miles of conduit system direct from the North Lake to the generating station to obtain an effective head of 600 feet.

Flume System

The construction of the flume system, including the intake dam, forebay, and wasteways, was started in February, 1912, the work having been let in one contract, to William Greenlees, of Vancouver.

It was planned to have the entire hydro-electric plant completed, if possible, by the end of the year, and it was therefore important to complete the construction of the intake before the high water flow of the river in May or June.

A mill was located near the site of the dam and the lumber required for both the dam and the flume was obtained from the timber limits close by the mill, some of the logs being brought down the river and others from the hillside above.

Intake.—The intake dam is a standard rock fill crib type set with a pile foundation to ensure greater stability. The site chosen enabled a suitable intake to be obtained by raising the level of the water ten feet from the normal level of the stream to the crest of the spillway, the grade of the

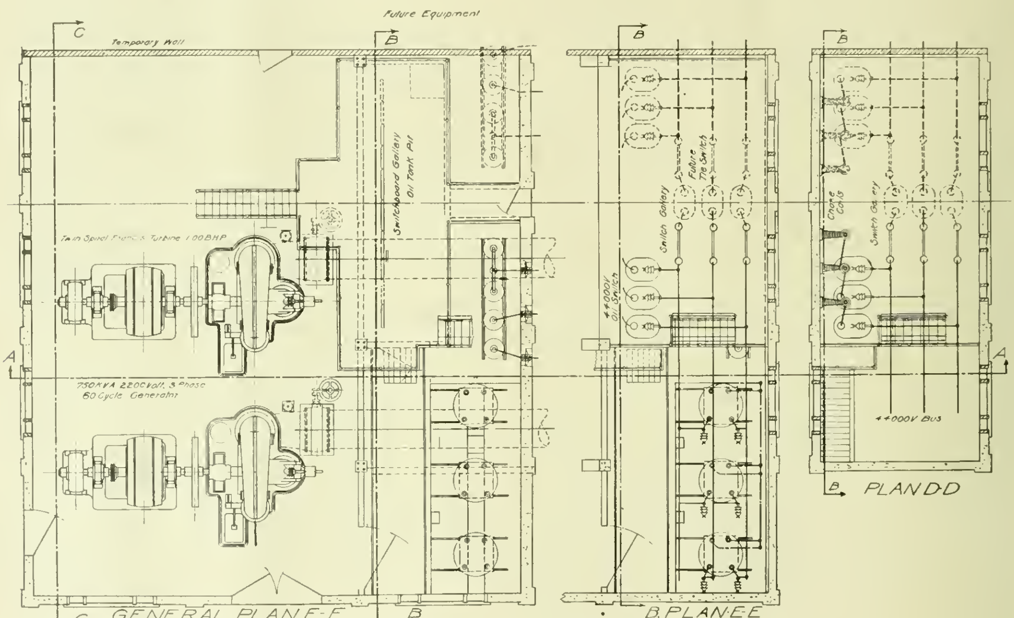


Fig. 1—General Plan of City of Kamloops Municipal Hydro-electric Plant.

river above this point being such that the flood level extended about 1,600 feet up stream.

The accompanying plan shows the general details of construction, from which it may be noted that the length of the crest is 240 feet, the spillway 110 feet and of sufficient depth to take care of a maximum flow of 7,000 cubic feet per second.

The intake for the flume is located on the north side, and a logway and a fishway are placed on the other side of the spillway, the logway being 12 feet wide and the fishway built in accordance with the requirements of the Provincial Government.

The beds of the stream at the site chosen consisted of a top layer of boulders, underlaid with alternate layers of quicksand and blue clay, but a satisfactory degree of water-tightness was secured by carrying the toe sheeting down to a depth of 12 feet, with the filling of mastic and puddled clay, an earth fill being made over this and carried to a height near the spillway by an easy slope.

The foot of the spillway was carried well down stream on piling, to take care of logs and roots which might get past the boom above the dam. The work was completed without difficulty by the middle of April, and passed satisfactorily the severe test of the high water flow of the following months.

Flume

The flume is designed for an ultimate capacity of 320 cubic feet per second and is 3.4 miles in length from the intake to the forebay. In design it is the standard type of timber flume, 8 ft. wide by 5½ ft. high, built up of 2 x 10 in. fir lumber, supported every four feet, and resting on trestle or cedar sills.

The quality of the lumber available was good, but a better quality of coast fir was used for battens and flooring at those sections where water-tightness was especially desirable. Probably the only section which required special attention in this respect was a length of about 1,000 feet, two miles from the intake, where the flume was carried past a steep bank at a horseshoe bend of the river. There appeared some danger of a slide occurring at this section, either from undercutting of the banks of the river or from water running down from the melting snow or leakage of the flume.

It was desirable, however, to continue the flume, if possible, along this section, in view of the necessity of getting timber down from the mill for the construction of the system, and to avoid the heavier expense of carrying a syphon across the river, the cost per foot of the syphon being about four times the cost of the flume for an equal capacity.

The flume system, including wasteways and forebay for penstocks, were completed in the fall, and unfortunately the city was then obliged to shut down on all work on the hydro-electric plant on account of the failure to sell the balance of the hydro-electric bonds due to the financial stringency.

The system as completed was tested out, however, and found to be in satisfactory condition for service, but when the completion of the plant was carried out, two years later, it was found necessary to build the syphon at the section above referred to, on account of a slide occurring which carried away about six hundred feet of the flume. This syphon is built with capacity for half the ultimate capacity of the system. It is wood stave pipe construction, 66 inches in diameter, 2,100 feet long and designed for varying head to a maximum of 120 feet.

The advisability of covering the flume as a protection against snow was considered, but as the design provided for a velocity varying from 6½ to 7½ feet per second, and careful inspection was required during the first winters' operation, it was decided to leave the system open until the need of a cover could be better determined from actual experience.

Forebay

The forebay is of timber construction and located in a small depression, so that a hogsback lies between the forebay and the power house as a protection against accident to the water system. Its general dimensions are 18 ft. by

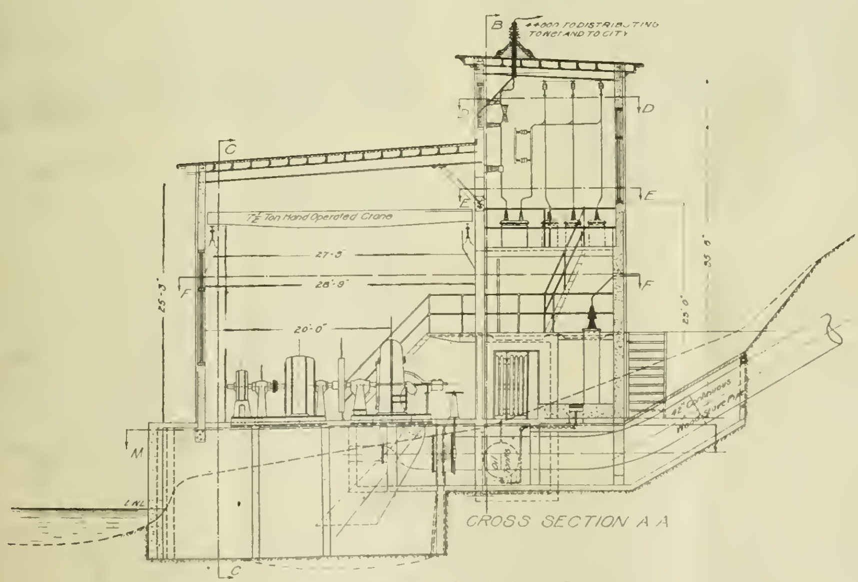


Fig 2—Cross Section Kamloops Municipal Hydro-Electric Generating Plant.

36 ft. long and 12 ft. deep, with ample provision for overflow to a wasteway down a small ravine to the river.

Penstocks

There are two 42-inch penstocks from the forebay to the power house, each 490 feet in length. They were built by the Vancouver Wood Pipe and Tank Company and are of wood stave pipe construction with staves 2½ inches thick and steel bands of ½ in. to ¾ in. diameter, spaced for pressure head from 30 ft. to 210 ft. Each penstock was connected up with its turbine by 28 feet of steel riveted pipe, anchored in concrete and connection between the wood stave and steel pipes was made by an expansion joint.

Generating Station Building

As already noted, the location of the generating station was governed not only by the plans for the present development, which can be brought up to at least 5,000 h.p., but the prospect of a future development of from 15,000 h.p. to 20,000 h.p. by a conduit system direct from the North Barriere Lake was also considered.

At the site chosen, the sub-surface conditions of alternate layers of gravel, quicksand and blue clay, required that the entire foundations of the building should rest on piles, and these were driven to an average depth of about 30 feet to secure a firm support.

The entire structure was built of reinforced concrete, the details for the tailrace and supporting walls, and beams for the units requiring considerable form work. The sand and gravel for the concrete was obtained close by the plant, and there were no unusual features of construction worthy of special mention.

The accompanying plan and elevation of the building show the general arrangement and some details of construction. The building as completed is intended to form half of the final structure, the construction of the other half will be carried out when other units are required.

The present dimensions are 45 feet by 48 feet, making the structure, when extended, 45 ft. by 96 ft. It will be noted on referring to the plans that the arrangement for the installation of the equipment is fairly compact, although the high tension equipment is well separated from the other section. The construction of the generating station was carried out by Wm. Greenlees, of Vancouver.

Turbines

There are installed two horizontal turbine units of 1,100 h.p. each, manufactured by the Platt Iron Works, of Dayton, Ohio, and installed by the C. C. Moore Company. They are the single discharge, inward flow type, mounted in scroll casings divided horizontally, and were designed to operate for 190 feet head at 600 r.p.m.

The runners are of bronze, 28 in. diameter, with a pump-head speed of 66 per cent. of the spouting velocity. The installation of each unit included a cast steel flywheel 5 ft. 6 ins diameter, a 42-in. butterfly valve hand operated, and a 10,000 ft. pound direct connected oil pressure type Lombard governor.

The guaranteed efficiency of the turbines was 81 per cent. at full load and 84 per cent. at 80 per cent. full load; regulation 2 per cent. with 250 h.p. thrown off to 10 per cent. by 800 h.p. off, and 20 per cent. by 1,100 h.p. off, under two second movement of governor.

Generators

The generators were supplied by the Canadian Westinghouse Company. They are direct connected to the turbines and are designed for 750 kw. at 3 phase, 60 cycle, 2200 volts. On the same bed plate and direct connected to each generator is a 40 kw., 125 volt, 600 r.p.m. exciter, each exciter capable of exciting both generators when necessary.

There were two banks at three 500 kv.a. transformers wound for 2,200 to 44,000 volts, oil insulated and water cooled. One bank for the generating station and the other for the sub-station at Kamloops.

Switchboard

The switchboard includes at present seven panels of natural black slate. They are mounted on a gallery commanding a full view of the units and have the usual standard switchboard equipment for low and high tension control. The panels are placed with a view to extension, so that on final completion of the building the switchboard will consist of about twelve panels centrally located.

The 44,000 volt wiring was done by 15/16 in. diameter bare copper; mounted on post type insulators, with copper bends, sleeves and T connectors, with pipe supports.

From the switchboard to the low tension delta at the transformers 500,000 cm. varnished cambric, lead covered three conductor cable in conduit, was used, and 300,000 cm. lead covered three conductor, 3,000 volt cable, from the generator to the switchboard. The transformers and switchboard equipment, including lightning arresters, was supplied by the Canadian General Electric Company.

Transportation

All of the power plant equipment was brought from Kamloops to the Barriere by the C. N. P. Railway, and was

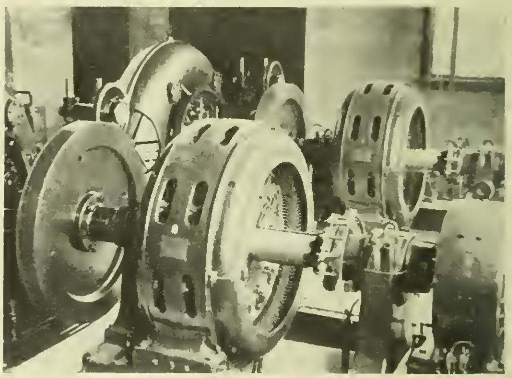


Fig. 3—Interior Kamloops Hydro Generating Station.

hauled in to the plant over a government road a distance of about five miles.

Transmission Line

The length of the transmission line from the Barriere generating station to the sub-station at Kamloops is 43 miles, and with the exception of two stretches of about eight miles each, the line passes through a comparatively open country parallel to the C. N. P. Railway line with overhead crossings.

It follows as much as possible on the river side of the railway to avoid future crossings when supplying power for irrigation. The poles are of cedar, varying in length from 40 to 50 feet generally, and are fitted with wooden cross arms designed with the view to a two-circuit line at some future time. These poles were obtained near the line of the C. N. P. Railway, about thirty miles north of the Barriere.

At a difficult section of the line along the Canyon 60 ft. and 70 ft. poles were used, and 80 ft. poles were used for the 640 ft. crossings of the South Thompson River at Kamloops. The standard spacing of the poles along the line is 200 feet.

(To be continued)

Electric Railways

"Safety First" Campaign of the Quebec Railway, Light & Power Company—Noticeable Decrease in Accidents

Among the electrical railway companies that have spared neither time nor money to advance the "Safety First" movement, and reduce the number of accidents to a minimum, is the Quebec Railway, Light, Heat and Power Company, of Quebec. The management of this company have not been satisfied merely to set the movement going, but

Fig. 1. Caution to the motorman.

they have been particularly aggressive in keeping the necessity for caution and safety continually before their men and before the public. A quantity of interesting literature has been distributed, and striking signs have been displayed at points where they are most likely to attract the attention of the average citizen.

In starting this movement the Quebec Railway Company began with their own employees, opening up with monthly lectures on accidents and their prevention, courtesy to passengers, etc., their object being to get their own men interested along these lines first, before they commenced operations on the public by distributing literature

Fig. 2.—Don't take the motorman's attention off his work.

and through various forms of advertising. These lectures have become a regular institution with this company, and it is found that they help to keep the men constantly interested in this subject. At these monthly meetings accidents that have occurred during the month previous are gone over in detail, and the men are shown, by means of black board drawings, how some of them, at least, might have been avoided.

Early in the campaign the company posted large "Safety First" cards in all their cars. These cards were placed in the back vestibule of all p.a.y.e. cars, facing passengers as they boarded the car. They were also placed in the upper side window close to the front door exit. A number of these cards are reproduced herewith. They were printed in both English and French, and were of such a size and color that it was practically impossible that passengers should pass without observing them. For example, the circular card shown is white on a garnet-red background; the two larger cards shown were bright red on white background; the other three were white on royal blue background. Most

Fig. 3.—Used in any conspicuous place.

of these cards were painted on oil paper, so that when placed on the window the effect was very agreeable and noticeable.

Accident Talks

The lectures were followed by a series of accident talks. One of these series, consisting of five different talks, was distributed monthly by tying them in bundles of fifty and hanging them up in the cars on the hand-strap rail in easy reach of the passengers. Another series, consisting of ten different talks, was issued in the same way, only every two weeks instead of monthly. Five thousand copies of each talk were printed in this scheme. As typifying the information given in these talks, we reproduce talk No. 1 and talk No. 2 of the latter series. These talks are printed in English on one side and in French on the other.

Another series inaugurated by the Quebec Railway Company is the distribution of small blotters, 4 by 9 inches, to the different scholars attending the various schools in Quebec, with short accident talks printed thereon. To date the

SAFETY FIRST

ATTENDEZ QUE LE CHAR SOIT ARRETE

Quebec Street Railway

Fig. 4. — Wait till the car stops — Displayed on the back vestibule and at the exit where the passenger can see it as he goes out.

SAFETY FIRST

DON'T GRAB AT A MOVING CAR

Quebec Street Railway

Fig. 5 Il ne faut pas sauter sur un char en marche.

company have distributed fifty thousand of these blotters.

We are indebted to Mr. H. G. Matthews, general manager, and to Mr. R. M. Reade, superintendent of the Quebec Railway, Light, Heat and Power Company, for the excellent information contained in this article. The officers of this company believe that to make a success of the "Safety First" movement—and success means a steady reduction of accidents—it is imperative that the subject be constantly kept before the employees as well as before the public. They find that if the subject is dropped for only a short period, interest begins to wane, people become careless again, and many go back to the old habit of taking chances. They emphasize very distinctly the necessity of keeping the public and employees continually interested in this subject.

This material came in response to our request for information as to what this company had been doing recently in aid of the "Safety First" movement. Our idea in sending out this and a number of similar letters was that we could assist in an interchange of ideas between companies, and, incidentally, re-arouse some of the companies to the importance of this work, which appears, in certain cases, to have languished during the last few months. We believe the Quebec Railway Company are right when they emphasize the importance of continually hammering at this subject—"everlastingly keeping at" this campaign of carefulness and watchfulness. In time, no doubt, we may hope that it will become just as much a habit of the people to be careful as it now appears to be their habit of being careless and thoughtless. This, however, is a millennium of affairs that cannot be looked for without a vast amount of missionary work to begin with, and a gradual and persistent development and schooling to which we must all subject ourselves.

In response to our letters we have a number of replies

SAFETY FIRST = SAFETY LAST = SAFETY ALWAYS

"HELP US PREVENT ACCIDENTS"

NEVER cross the streets except at street crossings.

NEVER cross the car tracks unless sure YOU can do so SAFELY.

NEVER cross in front of a moving car.

NEVER cross right behind a car, there might be another car on the other track.

NEVER cross in front of a car when driving a horse, running an automobile, or riding a bicycle.

NEVER get on or off a moving car. WAIT TILL THE CAR STOPS.

NEVER lean out of car windows.

NEVER get off a car backwards. FACE THE FRONT.

NEVER touch any loose wires that may be hanging or lying on the ground. THEY ARE DANGEROUS.

NEVER play, skate or sled ride on streets where there is a car track.

NEVER take chances. LOOK OUT FOR THE CARS. And LOOK BOTH WAYS before crossing the track.

NE JAMAIS traverser les rues ailleure qu'aux intersections.

NE JAMAIS traverser la voie ferree a moins de vous assurer que vous pouvez le faire sans danger.

NE JAMAIS traverser en avant d'un char en mouvement.

NE JAMAIS traverser directement en arriere d'un char. Il pourra se trouver un char sur l'autre voie.

NE JAMAIS traverser en avant d'un char lorsque vous conduisez un cheval, un automobile, ou un bicycle.

NE JAMAIS monter sur un char en mouvement, ni en descendre. Il faut attendre que le char soit arrete.

NE JAMAIS avancer le tete en dehors du char.

NE JAMAIS descendre du char a reculons. Tournez-vous vers le devant du char.

NE JAMAIS toucher un fil electrique, delie—suspendu ou par terre. Ces fils sont dangereux.

NE JAMAIS jouer, patiner ou glisser sur les rues ou les chars circulent.

NE JAMAIS s'exposer au danger. FAITES ATTENTION aux chars. REGARDEZ DES DEUX COTES avant de traverser la voie.

READ THE ABOVE CAREFULLY AND TALK IT OVER WITH YOUR PARENTS

QUEBEC RAILWAY LIGHT & POWER CO.
"Safety First Campaign"

General Offices
QUEBEC RAILWAY BLDG.
Phone 4750

Fig. 6. The Quebec Railway Company has distributed 50,000 of these blotters to the school children.

from other companies, but either none of the other companies have gone into this matter quite so fully as the Quebec Railway Company have done, or they have not sent in as complete information. We trust the attitude of the Quebec Railway Company in putting themselves out of their way to give us this information to pass along to others will be appreciated at its full value, and be accepted as a model on which other companies may base their operations.

We shall be very pleased in future issues of the Electrical News to give this matter of "Safety First" all possible prominence, and shall be grateful to any railway company that may see its way to send us, as the Quebec Railway Company has done, a complete description of their system of campaign.

Accident Talk No. 1

Talking to Motorman

At a trial in a nearby city it recently developed that a passenger on the front platform, who had diverted the attention of the motorman by talking to him, was very largely responsible for the accident, but of course the Company, and not the passenger, paid the bill. "Please do not talk to the Motorman" is just another way of saying "Please help us to avoid accidents." The passenger who stands on the front platform and engages in conversation with the motorman would probably never think of deliberately causing an injury, yet by taking the attention of the motorman from his work he greatly increases the likelihood of accidents.

A motorman cannot attend to his duties properly and engage in conversation. The Company's rules require motormen to refrain from entering into any unnecessary conversation and a passenger who draws a motorman into a conversation not only contributes to accidents, but may be the cause of an employee losing his position.

These remarks apply with equal force to conductors. Neither can render you satisfactory and safe service without having their whole attention on their work.

Platform Doors

The Conductors and Motormen are requested to keep platform doors closed at all times when cars are in motion. Please do not ask them to open doors or let you get off before cars are at an absolute standstill. This is against the rule, and this rule was made entirely to prevent injury to YOU. Don't jump on a car between stops. This practice is dangerous—you may be hit by a team, or you may fall. Don't take chances.

Suits and Witnesses

This Company has been sued for running by a passenger a few feet, for alleged discourteous conduct of an employee, and for accidents which never happened. From the frivolous nature of these claims, the necessity of conductors obtaining the names of witnesses in all cases of accidents, arguments, etc., is apparent. A conductor's devotion to the Company's interests is judged largely by his work in securing the names and addresses of witnesses, and we ask that you assist him and the cause of FAIR PLAY, by giving your name and address when requested to do so. Refusal indirectly encourages unjust claims and directly affects the ability of this Company to make the system one of the best of its size in the country.

Ideas

WE WANT YOUR IDEAS ON ACCIDENT PREvention. Oftentimes an outsider has splendid ideas which never occur to one engaged in railway work. We believe that many of our passengers who are interested in Accident Prevention can make practical suggestions which will be of real benefit and we ask that you give these freely and call our attention to any condition which might be the cause of accidents. Communications should be addressed to the Company.

The Quebec Railway, Light & Power Co.

Accident Talk No. 2

A Word About Witnesses

An eye witness of a street accident which occurred in this city about three months ago recently read in a Montreal paper that the injured parties had sued the Company. That man in going East made it a point to pass through Quebec and stopped over a train to give us the facts. That is all we ask of any witness—just facts, whether they are for or against us.

The Company is not trying to evade responsibility for accidents and will never ask a witness to distort the facts in such a way as to favor the Company. The Motormen and Conductors are cautioned to operate their cars so carefully that if an accident occurs, it will be the other fellow's fault, and not theirs. At the same time, we ask YOU to be very careful of your own safety. STOP. LOOK AND LISTEN. If the public and the Company both try to exercise such care that when an accident occurs "it will be the other fellow's fault," we will all witness a big reduction of accidents.

A Good Citizen

The Company is one of the best friends Quebec has. It has spent thousands of dollars for street pavement, snow removal, new equipment, improved facilities and in increased wages. At the present time it is building new cars in its shops, has a carload of copper on the way for the improvement of its lines. It employs regularly nearly 500 men who are spending their wages right here in Quebec, and is doing other real things which mean something for the city. Quebec citizens, on the other hand, are the best friends the Company has.

Growth of Quebec

We all want Quebec to be a fine, big city—right up to the minute in progressiveness. A great majority of the citizens of this place are interested in real estate and other investments which will increase in value with the growth of the city. Is there any one thing of greater importance to the growth of any city than the Street Car facilities? The street railway system cannot grow unless it is prosperous, and it cannot be prosperous unless its expenses can be kept down to a proper percentage of its receipts. Money now paid out for accident damages can, with much greater advantage to this community, be put into the property of the railway and into its service. It is just this thing we are asking you to help us to do.

Don't Pass Directly Ahead the Cars

Drive your auto or carriage out of side streets with great caution. HOLD BACK, LOOK, AND DON'T DRIVE ONTO TRACKS UNTIL YOU KNOW THERE IS NO CAR COMING. Don't cut in directly ahead of a car. It is much safer to pass behind.

A serious accident was narrowly averted on St. John Street recently through the quickness of the motorman. A little boy ran directly in front of a car. Have you told the youngsters not to do this? Repeat this word of caution to them every day until they have the danger of this practice thoroughly instilled in their minds. Tell them to wait, WAIT, WAIT.

The Quebec Railway, Light & Power Co.

New Books

Central Station Management—by H. C. Cushing, Jr., and Newton Harrison, E. E.; D. Van Nostrand Company, New York, publishers; price $2 net. It is the purpose of this volume to set forth clearly and simply the principles today adopted by the successful electric light and power stations of the United States. It is pointed out in the preface that it is the attention to these details in central station management that marks the dividing line between profitable and unprofitable generations, transmission, and sale of current. It is also noted that it is the fair and cordial relations between the public service company and the public that establish the permanency of the central station. The book will interest every central station man who is anxious to improve his methods and increase the efficiency of his plant. 400 pages; 5 x 7½ ins.; bound in red cloth.

Lighting Connections—fourth edition, by W. Perren Maycock, M.I.E.E.; a book dealing with the subject of electrical switching which will be found of interest to the consulting engineer, station engineer, the architect, the contractor and the wireman; contains 180 diagrams and illustrations; A. P. Lundberg & Sons, 477 Liverpool Road, London N., publishers; price 7d.

The Dealer and Contractor

The Lighting of the Timothy Eaton Memorial Church, Toronto, with the Indirect System

By George J. Beattie*

The Timothy Eaton Memorial Church, of Toronto, Ontario, recently completed, is probably the finest church building of its kind in the Dominion. Very careful attention has been given to every detail of its construction, including both the erection of the building, and its interior furnishings.

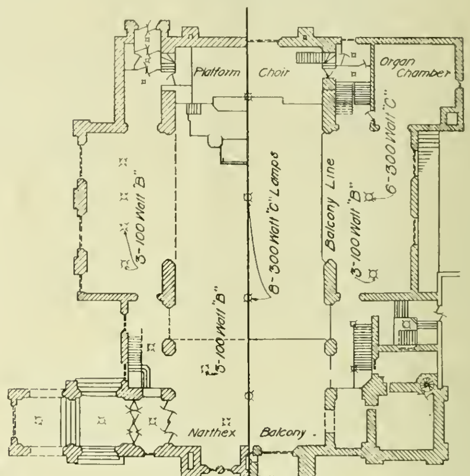
The main auditorium is of strictly gothic architecture, with elaborate memorial windows, heavy ceiling beams, and long, sweeping side arches, all following gothic lines. The auditorium consists of a long central nave, flanked on either side by transepts, thereby producing the shape of a cross.

When the problem of supplying an adequate artificial lighting system for this beautiful auditorium arose, it was decided that some system of lighting must be employed which would not only give the proper illumination from the utilitarian standpoint, but which would also correctly distribute the light over the ceiling and side walls, so as to bring out the beauty of the interior in all its splendor. A system of lighting has, therefore, been installed, in which the illumination is provided from entirely concealed sources. Large gothic fixtures are suspended from various portions of the ceiling, and these fixtures conceal lamps and reflectors,

Copyright—
Corridor Lighting, Eaton Memorial Church, Toronto.

which diffuse the light over the ceiling, and produce uniform and practically shadowless illumination in the church, which can only be secured by indirect lighting. When it is considered that all the woodwork in the building, including the pews, side wall paneling, ceiling paneling, and beams is a dark finish, the resulting illumination secured for the expenditure of current is quite remarkable.

The nave of this auditorium is 45 feet wide, 118 feet



HALF MAIN FLOOR PLAN | HALF BALCONY FLOOR PLAN

long, and 57 feet from the floor to the apex of the ceiling. The side transepts are 26 feet wide, and 38 feet long, and measure from the floor to the balcony ceiling 11 feet in height, and from the balcony floor to the upper ceiling 32 feet in height. The ceilings throughout are finished in a very light cream, whereas the walls are finished in a darker tone of brown, as partially shown in the photographs.

The nave is illuminated by means of four large indirect fixtures, each of which is supplied with eight 300-watt Mazda "C" lamps. The transepts under the balcony are illuminated by means of four indirect fixtures, each equipped with three 100-watt Mazda "C" lamps, and over the balcony by means of one indirect fixture, equipped with six 300-watt Mazda "C" lamps. The total wattage consumption, therefore, for the main auditorium is 17.4 kw., which operates to illuminate a floor area aggregating 9,270 square feet.

It is estimated that a uniform intensity of light, averaging 4 foot candles, is secured on a 30 inch working plane in this installation. This intensity of light is ample for easy reading of the closest print, without any strain on the eye whatsoever.

Throughout this installation each lamp in each fixture is equipped with an individual X-Ray reflector, a one-piece crystal glass unit, plated with pure silver, thus forming a high initial reflecting surface. These reflectors are de-

*Illuminating Engineer, Toronto.

Church lighting from concealed sources—Timothy Eaton Memorial Church, Toronto. Copyright

signed with special corrugations, used exclusively for indirect lighting purposes.

The indirect fixtures employed in this installation are of special design, following strictly gothic lines, to be in keeping with the interior architecture. The bowls are suspended from the ceiling by means of cast bronze hangers, and are supplied with cathedral white glass panels. These panels are softly illuminated to give an added decorative and artistic effect to the lighting unit. Such a fixture, with its harmonious design and finish, naturally fits in as a necessary part of the completed interior decorations, and is in strong contrast therefore to many similar installations where the fixtures seem to have been added as an afterthought.

Owing to the excellent way in which the interior design of the auditorium is displayed by means of the concealed artificial lighting system employed, many observers have given it as their opinion the auditorium appears at its best at night.

Particular attention has been paid to the lighting of the memorial window, shown in the larger photograph herewith. In most churches the beautiful colors of the art glass decorations are lost through lack of proper lighting, as it is only in a bright light that these appear at their best. Many church windows are practically useless as decorations at the evening service. This has been overcome in the Eaton Memorial by illuminating the window artificially so that it shows up even more prominently in the evening than during the daytime. This illumination is produced by a powerful searchlight mounted some distance from the window on a steel tower. A large amount of experimental work was necessary before the proper height, distance, and intensity of the light source was determined, but it is believed the result is an ample justification of the labor and expense incurred.

The Underwriters' Laboratories have just issued their March number of Electrical Data, containing a quantity of interesting information for the central station, engineer and contractor. The following topics are discussed: New York Testing Station; An Electric Toaster for Ten Cents; Motion Picture Equipment and the Labeling of Slow-Burning Films; Dental Panelboards; Electrically Heated Pads, Foot-Warmers and Blankets; Steel or Brass-Coated Iron in Electrical Fittings; Fires and Accidents.

The new hydro electric development at Stave Falls, P. Q., owned by the Laurentian Power Company, is now supplying about 2,000 horse power to the Quebec Railway, Light, Heat and Power Company. The latter concern is now building its own cars in the workshops at Ste. Anne de Beaupre.

Buffalo Mines, of Cobalt, will purchase in the near future the motors required for the operation of a 100-ton mill and compressor.

Licensing Electrical Contractors in Manitoba— Action by the Can. Soc. Civil Engineers

In January last the electrical section of the Manitoba Branch of the Canadian Society of Civil Engineers appointed a committee of five to consider the question of licensing electricians in the province of Manitoba. The following report has just been submitted, and is being discussed at an early meeting of the section. This is along the line of an Act which it was hoped would be introduced at the present Session of the Ontario Legislature, but which Ontario contractors have decided to temporarily abandon:—

Report to the Members of the Winnipeg Electrical Section, Canadian Society of Civil Engineers re Motion submitted at the meeting held in January, 1916.

In complying with your resolution of January 26th dealing with the motion presented by Mr. Wilson that a committee of five be selected from the members of the Section for the purpose of enquiring into the present status of the Electrical Worker in Manitoba, to formulate a scheme from which legislation might be framed for the object of licensing such workers, the committee beg leave to report as follows:

Main Report

The Committee has held three meetings, all members being present at each meeting. Mr. Leamy was elected chairman and Mr. Wilson, secretary.

Consideration of the original motion at once brought out the fact that the want of status of the electrical worker was due to the present unregulated conditions of electrical work in general. In support of this a quotation from Mr. Cambridge's original report is herewith given:

"Under present regulations of the City of Winnipeg as contained in By-law 7657, two classes of permits are recognized. First, a permit that is required for each individual job, and second, a General Permit the use of which is restricted to railways or other large industries having competent electricians in their own employ.

In regard to the latter form of permit it has been the practice to issue this, good for one year, and to renew the same.

All work done under a general permit has to comply with the rules of the city and is subject to inspection. The work under such a permit is restricted to buildings owned or occupied by the holder.

In regard to the ordinary or individual permit any person may take out such a permit, whether competent to do electrical work or otherwise, and this is the weakness of the system. The only power to refuse a permit is contained in section 3 of the above by-law, which provided that an applicant for a permit having previously committed a breach of this by-law, and such breach continuing after due notice, may be refused a permit until such breach has been remedied.

Under practical every day conditions we find that all kinds of people take out permits and attempt to do all kinds of electrical work."

The Committee concur in the views of Mr. Cambridge and believe these conditions exist throughout the province. The status of the electrical worker cannot be considered by itself. Six prime interests, the owner, the architect, the contractor, the employee, the union and the general public are involved. In order to present a scheme to improve existing conditions, the enquiry would therefore have to be broadened to include these interests.

Supplementary Report

The various subheadings enumerated in the main report of your committee were referred to the individual members and further discussion led to the development of the following suggestions:

It would be expedient to have four grades of licenses somewhat as follows:

A. A contractor's license entitling the holder to engage in the business or calling of an electrical contractor.

B. A certificated electrician's license enabling the holder after having passed successfully the examination of an examining board, to superintend or be in charge of the work of installing electrical conductors and apparatus.

C. A special license issuable to corporations or interests authorizing the installation or maintainance of electrical wiring or apparatus on premises owned or controlled by such.

D. A special permit entitling the holder to install a particular job but not to apply to any other work.

That an examining board be considered to pass upon the qualifications of applicants for any of the licenses heretofore mentioned.

No one but a licensed contractor with a certificate "A" should be allowed to undertake electrical work in the province. He would be compelled to employ one or more certificated electricians holding license "B".

He, the contractor, could hold both certificates "A" and "B" if he wished to undertake the supervision of the work himself, but he need not necessarily be an electrical man if he employed a man with certificate "B" to supervise the installations.

The qualifications for certificate "A" would be:

(a) That the contractor put up a bond.

(b) That he have a telephone address.

(c) That he have a regular place of business.

The qualifications for certificate "B" would be:

(a) That he has spent say five years at the trade.

(b) That he possess certain limited technical qualifications.

(c) That he successfully pass the examination set by the examining board.

Details of the above scheme would require to be thrashed out, for example, (1) the qualifications of the men forming the examining body so that it could not claim the same abuses that are at present said to occur in connection with the Steam Engineer's license, (2) the nature of the qualifications of certificate "B", (3) the number of men and apprentices working under one certificated electrician.

Central station authorities dealing with work on their own premises, and for the public, up to and including the meter installation should not be included in the scheme. It would be necessary however to define the boundary line.

The Committee suggest that a special general meeting of the section be called to discuss the report in detail as it feels that the opinion of the section should be expressed.

A. H. Winter Joyner, Limited, of Toronto, have opened an eastern branch office at Room 1001 Lewis Building, 17 St. John Street, Montreal. Mr. S. E. File, who has been with the head office at Toronto for several years and who is thoroughly conversant with the methods for which this firm have become well known throughout Canada, will be in charge. The three main specialties—street lighting equipment, indicating and recording instruments and detail equipment for generating and distributing systems—will be carried on from this office. Among other products that will be handled in Montreal may be mentioned those of the Bristol Co., General Devices and Fittings Co., G. & W. Electric Specialty Co., Philadelphia Electrical and Manufacturing Company.

The Interstate Electric Novelty Company of Canada, Limited, Toronto, announce that they have concluded arrangements with the Harland Engineering Company, of 102 St. Antoine Street, Montreal, to handle their line of Gold Medal flashlights, radio batteries, radio lamps, and miscellaneous material in the province of Quebec and the city of Montreal. The above concern will carry a complete stock at all times.

We'll Wire Your House at (Whose?) Cost

The National Electrical Contractor shows its disapproval of the "Wire your house at cost" cry in the accompanying sketch. We do not get anything for nothing in these days of strenuous competition—or, to put it in another way, we get exactly what we pay for. It is possible, however, that the distribution of payments may be unfair, and this is evidently the case where, as portrayed in this sketch, the consumer is made to pay a higher rate per kilowatt hour as a result of a certain section of the central station business being carried on in a method which is in opposition to business principles. The poor consumer shown here is plainly one of those who are paying the higher rate so that some other consumer may have his house wired "at cost."

Hydro Rules and Regulations

Mr. H. F. Strickland, chief electrical inspector of the Hydro-Electric Power Commission of Ontario, acting under instructions from the Commission, is sending out notices to all contractors, jobbers, manufacturers, and others who may be interested, requesting them to meet on Tuesday, April 25, to discuss proposed amendments to the Rules and Regulations of the Commission. By an open discussion it is hoped that any section of the rules which may have shown themselves weak or to have met the conditions imperfectly may be remedied and the rules amended forthwith. We consider this a matter of very great importance, and trust that the various interests concerned will take full advantage of the opportunity now furnished by the Commission to present their views. It is expected the meeting will be held in the rooms of the Retail Merchants' Association at 2 College Street, Toronto.

Vancouver Electrical Contractors Form Association

The electrical contractors and dealers of Vancouver, B. C., have had several meetings recently to consider the question of forming an Association to assist those engaged in the business. These meetings have been fully attended, with the result that on Tuesday, March 21st, the British Columbia Association of Electrical Contractors and Dealers was duly formed. It is hoped to bring all interested in the business into this association, which has the support of all the large wholesale houses in the district.

By a unanimous vote Mr. C. H. E. Williams was elected the first president of the association, his address being North-West Trust Building, Vancouver, B. C.; Mr. E. Brettell, of the Electric Supply Company, Ltd., 781 Granville street, Vancouver, is the secretary-treasurer.

As a new association which has for its object "Co-operation," the British Columbia Association of Electrical Contractors and Dealers invites correspondence from similar associations, and will be glad to welcome any members of other associations, when they visit the Coast.

Success of the Electric Show Assured

The Ontario Electrical Contractors' Association are distributing an attractive blotter which calls attention to their Second Annual Convention and Electric Show to be held in Massey Hall, Toronto, June 6, 7 and 8. The secretary of the Show Committee, Mr. E. A. Drury, advises that to date out of 27 booths for sale, according to the plan of the Electric Show published in our last issue, 21 booths have already been signed for. This would indicate that the Show Committee will have no difficulty whatever in filling the space and that it will merely be a matter of selecting the most suitable applications.

Jakfrosst for Nitros

The principal claim made by the manufacturers of a new frosting for Nitrogen Lamps is that it is an adequate substitute for the sand blast. In other words, the frosting is ingrained into the glass so that no heat or acid or any other test can peel it off. The process of frosting is easy and expeditious, as more than two dips into the liquid are seldom necessary, the time involved being thirty seconds at the outside. "Jakfrosst" has just recently been put on the market, and already, to use the words of the manufacturers, the response has been such that the trade seems to have been aching for it. The "Jakfrosst" people also specialize in waterproof colorings, which include ruby red, blue, pink, ground glass, opal white, yellow, green, purple and amber.

Mainer Electric Changes Management

The well known firm of the Mainer Electric Company, at Winnipeg, has made several changes during the last few weeks. Mr. J. G. Smith has been appointed manager and Mr. T. J. E. Papineau sales manager. These appointments date from March 1st.

Formerly this Company did both a wholesale and retail business at 61 Albert Street, Winnipeg, but at March 1st a new policy was put into effect—to sell wholesale only. The change, we understand, has worked very satisfactorily and there seems to be no doubt but that the firm will make rapid strides under the able management of Mr. Smith.

Messrs. Weiss & Biheller (Canada), Limited, 115 Bay Street, have been appointed Canadian selling agents for the Hocking Glass Company, Lancaster, Ohio, manufacturers of lighting glassware. This line is new to the Canadian trade, but, we understand, is a very comprehensive one.

Electrical Matters in New Brunswick

A Bill has been introduced in the local legislature of the province of New Brunswick incorporating the St. Croix Power Company. The object of the incorporation is to permit the development of light, power, and heat from the St. Croix River. The application is opposed by the St. Stephen Electric Company, who claim that they are properly serving the interests of this district.

Attorney-General Baxter has introduced a Bill into the local legislature calculated to facilitate the organization of rural telephone companies. Under the Bill any five or more people may become incorporated as a rural telephone company, having their signatures verified by a justice of the peace. This memorandum will then be sent to the provincial secretary, passed upon by the Attorney General, and a charter will immediately issue. The fees will only be $20 where the capital of the company is $5,000 or less.

N. E. L. A. Committee in Toronto

The Accident Prevention Committee of the National Electric Light Association recently met in Toronto. We believe this is the first committee meeting of the N. E. L. A. ever held in Canada. Mr. Wills Maclachlan, who has become so closely associated with accident prevention work among the central station companies in Canada, is a member of this committee, and was chiefly instrumental in bringing them to Toronto for this meeting.

The Ferranti Electrical Company, of Canada, Ltd., head office Toronto, Ont., have been awarded the contract for a 600 kw. motor converter and switch gear for the city of Saskatoon, Sask., amounting to $13,000.

L. C. Barbeau and Company, electrical jobbers, have opened offices and showrooms at 70 Victoria Square, Montreal. Mr. L. C. Barbeau is manager.

W. H. Spencer, Limited, electrical engineers and contractors, 340 University Street, Montreal, have just received their charter of incorporation. The company have acquired the business of Spencer and Aspinall, Limited.

Vincent & Say, (Henry Vincent and Conrad Say), have registered to carry on an electrical contracting business in Montreal.

Gagnon, Dubeau & St. Amour, electricians, Montreal, Que., have registered.

Obituary

William Chisholm, superintendent of the Windsor, Essex and Lake Shore Railway Company, was electrocuted on March 22nd while coupling cars at a gravel pit in Essex.

W. R. Waghorne, manager of the hydro-electric system in Wallaceburg, died in the General Hospital, Chatham, March 23, following an operation.

Personal

Mr. M. H. Williams, of Montreal, has been appointed publicity manager of the Montreal Light, Heat and Power Company.

Mr. A. N. Wilson, for many years manager of the C. P. R. Grain Exchange telegraph office, Winnipeg, and later of Brandon, has resigned to go over seas with the 181st Battalion.

Mr. J. S. Rickard, formerly connected with the Metropolitan Engineering Company of New York City, has joined the sales force of the Philadelphia Electrical & Mfg. Company, and will devote his time to the sale of Pemco Products.

Mr. Lawford Grant, sales manager of the Eugene F. Phillips Electrical Works Limited, Montreal, has just returned from a trip to the Pacific Coast. He reports that business in the West is reviving, and he is very optimistic as to general conditions.

Mr. W. J. Curle, Toronto, has been appointed general manager of the Chatham, Wallaceburg & Lake Erie Railway, to succeed the late William Norris. Mr. Curle was formerly connected with the Canadian Pacific Railway and the Canadian Northern Railway.

Mr. F. P. Holliday, formerly of the Swedish General Electric Company, Toronto, has been gazetted in England 1st Lieutenant in the Royal Flying Corps. Mr Holliday enlisted during the first week of the war as a sapper in the 2nd Field Company Canadian Engineers, under Major T. C. Irving, Jr., and has done excellent work for his unit. He is a former contributor to the "Electrical News."

Major A. G. L. McNaughton, of Montreal, has been appointed to a command, according to a London cable. Major McNaughton, who was seriously wounded at Ypres, was in practice as an electrical engineer in Montreal before joining the overseas forces. He graduated from McGill University, where he was for some time a demonstrator in the electrical course. At the battle of Langemarck, despite a serious wound in the arm, he stayed with his battery for twelve hours and directed its operations. He had two orderlies hold his maps in front of him, and he kept two telephones going in despatching orders.

Mr. H. L. Lissfelt, who has made many friends for himself and the Macbeth-Evans Glass Company during the few years he has acted as manager of that company in Toronto, has been transferred to the management of the company's Philadelphia office. We understand Mr. Lissfelt will have charge of the section of United States territory lying to the

Mr. H. L. Lissfelt.

southeast of that city. He is succeeded in the management of the Canadian Company by Mr. J. F. Heffron, who has been with this office for some time, and is thoroughly conversant with the requirements of the Canadian trade.

Electrically Operated Baker's Machinery

The cleanliness of electric drive adapts it admirably for service in the bakery and a complete line of electrically driven baker's machinery has recently been developed by The American Bakers Machinery Co., St. Louis, Mo. Two

Fig. 1 - Rounder.

of these machines, the dough divider, and rounder are shown herewith.

The dough is placed in the hopper at the top of the divider, and falls into a square box. It is then forced into a cylinder where a knife blade cuts it into loaves. This machine can be set to cut loaves of any size. After the cutting operation the cylinder revolves through a half turn and when in the downward position the loaves fall onto an

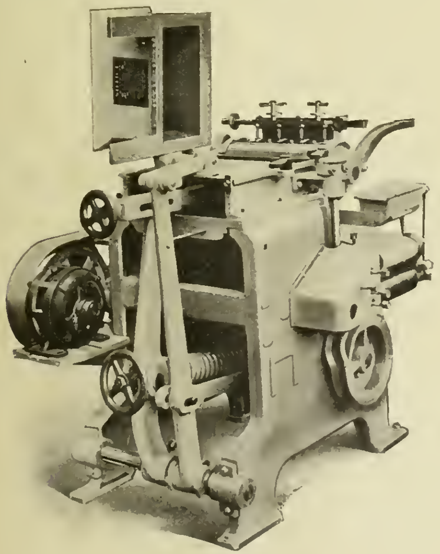


Fig. 2—Dough Divider.

automatic conveyor which carries them to the rounder, where the loaves are shaped up ready for the oven.

The divider is made in capacities of 1,800, 2,700 and 3,600 loaves per hour. Both machines are equipped with Robbins & Myers Motors which are connected through gears. Both the divider and rounder are so constructed that all parts which come in contact with the dough may be easily removed for cleaning.

The Wagner Electric Manufacturing Company of Saint Louis announces the removal of its Pittsburgh office to 947 Penn Avenue, to continue in charge of Mr. Ludwig Hommel. The new telephone number will be Grant 3627.

The Acme Lighting Company, (Rodolphe Levesque and Charles H. Milot), electrical contractors and dealers in electrical supplies, Montreal, have registered.

The Holtzer-Cabot Electric Company, Boston, have issued a little booklet describing their progress and development during the forty years of their existence.

Trade Inquiries

Name and address of inquirer may be obtained from Dept. of Trade and Commerce, Ottawa

284. **Presspahn for electric insulation.**—A Manchester importing firm wishes to be placed in touch with Canadian manufacturers of presspahn in the following sizes: Sheets about 23½ inches by 31½ inches or larger, in thickness from 0.2 m/m up to 4.0 m/m. Quotations are requested per ton of assorted thickness. Sample may be inspected at the Department of Trade and Commerce. (Refer File A-769.)

Trade Publications

Conduline—pamphlet issued by the Mica Insulator Co., New York and Chicago, describing "an ideal compound for filling the joints of cables."

Regulator—Bulletin No. 45500-A, issued by the Canadian General Electric Company, describing, with illustrations, automatic generator voltage regulators.

Protective Apparatus—two bulletins issued by Schweitzer & Conrad, Chicago, describing with illustrations, this high-capacity, primary cutouts and their type "H" automatic resistance horn arresters.

Dictionary of Altitudes—by James White, F.R.S.C., F.R.G.S., Deputy Head and Assistant to Chairman, Commission of Conservation This is a dictionary of altitudes in the Dominion of Canada, covering the various provinces.

Conducell—pamphlet issued by the Mica Insulator Company, New York and Chicago, describing a method of insulating cable joints in underground transmission system. This pamphlet is illustrated, showing the progressive stages of installation work.

Water Wheel Generator Sets—A very attractively illustrated art circular has just been issued jointly by the Pelton Water Wheel Company of San Francisco, New York, and the Westinghouse Electric & Manufacturing Company of East Pittsburgh, Pa., describing the Pelton-Westinghouse waterwheel generator sets and their applications.

Architects and Engineers—The Canada Sales Company, 165 Church Street, Toronto, factory representatives of a number of large electric manufacturers and well-known specialists in the highest grade goods, are distributing a little booklet specially addressed to architects and engineers. This folder illustrates a number of pieces of equipment handled by the Canada Sales Company, including panelboards, knife switches, telephone apparatus, automobile time control devices, lighting fixtures, etc

Current News and Notes

Appin, Ont.

The village council are considering the installation of an electric lighting system. Power will be supplied from the lines of the Hydro-Electric Power Commission of Ontario.

Bedford, Que.

A group of citizens of Bedford, Que., have made a proposition to the town council to purchase the stock and shares of the Bedford Light Company and to undertake to supply the town with a complete system of lighting and waterworks.

Calgary, Alta.

Under the daylight saving plan, by which the clocks will be advanced one hour during certain months of the summer in Calgary, Alta., the Electric Light Department fear a reduction of their surplus.

The city of Calgary has given a contract to the Eugene F. Phillips Electrical Works, Limited, Montreal, for a quantity of one million c.m. single conductor, paper insulated, lead covered, 2300 volt cable and for 300,000 c.m. three conductor cable.

Edmonton, Alta.

The Alliance Power Company, Limited, has been incorporated with head office Edmonton and capital $250,000.

Glencoe, Ont.

The town council will secure estimates on the cost of introducing Hydro light and power.

Halifax, N.S.

A Bill has been introduced in the House of Assembly of the Province of Nova Scotia incorporating the Valley Electric Company, with a capital of $49,000. The company has power to acquire water powers on the Paradise Brook and other streams, and to build electric railways in Digby, Annapolis, and other counties of the province.

Kenora, Ont.

The Keewatin Power Company has issued an injunction restraining the town of Kenora from holding back the flood waters of the Lake of the Woods. The town of Kenora have an impounding dam across the east branch of the Winnipeg River at Kenora.

Martintown, Ont.

The Martintown Rural Telephone Company, Limited, have been granted a charter.

Mono Mills, Ont.

The Independent Telephone Association, Limited, Mono Mills, Ont., have obtained a charter.

Montreal, Que.

The J. G. White Company have entered suit against the Canadian Light, Heat & Power Company, claiming $200,000 due for services rendered in supervising the work of construction of the power plant of this company at St. Timothee.

John Forman & Sons, dealers in electric supplies, Montreal, Que., have registered.

Faure & Diochon (Paul Faure and Georges Diochon), dealers in electrical supplies, Montreal, have registered.

Nelson, B.C.

The B. C. Telephone Company promise to establish a central energy system in the immediate future.

New Westminster, B.C.

The city council are unwilling to arbitrate the question of electricians' wages with their striking employees. It is stated that the strikers have been replaced by competent men, and that the city is satisfied everything is going along safely and smoothly.

Port Elgin, Ont.

At the annual meeting of the Bruce Municipal Telephone System, Messrs. D. McNaughton, A. McLean, and J. J. Hunter were re-elected commissioners. Mr. McNaughton was also appointed president for the year. The question of connecting up with the Bell Telephone System was discussed, and it was decided to close an agreement with this company if their terms were not too severe.

Rodney, Ont.

A by-law will be submitted some time during April authorizing an expenditure of $7,000 on an electric distributing system, power to be obtained from the Hydro-Electric Power Commission of Ontario.

St. Genevieve de Pierrefonds, Que.

The Pierrefonds Electric Company, Limited, St. Genevieve de Pierrefonds, Que., has been incorporated.

Sault Ste. Marie, Ont.

The Steelton Sign Shop is the name given a new industry which is locating in the Soo for the manufacture of electric signs.

The Great Lakes Power Company, Limited, Sault Ste. Marie, Ont., have obtained a charter.

Stoke, Que.

The Stoke Telephone Company (J. O. Lemire, J. A. Malenfant and George Mace), Stoke, Que., have registered.

Toronto, Ont.

As a result of certain alleged discrepancies in the financial accounts of the Hydro-Electric Power Commission of Ontario, the Public Accounts Committee of the Ontario Legislature recently decided to have an independent audit of the Commission's books, and have appointed Mr. E. R. C. Clarkson for the work.

Vernon, B.C.

The city council are considering the installation of a fire alarm system to cost some $6,000.

Winnipeg, Man.

Tenders are received up to April 17 by the City Council of the city of Winnipeg for the supply and installation of three 1,000 kv.a. transformers with switching apparatus; also for one year's supply of watt-hour meters.

The original announcement that the Winnipeg Electric Railway Company had passed their dividend for the current quarter appears to have been premature. A director of the company has stated that it is merely the intention to pay the dividends half-yearly instead of quarterly, and expresses confidence that at the end of the half-year a dividend will be forthcoming.

The Department of Public Works of the province of Alberta have included in their estimates for the year 1916, $250,000 for telephone construction.

Electrical News
Generation Transmission and Application of Electricity

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ADVERTISEMENTS

Orders for advertising should reach the office of publication not later than the 5th and 20th of the month. Changes in advertisements will be made whenever desired, without cost to the advertiser.

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The Engineers' Opportunity

Every live Canadian has a growing feeling of unrest and dissatisfaction at the methods adopted in the management of our various public affairs. Charges of graft are becoming everyday matters; evidences of incompetence in our administrators are available on all sides; proof, unmistakable in its directness, that the public good is being placed in a secondary position to the demands of party politics or personal gain, daily confronts us. Our citizens are asking themselves—Where is it going to stop? Does the honor of the nation not demand that we lay aside our regular daily tasks for a little and "house-clean"? In the interests of self-preservation, even, must we not act soon?

We do not lay claim to any originality in pointing out the cause of the trouble—the men who hold power simply do not have the necessary qualifications to carry on the business with which they are entrusted. They frequently have no training and little adaptability. What private individual or corporation would appoint men of so slender experience and training to positions of such important engineering and financial trust? Yet this is the very foundation on which our government organization is based—that the men holding the most important positions are simply the men who possess the keenest instincts for securing those positions.

We allow all due respect to the politician's qualifications, but they do not fit him for a business career or for conducting the affairs of the nation. It seems to be the failure to realize that the nation's business at Ottawa could be run as efficiently, for example, as any manufacturing concern, that keeps us from making progress. Surely though, we have looked upon politics and politicians long enough as necessary evils. Surely we are about through with being humbugged by a lot of people whose prime qualification is the ability to humbug us. Surely we are due for a house-cleaning and a re-organization of our business methods, when men shall be appointed to positions of trust because they can be trusted, and to positions requiring organizing and constructive ability because they have special training and fitness for this work. Surely the people are realizing that we are living in a different age—an age of efficiency. Inefficient governments like inefficient business must give way to the competition of better methods and if we hope to continue in this race here in Canada, we must re-organize soon and thoroughly.

* * *

A good letter comes within the last few days from one of our readers, a consulting engineer of international reputation and respect, which puts the matter, we believe, in the same light as viewed by the vast majority of independent thinking men to-day. An extract from the letter says:—

"Herewith something which might be of interest—a report of the speech of the Honourable Sir George Foster, Minister of Trade and Commerce, delivered some time ago. The outstanding quotation to my mind is this:

> "'My view is that every application for public work should come before a competent board of engineers and business men and should be reported upon by them for the information of the government, and that every application would have to show some cause of necessity or public benefit, or future usefulness, before it would be passed and put into the estimates.
>
> "'I do not believe that we shall get down to a proper system of husbanding our resources or of confining ourselves to useful and necessary public works until we get some machinery of that kind.'"

"Can you imagine any politician making a statement of this kind concerning his own government and his own class five years ago? It seems to me that 'Searchlight' might find this a pretty good text to preach from, not so much to the public as to the engineers themselves, and get them to boost this thing along and stand up to the public for that position in the community which is their due.

"Engineers are non-political, and owing to their methods of training and disposition of mind never will make partizan politicians, but the force of economic necessity is going to place them, practically in spite of themselves, virtually in control of the machinery of the government."

* * *

Here at least is one remedy for the ills from which we suffer. The engineer is a trained man, an able man, and an honest man. Unfortunately, as our correspondent infers, he is not attracted by political life. Why? Because political methods, as we know them to-day, are so diametrically opposed to his ideas of the way things ought to be done. Is it the duty of the engineer to hold back because he disapproves, or to take hold and apply the remedy? When our government plant fails to give efficient service, is it not his duty and his right to apply the same methods of argument and action as he would apply to a broken down bridge or a disabled transmission line?

We believe this question of public service should no longer be side-tracked by the engineering profession. They must realize the dire necessity for greater efficiency in our government business. They must also realize, if their traditional modesty will allow them, that as trained men their services would be valuable in bringing about the greater efficiency desired.

Decent Consideration

Dean Cappon, of Queen's University, voices the sentiments of a very large percentage of the Canadian people when he says: "Let there be decent consideration for those who think they have good enough reasons not to go, at least as yet, to the war."

Possibly, if Dean Cappon spoke all that is in his mind, he would put it more strongly. Doubtless he has seen the ill-advised methods of recruiting that are being utilized from day to day by the rank and file of various battalions. Doubtless he realizes that the present system of semi-coercion has little to commend it, and in a very large number of cases does more harm than good. Its biggest weakness, perhaps, is that it fails to discriminate between the man who holds back because he is a coward and the man who delays because his intelligence tells him that his proper place, as yet, is where he is.

The methods of recruiting as practised in Canada, if Toronto may be taken as a criterion, lack nothing so much as intelligence and good sound horse-sense. There is ample and laudable enthusiasm—but misdirected. Khaki enthusiasts fail to see, or refuse to see, that the business of the country is next in importance to the war, and as such demands fair consideration. They fail, or refuse, to see that many a young man, however desirable as a member of their unit, may be, by comparison, still more useful as a civilian in this present time of stress. They fail, or refuse, to grant to the intelligent individual the right to use his own judgment as to when is the proper time for him to give up the one and take hold of the other. In other words, the present system of recruiting is specially designed for the dilettante, the indifferent, the man lacking in moral and mental fibre; it is a reflection on the man who does his duty as he sees it.

All of this, and more, no doubt, Dean Cappon has prominently in mind when he makes a plea for merely "decent consideration" for the men who do their own thinking. If these men had followed the line of least resistance many of them would have been in uniform months ago. Fortunate it is, as we see it, that, in the absence of the slightest apparent effort on the part of our Government to cope with this problem of filling up the ranks of the numerous battalions they have authorized, there are men strong enough to brave the jibes and insinuations of these miscellaneous, misguided recruiting agents. They are simply making juvenile attempts at a man's job! How can we combat efficiency except with efficiency?

The men who are strong enough to "think" to-day, men who are strong enough to resist following the lines of least resistance, cry out for some movement on the part of our Government which will enable us, as a nation, to carry on our share of this war in such a way as to conserve in the best possible manner our fighting resources—present and future. There is not a man of these who is not ready to go when and where he is told—if the authority who gives the order **knows.** Why doesn't our Government find out? Why hasn't it an inventory of every citizen of Canada, that it could say to him, "Here is your place!"? But instead of acting, our Government delegates this authority to the illiterate private in the ranks, and, indirectly at least, authorizes the man of small intelligence to badger and coerce the man who sees his duty clearly and is doing it. Why cannot our Government move in this matter? Why cannot they give so important a question at least "decent consideration"?

The Edmonton Power Co's. Plans

The Edmonton Power Company, Limited, has made an agreement with the city of Edmonton covering a period of 21 years, for a minimum annual supply of electric energy of 35,000,000 kilowatts at the rate of 1c. per kilowatt hour during the life of the contract, the price to decrease on a sliding scale until the consumption of the city reaches 110,000,000, when the rate becomes ½c. per kw. hour. As those interested in the proposition required legislative assent, a bill was introduced into the Alberta Legislature to ratify and validate the agreement, which bill has now received its third reading.

About three years ago the Federal authorities granted to Mr. G. W. Farrell, Edmonton, water rights with a view to developing power for Edmonton. Associated with him was Sir John Jackson, of Sir John Jackson, Limited, London, England. Sir John Jackson, Limited, it is understood, has been awarded a contract for the dam and power house. An electric railway is also to be constructed to the site of the dam. The charter for the railway was granted by the Federal House this session to the Edmonton & Southwestern Railroad. The power line from the generating source will be brought down to the south side of the Saskatchewan River.

Telephone Progress in 1915

The Department of Railways and Canals have just issued their annual report on telephone statistics of the Dominion of Canada for the year ended June 30, 1915. The statistics show that reports were received from 1,396 units during the past year, as compared with 1,136 in 1914, and in every respect the returns disclose marked growth in the telephone interests of the Dominion. The number and character of the various organizations which made returns for the year are shown in Table 1.

The total capitalization of the telephone business in 1915 reached a total of $74,284,991, including the Bell Telephone Company, which accounts for very nearly half of this amount. There were 533,090 telephones reported as being in use in 1915—an increase of 11,946 for the year. This, the Department estimates, averages one telephone to every 15.1 persons. Of the total number of telephones, 313,225 are operated by central energy, and 219,865 by magneto—the latter in rural districts and villages. There were 15,072 persons in the employ of the telephone companies on June 30, 1915, as compared with 16,799 in the previous year.

Table 1

Province	Government.	Municipal.	Stock.	Co-operative.	Partnership.	Private.	Total.
Nova Scotia			29	83	3	8	123
New Brunswick			16	6		4	26
Prince Edward Island			4	22		1	27
Quebec			54	58	2	31	145
Ontario	1	50	148	209	21	63	492
Manitoba	1	5	6	15	2	9	38
Saskatchewan	1	5	310	204			520
Alberta	1	1	5	3			10
British Columbia		1	11	1		1	14
Yukon			1				1
Total	4	62	584	601	28	117	1,396

The various organizations which go to make the total of 1,396 mentioned above are classified as follows: Government, 4; municipal, 62; stock, 584; co-operative, 601; partnership, 28; private, 117.

The contract for the 550 kw. generator and the exciter for La Compagnie Hydraulique de Portneuf, P. Q., has been awarded to the Electrical Machinery Company of Minneapolis, Minn., while the cables and accessories will be supplied by the Engineering Company of Canada, Montreal. The power house will be constructed by Archambault & Conway, Montreal. The plans for this development on the St. Ann's River, Portneuf County, were drawn up by Mr. De Gaspe Beaubien, Montreal.

Striking Photo of 300,000 Volt, 200 Cycle Arc

The reproduction herewith is a photograph of an electric arc taken at the Peterboro factory of the Canadian General Electric Company, by Mr. R. B. Carson, of the Transformer Engineering Section. The arc was made at approximately 300,000 volts, the transformer being excited from a 200-cycle source of supply. In order to spread out the arc, a ⅝-inch brass rod was used for the lower part of the gap. This rod and its support, are dimly visible in the photograph.

The upper part of the arc terminates in a hand-made brush composed of several small copper wires twisted together.

The main interest in the photograph attaches to the filmy appearance resulting from the separate impressions made by each individual half cycle discharge, and keeping in mind the frequency of the circuit used, it is interesting to count these separate discharges inasmuch as the circuit was opened by hand, the instant that the arc was established. The small "pocket" showing near the top of the photograph, is also of especial interest in that the separate discharges appear to have evaded some foreign particle or pocket of gas, in the air.

Have Reached Agreement

Following the suggestion of the Quebec Public Utilities Commission, the Montreal Electrical Service Commission and the various power and other companies interested in the underground conduit system, have come to a satisfactory agreement as to the construction of single and double manholes.

It will be recollected that the Utilities Commission held several meetings at which evidence and arguments were heard on the question as to the safety or otherwise of common manholes where high and low tension cables are laid in the conduits. It was contended by the objecting companies that the common manhole was a source of danger. Following the hearings the law was amended giving the Commission authority to approve of the use of common manholes for low and high tension wires.

With the object of securing by mutual agreement a system which will meet the needs of all the parties, and of saving unnecessary expenditure—the cost of the entire work is borne by the companies—the Commission proposed a conference of all those interested. The Commission at the same time intimated that "it may be quite necessary at certain places to have separate manholes, without establishing any general rule, and that it is quite obvious, to a great extent, that a system of common manholes is reasonably safe and much more economical."

The Electrical Commission and representatives accordingly met, and after discussing plans 6 and 7, for down-town districts, agreed that where there are more than four signal cables double manholes will be constructed; in other cases, single manholes will be installed.

The Public Utilities Commission held a sitting on April 20, when representatives of the companies were requested to make objections to plans 6 and 7. The companies had previously been requested to file any agreements and failing agreements to submit written statements as to their contentions. At the hearing all the companies were represented but no objections were raised to the plans as amended.

Worlds Greatest Telescope at Victoria

For a considerable period, at any rate, British Columbia scientists will enjoy the distinction of possessing the world's largest telescope, which will shortly be installed in the new Dominion Government Astronomical Observatory being erected on a summit of Little Saanich Mountain, seven miles from the Capital. A model of this wonderful 72-inch Reflecting Telescope and 66-foot Revolving Dome, constructed one-tenth actual size, was exhibited by the builders, The Warner & Swazey Company, Cleveland, Ohio, at the Panama-Pacific International Exhibition at San Francisco, where it attracted much attention. The Warner & Swazey Company made the mountings for the 40-inch Yerkes telescope, the 36-inch Lick telescope, and the 26-inch telescope of the United States Naval Observatory.

The McAlpine Robertson Company, Ltd., Vancouver, contractors for the building and concrete work, made a start on the foundations early in July last. Many difficulties had to be overcome owing to the inaccessibility of the site, but they were dealt with successfully and a good rate of progress was maintained. The massive reinforced concrete piers for the telescope were completed early in November, and construction has now reached the point where the dome commences. The building is 66 ft. in diameter, with steel frame; the height up to dome is 40 ft., and height over all 75 ft. The steel frame is being covered with galvanized Toncan (rust resisting) sheet metal. The foundation floor is a slab of cement three feet in thickness resting on solid rock, and capable of supporting many times the weight of 260 tons which will represent the finished structure.

The revolving dome was designed and is under construction by the Warner & Swazey Company, together with the mountings. The dome is of the same diameter as the lower portion of the building, with a double shutter having an opening of 15 feet, and provided with an elevated observing bridge, as shown in the illustration. Both the dome and the observing bridge will be operated by electric motors.

When the observing floor is finished the piers shown in the illustration will show above its surface. They are set true north and south parallel with the earth's axis. The telescope itself will correct any deviation if such exists. The reflector will be mounted upon an axis parallel to the earth's axis, extending from the one pier to the other.

The instrument will weigh sixty tons. The tube, which will be 30 feet long and more than 7 feet in diameter, will weigh 12 tons. The principal speculum, or mirror, is a disc of Belgian glass 73 inches in diameter, 12 inches in thickness, and weighing approximately 2¼ tons. The tube and the declination and polar axes with their attachments weigh 35 tons, and each part is so designed and constructed that the powerful driving clock, operated by electricity, will revolve this immense weight with such accuracy and uniformity that the spider line in the eye-piece of the pointing telescope attached to the great tube can be kept exactly on the centre of the star in observation. Quick movement of the telescope, both in right ascension and declination, will be by means of electric motors.

The optical parts for the reflector were made by the John A. Brashear Co., Ltd., Pittsburg, Penn.

When used as a Cassegrainian instrument a second reflector 19 inches in diameter is placed near the outer end of the tube for reflecting the rays back through a hole in the speculum, 10 inches in diameter, to the great spectroscope attached to the tower end of the tube.

As a Newtonian instrument the secondary reflector will be a flat mirror placed at 45 degrees for reflecting the cone of rays at right angles into the photographic or other apparatus at the outer edge of the tube.

When the instrument is used in prime focus no secondary reflector is employed, the prime focus being at the extreme outer end of the tube, where photographic, spectroscopic and other apparatus may be attached. Visual observations may also be made with any of the above described combinations.

Cost of Developing Electric Power at the Municipal Plant of Stettler, Alta.

By Arthur J. Cantin

Electrical men are always interested in knowing what the cost of power per kw.h. is in a small generating station. The writer had an opportunity to investigate this, on a recent visit to Stettler, through the kindness of Mr. H. Baron the town electrician and engineer, who has kept accurate records since taking charge of the plant.

Stettler is a typical prairie town of approximately 1,600 inhabitants scattered over a moderate area, having good business buildings and private dwellings. It has a number of grain elevators, a flour mill, a cigar factory, and other small industries.

Previous to August 1915 it had only a night electric service, but since that date they have a 24-hour service. The load-factor in a town of this size is of course very low and we could not arrive at anything definite. It is somewhere close to 35 per cent.

The engine is larger than it should be for economical day operation, a 40 or 50 hp. engine would be desirable, but as is the case in most towns in Western Canada since the war it is a difficult matter to finance any extension. The present 200 hp. Robb compound engine is doing duty day and night without giving any trouble.

The cost of coal, labor, and oil for the year 1915 is as follows:—

Coal	$4,100.00	
Labor	2,295.00	
Oil	160.00	$ 6,555.00
Fixed charges:		
Int. on debentures	1,500.00	
Insurance	509.00	
Depreciation	673.00	
Administration	646.00	3,328.00
		$ 9,883.00
Total output of plant in kw.h.		130,000.00
Cost of production per kw.h. in cents		7.60
Revenue from street lighting		1,920.00
Total revenue		10,540.00

Good quality of lignite coal costs, delivered, $2.85 per ton. The charge to the public for light service is 18 cents per kw.h. with a discount of 10 per cent. for prompt payment. For power there is a sliding scale down to 7c per kw.h. The cost of 7.51c per kw.h. is high, but taking in consideration the size of the plant and the load factor it is not exorbitant. There are three men operating this plant; the chief engineer, who is also town electrician, operates the plant for about four hours a day. The balance of his time is taken up in connecting new installations, repairs, renewals, and looking after the business in general. The two other engineers work 10 hour shifts.

It will be seen there is no depreciation set aside for repairs, etc., all repairs and renewals being taken out of current revenue, a practice which has proven detrimental to good management in a number of towns in the west. The majority of council members however seem to think that if they can make a good showing for the two years they are in office that is all they are concerned with. Some of the plants show great evidence of neglect, both in operation and maintenance. This practice is regrettable, but until some legislation is passed correcting this evil nothing much can be done. In Northern Alberta there is only one plant which is privately owned; the balance are owned and operated by the municipalities.

Saskatoon Installing Motor-Converter

The city of Saskatoon propose building a small addition to their power house during the early summer, to accommodate a new motor-converter and electrically-controlled switchboard. The converter is being supplied by Messrs. Bruce Peebles, of Edinburgh, and the switchboard by the Northern Electric Company, of Winnipeg. Tenders for the necessary cable will be called shortly. The city of Saskatoon have recently reduced their rates from 4 cents to 2¼ cents per kw.h. as a means of increasing the summer load. With this in view the city is co-operating with the local dealers in educating the public in the use of household appliances.

Society for Electrical Development

The fourth annual meeting of the Society for Electrical Development, Inc., will be held May 9th at its executive offices in the United Engineering Societies Building, New York. The Board of Directors for the ensuing year will be elected. An ammendment to its by-laws will also be voted upon. General Manager J. M. Wakeman will read his annual report of the Society's activities and also outline the extensive plans for "America's Electrical Week" campaign, this fall. It is highly encouraging to the supporters of the Society to find that the "Electrical Prosperity Week" campaign, the "Wire Your Home" Month campaign, and its regular activities has yielded a large number of new members, especially central stations and dealers. The Society has some very big plans under way for similar movements which have not been announced.

Montreal Aqueduct Power Scheme

Plans are being prepared for the new power house in connection with the Montreal aqueduct scheme for the hydro-electric development. Part of the power will be used for pumping for the waterworks and the balance for street lighting. This is the scheme which was opposed by the Council of the Canadian Society of Civil Engineers on the ground that it was unnecessary and extravagant. Controller Cote has promised that the plans shall be submitted to engineers before any expenditure is incurred.

City of Kamloops Hydro-Electric Plant

Detailed Description of Engineering and Economic Features of Power Generating and Pumping Systems of this Growing Western Centre

By H. K. Dutcher, M. Can. Soc. C. E.

Transmission Line (Contd).

The three phase circuit conductor is No. 2 aluminium seven strand, steel core cable, supported on lock pin type No. 319 brown glazed insulators. A telephone circuit was carried along under the power circuit with direct connection between the generating station and the city plant. The construction of the line was carried out by Tully R. Cornick, and the most of the line material was furnished by the Pierson Roeding Company, of Seattle.

Sub-Station, Steam Plant and Pumping System

The power line from the Barriere plant is brought across the South Thompson to the steam plant building, located near the river at the eastern limits of the city. The main building is of reinforced concrete construction and is about 90 x 75 feet in ground area. It is divided into three bays, consisting of boiler room, turbine room and high tension sub-station. In the basement at the extreme west end is located a reservoir from which the waterworks pumps take their suction. This basement also contains the condenser and condenser auxiliary. The basement under the turbine room is on the same level as the boiler room floor and the well for the pumps is connected by some six hundred feet of 16 in. mains to the pump house at the river's bank.

The architectural features of the building have been carefully thought out in order to furnish a substantial structure with ample lighting and good ventilation. The roofing over the boiler room is supported by trusses, while that over the turbine room and switchboard is supported by deep web I-beams. The horn gap structure for the high tension lines allows them to come in through the roof cones, well within the confines of the plant.

The reservoir into which the water is pumped is located in the Beckman addition, about a mile away from the plant. There are large mains leading to it with frequent laterals for supplying the various sections of the town. When water is being drawn from the laterals, the head under which these pumps operate is somewhat modified, but it is usually kept within from 320 to 340 feet, depending upon the quantity of water being taken out of the system.

The discharge from the waterworks pumps is measured by a Simplex Venturi meter, located just outside of the building wall, the recording and integrating apparatus being placed in the corner of the turbine room.

Main Plant Equipment

The boiler room contains four Babcock and Wilcox water tube boilers of 250 h.p. each, and are arranged so that the superheaters can be later added should conditions of operation warrant their installation. The boilers are supplied with shaking grates for hand firing and can be readily converted to oil fuel. The coal fuel which is used at the present comes from the mines in bottom dump cars and is hauled in over the main line of the Canadian Pacific Railway. It is dumped from an overhead spur into the furnaces. The ashes are raked from under the grates into the boot or hopper of a motor-driven conveyor elevator of the endless chain type. This conveyor then discharges the ashes from within the boiler room to a point forty feet east of the boiler room. From the ground storage the ashes can be carted away or otherwise disposed of.

The boilers are served by a brick flue, with reinforced concrete cover, leading to a reinforced concrete smokestack or chimney 89 inches in diameter and 180 feet above the boiler room floor line. The chimney is heavily reinforced with 5/8 in. steel rods and is of the tapering or coniform type. This type of chimney readily lends itself to construction of a stable character, providing a large base and pleasing lines.

The generating equipment consists of two Curtis turbo-generators of 600 kw. capacity each, and operate at 3,600 r.p.m. They are wound for 2200 volts, 3 phase, 60 cycle. The governor mechanism operates six inlet valves, giving very close speed regulation. Each unit is supplied with electric speed unit changing device and with an over-speed safety trip. The speed of the turbo-generator is thus controlled by the switch operator, materially facilitating the paralleling of the machines at time of bringing a machine on to the line.

Excitation is provided by means of one 20 kw. General Electric motor generator exciter running at 1,200 r.p.m. For breakdown service and for starting, a 15 kw. Curtis steam turbo-generator exciter is provided.

Auxiliary Pump House

The auxiliary pump house, located out on the river, contains two vertical centrifugal pumps operated and driven by vertical motors, which are above the highest possible known water level. This pump house is constructed of concrete, and so arranged as to admit water to the inside of the house through long intake pipes connecting the house with a screened inlet located in the middle of the river. The inlet pipes terminate in gate valves hand operated from the motor floor level. These pipes discharge into a separate chamber

Fig. 4—Intake Dam, Hydro Plant, Kamloops, B. C.

in which a secondary double system of screens are installed which prevent to a large measure foreign matter getting into the system. Beyond these screens there has been constructed provision for stop logs which will serve as an auxiliary means of permitting access to the pumps for cleansing or repairs, should anything prevent the use of the main gate valves for the purpose of shutting off the water.

The pump house is of concrete, heavily reinforced throughout. The water comes through grizzlies or screens into the base of the pump house, and is there handled by the vertical centrifugal pumps. These discharge the water through the 16-in. main above mentioned.

The pumping system is so arranged that the filter beds can be later constructed in the space between the auxiliary pump house and the main pump house. These filter beds are to be of the gravity type and of such elevation as to allow the discharge from the auxiliary pump house to run through the filter beds and then by gravity to the reservoir in the basement of the pump house.

The pumps at the auxiliary pump house are operated from the main switchboard, one of them being operated by standard hand operated starter and the other by an automatic patent starting device controlled by a float switch. This device maintains the water in the res rvoir forming the suction chamber for the main pumps at a given level. It is found that by proper regulation of the inlet valves this automatic pump is kept in practically uniform service though its arrangement will permit of its starting and stopping to automatic control at the level in the reservoir.

Waterworks Equipment

In the waterworks department there are supplied two Platt two-stage centrifugal pumps of the horizontal split casing type, fitted with bronze runners and arranged for motor drive. These pumps have an efficiency of 68 per cent. and are driven by two 200 h.p. 1,760 r.p.m. induction motors. The third pumps in the waterworks department is a steam-driven unit.

These pumps are piped into the main system so that they can all be operated at once, though it is estimated that one of the pumps in continuous operation on twenty-four hours service will supply the requirements of the city for some time to come. The large reserve pumping capacity in this case is considered advisable in order to take care of any possible contingency that might arise in connection with fire protection in the business section. These pumps are each capable of handling 1,200 Imperial gallons per minute against a head of 330 feet.

The Condensing Equipment

The turbines exhaust through corrugated copper expansion joints into cylindrical surface Wheeler condensers equipped with steam turbine driven circulation pumps and Edwards patent suction valveless air pump.

Switchboard

The plant is served by an elaborate switchboard of natural slate, consisting of twenty-two panels. The board is of neat design and when lighted up presents a very fine appearance. All high voltage connections on switchboard leads which would prove dangerous to the operators are on a structure some distance to the rear of the switchboard and operated by remote control. There is no apparatus actually on the panels at a potential above 110 volts.

The switchboard consists essentially of a station lighting panel box for distribution of station lighting, two generator panels with blank panel for future generator, two station power panels and two incoming high tension line panels. The balance of the panels are feeder panels.

At the extreme end of the board are located the constant current panels for control of the constant current tube on the series arc lighting system of the town. There are provided all the necessary curve drawing instruments for keeping proper record of the load. The voltage on the system is controlled at constant voltage by a Tirrell automatic voltage regulator.

Behind and above the switchboard, suitably partitioned off from the balance of the equipment, is the high voltage apparatus for the incoming high tension lines from the Barrier water power development. This consists essentially of the oil switches, aluminium lightning arrester and static transformer by which voltage is reduced from the incoming line at 44,000 to the distribution system at 2,200. Under the transformer is provided suitable oil tanks and paper piping to serve the proper cooling and intercooling of the oil in the transformer.

All high tension wiring has been put in with copper tubing suitably insulated and there are installed suitable selecting switches by means of which either side of the double transmission line can be thrown into service.

The Steam Piping

The general arrangement of the piping system can be seen from the reproduction of the interior of the plant. The boiler branches leading from the four boilers are double valved, being provided with automatic steam stop and check valves at the boiler nozzles and a double wedge gate valve at the header. The header is carried on the boiler room side of the partition between the boiler room and the tur-

Fig. 5—Flume System, Hydro Plant—Kamloops, B. C.

bine room and the branches to the turbine are brought through openings left in the concrete wall. Gate valves are placed on each turbine branch. An auxiliary header is installed within the turbine room, from which branches are carried down for operation of the air pumps and circulation pumps.

The atmospheric exhaust connection after leaving the atmospheric relief valve is of riveted galvanized iron and is carried through the partition wall into the boiler room and discharges above the boiler room roof.

Engine Room Crane

In order to provide means for readily handling all parts of the power plant machinery a ten-ton hand operated travelling crane has been provided which runs over the entire turbine and pump room. By this means any of the machinery can be readily transmitted for the purpose of inspection or repairs. By means of transfer cars the transformers can be wheeled out under the crane to facilitate handling their cores for inspection or repair should occasion demand.

Contracts

The construction of the main building and pump house was carried out by Messrs. Johnson & Gill, of Kamloops, and the installation of the complete plant equipment was carried out by Messrs. C. C. Moore & Company, of Seattle, and included turbines, units, motors for pumps, and complete switchboard equipment supplied by the Canadian General Electric Company.

Reservoir

The new reservoir has a capacity for 1,500,000 Imperial gallons and is located south of the eastern part of the city, between Eighth and Ninth Avenues at an elevation of 30 ft. head above the river. The 14-in. steel main running up

Ninth Avenue connects westward with the old power station through the city distributing system, and eastward through a 14-in. and 16-in. main with the new power and pumping station. This main is lapwelded with Matheson joints and in addition to the regular coating has an extra wrapping of burlap as a protection against the strong alkaline action of the soil peculiar to the district.

The design decided upon was a totally enclosed reinforced concrete type with interior dimensions 160 x 96 feet, and a depth of water of 15 ft. 6 in. at the eastern end. The roof consisted of a four-inch slab resting on a beam work supported on square columns 16 ft. centres each way. The floor has a slope eastward of one foot in its length, and as the columns were all the same length the roof had a similar grade.

The first layer is 4½ in. and was poured before any forms were erected, and had embedded in it No. 26 mesh. After the forms had been removed the final layer 4 ins. thick of selected materials was put on without any particular bond with the first floor beyond carefully washing it down. No mesh was laid on the final layer and ⅜ x ¼ in. "V" joints were left about ten feet from the walls after each day's work. This floor and the wetted area of all walls, which were purposely left rough, was given a plastered coat of 1:1½ well trowelled in, on which was put a glazed finish of neat cement and water. The "V" joints were then poured with hot asphalt. Expansion joints divide the walls vertically into sections about 32 feet long. These were formed by allowing no special bond between sections, apart from a dovetail and a 16-in. gauge copper strip with a ½ in. "V" notch across the joint.

All reinforcement was lapped at least thirty diameters to form the splice. Concrete 1:2½:5 mix was used in the rough floor and all footings, and 1:2:4 mix elsewhere, excepting the plaster coat of 1:1½.

On September 24th, 1911, the reservoir was put into permanent commission. The wisdom of putting in the expansion joints was apparent as cracks soon appeared in the walls, which were in every case isolated at those joints and rendered harmless by the copper strip and subsequent plaster coat. An examination six weeks later showed no traces whatever of leakage, all drains being perfectly dry.

Fig. 6—66" Wood Stave Pipe Syphon, Kamloops Power Plant.

Economics of the Power Plants Systems

On the completion of the above projects the total expenditure was found to be about $550,000, of which $295,000 would be chargeable to the hydro-electric plant, $130,000 to the steam plant and $135,000 to the waterworks system, including the pumping plant and reservoir.

Hydro-Electric Plant

An additional expenditure of $25,000 was made on the hydro-electric plant for the construction of the syphon on the flume system, and the overhauling of the flume after the two years' delay in completing the plant, and all or part of this should be charged to annual maintenance. This charge added to the capital cost would bring the expenditure of the hydro-electric plant to $320,000, or $160 per h.p. installed.

The cost of the transmission line and sub-station plant was $90,000, so that the capital cost of power at the generating station is $115 per h.p. With another 2,000 h.p. unit installed, however, the capital cost per h.p. will be reduced to about $85 at the generating station and $110 for the power delivered to the sub-station. In view of the fact that the greater part of the plant system is already built for the full development, the cost of development for h.p. through the life of the plant is more accurately represented by these later figures.

For a small development the capital cost is, therefore, low, and the cost of maintenance of the plant appears to well justify the venture, especially in view of the purpose of the development to not only supply the city with cheaper power, but also to obtain a better development of the farm lands in the district by supplying power at a low rate for irrigation.

The annual charges on the plant are estimated for the 2,000 h.p. at $22 per h.p. or on the kw.h. basis the cost at 30 per cent. load factor is 1.1 cents per kw.h. at 50 per cent., .7 cent per kw.h., and .5 cent for 70 per cent. load factor.

Combined Plant

Since, however, the hydro-electric and the steam plant are designed as a combined system for the generation of electric power, the economics of the combined power plant system should be considered in relation to the economics of a steam plant without the hydro-electric and if favorable to the hydro-electric plant under the initial conditions of only a 2,000 h.p. installation at the Barriere plant the conditions will be naturally much more favorable when four or five thousand h.p. is obtained from this plant.

In the operation of the two plants as a combined system it is assumed that, for a while at least, the steam plant will be operated on an average of six hours per day throughout the year. This average includes the continuous operation as a reserve when the hydro-electric may be shut down for several weeks in the winter, and also during the periods of heavier peak on the system when the operation of the steam plant may absorb the peak.

The capital cost of the combined system as completed for 4,000 h.p. will then be $114 per h.p., and with a 30 per cent. load factor on the system, the cost per kw.h. is estimated to be nine-tenths of a cent and for a 50 per cent. load factor six-tenths of a cent.

The accompanying curves will clearly indicate the downward movement of the costs per kw.h. as the load factor increases, and the point where the cost curve of the combined system crosses the cost curve of the stem plant is of particular interest. It will be observed that this point is passed when the average daily load on the system is 10,000 kw.h. or 3,650,000 kw.h. per year.

Steam Plant

A study of the economics of the steam plant was made on the basis of the cost of fuel at one cent per kw.h., this being as near as could be determined the cost of oil for fuel delivered to the plant. The cost of coal is slightly higher, about 1 1 cents per kw.h. using the Nicola coal at $1.20 per ton. On this basis and including all charges, the annual cost per h.p. for a 30 per cent. load factor is placed at $30.50, which corresponds to about 1.5 cents per kw.h.

For a 50 per cent. load factor the annual cost per h.p.

on the same basis would be $43.20 and the cost per kw.h., 1.3 cents. On the basis of total kw.h. production it will be noted on consulting the charts that the cost of power from the combined system becomes cheaper per kw.h. produced only after the daily demand passes the 10,000 kw.h., and this point was passed over a year ago.

Market for Power

As already noted, the recent rapid growth of the city of Kamloops appeared to justify a comprehensive scheme of construction for electric power and water supply systems, which could be extended or developed from time to time along a definite plan as the conditions would warrant.

The double tracking of the C. P. R. and the construction of the C. N. P. Railway down the North Thompson, promised also a development of the surrounding districts and a demand for power for irrigation.

It was estimated from the application for power that the city would obtain a power load along the route of the transmission line of at least 1,000 h.p., and a contract was made with the Iron Mask Mine a few miles out of the city for 600 h.p.

Power rates for irrigation loads were arranged to average about 1½ cents per kw.h. and the accompanying charts were drawn per season according to the head and other conditions noted therein.

For example, reference to Curve 6, Chart 5—132 shows that on the basis of a duty of one acre foot and 12-hour service at one cent per kw.h. plus a fixed charge of one dollar per h.p. per year, the motor required for 100 acres at 60 feet lift would be at 14 h.p., or say 15 h.p., and from curve 5 the cost per acre per season would be $2.90.

All the curves or charts accompanying this paper are worked out as far as possible on a unity basis, to afford easy correction for varying conditions.

Operations of the Systems

A paper on any power plant system seems hardly complete without some reference to the organization for the management of the system, and this applies with particular force in the case of municipal systems.

During the construction of the several projects herein described the city of Kamloops was fortunate in having a strong Mayor, and the co-operation of the Mayor and Councils with the consulting engineers, together with the able assistance of the city officials, enabled the construction of the works to be carried out with a degree of smoothness and success not usually in evidence on municipal works.

It was recognized, however, that the ultimate success of the power plant system would depend a great deal upon an efficient organization and business-like management, and recommendations were made that the entire system be placed under the control of a commissioner or general manager who would combine the requisite qualifications of engineering experience and business ability with comparative freedom from municipal politics.

Engineering

The engineering of the several projects included in the systems described and which were intended to form a complete scheme for future development was carried out under the direction of the writer as Consulting Engineer, and his firm, Messrs. Ducane Dutcher & Fergusson, ably assisted by members of the staff, including Messrs. N. M. Hall, W. E. McLean, and H. A. Daubner.

Electrical Development in Australia

An Interesting Review of the Conditions Surrounding our Far-off Cousins—Mr. C. G. Calman Describes Recent Progress before I. E. E.

Although electrical undertakings throughout Australasia may not have developed as quickly as those in some other countries, there is no doubt that they have expanded much more rapidly than the various communities which they serve. The larger cities have supply systems owned either by companies or by the municipalities themselves; and many of the municipalities adjacent to those owning power stations have entered and are entering into contracts to take a supply in bulk in order to distribute electrical energy within their own boundaries.

The last few years have seen a large number of small plants installed primarily for country-town lighting. These usually have a few motors connected to the mains, but up to the present the majority have had to rely upon the lighting load for the bulk of their revenue. Such plants are nearly always continuous-current installations with a secondary battery, and the prime-mover is frequently a gas engine, running sometimes upon town gas, or more often upon producer gas. The supply pressure is usually 220 to 240 volts two wire, or three wire with 440 to 480 volts across the outers. Unfortunately, some country towns wishing to install such plants are hampered by the absence of proper State legislation. All the States in Australia are not on the same footing in this respect, in that some have an Electric Lighting Act. In Victoria, for instance, such an Act is in force, and these small town installations have been completed in large numbers. On the other hand, New South Wales has no such Act, in spite of the representations which have been made from time to time to the Government by persons interested in the electrical industry.

Although this paper deals mainly with power plant, a few words about general illumination may be of interest. The introduction of the metal-filament lamp has, of course, had the same effect in Australasia as in other countries, and the so-called half-watt lamp promises to revolutionize lighting practice in certain respects, just as the one-watt lamp did some years ago. The maintenance of arc lamps under the prevailing conditions, apart from the high cost of labor, makes certain the general substitution of the nitrogen-filled lamps for the arc lamp.

The expansion of electric tramways during recent years has been in keeping with the growth of population. It is of interest to note the work in hand for, and proposals concerning, the electrification of railways. The most important of these, and that for which construction work is already commenced, is the electrification of the Melbourne suburban railways. This will be one of the most important steam-road conversions that has so far been undertaken in any country, and it is estimated that the completion of the work as contemplated at present will take fully three years. The proposed electrification of the North Shore line in Sydney, and the Sydney Underground Railway and North Shore communication scheme, will be projects which are likely to be developed at an early date and promise to be large undertakings. The Tasmanian Government Hydro-electric Development will possibly introduce electric traction on railroads. In New Zealand the Lake Coleridge Hydro-electric Development will probably supply the electrified section of the East and West Coast Railway where it passes through the Otira Tunnel, some five miles in length, which is now under construction. The matter of electrifying the Christchurch-Lyttelton Railway, which passes through a lengthy tunnel, is also under consideration. These few examples are intended merely to give some idea of the work in hand and under contemplation as far as electric traction is concerned, and are not put forward as a complete statement of such schemes.

Australian Electric Supply Systems

The mainland of Australia is in a very different position from Tasmania or New Zealand as regards water power. The latter have large numbers of streams or lakes which are admirably adapted for generating electric power, whilst the few isolated waters on the Australian Continent are of limited possibilities and are situated at too great a distance from the main distributing centres. This is so marked that the Sydney (N.S.W.) Municipal Council, which at present has the largest municipal electrical load in Australia, recently had under consideration the purchase of a coal-mine anywhere within a radius of 50 miles of Sydney, the idea being to transmit to Sydney electrical energy generated on the coal-field, instead of bringing coal to the generating station in Sydney as at present. Taking into account that the bulk of the power used in New South Wales is used on the coast line and within a comparatively short distance of the various large groups of coal mines, and also in view of present-day developments in long-distance transmission and the perfection of e.h.t. apparatus, it seems only reasonable to assume that within a comparatively short time the New South Wales coal areas will be the sites of large generating stations working in conjunction with one another.

Other localities are not so favorably situated in respect to coal supplies and concentration of load, and will continue with scattered generating stations. Most of the inland towns, as mentioned previously, use suction-gas plants, and as the loads in such places are unsually very limited, this type of plant is likely to be retained. The cost of coal at most of the country towns is prohibitive, and as wood fuel is continually becoming dearer owing to the exhaustion of near-by supplies, the suction-gas plant, operated upon coke or charcoal, shows to advantage for such work.

If small alternators could be operated satisfactorily in parallel when driven by single-cylinder gas engines, this would permit of an alternating-current supply in certain cases where it might be advantageous. Numbers of small towns operate their pumping plants by electric motors, and more would be permitted to do this, or be able to do it more economically, if the supply voltage could be efficiently stepped up or down. Although continuous current is generally best suited to the requirements of the country towns, the driving of alternators in parallel by internal-combustion engines of a less costly type than the multi-cylinder engine would be the best solution in some instances.

There are some mining districts in Queensland and elsewhere which might to advantage be provided with electrical energy from large central stations. Such arrangements may be expected when the mines to be served are further developed and more improvements have been made in long-distance transmission apparatus. The absence of water power makes such schemes dependent upon coal and wood fuel or coke. In the case of proximity to a coal-mine with coke ovens, gas engines will probably play an important part. The cost of oil fuel is too high and uncertain for such fuel to be used to any considerable extent in Australia.

In New Zealand and Tasmania the Government hydro-electric schemes will supply large areas. In the former country the development of a number of head waters was decided upon a definite yearly capital appropriation fixed for such development. The first of these schemes, that of Lake Coleridge in the South Island, is now completed, and it is to be hoped that the results will prove a strong incentive to push ahead with the programme mapped out. In New Zealand the Government is not the only party engaged upon this work. The Dunedin Council have had their plant at Waipori in operation for some considerable time. Several years ago the Ross Goldfields harnessed the outfall of Lake Kanieri, 25 miles distant from their mine, and there has recently been completed the plant of the Waihi Gold Mining Company, which has utilized the Hora Hora Rapids and erected a transmission line about 50 miles long to supply their mine and mill. The Mount Lyall Mining Company have also recently completed their Lake Margaret scheme in Tasmania. Apart from these larger undertakings there are numerous smaller water-power installations supplying various townships throughout both New Zealand and Tasmania, and it is not unreasonable to hope that the near future will see practically the whole of New Zealand and Tasmania supplied from large stations possibly working upon common networks.

As far as electricity in the service of agriculture is concerned, practically nothing has been done up to the present.

Commercial Electrical Work

Under this heading it is proposed to note a few aspects of Australasian conditions from the point of view of the electrical contractor, and not so much from that of the manager of a supply undertaking. The majority of the electrical plants installed in Australasia are imported. It might almost be said that the whole of it is imported, as at present there is really only one firm in Australasia which attempts generator and motor manufacture. There are, of course, numerous small workshops which make up switchboards from imported parts, and which construct various small electrical appliances, control gear, heating and cooking apparatus, etc., and carry out repairs; but beyond this there are practically no electrical workshops. The supply of electrical plant and goods is therefore mainly in the hands of agents for, or direct representatives of, the electrical manufacturers of other countries. The distance of these representatives from the manufacturing concern creates problems which are peculiar to countries removed so far from the manufacturer.

The most pressing need is for uniformity in the distribution systems. Whilst the want of this might not give rise to much inconvenience in manufacturing countries where machines of small and medium size for any voltage, frequency, etc., could be delivered within a few weeks of the order being placed, such is not the case in Australasia. When a machine is imported it is a matter of months before delivery can take place, and this delay is the cause of a great deal of inconvenience and waste of money. The obvious remedy is for contractors and agents to carry local stocks from which they can give immediate delivery of any small or medium-size machine. The difficulty here arises, however, that if stocks were carried for all the system they would be found extremely large and unprofitable. Consequently only such stocks are carried as are found sufficiently saleable to warrant their existence, and such undertakings as are unprovided for by these have either to carry their own stock, keep stand-by machines, or put up with long delivery periods.

The demand for continuous-current machines is mainly for pressures between 220 and 240 volts, or 440 and 480 volts. In the case of alternating-current supplies, practically only 50-cycle systems are catered for from stock, but both single-phase and 3-phase motors are required. As regards single-phase, the voltages are 200/400 volts 3-wire. The 3-phase demand has been created mostly by 415-volt systems. It is to be hoped that no more single-phase systems will be installed for power supply. If the above pressures were universally adopted it would tend towards better conditions for both suppliers and users of electrical plant.

Despite a high tariff on all electrical machines and the further preference given by some of the Government Departments to Australian products, the local output of machines has been exceedingly small, and also restricted as regards size and variety of types. The great difficulty in machine construction, as well as in many other businesses throughout Australia, is in obtaining suitable labor at a reasonable wage; and even when secured, the industrial disputes, which are so rife, have to be contended with.

The manufacture of panel-type switchboards presented a different aspect from that of machine manufacture until quite recently. The tariff provided a duty of 20 per cent. on complete switchboards, and no duty on instruments, switches, etc., of United Kingdom manufacture. This arrangement, coupled with the high cost of sea freight on complete switchboards, and the extra packing costs, risk of breakage, etc., prompted the local construction of switchboards from imported parts. Suitable marble and slate could be obtained from importers and merchants at satisfactory prices, and the concerns undertaking switchboard manufacture could usually compete easily with imported switchboards. It should be understood that these remarks apply only to the more simple switchboard work. Complicated, large-capacity, or extra-high-tension alternating-current switchboards have necessarily been imported complete, as none of the local shops are laid out to handle such work. Quite recently the tariff on individual switchboard parts has been altered considerably. For instance, switches, fuses, circuit breakers, etc., which previously were free of duty if made in the United Kingdom, are now dutiable at 20 per cent. even when imported separately. The effect of this will be to place the local workshops at a disadvantage, as there is now a smaller difference than previously in the amounts of duty payable on component parts and on complete switchboards.

With regard to specifications for plant to be installed in this country, there are a few points of importance which are not always recognized, although their general recognition is more marked latterly. One of these is the high atmospheric temperature obtaining in Australia, and especially in Queensland, the Northern Territory, and the inland districts of all States on the mainland. How absurd is a reference to air temperature of 25 degs. C. for, say, Queensland, can be appreciated when it is remembered that maximum shade temperatures of 110 degs. F. (43 1/3 degs. C.) are common and are sometimes exceeded. Although it would be unreasonable to expect such a high figure for an international reference air temperature, the necessity for the abandonment of 25 degs. C., and possibly even 35 degs. C., is apparent. A point worthy of note is that engine-room temperatures are usually above the outside shade temperatures in any locality, except where special building designs and ventilation are employed. On this additional score it seems advisable that the reference air temperature should be raised above 35 degs. C.

Non-corrodible brush-gear and damp-proof insulation are features which are not merely desirable but absolutely necessary for many situations.

Installation and Maintenance of Plant

The conditions affecting the installation of plant in Australasia are at times unique. The purchasers may elect to erect the plant altogether at their own responsibility and cost; the contractor may provide supervision, or supervision and skilled labor only; or the whole of supervision and skilled and rough labor may be provided by the contractor. Again, especially in the case of smaller installation work, a separate contract may be entered into with another contractor for the erection.

A point of great importance in connection with any machine which has been sent overseas is the condition of its insulation before setting to work. This is not sufficiently appreciated in the majority of small installations, and especially in cases where the purchaser carries out the erection. A great number of the machines which come to Australasia suffer a considerable change in the condition of their insulation, and although this may not permanently alter the good qualities of the insulation it is always essential that thorough investigation should be made before the machines are put into service. Insulation-resistance tests frequently indicate a "dead" earth when taken immediately machines are unpacked. This may be due to pockets of moisture or to a general dampness of the insulation, or even to "sweating" over the face of a terminal plate. The trouble can usually be overcome fairly easily by drying out in an oven or by passing current through the windings in the most convenient way. Very stubborn cases are met with now and again, but unless some permanent injury has been done to the insulation, they will usually yield to proper treatment.

Coils with "damp-proof" insulation have been found, after long sea voyages, to be so full of moisture that when the outer insulation was cut or unwrapped, the moisture actually dripped from between the turns. With such a type of insulation it is possible to obtain high resistance readings to earth or between different windings even when the insulation between turns might be extremely low. This type of insulation presents greater difficulty in "drying-out."

The packing of machines in zinc-lined cases for overseas transport is a costly method and really defeats its object. Machines so packed and received in this part of the world show a greater percentage of very low insulation-resistance values than do machines which come out in ordinary cases provided with ventilation holes covered by wire gauze and lined throughout with tarboard. The zinc linings add to the "sweating" which always occurs to some extent, and as they are hermetically sealed this does not improve the condition of the insulation. The ventilated, tarboard-lined cases, on the other hand, allow any deposited moisture to be carried off more or less rapidly and they produce better results at lower cost.

Training Facilities in Australasia

It is of interest to note that the courses provided by the universities, colleges, technical schools, and schools of mines, cater not only for those who enter the broad field of electrical engineering with the hope of attaining eminence in the profession, but also for the mechanic, wireman, etc. The country needs the latter as much as the highly trained technical man.

As Australia and New Zealand are not electrical manufacturing countries there is no demand for the machine designer, or for the machine-assembly and testhouse workmen. Winders are required in small numbers to cope with the repair work which always has to be carried out, and this repair work involves a small amount of machine work as well. Although actual design calculations are not required it is of course necessary for those who have to deal with electrical machinery, either commercially or in operating work, to be acquainted with general machine-design characteristics. A knowledge of the general layout of generating plant, mains, sub-station equipment and distribution networks, as well as of application engineering, embracing the necessary acquaintance with various manufacturing processes, is more frequently required by commercial engineers. This is naturally the case in a country where the commercial engineer has to deal almost solely with the sale of plant and with its operation. He must, however, know the fundamental principles of the design of the machine which he sells, as he frequently has to give advice and information and has not time to refer questions to the works in most cases. Operating engineers must have very similar knowledge, coupled with more particular knowledge of the industry concerned.

The field of the consulting engineer, on the other hand, embraces both that of the commercial and that of the operating engineers. The work of the consulting engineer calls for a long and broad experience; especially broad in countries like those in question, where the conditions are such that a man cannot afford to specialize on one particular process or type of plant.

The training facilities in Australasia are sufficient to provide thorough technical and fairly good practical training for the engineers and artisans that are required. The practical training provided by any university or college course is always largely supplemented by that obtained in the earlier years of actual work; and with the rapid growth of electrical undertakings throughout Australasia the facilities for good practical experience are daily increasing.

High Cost of Gasoline Helps the Electric

Coupled with This Are the Many Advantages of the Electric Car and the Further Fact that Electric Current is Constantly Getting Cheaper

By A. Jackson Marshall

The gasoline situation is very much more acute than is perhaps generally realized, causing considerable worry to the gasoline car people, and it would seem that it presents a unique opportunity to accentuate the economies of the electric vehicle. Most users of gasoline cars heretofore have not bothered about costs, but the soaring cost of gasoline is causing many to think, and investigate the economies of the electric, resulting in increased electric vehicle sales.

It might be interesting to note that there has just been incorporated in the State of New York the United Motor Fuel Corporation of Manhattan, with an initial capital of $25,000, which, however, will ultimately be raised, we are advised, to carry out the project for which the company has been formed, which is to produce gasoline, kerosene, lubricating oil and all by-products of petroleum, not, it is said, for the purpose of injuring the business of the present manufacturers, but to show that the price of gasoline could be materially reduced without the loss of profit. It is reported that the National Automobile Chamber of Commerce, which represents most of the automobile manufacturers of this country, is very much interested in this development.

Simultaneously with the announcement of the filing of the papers of the United Motor Fuel Corporation of Manhattan came a statement from Dover, Delaware, that a corporation known as the People's Engine Products Company, with a capital of $4,000,000, had been formed April 4th, to manufacture, produce and refine, buy, sell and handle in every legal way petroleum, gasoline, gas and lubricating oils.

There are also newspaper reports that some officials of the United States Government favor the government going into the manufacture of gasoline and some crude oil by-products for use by the Navy and other government requirements.

There is also a report that the Pittsburgh Automobile Dealers' Association is overlooking nothing in its campaign for a substantial reduction in the price of gasoline, and have agreed to buy no more gasoline from the Standard Oil Company until its prices are justified.

Innumerable instances could be given which would indicate the very serious situation engendered by the high cost of gasoline. On the other hand, the cost of electricity for charging electric vehicles is constantly being reduced, and the time does seem most opportune to emphasize the inherent economies of the electric.

In an effort to minimize the effect of increasing gasoline cost on users and possible purchasers of gasoline cars, many schemes are being employed by gasoline interests, and the following article appearing in the current issue of the Club Journal (the official organ of the Automobile Club of America, New York) by Mr. Herbert Chase, the club's chief engineer, is interesting.

"The rapid rise in the price of fuel used in automobile engines has resulted in certain apprehension on the part of motorists as to its effect on the general increase in the cost of motoring. Having this fact in mind the Club has recently been accumulating data with the view to determining the exact percentage of increase in car operation due to the rise in fuel prices. A careful analysis of this data reveals the fact that other expenses resulting from the use of motor cars are such as to make the rise in the price of fuel an almost negligible factor in considering total expense. This is said not with a view to disparaging any efforts that may be on foot to minimize waste and decrease the average fuel consumption in automobiles, but rather to show that similar economy in the other expenses incident to motoring may be made to offset the increase in fuel prices. The data given

Table I—Cost Per Month of Operating Large Town Cars

Car	A 38 H.P.	B 51 H.P.	C 38 H.P.	D 32 H.P.	E 25 H.P.	Average	Per Cent. of total
Miles travelled ...	903	883	862	1,005	590	848	
Fuel consumed, gallons ...	141	175	147	121.5	119	140.7	
Cost of Fuel at 30c. per gal. ...	$42.30	$52.50	$44.10	$36.45	$35.70	$42.21	27.6
Cost of lubricants ...	1.59	2.17	.87	2.73	.....	1.45	.9
Tire expense ...	50.91	54.95	39.31	18.78	33.89	45.57	29.9
Insurance ...	29.13	17.14	10.35	13.80	7.47	15.58	10.2
Storage ...	40.00	40.00	40.00	40.00	40.00	40.00	26.2
Supplies, license fees ...	4.14	13.66	3.54	15.36	2.76	7.91	5.2
Total ...	$168.07	$180.12	$138.17	$157.12	$119.82	$152.72	100.0

in the appended table was compiled by an examination of the cost accounts of five town cars used almost entirely for city operation in cold weather when the fuel consumption per mile is at a maximum.

"It is to be noted that the record does not include any charges for depreciation, repairs or chauffeur's wages, three items which, if considered would bring the total cost of car operation much above the figures given. Without considering these items and taking the cost of gasoline at 30 cents per gallon, it has been found in the cases cited that the cost of fuel amounted to less than 28 per cent. of the total operating cost; the other major items being tire expense approximately 30 per cent., storage about 26 per cent., and insurance about 10 per cent. If, without changing the other items, we take the cost of fuel at 20 cents a gallon, the price at which it retailed a few months ago, the ratio of fuel cost to total operating expense is approximately 20 per cent., tire expense 33 per cent., storage 29 per cent., and insurance about 11 per cent. Thus an increase of 50 per cent. in the price of fuel increases the ratio of fuel expense to total expense only 7 per cent.

"If in making a comparison we include an item of depreciation charged at the rate of 20 per cent. a year and other items such as repairs and chauffeur's wages we shall find that the cost of fuel even at 30 cents per gallon is well under 10 per cent. of the total operating expense.

"Looking at this situation from another angle it has been found that the average car operated from the Club garages consumes about 3½ gallons of gasoline per day, this average including, of course, some cars which do not leave the building every day and others which are in almost constant service. An increase in fuel price of 10 cents per gallon would make a difference of only 35 cents per day, or approximately $10.00 per month in the cost of car operation.

"While discussing the subject of fuel consumption, it is well to consider a fact well recognized by all automobile engineers, that the fuel consumption of the average car is fully 25 per cent. higher than it need be if the operator would see that the carburetor is set and kept in proper adjustment. If all car owners would give this fact the consideration it deserves, not only would their own bills be lower, but the average consumption of cars in general would be so much decreased that the smaller demand should operate to decrease the retail price.

Many Causes of Waste

"Another prolific source of waste in fuel is that which results from undue friction in the mechanism of the car, notably at the brakes. In nine cars out of ten the brakes drag to a considerable extent, while those of the other 10 per cent. are seldom in such perfect adjustment that they do not drag at any point. The resultant friction not only increases the fuel consumption by making necessary the development of more power in the motor, but also means more rapid wearing out of the brake lining and brake drums.

"Care should be taken to see that the compression of the motor is not allowed to fall off, due to an accumulation of carbon on the valves or to worm or loose-fitting pistons. By observing these simple precautions the fuel consumption of the average car can be decreased from 10 per cent. to 30 per cent. or even more."

It is interesting to note the second paragraph of the foregoing article, wherein it is stated that the cost record "does not include any charges for depreciation, repairs or chauffeur's wages, three items which, if considered, would bring the cost of car operation much above the figures given." The incomplete information given will be very interesting to compare with electric vehicles capable of performing the same service.

The tendency apparently has been for persons when they have saved up sufficient money to purchase gasoline cars, to immediately lose sight of the investment and forget about depreciation, interest on investment, etc. Furthermore, the average human being does not desire to be reminded of what pleasure really costs, but when the cost of gratifying one's wishes becomes burdensome a halt may be forced and the investigation which may follow might result in the employment of new methods of obtaining recreation. While it may be possible to forget the original cost, yet the gasoline motorist, who every so many miles has to replenish his empty tank with expensive fluid, is forcibly reminded that automobiling may be expensive, and if he also has advices that the item of gasoline represents but a small fraction of the total cost, it is likely that he would prove a fit subject for initiation into the realms of efficient and economic electric vehicle operation.

In the Public Eye

A budget of comment presented in the interest of public welfare, independent of party politics and with malice toward no one.

After eighteen months of silence "Industrial Canada," the mouthpiece of the Canadian Manufacturers' Association, has joined its voice to those of other journals that could not stomach what went on at Ottawa in connection with the letting of contracts for shells and fuses by the late Shell Committee. "Industrial Canada" tells us in its latest issue a few things it knows about fuse contracts and says that eighteen months ago the Canadian Manufacturers' Association went to the Government and tried to make it realize that the "license to loot" ought to be terminated. Their warnings, like those of many of the Government's political supporters were, according to "Industrial Canada," allowed to pass unheeded. So, at this late date, after giving the matter eighteen months of silent thought, the organ of the Canadian Manufacturers' Association, the members of which are both liberal and conservative, comes into the lime-light with its statement of some of the things that have come under its notice.

* * *

I will outline the story told by "Industrial Canada" a little later on, after I have said what I feel about the part this mouthpiece of the manufacturers has been taking. While the making public of this story is better late than never, I cannot help wondering how such a journal can square itself with its own conscience for having kept silence all these months. It seems to me that this is just another example of the weakness exhibited by 90 per cent. of the journals of Canada in failing to do their plain duty. What is a public journal for, if it is not to tell the public some of the plain facts about its public men, especially when the good name of the country is being soiled? When the testing time comes, many of these journals lack the backbone, or the nerve, to speak out. They act the part of Falstaff whose chief maxim was the comfortable idea that "discretion is the better part of valor" and they just keep mum. They wait until the burglar gets away with the swag, and finally, when so much has been filched from the public purse that no one can shut his eyes to it any longer, some of them join in the chase with a great hue and cry.

Why did not "Industrial Canada," in the interests of manufacturers, make its public protest eighteen months ago, when the trail was hot and there was some prospect of getting hold of the culprits before they cleared off with whole skins and a big swag? It was left to this paper—the Electrical News—to make the first protest in the interests of the manufacturers of Canada, and in the interests of clean government and the good name of the people of Canada; and for some time it was left to us also to continue the protest almost alone. The Canadian Manufacturers' Association, through their organ "Industrial Canada," made their protest silently and without effect eighteen months ago. They should have followed this up at that time with a public statement, instead of waiting for eighteen months and watching the continuation of those evils about which they told the government in a whisper.

I do not relish the idea of saying much about my own doings, but I may be excused for pointing out such shortcomings on the part of other journals, and saying, that in spite of my own loneliness all these months, I have felt, and still feel, that I have been doing the Canadian manufacturers and the Canadian public a real service in laying bare some of these ugly truths; a service which the public had a right to expect, the manufacturers especially, from those other journals, and more especially from their own industrial mouthpiece.

* * *

Here is the story of "Industrial Canada," told as briefly as we can put it:—Eighteen months ago the Canadian Manufacturers' Association approached the Government and told them some of the things they knew about the way in which fuse contracts were being given to Americans and refused to Canadians, and what people were saying about it all. "The reception given these suggestions, says Industrial Canada; "was not of a character calculated to invite further co-operation."

"There are limits," Industrial Canada continues, "to the patience of loyal citizens even in war time, and much as we may deplore the disgrace that the fuse scandal has brought publicly home to Canada, and warmly as we may resent the effort to make political capital out of it at a time when our national energies ought all to be centred on winning the war, there is no getting away from the fact that the situation was intolerable, and that the license to loot had to be terminated."

After a little more in the way of an introduction, the article continues, saying that Mr. T. A. Russell and Mr. Lloyd Harris, of the Russell Motor Car Company, Limited, heard in April, 1915, that fuse contracts had been "going begging," since November, 1914. Their first information about it was received in New York from Sir Sam Hughes, who, by personal introduction referred them to Col. Allison in the Manhattan Hotel for details. Preferring to do business direct with the Shell Committee, Messrs. Russell and Harris went to Montreal and made overtures to the Committee through Gen. Bertram and Col. Carnegie." The upshot of this business was that they were again referred to Col. Allison, "who was said to have the matter in hand for prospective contractors in the United States." After considerable perseverance and general rebuffs, Messrs. Russell and Harris "were given a promise that one million of the five million fuses required would be held, pending the receipt of a tender from them, providing that tenders were submitted within a reasonable time." A reasonable time in their case "was defined as two weeks, notwithstanding the fact that Allison had presumably been busy on the proposition for five months without being able to offer anything definite."

Within the two weeks Messrs. Russell and Harris notified the Shell Committee that their proposition would be ready on the date specified. "And now for the fact that requires explanation," continues the article in Industrial Canada. "On May 25th, 1915, the Russell tender was turned in, offering to make 1,000,000 fuses at \$4.20. On May 19, without waiting for this competitive tender, which was known to be on the way, and regardless of the promise given to hold at least a portion of the business open, the committee awarded contracts for the whole of the 5,000,000 fuses to the companies promoted by Allison and his associates, a small fraction of them at \$4.00, but the majority of them at \$4.50. The loss in money is a matter of easy calculation from the records of the committee. The loss in time of delivery is also determinable, because whereas the United States contractors have fallen far behind with their obligations, the Russell Motor Company are now delivering ahead of time under a contract they subsequently secured at \$3.70. The indirect loss to Canada and to the Empire through the sacrifice of domestic to foreign enterprise is beyond computation."

* * *

It is unnecessary to comment on this story at present. It simply adds a chapter to many that I have already published. Nor is it necessary to say much about the characters of the parties who are referred to as taking part in it. The fact that one of these parties is Mr. Lloyd Harris, stamps the story as deserving of every confidence. Mr. Lloyd Harris is one of the brightest and cleanest men we have in Canada today, and there are a good many others of his type. The thing that I cannot quite understand is why he, or others of his calibre, were not employed by the government in this crisis. Can it be that he was too big a man for them? Whatever reply you give to this question, the Dominion Cabinet needs a good cleaning out, if the conservative party is to be saved from defeat.

* * *

Just by way of an example of the above idea, I may mention the case of Hon. A. E. Kemp, the chairman of the Purchasing Commission, who also has been acting Minister of Militia during the absence of Sir Sam Hughes. Is it in the interests of the people that a man who is so interested in companies selling goods to the Government should be occupying an important position on a Purchasing Commission? Is there not even a sufficiently vigorous public opinion in Canada to teach such men that their positions as members of Parliament are positions of trust, to be exercised for the public welfare, not positions of profit to be utilized in their own interests? Does it not make you question whether the men who get to the top of the tree in our political life are men of the large calibre they should be? In the name of Heaven, are there no big men in this country who could handle our affairs more after the manner in which we have every right to expect they should be handled?

SEARCHLIGHT

According to Mr. Alderman Graffety, commissioner of electric light, the city of Westmount's electrical department has had the most successful year in its history, due to the loyal support given by the citizens to the municipal plant, the profits of which will go back into the general development and improvement of the lighting system. The depreciation fund totals \$167,000, most of which has been used in the development of the electric light system. This money has been replaced by city bonds as security, and will be again replaced by cash as soon as the new bonds are sold.

The Board of Water Commissioners of the town of Collingwood have awarded the Turbine Equipment Company, Toronto, a contract to supply and instal two De Laval single stage centrifugal pumps, each having a capacity of 1,000 Imperial gallons a minute, against 165 feet head, and each direct-connected to a 75 h.p. Canadian Crocker-Wheeler motor, complete with valves, piping and Venturi meter.

Electric Railways

History of Development in High Voltage Direct Current Railway Practice

By Clarence Renshaw*

Ten years ago, the idea that aproximately 600 volts was the maximum potential to be hoped for in the operation of d-c. railways was almost as firmly established as was the belief in the days of Columbus that the earth was flat. On a few roads, it is true, 650 or even 700 volts was carried at the station and in an occasional rare instance, the use of a booster gave a maximum of 800 or 900 volts. Drop in the feeders, however, usually reduced these values considerably before they reached the car, so that these instances represented merely the generation of d-c. power at voltages above the nominal 600 rather than its utilization by the car motors.

Then suddenly the plan was suggested of coupling the four 600-volt motors ordinarily employed on interurban cars in pairs of two in series instead of two in parallel, and of connecting the generators in the station in a similar manner, so as to employ 1,200 instead of 600 volts. Two railways then under construction were willing to try the scheme, although there were some misgivings as to whether it would work or not; it did. The entire railway industry as a result has been given a lesson in open-mindedness which it should not soon forget and the use of d-c. voltages of from 1,200 to 1,500 for the operation of interurban railways has become so common that today we are able to discuss details of high-voltage d-c. practise.

Motors

Limiting ourselves for the time being to voltages of 1,200 and 1,500 in discussing the matter, the first element to be considered of a high-voltage car or locomotive equipment is of course the motor. As far as voltage between terminals is concerned, the requirements for motors to operate two in series on such voltages differ from the well-standardized designs for low-voltage service only in the fact that slipping of the wheels to which one of the two motors in series is connected may interfere with the normal voltage distribution between them and concentrate a large part of the total voltage at the terminals of one machine. Fear of this contingency at first led to the design of motors for high-voltage service with a much larger number of commutator bars than for corresponding 600-volt service. More extended experience, however, showed that such precautions were unnecessary.

Insulation and creeping distances on motors for high-voltage service must of course be made suitable for the full potential. This was accomplished at first by "main strength and awkwardness," as it were, and the limitations imposed by the extra insulation, extra creeping distances and extra commutator bars ordinarily carried with them a considerable sacrifice in capacity when a given motor was wound for operating two in series in 1,200 volts instead of two in parallel on 600. As in the matter of commutator bars, however, wider experience gradually overcame this difficulty. The extra insulation required for 1,200-volt operation is now obtained by the use of better quality rather than greater quantity of material, and the extra distances by improved shaping and arrangement of parts. Generally speaking, therefore, motors are produced today for use in series on 1,200 or 1,500 volts with the same dimensions and weights as if made for use on only 600 or 750 volts.

In referring to motors above, I have spoken as if the coupling of two 600- or 750-volt motors in series was the only arrangement ever employed for utilizing 1,200 or 1,500 volts. There have been, however, one or two instances where motors have been wound directly for the full line potential. Speaking generally, such motors are heavier and depart more radically from standard low-voltage designs than motors for operating two in series, and moreover, they do not lend themselves as well to the operation of the cars partly on 600 and partly on 1,200 volts as is so often required. In general, therefore, they seem to offer no particular advantages and are hence but little employed.

High voltage d-c. railway practise, therefore, in the matter of motors may be said to consist in the use of two machines in series, these being identical in construction with standard motors for low-voltage service except in the comparatively minor details of quality of insulation and length of creeping distances.

Control

In control apparatus for high-voltage d-c. railway equipments, the fundamental requirements are to provide sufficient circuit-opening capacity to overcome the greater tendency to hang which the high-voltage arcs possess, together with the necessary means to confine these arcs within proper bounds.

The first result was secured in the early high-voltage apparatus by using two 600-volt switches in series at practically every circuit-opening point, and the second by liberal increases in the insulation and space surrounding all live parts. Thus our first 1,200- and 1,500-volt car equipments employed 13 pneumatically-operated switches, where with the same current at 600 volts eight would have been sufficient. The groups in which these switches were assembled, also, were approximately 24 in. (60.9 cm.) wide and 24 in. deep as compared with 18 in. (45.7 cm.) wide and 22 in. (55.8 c.m.) deep for the corresponding 600-volt apparatus.

As with the motors, however, greater experience led to a reduction of these differences in the fundamental parts. Some of the extra switches in the first equipments came into play only when the controller was "backed off" from parallel to series, and by improvements in interlocking the work of opening the circuit at this time was transferred to another point so that these extra switches could be omitted. Another switch had been employed because it was feared that the high-voltage motors might require more careful handling and hence more resistance notches than standard 600-volt motors. It was found later that such was not the case and this switch also was omitted in future equipments. In these ways, in the types of equipment most generally employed, the additional switches necessary on account of the increased voltage have now been cut down to two for small

* Before the A. I. E. E., New York, April 14, 1916.

equipments or three for large ones. In dimensions also, it has been possible to work out designs for 1,200-volt switch groups with the same cross-sectional area and the same weight per switch as those for 600 volts.

Auxiliary Control Devices.—The introduction of the new element of operating at double voltage has greatly increased the number of possible combinations and alternatives which must be considered in any given case in order that they may be adopted or rejected.

In the first equipments for use on 1,200 volts, it was considered undesirable to attempt to employ this voltage for the auxiliary circuits such as lights, control, air compressor, etc., and so a dynamotor was included as a part of the equipment to provide a supply of 600-volt current for such purposes. To reduce the capacity required of the dynamotor, the air-compressor motor was next wound for operating at full line potential, so that only the lighting and control circuits need be supplied at 600 volts. Even on this basis, the presence of the dynamotor in addition to the air compressor seemed unnecessarily burdensome, so that the next step was to combine the two machines in a dynamotor compressor. In this device, the air compressor, instead of being driven by a separate motor, as previously, is connected to or disconnected from the dynamotor when required by a suitable clutch controlled by the pressure governor. In locomotives or other equipments where forced ventilation is required, the operation is still further consolidated by mounting the blower fan on the shaft of the dynamotor so that the same machine in such cases serves a triple purpose. This offers considerable advantage in simplifying equipments, and the scheme of driving the compressor and providing 600-volt current for the auxiliary circuits from the same machine has become firmly established in high-voltage practise.

Where equipments are to be mounted on cars of small or moderate size, however, even this arrangement is somewhat of a handicap in the matter of cost and simplicity when comparison is made with the usual 600-volt equipment of the same capacity, so that the next step was to arrange the lighting and control circuits for operation directly from the line voltage. With electropneumatically-operated control, this was readily done and on such a basis, 1,200- or 1,500 volt equipments have been made practically as, simple, reliable and easy to maintain as those operated on 600 volts.

As the art now stands, these two general arrangements for handling the auxiliary circuits constitute a dual standard and one of the first decisions to be made in planning any given installation is between these two schemes.

Operation on Two Voltages

Operation on Two Voltages.—The most prolific source of vexatious problems is the use of equipments part of the time on low voltage and part of the time on high. As far as the main circuit apparatus is concerned, any high-voltage equipment will of course run on half voltage with a corresponding reduction in speed. In order that such operation may be satisfactory, however, special arrangements must be made to care for the auxiliary circuits.

Many interurban lines operate at high speeds over their own rights-of-way in the open country but enter one or more towns over the tracks of local 600-volt systems. High speed in the city is not permissible in any case and so approximately half of the normal speed when runnning on 600 volts is sufficient. For cars operating under such circumstances, it is common to provide for reconnecting the lighting and control circuits so that these will receive full voltage when the car is in the 600-volt section but so that the main motors will remain permanently coupled in series and thus operate at half speed.

If a dynamotor compressor is employed on cars which operate in this way, the same changes which are necessary in any case to care for the lighting and control circuits automatically care for the air compressor as well, connecting this for full speed on both voltages. In cases where approximately half speed on low voltage is sufficient for the main motors, however, the distances are usually short and half speed of the air compressor also is sufficient. Where cars which operate in this way employ a high-voltage compressor instead of a dynamotor compressor, therefore, no change is ordinarily necessary in its circuits for the low-voltage operation.

Since the motors on high-voltage cars are in general wound for only 600 or 750 volts each, the car can if desired be arranged to operate at full speed on both high and low voltage. Where this is required, a main change-over switch is employed which connects the motors of each pair either in series for high voltage or in parallel for low voltage, and which connects the two halves of each step of the main resistance in a corresponding way. Suitable connections for air compressor, lights and control circuits can also be included in the same switch so that the setting of a single piece of apparatus into one or the other of two positions changes the car at once for use on high voltage or low voltage.

The Change-Over

When the proper scheme of operation on the two voltages has been decided, the next point to determine is the manner in which the change-over should be effected. The simplest method in either case of course is the use of a manually-operated switch on each car. It is sometimes desirable, however, to have the change-over switch located beneath the car and arranged for operation from the platform. In other cases, it is desirable to have the switches arranged not only for distant control in this way but also for simultaneous operation throughout a train of cars.

To supplement the apparatus for changing connections on equipments so that they may be operated on either high or low voltage, protective devices are sometimes desired to prevent or minimize the trouble which may occur in case a car is subjected to high-voltage when its change-over switch is arranged in the low voltage position. Such devices ordinarily consist of relays of some form which are so connected, when the change-over switch is in the low-voltage position, that they act quickly in case a voltage in excess of the normal is applied to the car, and cut off the circuits which are likely to be damaged.

The choice between automatic and non-automatic acceleration is not influenced particularly by the use of high voltages except that such voltages are more often employed for interurban lines where non-automatic acceleration is ordinarily considered preferable. The necessity for running on both 600 and 1,200 volts in many cases also usually introduces certain complications in high-voltage equipments and there is a tendency to adhere to non-automatic control so that the simplicity of this will, as far as possible, offset the various complications which must be retained.

Control Apparatus

The use of field control or non-field control also is not particularly affected by the employment of high voltages except as influenced by the same general idea mentiond above with regard to the choice in the type of acceleration. For the sake of simplicity, there is a tendency to adhere to non-field control to offset unavoidable complications at other points.

Alternatives in Control Apparatus—It will be seen from the above that even with common practise in high-voltage equipment fairly well standardized, a host of alternatives usually present themselves for settlement in almost every case. The most common questions are—should the voltage be 1,200 or 1,500; should the equipment be of the dynamotor compressor or of the non-dynamotor type; will it have to operate on high voltage only or on both high and low voltage; if required to operate on low voltage as well as high, will half speed be sufficient on main and compressor motors or will full speed on both voltages be necessary; must the change-over switch be arranged for indirect control or will manual operation be sufficient; if indirect control is required, can it be confined to the individual cars or will simultaneous operation throughout the train be required; is a protective device essential to guard against damage by the application of the wrong voltage or will this not be required? Other similar questions might be added to the list but these are the most important ones.

Most of these matters are largely influenced by the individuals who control the local situation, so that it is difficult to generalize with any degree of accuracy. As far as I can judge, however, current practise seems to be tending in the following directions.

Where the high-voltage cars must run over existing 600-volt lines to any considerable extent, the exact ratio between 600 and 1,200 volts offers some advantages. Since high-voltage motors are made from existing standards also, there is a wider range of choice for 1,200-volt operation than there is for 1,500 volts, especially where small sizes of motors are required. So far, 1,500 volts has been used in sections where 600-volt lines have been established only to a limited extent, that is, in comparatively virgin territory, while 1,200 volts has been employed in sections where there has already been considerable 600-volt development. It seems probable that high-voltage practise will continue to follow these lines except in the case of the electrification of branch lines on steam railroads or similar instances where connections with existing lines will have little bearing.

The Dynamotor Compressor

Speaking broadly, the general tendency is toward the use of the dynamotor compressor on large expensive cars, particularly where full speed is required on half voltage, since this arrangement lends itself readily to such operation. Dynamotor compressors also are particularly suitable for locomotives where forced ventilation is utilized. For smaller and less expensive rolling stock, non-dynamotor outfits are generally employed, although there is and always will be a certain amount of over-lapping.

In the older sections of the country where distances of four or five miles must sometimes be run on city tracks, and where through cars over 600 volt lines are likely to be employed, equipments are usually required to operate at full speed on half voltage. Equipments for operating at half speed under these circumstances, however, offer considerable advantage in weight, cost and general simplicity and will undoubtedly find a considerable field where circumstances are favorable to their use.

Where large cars are arranged for full speed on both voltages, the tendency is toward the use of full speed for the air compressor also. On smaller cars where as a rule the compressor has more margin, half speed of this device is ordinarily thought sufficient even where the main motors operate at full speed.

In the matter of change-over switches, the general tendency is to employ the simple manually-operated type except where cars are operated at close headway or are constantly used in trains. In most cases, also devices to protect against the wrong voltage are not considered necessary.

Equipments with Drum Control—I have spoken in all of the above with particular reference to equipments using indirect or multiple unit types of control and primarily with reference to those using electropneumatic control. While high voltage equipments are occasionally used with drum type controllers, especially double equipments with rheostatic control where cars for city service are operated in small towns by interurban companies, the number of these is too small to warrant inclusion in any generalization such as that with which we have been dealing.

Power Supply

Direct-current power for high-voltage lines was first obtained by the use of two 600-volt generators, either engine- or motor-driven, connected in series. Since there was no particular object in retaining two generators in series such as there was for retaining two motors in series on the cars, generators for delivering 1,200 or 1,500 volts directly were soon produced. At first these were of the ordinary commutating pole type. Such machines now, however, usually employ a compensating winding as well as commutating poles.

The next step in the production of high-voltage d-c. power was the use of two 600-volt, 25-cycle synchronous converters connected in series, and while this was considered a radical step at the time it was first proposed, the performance obtained was so satisfactory that single 25-cycle converters producing 1,200 or 1,500 volts on one commutator have now been developed and are in successful use. With 60 cycles, the maximum voltage so far employed from a single machine is 750 so that two machines in series are still required for high voltage lines. The performance on this basis, however, is most excellent.

Common substation practise for high voltage d-c. lines is now to employ single synchronous converters where power at 25-cycles is available, and to use either motor-generator sets or two converters in series, where 60-cycle power is employed. A particularly efficient substation arrangement on the latter basis is secured by installing three synchronous converters so arranged that any two of them may be connected in series. This gives a spare machine at a minimum expense. If a single bank of three transformers is used for supplying these converters, a spare transformer as well as a spare converter is also secured so that the station is prepared for almost any emergency.

Switching

In the matter of switching, the principal changes which have been made in handling current at 1,200 or 1,500 volts instead of at 600 volts have been for the purpose of insuring safety to the operators rather than for any other reasons. For this purpose, switchboard panels have been made higher than for 600-volt service and the circuit breakers located on them so as to be out of direct reach. For opening and closing the breakers, long wooden rods leading to insulated handles on the lower part of the panel, are provided. Where two or more breakers are located side by side, large barriers are placed between them to prevent any tendency to flash across. Knife switches have also been located out of reach in a manner similar to the circuit breakers and arranged with rods for distant control.

Line Construction

The first 1,200-volt lines employed direct-suspension overhead trolley with a special form of porcelain insulators. The catenary form of construction offers so many advantages for such lines, however, that generally speaking, the most common practise is now to employ this. Several interurban lines are using 1,200-volt third rail successfully for supplying power but the voltage surges to which this may give rise under certain circumstances, the difficulty of clearing a car in case of accident and the general safety hazard incident to the maintenance of a live conductor so close to the ground seem likely to limit the use of this form of construction.

A growing practise on high-voltage systems is that of carrying the feeders for a considerable distance from the station before tapping in to the trolley so as to limit the possible current flow in case of trouble of any kind on the cars. With the excellent voltage conditions which can so easily be secured on high-voltage lines, the slight sacrifice which need be made for the sake of protecting the substation apparatus in this way can usually be well afforded.

Economic Significance

In studying the development of 1,200- and 1,500-volt practise, the fundamental point which appeals to me is the ease, success and speed with which so radical a departure from previous practise has been carried out. In most developments of so far-reaching a nature, many sources of difficulty are usually overlooked at first and must be cared for in later apparatus at increased expense. In the high-voltage d-c. railway system, however, just the opposite has apparently happened. Many of the possible difficulties seem to have been over-estimated in importance and much of the trouble anticipated has failed to appear. It has therefore been possible to gradually simplify and cheapen the various fundamental parts which go to make up the system instead of having to follow the opposite and more usual procedure.

It is difficult to say whether this exceedingly gratifying condition was due to the more advanced engineering ability of the times, to the inherent simplicity of the d-c. railway apparatus, to the very excellent state which such apparatus for 600-volts had reached before its extension to higher voltages was attempted, or to the fact that the jump to 1,200 or 1,500 volts, while seemingly radical, really subjected the apparatus to conditions differing comparatively little from those met with in 600-volt practise. Whatever the cause may have been, however, the result remains as a remarkable tribute to those who shared in its accomplishment.

The general results of the high-voltage d-c. system have been to make possible the construction of interurban lines or the electrification of branch steam railroad lines at considerably less expense for a given grade of construction than with 600 volts, or to render possible for a given expenditure the construction of lines capable of handling much heavier traffic. The usual practice has apparently been a compromise between these two possibilities, which has served to finally transfer the electric line from the street car to the real railroad class as far as transportation possibilities are concerned, while still maintaining the relationship and similarity with reference to the simplicity and reliability of the apparatus. With practically no greater expenditure for substations and feeders than the usual 600-volt trolley line, such roads are able to employ freight or passenger trains after the manner of steam lines in accordance with the needs of their business instead of having to restrict them on account of limitations in the distribution of power.

2,400 and 3,000 Volts

The comparative ease with which the use of 1,200- and 1,500-volt direct current was transferred from the realms of uncertainty to the list of every-day standards soon suggested the employment of still higher voltages. Inasmuch as the 1,200-volt system had been brought about by the use of two 600-volt motors in series and as a few motors wound directly for this voltage had been produced with no particular difficulty, the obvious procedure was to continue the geometric progression and connect 1,200-volt motors and generators in series so as to operate at 2,400 volts.

From a technical standpoint, there was apparently no particular difficulty in doing this, and one line installed on this basis has had a remarkably successful record. From a general standpoint, however, while the results have been welcome as a contribution to the development of the art, suitable applications for this particular voltage are apparently somewhat lacking. For trolley roads of the usual interurban class, it has the inherent disadvantage of requiring apparatus which departs too widely from the existing standards with which the operating forces have become familiar, as well as of not lending itself to interchangeable operation over 600-volt lines. For heavy traction, on the other hand, this voltage is much too low to solve the problem in a sufficiently comprehensive way to attract the investment of capital in electrification. Even 3,000 volts, while overcoming the latter disadvantage to some extent, does not do so completely. It is regrettable also that both 2,400 and 3,000 volts have been employed and that in carrying on the upward progress in d-c. voltages, 1,500-volt apparatus was not used at once for coupling in series, for carrying on the geometric progression, without the intermediate 2,400 volt step.

Ultimate Limits of D-C Voltage

The general limits upon which standard practise in any industry ordinarily settles are usually fixed by broad economic considerations rather than by physical limitations. It is entirely possible for instance to operate trains at miximum speeds of 90 miles per hour or more, yet the maximum ordinarily attained is from 60 to 80 miles per hour. Physically speaking, also, interurban cars can be run at speeds similar to these, yet the general average on such roads is from 50 to 60 miles per hour. These values have been established by gradual increases from lower ones until without any conscious effort, standardization has been automatically secured.

In the voltages which may be employed with the d-c. railway system, there is some tendency toward this same procedure. If no efforts were made to the contrary, it is not improbable that starting from the voltage of 3,000, which we have today on the Chicago, Milwaukee & St. Paul, we would next hear of the employment of 3,600 volts, then possibly 4,200 volts and so on up in corresponding steps. Sooner or later, however, a point would be reached where, by common consent, these increases would stop just as this has happened in the matter of speeds.

While in a way, such a procedure would be the conservative and natural way for progress to come about in the use of higher d-c. voltages, its disadvantages are too obvious to require mention. The apparently more radical plan of tying to select in advance the voltage at which such increases would naturally stop and of going at once to this voltage would hence seem to be the more rational and really the more conservative as far as the general good of the industry is concerned. It has been with this idea in view that our efforts toward the use of direct current at 5,000 volts are being put forth. With practical apparatus for this voltage available, the problems of distributing and collecting the necessary power for the largest locomotives likely to be required can be readily solved so that although further increases might be possible, they should be entirely unnecessary.

Operation of 5,000-Volt Equipment

The general construction of the 5,000-volt experimental equipment on the Grass Lake line of the Michigan United Traction Co. and the results of its first few months' operation have been so widely covered by the technical press that it is unnecessary to refer further to them except to say that the equipment is still in operation on the same successful basis, and that at the time this is written, it has run a little over 30,000 miles. During the five months from October 1st to March 1st, the car averaged 5,295 miles per month on a schedule which allows only 15 miles per hour and its record would have been even greater than this had it not been for numerous mechanical difficulties with the trucks, wheels, brake rigging, stove, pilots and other mechanical parts of the car for which the equipment was in no way responsible. Duing the four months of November, December, January and February, which, on account of weather conditions, are ordinarily considered the worst in the year, the car ran 23,320 miles or an average of 5,830 per month.

During this period the car operated through severe snow, sleet and rain storms and for a short period even ran with two of the commutator covers missing, these having been lost on the road. The motors and control were purposely allowed to go with a minimum of cleaning and other care, and various reports sent in by the men in charge refer to the presence of wheel wash, dirt and other obnoxious substances in the motors and switch groups, although no damage was caused by them.

A half-dozen or so failures have occurred during the winter but these have been mostly in the nature of broken motor leads or similar troubles which served merely to test the practicability of the use of such a voltage under the general rough conditions to which car equipments are subjected rather than to indicate any inherent weakness. These troubles showed that this equipment could as easily withstand such ordinary mishaps as any equipment for 600 volts. Only two of the failures were in any way due to the use of 5,000 volts and these consisted of grounds on the grid resistance which took place through the water-soaked flameproof covering on certain of the leads where the cables had not been properly insulated and supported.

While as yet only the one equipment now in experimental operation has been built, various designs of other sizes have been considered and with the special double armature type of motor and double jaw type of switch which have made this equipment possible, unusual flexibility in meeting a wide range of conditions can apparently be obtained.

In most of the considerations of the use of d-c. voltages of 2,400 and 3,000, there has always been a certain minimum size of motor which could be economically produced and this size has been undesirably large for certain classes of service. With the special double armature type of motor for 5,000-volt equipments, however, the experimental equipment already in use is about as small as would ordinarily be required.

Conclusion

Broadly viewing the high-voltage d-c. practise which we find today, and its significance to the industry, there are four ideas which appeal particularly to me. The pernicious flexibility of the 1,200- and 1,500 volt systems and the innumerable alternatives which they present for application to any definite case in interurban work seem to give timely warning of the great desirability of early standardization in the matter of higher d-c. voltages. The comparative ease with which apparatus for these voltages has been developed gives a most encouraging feeling for further development along the same lines. The possibilities which a d-c. system at 5,000 volts would offer were the apparatus commercially available make this voltage seem a logical one, and the results obtained with the experimental equipment now in operation give great hope that this voltage may some day be established commercially as a standard of high-voltage d-c. railway practise.

Modern Shop Methods

By P. V. See*

On the Hudson & Manhattan Railroad the average daily car mileage is 118, the average schedule speed is 17.3 m.p.h., including 1.6 stops per mile, and the schedule speed on the high-speed line is 28 m.p.h. During a day each car encounters curves amounting to forty-two complete round turns and ascends grades equivalent to an elevation of 4,685 ft. The minimum radius of curves is 90 ft. and the maximum grade is 5 per cent. All cars have two-motor equipments with full automatic multiple-unit control. Six-car and seven-car trains are operated during rush hours under ninety seconds headway, being controlled with automatic signals and train stops.

Under the above conditions rigid inspection is necessary. Each inspector is paid a bonus of 25 cents per day when his equipment causes no trouble for a week or when he passes a weekly inspection test. This test is made by a man not connected with the inspection force and consists in noticing existing defects or making artificial ones on cars before they enter the inspection shop and checking afterward to determine whether or not the repairs have been made. All work done in the repair shops is checked by the inspection force, and the inspection shop is never allowed to claim that road trouble is the fault of the repair shop.

While the practice of the company is to have repairs made in the shops as far as possible, nevertheless certain classes of light repairs and train defects have to be repaired by road trouble men. A scheme of picking out the best men for this work is employed in which a train in the yard is disabled and the men are tested individually by being put upon the task of repairing it under conditions as nearly as possible like those of the road.

In inspecting the electrical jumpers used in making up trains, one Sunday every three months is devoted to jumper inspection. A jumper test train is taken over the road, stopping at each terminal long enough for the crew to collect all jumpers in the terminal. These are brought into the test train and inserted in sockets wired to the testing board. A current of 25 amp. from the heater circuit is sent through all the jumper wires connected in series, and a 10-point switch is so connected that on each point a 3-volt lamp is connected across one of the jumper wires. While current is passing the jumper is worked back and forth. Both heads are tested at the same time for grounds.

On this road the numerous sharp curves caused the end thrust of the motors to wear out the axle lining collars rapidly. Bronze shims screwed to the lining collars also wore out soon, but collars of high-grade tin babbitt wore better than the original bronze of the lining. The babbitt is cast in a dovetail groove in the collar. Wheels are shrunk on the axles, after heating with gas rings on tread and hub. After cooling the fit is tested in a press to 75 tons.

Traffic conditions on the Hudson & Manhattan Railroad do not permit the setting of control relays by test runs. Also it was desired to set the current element of the relays high to provide power to start trains on 4½ per cent. grades with one-half of the cars inoperative. Hence the adjustment is made on the time element by adjustment of the air dashpots with the aid of a stop watch, the current control being set with a 5-volt generator so that the armature will just drop at 525 amp.

The practice of the company in car painting is to use forced drying. For complete repainting the steel is cleaned with the sand blast, six nozzles being operated at once. A car can be cleaned and a priming coat applied in one day. Tests have shown that a No. 16 steel sheet can be cleaned 100 times before it is worn through. After sand blasting a car receives four coats of paint, and with the accelerated drying process three coats can be applied in one day, although two is the usual number. The drying is done in a portable canvas tent by means of electric heaters.

The car-cleaning practice of this company in applying paraffin oil with floated silica and then brushing with rotating window brushes driven by small electric drills. This is done once a month at a cost of about $1 per car, 12 cents being for materials and 90 cents for labor. The treatment is not injurious to paint or varnish. Whiting and water are used in cleaning interior surfaces with high-gloss enamel finish.

* Superintendent of Car Equipment Hudson and Manhattan Railroad, New York, before N.Y.E.R.A.

Justice for Electric Railways—Charles L. Henry, President A.E.R.A., at Mid-year Dinner

As in the beginning the public in no way provides any of the capital necessary for the construction of the electric railway property, so it assumes no responsibility for the financial results of the operation of the property, and, even if regulations prescribed by its governing bodies cause loss to the company, the public does not make good such loss. The natural result of this peculiar relation which we occupy to the public is that the companies are sometimes very seriously embarrassed in the management of their property.

It not infrequently happens that by reason of burdens in the way of taxes, street improvements, additional service, the making of unreasonable regulations regarding transfers, and otherwise, it is made impossible for a company to earn enough to pay operating expenses, including these burdens, and have anything left to pay a reasonable income upon the capital invested; that is, the persons who have furnished the money to build the property and thus make it possible for the people to enjoy its benefits and advantages are compelled to go without any compensation or pay for the use of the money thus provided. It is plain to see that if such a condition is brought about in even a few cases, holders of money for investment become frightened and afraid to further invest in such property, and then the public also suffers, because without sufficient capital electric railway properties, like any other business, cannot be properly maintained or operated—the necessary improvements and additions cannot be made, and the public then cannot have the transportation facilities which they desire and ought to have.

Intelligent Public Supervision

If public supervision is intelligently and properly exercised, then, instead of public supervision being an injury either to the company or to the public it should be of very great benefit to the company and of very much greater benefit to the public—though I feel compelled to say that so far as my observation has gone, supervision of such a character is, up to date, largely theoretical and not often manifest in actual practice.

It is entirely proper that the public should have an oversight of the construction of electric railway properties to the end that they be constructed and equipped so as to give the best results in their proposed service for the public. It is also entirely proper that the public should have a supervising hand in the operation of these properties, so that the purpose for which they are constructed and being operated shall be fully and satisfactorily met.

The great difficulty, however, especially during such times as we have been passing through for the last few years, is the disposition largely dominating the public mind, on the one hand, to unjustly criticize and find fault and, on the other hand, to call for additional service and the adding of additional burdens very frequently without any careful or comprehensive consideration of the question, and quite generally without regard to the financial effect upon the electric railway company, and, therefore, upon the service it is called upon to render the public.

Every dollar that the street railway company is compelled to pay in the improvement of streets unjustly adds just one dollar to the cost of transportation; that is, the man who rides upon the cars must pay his part of that dollar for the improvement of the street which should be paid for by the abutting property owner. Because it does not at first blush clearly appear that this is the case, it is not taken into consideration and thousands of dollars are annually paid by electric railway companies which are, in fact, only a donation to the abutting property owners. The traveling public must pay these thousands of dollars more for their transportation than they otherwise would or ought to pay.

Without being dishonest with those holding the company's obligations, one man cannot ride for less than his ride is worth. The company cannot in fair honesty to all pay—in fact, donate—the expense of street improvements properly chargeable to abutting property owners, nor can it carry a passenger a longer ride than he pays the value of, without those who ride upon the cars contributing just that much to the finances of the company.

Unjust Demands

An idea seems to have grown up in most communities that an electric street railway is a natural and proper prey for any and all kinds of demands, whether just or unjust, and this manifests itself in connection with damage claims as much as in any other way.

It needs no extended argument to show that we must fear for the future of electric railway companies unless this condition of the public mind and this inclination on the part of the public can be changed from what it now is.

I take it, therefore, that the most important thing to which electric railway people can devote themselves is the education of the public mind upon these questions; and right here is where every person interested in the industry can assist.

However, we cannot hope to influence the people unless they are at least in a friendly state of mind.

Moreover, the manner in which we perform our duties will have much to do with the influence which we have upon the thoughts of those about us. The conduct of employes is to most people the one thing which determines their view of the company. Courteous conduct on the part of trainmen, agents and other employes of the company who come directly in contact with the public will go very far toward disarming the public of prejudical feeling against electric railway companies, and this same kind of conduct on the part of the President and the General Manager and their hundreds of assistants will add materially toward winning the contest in which we are engaged.

The Public Do Not Understand

What is it we want to teach the public? What change is it we want made in the public mind? In the first place, we want them to fully appreciate, feel and know that we are really their agents, transacting their business for them, doing for them what they have delegated to us because, as stated, it has been demonstrated that private companies can and do operate electric railway properties more satisfactorily and more to the interest of the public than this public could itself operate them. We want them to understand that while thus acting as their agents we are entitled as such to just and fair consideration and treatment, and that if we are not accorded this we can not on our part properly perform our part of the compact.

In brief, what we want the public to learn and act upon is that when a demand is made of any of our companies it should be answered the same as if the public itself owned and operated the properties which we own and operate. Let the acid test be applied, namely, that we should have for our services the same compensation the public would demand, that we should have the same rights and privileges guaranteed to us which the public would demand, and that we, as the agents of the public, should be oppressed with no burdens that the public would not allow the same properties to be oppressed with if they owned and were themselves operating them.

In my opinion, the public will be fair and just when they understand the questions they are to act upon; some may not be able to lay aside their prejudice and selfish interest, but the large body of the public will be inclined to what is fair and will want to see justice done between the companies and the individuals constituting the general public.

The Dealer and Contractor

Amendments to the Power Commission Act which Directly Affect the Contractor and Dealer

"An Act to amend the Power Commission Act and to confirm certain by-laws and contracts" has been introduced in the Ontario Legislature, two sections of which are of considerable practical interest to the electrical trade. One has reference to the purchase and sale of supplies by the Commission to municipal corporations, and the other to the installation and regulation of electrical wiring and equipment of various sorts.

The amendment referring to the purchase of supplies reads as follows:—

(1) The Commission may, out of any funds in its hands, from time to time purchase such electrical, hydraulic or other machinery, appliances, apparatus and furnishings as may be used in the transmission, distribution, supply or use of electrical power or energy, and may dispose of the same from time to time to municipal corporations and commissions.

(2) The Commission may undertake and carry out the installation, construction, erection or purchase of supplies for any plant, machinery, wires, poles and other things for the transmission, distribution, supply or use of electrical power or energy for light, heat or power purposes, by a municipal corporation or commission which has entered into a contract with the Commission for the supply of electrical power or energy, and the Commission may charge and collect from such corporation or commission the cost of any work done or service rendered by the Commission, its officers, servants or workmen under this subsection.

This legislation is retroactive, taking effect from the 31st day of October, 1910, and so is evidently merely intended to legalize the already established practices of the Commission in its relation to the municipalities, rather than to suggest any new inroads into the recognized field of the established dealer or dealer-contractor. Indeed, it is understood that the Ontario Commission have now gone on record as favoring the establishment of a reasonable re-sale price on all electrical appliances, and that municipalities engaged in such sales must in future operate on a sound business basis. This removes in very considerable degree the objectionable features surrounding the sale of appliances by various municipalities as carried on in the past, in that the bargain-counter methods will now give way to legitimate and reasonable, and therefore helpful, competition.

The second section is apparently calculated chiefly to strengthen the hands of the Ontario Commission in carrying out the rules and regulations at present in force. Up to the present time the enforcement of these rules has been more in the nature of moral suasion. The officers of the inspection department, for example, have apparently lacked the authority to enforce the remedying of even the most glaring defects in the installation of wiring or appliances. Each particular case, as we read the Act, has required an order from the Commission, which, so far as we can learn, has never been forthcoming. Thus, the Act, in so far as it referred to enforcement of the recognized rules and regulations of the Commission, and the imposition of penalties where these rules were ignored, has been a dead letter, and the work of the inspection department has been correspondingly unsatisfactory.

Under the amendment it is stated that the penalties imposed by or under the authority of this section shall be recoverable under the Ontario Summary Convictions Act, which means, we take it, that any one so disposed may hail a delinquent contractor, or property owner, or central station, before the police magistrate and have the matter settled without delay. It only remains, then, that the Ontario Commission shall now see to it that their officers, and more particularly those in charge of the inspection department, be given definite authority to carry out this Act and definite assurance that any action they may take to enforce the rules will be backed up by the Commission. Under such conditions we believe the amendment as at present worded will very materially improve conditions surrounding the electrical contracting business. The exact wording of this section, which replaces section 37 of the Power Commission Act, is as follows:—

(1) The Commission may make regulations as to the design, construction, installation, protection, operation, maintenance and inspection of works, plant, machinery, apparatus, appliances, devices, material and equipment for the generation, transmission, distribution, connection and use of electrical power or energy by any municipal corporation or commission and by any railway, street railway, electric light, power or transmission company, or by any other company or individual generating, transmitting, distributing or using electric power or energy, or whose undertaking works or premises are electrically connected with any plant for the generation, transmission or distribution of electric power or energy, and the Commission may impose penalties for the breach of any such regulations.

(2) The Commission may, at any time, order such work to be done in the installation, removal, alteration or protection of any of the works mentioned in subsection 1, as the Commission may deem necessary for the safety of the public, or of workmen, or for the protection of the property damaged by fire or otherwise, and pending the performance of such work, or in case of noncompliance with the regulations or with any order of the Commission, may order the supply of electrical power or energy to be cut off from such works.

(3) The Commission may appoint inspectors for the purpose of seeing that the regulations and orders of the Commission, made under the authority of this section, or any other provision of this Act, are carried out and may collect the fees to be paid by any municipal corporation or commission, or by any company, firm, or individual under the regulations or by order of the Commission, and may provide for the payment of the remuneration, travelling and other expenses of the Inspector out of the fines and fees so collected or out of the funds appropriated for carrying on the work of the Commission.

(4) Every Inspector so appointed may, during any reasonable hour, enter upon, pass over or through any land, buildings or premises for the purpose of carrying out the regulations and orders of the Commission, and perform the duties assigned to him; and every municipal corporation or commission, company, firm, or individual, molesting, hindering, disturbing or interfering with an inspector in the performance of his duty, shall be guilty of an offence, and shall incur the penalty provided by subsection 7.

(5) Every municipal corporation or commission, and every company, firm, or individual, upon receiving notice in

writing by the Commission to remedy any defect or to make any alteration, or carry out any work, or comply with such notice within the time thereby prescribed, and in default, shall incur the penalty provided by subsection 7.

(6) Every municipal corporation or commission, and every company, firm or individual, supplying electrical power or energy for use in any electric works, plant, machinery, apparatus, appliance or equipment before the same have been inspected and such supply authorized by the certificate of the Commission, shall incur a penalty of not less than $300 nor more than $500.

(7) Every municipal corporation or commission, and every company, firm and individual, refusing or neglecting to disconnect or discontinue the supply of electricity to any electric works, plant, machinery, apparatus, appliance, or equipment, without notice in writing from the Commission so to do, shall incur a penalty of not less than $300 nor more than $500.

(8) Nothing in this Act shall affect the liability of any municipal corporation or commission, or of any company, firm, or individual, for damages caused to any person or property by reason of any defect in any electric works, plant, machinery, apparatus, appliance, device, material, or equipment, or in the installation or protection thereof, nor shall the Commission or any inspector incur any liability by reason of any inspection or the issue of any certificate or on account of any loss occasioned by the cutting off of the supply of electrical power or energy in accordance with the orders of the Commission.

(9) Every municipal corporation or commission, and every company, firm or individual, disobeying the provision of this Act, or of the regulations, or any order of the Commission, shall incur a penalty of not less than $10 nor more than $50, and in the event of continuing the offence, of not less than $10 nor more than $50 for every day during which such offence continues.

(10) The penalties imposed by or under the authority of this section shall be recoverable under The Ontario Summary Convictions Act and shall be paid over to the Commission.

The Manufacturers' Attitude Toward Concentric System

C. W. Abbott explains it to the Western Association of Electrical Inspectors

Manufacturers, as a class, are still opposed to concentric. Opposed to it solely and only because they do not believe that it is backed by real merit; because they do not believe that its adoption would be a step in the right direction, but that, on the contrary, it would be an unwise, a positively dangerous step.

This opinion is not based alone upon what they have been able to learn through unprejudiced sources abroad—and I believe that when all the returns are in it will be found that the best of unprejudiced European opinion will condemn it—but upon certain known conditions here against which concentric can be measured—conditions with which every practical man and particularly men of your experience are perfectly familiar.

What, for example, will the general public do to concentric? And when I say the general public I refer to the janitors, the office boys, the ten-year-old Thomas Edisons and all the rest of that vast army which you know and I know are constantly making extensions here and there; the unskilled, technically ignorant class that would not report their work for inspection even if they knew it existed, as many of them do not.

Bearing in mind that concentric is certainly small and neat, that its fittings are little better than toys and—above all else—bearing in mind that concentric **need not be grounded** to make a lamp burn or a toaster toast—what will be its fate at the hands of this unskilled class? I need not attempt to picture for you what I think it will be, for there is not one of you present here to-day who does not know the answer as well or better than I do.

But the gentlemen who are promoting the concentric idea do not feel that this question of "what will the general public do" constitutes a valid objection to its approval, for they tell us in the first place that they propose to control its sale by seeing that manufacturers distribute only through sources which can be relied upon to see that the material gets into none save skilled hands. And, as a manufacturer, I want to say in answer to that that in this day and age, when even the department stores and the five and ten-cent stores are dealing in electrical supplies, they can no more control the sale of concentric than they can control the elements. If it is approved, the public will get hold of it fast enough.

Will Make Vast Difference

In the second place these gentlemen say that they cannot see what difference it makes whether this uncontrolled, uninspected, clandestine sort of work is done with concentric wire or drop cord; and in answer to that I contend it will make a vast amount of difference, for the standards maintained in the manufacture of drop cord and similar materials to-day certainly offer some margin of safety against abuse, whereas with concentric ungrounded as it would be in most cases of the kind, there would be no margin of safety whatever.

And in the third place these gentlemen tell us that there has been little trouble with the public use of concentric in Europe because the material "stumps" the unskilled man, and that since human nature is much the same the world over, we should expect no trouble here.

Now it may be that human nature is much the same the world over. I am not prepared to discuss that. But whatever may be the attitude of European citizens in times of peace, I know from my own inspection experience that the average American citizen seems to feel that the right is guaranteed him by the constitution to monkey with the lighting system in his home or place of business whenever and however he pleases. There is a certain percentage of the public, to be sure, that is outgrowing this habit, but I firmly believe that just so long as it is possible to scrape insulation off wire with a pen-knife, the great majority will continue to feel free to muss up their lighting system, and I think that most of you agree with me.

And as for their being "stumped," I wonder how many of you believe that they will be "stumped" by any material which can be easily bent, which can be cut with a knife or a can opener and which can be fastened along the baseboard with ordinary carpet tacks, as Stannos type concentric wire can be and will be if it is approved.

And then as to the question, the all important question, of grounding.

It must be admitted that if concentric is approved it would seldom be installed in a building where a gas or water line was not available for grounding purposes, and if the work of grounding is done by a responsible contractor, by experienced men (and that is certainly a big if), if that is done, the mechanics of grounding will probably be well carried out in most cases. But it has been my experience that a mechanically good ground, a ground which has every outward appearance of being good, may be of such high resistance as to defeat its purpose. And don't let us forget, too, that where these high resistance grounds occur in systems like concentric, the current is going to seek some ground path of lower resistance. Suppose it chooses a gas pipe. What is going to happen if there are a few leaky couplings of comparatively high resistance?

We certainly cannot afford to lose sight of this danger from miscellaneous grounds in considering concentric, particularly so long as we have combination fixtures and careless workmen to contend with.

But to pass over the question of obtaining a ground, how about maintaining it?

You have all had experience along this line, regardless of whether the grounding of secondaries has long been practiced in your community or not, for we have been grounding conduit for a good many years. You all know, particularly if you have had re-inspection experience, as I have, how frequently grounds are found which have been interrupted through the agency of some plumber, some small boy or any one of a dozen other causes.

Causes Much Trouble

Or if there is any uncertainty in your minds on this score go out and look over a few installations which are supposedly grounded, or, better still, go and talk with the Bell telephone officials in your own city, people who have had more experience in grounding, who have been at it longer than any other branch of the industry. And then, in the light of these investigations, ask yourselves if you are willing to make the life and safety of your family and the protection of your property solely dependent upon the stability and efficiency of a ground wire, as they would be with this concentric system.

But the gentlemen who are promoting the concentric idea apparently have no misgivings on this point, for, I am told, that they believe failure of ground wires can be prevented by occasional inspection.

Occasional inspection! I wonder if they would be just as sanguine about hanging a stick of dynamite from their ceilings and depending upon "occasional inspection" to see that the string was not going bad, for it seems to me that maintenance of ground in concentric system is fully as important.

And then as to costs. The principal argument advanced in favor of concentric has been based upon its alleged low cost. A cost, we have been told, that would enable the central stations to reach out and add to their lines thousands of small homes now closed to them by the excessively high cost of present wiring systems.

Not Cheap

Unfortunately, there is very little data available upon which we can base an estimate as to the correctness of these claims, but I personally believe that the idea that concentric would be found so cheap is a mistaken one—or would be when you had finished surrounding it with safeguards which I am sure you would demand before its acceptance.

I am told, for example, that a price of thirty-one dollars per thousand feet to the contractor has been established for No. 14 Stannos wire. I cannot say if this is correct, but if it is I am sure that all of you who know anything of costs will agree that it promises nothing very startling.

And then as to labor. We have heard that labor was going to be a very small item in concentric, but I personally feel that that idea, too, would be found to be based on theory more than anything else, particularly since I have inspected one of the sample installations recently made in the east.

For, in the light of that inspection and as a practical man, I am going to tell you that even a fair installation of concentric wire of Stannos type is going to call for a grade of skill not possessed by many American wiremen. A good installation is going to call for the sort of man that is now required for the assembly and installation of high grade chandeliers and that sort of thing.

Personal

Mr. W. H. Dinsmore has been appointed traffic superintendent of the Vancouver city and suburban lines of the British Columbia Electric Railway, succeeding Mr. James Hilton, resigned.

Mr. G. H. Stevens has resigned his position as electrician-in-charge of the Fort Erie district for the Canadian Niagara Power Company, and commenced his duties as power apparatus specialist, Northern Electric Company, Montreal, on April 1st.

Mr. J. F. Heffron has been appointed general manager of the Macbeth-Evans Glass Company, Limited, of Canada,

Mr. J. F. Heffron

succeeding Mr. H. L. Lissfelt. Mr. Heffron represented the Macbeth-Evans Glass Company for a number of years in the United States, before coming to Canada in 1913, and since that time has been associated with Mr. Lissfelt at the Canadian head office, Toronto. He is well and favorably known among the electrical trade throughout the Dominion and, being thoroughly conversant with the policy of his company, will be able to carry on the work which Mr. Lissfelt has laid down, to the satisfaction of the trade generally.

Join!

Join the Electrical Contractors' Association of Ontario. Meet the other fellows in your business, interchange ideas with them, learn how to conduct your business better. The yearly fee is at the rate of 4c per day. Would it not be worth that much to you?

What is New in Electrical Equipment

Haag Twin Electric Washer

A new electric washer of the twin type has recently been developed by Haag Bros. Company, Peoria, Ill. A feature of this new machine is the two controls with which each tub is provided. The mechanism is stopped or started automatically by raising and lowering the lid, or by means of levers at each end of the machine. If the operator wishes to use but one tub, the other can be stopped with this lever without raising the lid, or both tubs can be stopped without

lifting the lids, thus retaining the head in the water while the machine is idle. The wringer revolves completely around in either direction and can be locked in any position. A wide, reversible drain prevents water from splashing on the floor when wringing. There is very little machinery on the tops of the tubs and the mechanism is so constructed that it is impossible for the hands or clothing to become caught. The light weight of this mechanism makes it easy for the operator to raise the lid. The machine is 26 inches wide by 52 inches overall with the extension rack folded. The rack is 18 inches wide. The machines are equipped with the new Robbins & Myers washing machine motor which was recently described in these columns. This motor is provided with special end heads which have overhanging grids which protect the motor from water and at the same time allow thorough ventilation. The motor is mounted on a platform under one of the tubs and is belt connected to the machine.

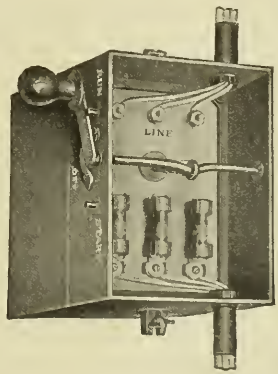
Cap Has Elongated Neck

A new Hubbell cap, which interchanges with their entire line of wall and flush receptacles, has just been placed on

the market. It is made of a durable heat proof composition and provided with an elongated, knurled neck which presents a convenient grip. The purpose of this elongated neck is to serve as a means of withdrawing the cap from the receptacle and it is expected that the ease with which this can be done will discourage the tendency to use the cord for this purpose. This, as well as all other Hubbell non-polarized caps, interchange with the entire line of Hubbell wall and flush receptacles.

Condit Type I Oil Starter

The demand for a fused oil switch for use in starting small induction motors which are thrown directly on the line without the use of a starting compensator is met by the Condit Electrical Manufacturing Company's Type I oil starter. This starter is designed for motors whose normal running current does not exceed 30 amperes at 600 volts or less. It is a fundamental engineering principle that for safe and satisfactory operation as well as for economical maintenance of the apparatus, the making and breaking of an alternating-current circuit should take place in oil, irrespective of capacity or potential. Also, from the standpoint of "Safety First," an oil starter is considered a necessity. Because of the heavy starting current taken by induction mo-



tors which are thrown directly on the line, it has been customary to use fuses whose capacity was far in excess of the normal running current, and thereby the motor was afforded no overload protection under running condition; this is one great objection to the ordinary open or enclosed, fused, air break switch used for starting small motors of this type. The use of the Type I starter permits the motor to be fused for proper overload protection without blowing the fuses in starting the motor, and at the same time affords ample protection during the starting period. As this starter is totally enclosed, there is no danger of the operator coming in contact with either the operating mechanism or any live parts. The starter is arranged for wall mounting and is sold by the Northern Electric Company, Limited.

Trade Publications

Fireproof Wires.—Catalogue No. 5, by the D & W Fuse Company, Providence, Rhode Island, describing Deltabeston wires. The booklet is published with the object of listing asbestos-covered wires manufactured by this company, and of acquainting the trade with improvements recently made in its manufacture.

Panel Boards, etc.—Bulletin 62 by the Krantz Manufacturing Company, describing safety and live faced panel boards, switchboards and switches; illustrated.

An Electric Water Heater

The accompanying illustration shows the method of installation of the Lee electric water heater. It is not required to disconnect the water tank from the previous coal or gas heater, but to just insert in the tank through the standard opening in the top the Lee heating element. As shown in the illustration the hot water device appears like a long

rod reaching almost to the bottom of the tank. In this rod is contained the heating element. The rod is about 1½ ins. in diameter and, being entirely immersed in the water, gives off every bit of the heating energy to the water contained in the boiler. The devices manufactured by this company have two capacities—500 watts and 750 watts.

Double Contact Push Button

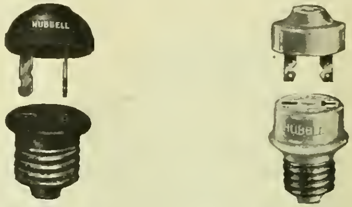
A new type of push button has recently been placed upon the market by the Connecticut Telephone & Electric Company, of Meriden, Conn. This button is fitted with long self-cleaning contact springs which have a double wipe. This is the only push button upon the market with a double rubbing contact. Contacts are protected by a heavy metal guard,

and lugs on side of binding post screws keep the wire connections in position—no soldering is necessary. The push button has a large oval centre which has a solid stop—entire button is solidly built and is practically indestructible. This button is arranged to be mounted singly or in groups and designed to fit a ⅝-in. hole and can be furnished with black, white or pearl centre as desired.

The Lincoln Electric Company of Canada, 311-12 Kent Building, Toronto, are distributing a little booklet describing the underlying principles of arc welding practices. The booklet is well illustrated and contains a quantity of very interesting information.

Plug with Polarized Contacts

When direct current is used it is extremely important that the flow of current be always maintained in the same direction. Harvey Hubbell, Inc., have just placed on the market a small separable attachment plug with polarized contacts. The slots in the base are placed at right angles and the knife blade contacts in the cap arranged to correspond. Using this plug it is impossible to reverse the polarity once it is established in the cap. This plug can be used either as a polarized plug or, if so desired, the cap will interchange with all Hubbell T-slot receptacles of the surface and flush types consuming either alternating or direct current. It is made of a tough heat proof composition with a nickel plated screw shell presenting a compact and pleasing appearance. To increase the service possibilities of this plug



the base of the standard No. 5406 has been arranged to take either the porcelain cap, usually supplied with it, or the polarized composition cap of the plug described and illustrated above. The accompanying cut illustrates this feature.

A Treatise on Electric Railway Material

The Ohio Brass Company, Mansfield, Ohio, are distributing their No. 16 catalogue. This supersedes and cancels all other O-B catalogues with the exception of Valve Catalogue No. 50, and customers are requested to destroy their old catalogues lest reference to them cause confusion in ordering. This catalogue is being distributed in Canada by Mr. P. A. Hinds, 88 Farnham Avenue, Toronto, Canadian representative of the Ohio Brass Company. It may justly be termed a treatise on electrical railway material; profusely illustrated and contains 654 pages of valuable information. The scope of the matter covered may be judged from the following general index of material: Catenary Line Materials, 71 pages; Direct Suspension Line Materials, 204 pages; Hi-Tension Porcelain Insulators, 184 pages; Rail Bonds and Tools, 62 pages; Third Rail Insulators, 18 pages; Car Equipment Materials, 74 pages; Tables and Data, 16 pages. This is one of the most valuable and complete catalogues we have seen.

J. D. Lachapelle & Company, General Agents and Engineers, Montreal, are laying out and doing the purchasing of the electrical equipment for the new million dollar plant which is being installed at Montmagny for the General Car & Machinery Company.

Trade Inquiries

Names and addresses may be obtained from the Department of Trade and Commerce, Ottawa, Ont.

362. **Steam-electric power plant apparatus and engineering specialties**—A gentleman who intends visiting New Zealand during the coming summer is desirous of securing the agencies of Canadian engineering manufacturers of steam-electric plant apparatus and engineering specialties, and is desirous of receiving full technical description of apparatus, together with illustrations, weight of apparatus, shipping weight, and weight of heaviest piece and over-all dimensions. Present prices either f.o.b. Canadian or American port or c.i.f. New Zealand port.

Current News and Notes

Calgary, Alta.

The annual report of the Calgary Power Company, Limited, for the year 1915, showed gross earnings of $289,613, an increase of 25.3 per cent.; net earnings $237,158, an increase of 31.6 per cent. This net represents 4.33 per cent. earned on the company's capital stock.

Granby, Que.

The official opening of the electric railway branch of the Montreal and Southern Counties Railway Company, between the present terminus and Granby, took place on Saturday, April 29.

London, Ont.

The Utilities Board of the city of London are planning to extend an electric lighting system into London township to illuminate a considerable area to be used for camp purposes.

Marieville, Que.

The town council are considering installing an electric fire alarm system.

Montreal, Que.

A reduction is announced in the price of electric energy for lighting purposes in Montreal, by the Montreal Light, Heat & Power Company.

Mr. J. Pilcher, manager of the Montreal branch of the Canadian General Electric Company, on April 18 fell while bowling and broke his wrist.

The offices of the Montreal Electrical Commission will be removed from the New Birks Building to the Duluth Building, 50 Notre Dame Street West.

The output of the Shawinigan Electro-Metals Limited, a subsidiary of the Shawinigan Water and Power Company, has increased, and ten tons of metallic magnesium per month is now being manufactured.

The Cedars Rapids Manufacturing and Power Company have just put another unit into operation. This makes the tenth, each being a 10,000 kv.a., 6,600 volt, 3-phase, 60 cycle vertical water wheel driven unit.

The Montreal Tramways Company has placed an order with the Standard Underground Cable Company of Canada, Limited, Hamilton, for a quantity of cable for the Bleury Street section of the underground conduit system. The order is for 1½ million c.m. paper insulated lead covered single conductor cable.

Napanee, Ont.

The Pleasant Valley Telephone Company, Limited, has been incorporated, head office, Napanee.

The Palace Road Telephone Company have obtained a charter.

New Westminster, B.C.

The Trades and Labor Council recently voted unanimously to request the Minister of Labor, Ottawa, to appoint a board of arbitrators to deal with the dispute between the electrical workers and the municipality.

Niagara Falls, Ont.

That portion of Queen Victoria Park, Niagara Falls, in which the various electric power companies are located, is now closed to the public.

Mr. C. S. Hudson, for the last two years Niagara Falls manager of the Bell Telephone Company of Canada, is being transferred to Montreal, as travelling supervisor of accounting.

Ottawa, Ont.

The offices of the Ottawa municipal electrical department are being moved on May 1 from their present location on Sparks Street to more commodious quarters on the southeast corner of Bank and Albert Streets. A large display room will be maintained at this latter address.

The city council have awarded a contract to the Standard Underground Cable Company for the supply of cable to the approximate cost of $10,600. The Herbert Morris Crane and Hoist Company will also supply two cranes.

Saskatoon, Sask.

Judging by the quantity of electricity consumed in the city of Saskatoon, commercial conditions are rapidly returning to their pre-war activity. The record for March of this year shows the largest amount of electric current used in the history of the city, with two exceptions.

St. John's, Que.

The contract for lighting Richelieu Bridge, connecting Iberville and St. John's, has been awarded to J. Bessette Company, Limited.

Strathroy, Ont.

The town council are considering the purchase of an electric fire alarm system.

Toronto, Ont.

The Trent Valley Power Bill, validating the purchase of the entire interests of the Electric Power Company in the Trent Valley district, has been approved by the Ontario Legislature.

Victoria, B.C.

The Honorable Lorne A. Campbell, addressing the annual meeting of the Victoria Board of Trade recently, promised in the near future a thorough investigation of the water power and irrigation possibilities of the province. It was hinted that the government may consider undertaking the development of certain water powers for distribution

Welland, Ont.

The Welland Town Council have been asked by the local Hydro-electric Commission to advance them another $40,000 for the erection of a new sub-station. At a recent meeting of the town council, it was stated that the Welland factory district was the largest user of electrical energy in the province, the amount being something over 73,000 h.p. A local company, it is stated, is now applying for eight to ten thousand additional horse power.

Weyburn, Sask.

A by-law recently carried in Weyburn, Sask., to expend $35,000 on extensions to the electric light plant. This will include a 500 kw. steam turbo-generator.

Whitby, Ont.

Tenders have have been called up to May 1 for the installation of an electric fire alarm system.

Winnipeg, Man.

Out of a committee of 32 appointed to look after the $500,000 Patriotic Fund at Winnipeg no less than five of the Captains were members of the Winnipeg Jovian Order.

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Generation, Transmission and Application of Electricity

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The Combined Use of Water Power and Steam

A number of water powers in Canada and especially at certain points in western Canada are running to waste today on account of their irregularity of flow. In other words, though the average flow is amply sufficient to supply the necessary power eleven months out of twelve, or possibly 360 days out of the 365, there remains that element of uncertainty about the remaining odd days that causes a municipality or company to hesitate about installing expensive hydro-electric equipment and tying themselves up with contracts that they probably would be able to keep, but possibly might not. The installation of a steam reserve as an auxiliary is of course always open for consideration, but here again the problem is an abnormal one and expensive at the best, as a guarantee of continuous service would mean practically a duplicate installation of sufficient capacity to handle the peak requirements.

An interesting article on this very point is printed elsewhere in the present issue, which indicates how a similar situation has been handled by a United States organization, the Pennsylvania Water & Power Company. The flow on this company's system varied from 1 to 250, and yet without the expense of installing new stand-by steam plant equipment, this company have developed their water power to a very high percentage of its maximum capacity and have been able to maintain a continuous service. This has been accomplished by making arrangements with existing steam plants owned by one or another of their customers with whom they have been able to make contracts covering the periods during which water power is available—plants that otherwise in all probability would have been scrapped and have brought their owner comparatively little. It is true these steam plants in many cases may not operate efficiently, but this becomes of less importance in proportion as the length of time—always short—they are used diminishes. Then, under proper administration, the more efficient steam plants are used first, and the least efficient only comes into service as a final resort and thus is operated for a minimum period of time. By such "methods of co-operation between customers and power company," to use the author's own words, "there will be permitted the development, on fluctuating rivers, of large water powers now difficult to handle financially." The paper will be found decidedly interesting to municipalities or companies situated as the Pennsylvania company found itself or contemplating operations under similar conditions.

Heavy Price Increases

The increased price of electrical material is engaging the attention of every member of the electrical trade at the present moment. Not only are the prices very much higher, but there is great difficulty experienced in obtaining material on short notice, and it would seem to be the part of wisdom for contractors to use all reasonable caution in laying in advance supplies. As an example of what the trade has to contend with at the present time, we quote the following letter which has been distributed by one of our largest manufacturing houses, to their clients, during the past few days.—

"On account of the great and constantly increasing difficulty of securing reasonably prompt deliveries of the raw materials entering into our varied line of products and the scarcity of both skilled and unskilled labor due to the large number of workmen in all trades who have enlisted for overseas service and the large number who have left their regular occupations and are now engaged on munitions work, a curtailment of output and the consequent lengthening of deliveries are inevitable.

"Furthermore, we wish to emphasize the fact that higher prices are also inevitable and will probably obtain for a very long time to come due primarily to the increased cost of raw materials, the scarcity of labour and the present embargo on shipments from Europe which makes us dependent on receiving supplies from the United States where the rise in prices during the past year has been unprecedented. As an illustration we submit the following table which shows the increases there from March 1915, to March 1916:

	Per cent.
Copper	100
Pig Iron	60
Tool Steel	600
Steel Castings	33
Forging Billets	150
Insulating Materials, Varnished Cambric, Mica Sheets	35
Steel Plates	300
Electric Steel	150
Tin	50
Lead	150
Brass	200
Spelter	300
Cold Rolled Steel	220
Ferro-Manganese	1000

The difficulty experienced in obtaining these materials should also be borne in mind. For instance bars and plates which a few months ago could be secured in 30 to 60 days now take from 9 to 10 months. Copper which we could secure in 30 days now requires 4 months, and shipping promises on cold rolled steel run well into 1917, and such orders must be entered without cancellation privileges.

"We are issuing this circular letter to our customers in order that they may thoroughly appreciate the extraordinary conditions under which Canadian manufacturers are now operating and may co-operate with ourselves and other manufacturers by anticipating their requirements as far ahead as possible and thus avoid the disappointments that will result if the placing of orders is put off until the apparatus or the materials are actually required."

Exit The Electric Power Company

The act to confirm an agreement between the Electric Power Company, Limited, and his Majesty the King, just passed by the Ontario Legislature, marks another step in the history of municipal ownership in that province. The Electric Power Co. is comparable in size, organization and scope of its operations with the Hydro-electric Power Commission of Ontario, controlling at the time of sale, March of the present year, 22 electrical companies operating in and around the Trent Valley district These companies are as follows:—

1. Auburn Power Company, Limited.
2. Central Ontario Power Company, Limited.
3. City Gas Company of Oshawa, Limited.
4. Cobourg Utilities Corporation, Limited.
5. Cobourg Water and Electric Company.
6. Cobourg Gas, Light and Water Company.
7. Eastern Power Company, Limited.
8. Light, Heat and Power Company of Lindsay.
9. Napanee Gas Company, Limited.
10. Napanee Water and Electric Company.
11. Nipissing Power Company, Limited.
12. Northumberland Pulp Company, Limited.
13. Oshawa Electric Light Company.
14. Otonabee Power Company, Limited.
15. North Bay Light, Heat and Power Company.
16. Peterborough Light and Power Company, Limited.
17. Peterborough Radial Railway Company.
18. Port Hope Electric Light and Power Company.
19. Seymour Power and Electric Company, Limited.
20. Sidney Electric Power Company, Limited.
21. Trenton Electric and Water Company, Limited.
22. Tweed Electric Light and Power Company, Limited.

The Act states that the treasurer of the Province of Ontario is authorized to issue debentures of the Province of Ontario, to the amount of $8,350,000, in payment for this property the debentures to bear interest at the rate of 4 per cent. The operation of the newly acquired property has been handed over to the Hydro-Electric Commission of Ontario.

Electrical Employers' Safety First Campaign

In pursuance of the campaign of "Safety First" publicity which has been inaugurated by the Electrical Employers' Association of Canada the secretary frequently distributes specific information to central station officials throughout the Dominion bearing on actual working experiences of one or other of the member companies. The following letter sent out a few days ago by the secretary of the Association, Mr. Wills Maclachlan, is typical of the useful kind of work this association is doing:—

In view of the fact that an electrical employee was killed recently by shock and resuscitation methods were stopped by a doctor after having been carried on for only about fifteen minutes, we would draw your attention to the following facts and suggest that these be strongly impressed on all your employees:—

1. In the case of apparent death from electric shock, the prone pressure method or Schafer method of resuscitation should be **immediately** applied. This should be done even although mechanical means of resuscitation are to be used later. The reason for this is that the first four minutes are of extreme value in resuscitation and it is never possible to have a mechanical device operating in this time.

2. Men should be trained in resuscitation and be required to practice regularly. This is for two reasons: First—The average man is afraid of an apparently dead person. Second—At the time when his skill in resuscitation is most needed he is under great strain and it is most likely that it is his mate who has received the shock. Through practice he will gain confidence and will be able to perform resuscitation coolly, even though under mental strain.

3. In regard to the length of time to continue resuscitation, we quote from the British Medical Journal of March 8, 1913, page 498: "The importance of getting to work with artificial respiration without a moment's delay has often been emphasized by those who have had experience with electrical accidents. No less important is the necessity for continuing artificial respiration until **it is certain** that death has occurred; nothing less than cooling of the body or the onset of rigor mortis should be considered to be evidence of death here."

We would ask that you acknowledge receipt of this letter, giving at the time any comments on resuscitation you wish. We cannot impress upon you too strongly the necessity for having men practice resuscitation regularly as from our knowledge of the industry we can safely say that not more than 10 per cent. of the men connected with the industry are capable of performing resuscitation in an efficient manner.

Yours very truly,
Wills Maclachlan,
Inspector.

Treatment of Telephone Poles

At a recent meeting of the American Institute of Electrical Engineers, a paper was presented by E. L. Rhodes and R. F. Hosford, on recent results obtained from the preservative treatment of telephone poles. The paper covered the experience with treated poles over a period of eighteen years in the plant of the American Telephone & Telegraph Company and their associated companies, in the use of distillates of coal tar or wood tar for preservative treatment. The experience also covers several typical processes for applying the preservative, which served to show the varied possibilities through the choice of methods for applying the different materials studied. The paper further includes figures covering the rates of decay, increase in life by treatment, effect of seasoning, characteristics of the damage to poles caused by decay and by insects. The authors sum up the results of their experience in the following conclusion:—

"Because of the present incomplete stage of our experience with the different types of treatment described, conclusions can be reached for only a part of the problems whose solution was sought. The seasoning of poles offers at best only moderate advantages in the way of increased life. Its greatest value is as a preparation for the successful application of preservatives. The practise of applying to poles preservatives high in antiseptic power and insoluble in water has been shown to yield increased life. The amount of preservative applied and the depth to which it is made to penetrate appear to exercise controlling influences upon the results obtained. Mechanical failure of the treated layer is indicated as the principal limit to the effectiveness of light applications of preservatives."

Toronto Branch A. I. E. E. Resuscitated

The Toronto branch of the American Institute of Electrical Engineers held an organization meeting on Friday May 5 and appointed officers for the ensuing term as follows: Mr. E. T. Brandon, chairman; Mr. E. M. Ashworth, vice-chairman; Mr. Wills Maclachlan, secretary; W. G. Gordon, A. H. Hull and T. M. DeBlois.

The Fire Department of the city of Quebec have received tenders for a storage battery plant, switchboard, and the necessary auxiliary equipment.

LETTERS TO THE EDITOR

The Engineers' Opportunity

Winnipeg, May 4, 1916.

Editor Electrical News:—

Your editorial entitled "The Engineers' Opportunity" in the May 1st issue of the "Electrical News" should give all engineers who are proud of their profession, and interested in the welfare of their country, serious food for thought. Much has been written and much has been spoken on the status of the engineer, the engineer's responsibility to society and the education of the engineer; but it is not often that we have the privilege of reading anything on the subject of the engineer's place in the legislative halls of his country. We hear it talked about, yes, and I believe where engineers worthy of their profession are gathered together, unconsciously the subject is voiced and arguments pro and con are advanced, but due to their ingrained modesty, engendered maybe somewhat by the fact that they are in closer contact than other men with the stupendous forces of nature, they are somewhat diffident in pushing themselves into the limelight of publicity and its attendant light and shadows. No one will deny that the two greatest factors in the advancement of civilization to its present stage, namely light and transportation, are the product of the engineer, and yet, owing to the modesty of the engineer coupled with the traditional reverence of the mass of humanity for the clergy, the doctor, and the lawyer, the engineer has not so far, except in very rare instances, penetrated to the administrative circles of the community in which he lives.

The clergy, lawyers and physicians are not the whole incarnation of civic wisdom, nor the only storehouse of potential thought concerning the problems that confront mankind and human progress. The status of these and other professions have been raised to their present level, in a very great measure, by the fact that members of these professions have given their time and their ability to the solution of public questions. The engineer can do likewise, and putting aside the question of the professional status altogether in this instance, it is the duty of the engineer if he wishes to leave the world better than when he entered it, to give more of his time to public affairs; to the analysis of local questions, where his advice and help would be of eminent use, and to the greater questions of Dominion Administration.

Without casting reflections in any way on individuals who have governed the affairs of this country in the past let us take the position of Minister of the Interior for the Dominion of Canada. What type of man could give better services and greater honour to his own profession in this responsible cabinet position than an engineer of Dominion-wide experience, forethought, resourcefulness, and imagination—the last of which is perhaps the greatest of all? No large schemes, projects, or economical national benefits were ever achieved except from the initial impetus of the imagination of some great mind.

When we criticise the political conditions of a country we are told that we obtained the government we asked for; that we have it in our hands to appoint men to legislative positions, and that if we are not satisfied we can remedy same at the next election. This to a great extent is very true, but we must go a step further and if the material really needed for election is not forthcoming it is up to the electorate to try and produce the right material for representation.

Engineers have for so long remained in the background regarding administrative affairs of their country that the public have not been taught to look on them as their representatives, hence the initial step should be taken by the engineers themselves.

A great percentage of the work undertaken by municipal councils, provincial parliaments and Dominion bodies is of a nature demanding the solving of engineering questions and were the engineers among these bodies, millions of dollars would be saved to the electors besides which, more efficient results and greater advancement to the comforts and convenience of the public would result. Years ago Tregold gave a definition of engineering which stands today; namely that "Engineering is the art of directing the great sources of power in nature to the use and convenience of man." In the great struggle going on at present in Europe the instruments of destruction, both on land and sea, are the product of the imagination and brains of the engineering profession, and in no small degree will it be the engineer who will be responsible ultimately for the destruction of a terrible and tragic ideal of the relation of nations as created by the common enemy whom the Allies are endeavoring to crush.

Surely among engineers there are public spirited men who would be only too glad to give their services to their country, even as men of the other professions have done.

The engineering societies should take up this question of public service and discuss among themselves the advisability of urging some of their best men to place themselves in the ranks of candidates for civic positions or the various parliaments.

In the last analysis of this world struggle, efficiency in all branches of service, involved will win the day, and when the war is over and Canada amongst other portions of the Great British Empire reviews its economic and human losses, and realizes that economy and efficiency to the last straining point will be needed in the coming days of reconstruction, then surely it will be the duty of engineers to do more than work under the supervision and advice of others, who are often far less fitted by their walks in life to create and govern public enterprises.

Engineers, by the very fact of their working close to, and in harmony with the forces of nature are primarily men of integrity and honesty of purpose, and if ever the time was apparent for honesty in the public life of Canada, it is the present, and will be even more so when reconstruction days come upon us.

The premier engineering society of Canada numbers among its members men who have the handling of probably most of the engineering work throughout this great Dominion. Some of these men by their very education, their experience, and by the fact that their work is of a positive nature and not negative, are surely fitted by the exactness and honesty that their profession demands from them to give their ability to a broader and greater sphere of administration.

Yours very truly,

Charles F. Gray.

The Power Commission Act Amendments

Toronto, May 2, 1916.

Editor, Electrical News:—

Dear Sir—On Page 40 of your issue of May 1st, we note an article entitled "Amendments to the Power Commission Act, which directly affects the contractor and dealer." We would draw your attention to alterations which have been agreed to by the Government in the wording of Clauses 6 and 7. You quote these clauses as they appear in the original draft of the bill.

It will be seen by reference to Clause 6 that "Every Municipal Corporation or commission and every company, firm or individual supplying electrical power or energy for use in any electric works, plant, machinery, apparatus, appliance or equipment before the same has been inspected and such supply authorized by the certificate of the Commission shall incur a penalty of not less than $300 nor more than $500."

According to the exact meaning of this terminology, if the writer purchased a toaster in Montreal and attached it to his house service and such toaster had not been inspected and approved by the Power Commission, the Company supplying the electrical energy to the house in question would become automatically liable to the penalty.

It happened, curiously enough, that copies of this Bill were not distributed until the day before it was finally adopted. There was consequently very little time for action. The phraseology of this clause was, however, so manifestly extreme that it became a case for very quick action. We were successful at the last moment in having the clause altered so that it now reads—"Every Municipal corporation, etc., supplying electrical power or energy for use in any electrical works, appliance, etc., before the same have been inspected and after notice from the Commission of the unauthorized supply or use, shall incur a penalty, etc."

Clause No. 7 stated further that "the penalty was to be incurred by every municipal corporation, company, firm, etc., which refused or neglected to disconnect or discontinue the supply of electricity to any electric works, plant, appliance, etc., without notice in writing from the Commission so to do." We were successful in getting the wording "Without notice from the Commission" changed so as to read "Upon due notice in writing from the Commission."

The above may at first blush appear to be a trifling concession but, as a matter of fact, it amounts to a good deal. As the Bill first read any customer of a company supplying electrical energy might quite unwittingly subject the electrical company to a fine of $300 to $500. It is obvious that those who supply energy have only a small control over the method of its use. A more equitable arrangement would be one by which the user of the current laid himself open to penalty in the case of the violation of such a rule as this. A half a loaf is, however, better than no loaf at all.

I am, dear Sir,

Yours very truly,

Alan Sullivan,

Secretary-Treasurer.

Canadian Electrical Association.

The Economical Use of Water Powers

Having a Widely Irregular Flow—Combination with Existing Steam Plants—Proper Organization an Important Feature

By John Abbet Walls, before A. I. E. E.

To secure the most effective combined operation of steam and hydraulic power is a problem that has engaged for the past few years the serious attention of the Pennsylvania Water and Power Company. This company has built a hydro-electric plant at Holtwood, Pa., on the Susquehanna River only 25 miles from its mouth. This station has, at present, a capacity of 83,000 kw. The river flow fluctuates in erratic fashion, being subject to sudden and unseasonable variations from one-eight of that required for full power house output to a maximum flood of 250 times the low flow. Fig. 1 shows the daily discharge of the river at the power

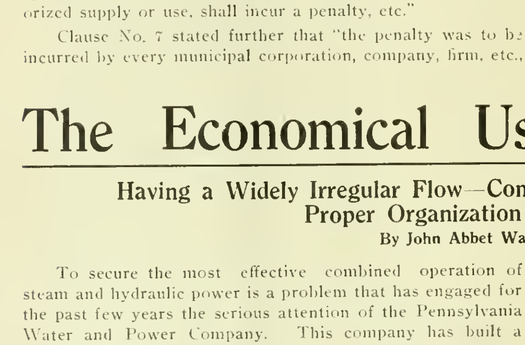


Fig. 1.

development over a year period and indicates the lack of dependable regularity in flow.

Rather than incur investment charges on equipment installed in advance of the time of there being load sufficient to justify its use, the hydraulic plant was so laid out as to permit of extensions being added on the unit plan as they were required and the problem has been to determine, from estimated load growths and from the hydraulic and power contract conditions, the proper division of load between steam plants and hydraulic station, and the resulting advisability of additions respectively either to hydraulic or steam equipment By appropriate conduct of its operation the company has felt itself warranted in adding to the hydraulic installation from time to time and in utilizing more and more of the possibilities of the river, until now the installed capacity is eight times the low water flow.

Taking up the question of how such full utilization of an erratic river has been brought about it must be noted, first, that the power company though not itself owning any steam equipment has yet been able to make appropriate arrangements with the customers, who possessed steam plants of more or less modernity at the time the contracts for the supply of hydroelectric power were entered into. The power customers are few in number and are large electric railway and distributing companies so that the hydraulic company may be considered as practically a wholesaler of hydroelectric energy. The various contracts for power differ considerably from each other in their essentials; hence, there might be said to have been obtained for the power company the benefits of a diversity factor from the power contracts themselves, as well as from the power loads.

The experience obtained from comparing the workings of these different types of contracts was of benefit when it came to provide for the sale of additional hydraulic power to the customers, for in the beginning, a natural distrust of the reliability of hydraulic power manifested itself in provisions which contemplated substantial steam standby and steam generation.

During the period of tuning up a new hydraulic installation, which period may be more or less extended, such precautions are quite justified. Gradually, however, as the hydroelectric service improved, or as the customers gained confidence in the reliability of such service, the maintenance of extended steam standby conditions with banked boilers and heavy operating force, and generation by steam, became less and less necessary. Without going into details, as it is a rather voluminous subject in itself it may be sufficient to say that by continuous experimenting, test runs, surprise drills, improvements in equipment and methods of banking boilers, laying fires, retaining heat, etc., the stand-by arrangements were made more effective while at the same time the stand-by was reduced in cost.

All this was preparatory to making it possible for the hydro-electric company to take up effectively with the customers the question of shifting over onto the hydroelectric plant more and more of that power load originally left outside of the power contracts

Looking at a sample daily load diagram, Fig. 2, representing total customers load, there is a limit, to the amount of load for which the hydroelectric company is justified in installing equipment to carry for that particular shape of

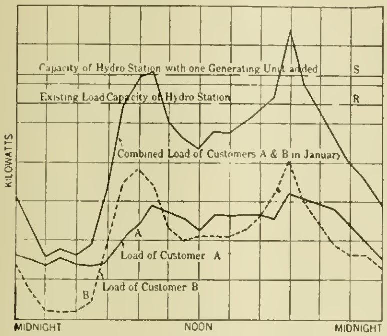


Fig. 2.

load curve. This is represented by the line marked R. If the hydroelectric company installs a unit of additional equipment enabling it to carry additional load included between the load line R and a greater load line S, then the income from carrying by hydraulic power such additional kilowatt-hours must be sufficient to cover the interest, depreciation, profit and operating charges on the additional equipment necessary. But the additional kilowatt-hours which may be so carried, vary from day to day with minor changes in the shape of the load curve. Then, due to seasonal effects on diversity factor, the shape of the load curve changes materially, progressively increasing and diminishing the possible kilowatt-hours in the load. An example of modification in shape of curve of combined loads of two customers, due to seasonal changes only, may be noted by comparing Fig. 2, where in January there is a high peak in the afternoon and Fig. 3 where only two months later the maximum load comes in the morning. Unanticipated industrial conditions affecting the general growth of the load would also have their influences. Again, even if the load should be actually available in accordance with the number of kilowatt hours estimated, still the river flow necessary to carry it may be lacking from time to time, and this must be allowed for. Then too, must be determined the saving in steam costs for the block of kilowatt-hours, and as this is represented by deducting the cost of generating by steam all energy above line S from the cost of generating by steam all energy above line R, and making due allowance for difference in stand-by costs resulting therefrom, it is necessary to make experimental steam runs to obtain this data sufficiently accurately, since we are concerned even with small differences in cost.

All this involves fullest co-operation between customer and power company in making the test runs, figuring out the costs, and making comparisons, before we arrive at a point where the operating data showing most effective combined operation are ready to be passed upon by those who are to decide as to whether the savings or profits involved are worth making. Of course there are many factors entering into such a determination. For example: the steam man must decide if he will thereby carry some labor which he cannot employ effectively in maintenance work or otherwise, but must have always available and which labor, by occasional idleness may deteriorate; and for example, the hydraulic man must decide to what extent he can depend upon using his spare equipment to carry occasional kilowatt-hours; hence, it is possible to work out the most effective method of combined hydraulic and steam operation only by effective combined efforts of both the steam and hydraulic representatives.

The above is concerned with generation under good river stage conditions. With low water new conditions arise. Fig. 4 shows a case of steam generation by two stations during low water. Steam station X ran at high load factor to get economical steam consumption; steam station Y carried its load as a peak during the afternoon hours. One would judge the latter form of low load factor generation to be inefficient as compared with the run of station X. But, as dictating the form of steam load carried, other factors may enter, such as the desirability of generating during only one shift, loading up to the capacity of only the most efficient generating units, assisting on the peak to cut down transmission line losses, exigencies of load dispatching due to equipment out of service, etc., and occasionally, contract provisions which when enforced prevent most economical combined operation.

In the steam stations themselves, the most efficient apparatus—usually that apparatus of largest capacity—is put first into operation and if the river flow continues to decrease, then, as is needed the less and less efficient equipment. To a certain extent this same scheme is carried out in connection with the different steam plants. Those steam plants where owing to one condition or another the kilowatt-hour cost of steam generation is high are brought into operation only after that equipment in the other stations, which gives lower kilowatt-hour costs, is fully loaded.

Ultimately these may become mere matters of load dispatching but first they must be worked out from the cost standpoint and provided for by contract understandings between customers and power company. The possibility of making a fair profit from steam generation during low water from otherwise idle steam equipment serves as an incentive for the steam man to experiment with various methods of steam generation in the endeavor to reduce his kilowatt-hour cost of generation sufficiently to secure in open competition the maximum possible kilowatt-hours of load and the maxi-

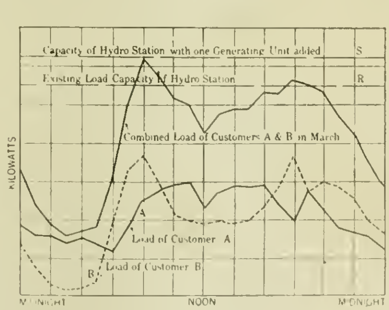


Fig. 3.

mum total yearly profit therefrom. It is almost impossible at the time of drawing up a power contract to fix a hard and fast rate for a large and irregular supply of steam generated power, for if the price of such power is made high enough to cover almost any conceivable condition of steam generation which might be called for, then that price is too high for effective ordinary use, and naturally the supply will be obtained from other sources. It is equally difficult in the face of changing costs of coal, and labor, of gradual obsolescence of installed steam equipment, of improvements in the art of steam generation, and of a lack of knowledge of future conditions of power supply and demand, to provide rates and delivery specifications equitably to apply against future transfer of portions of steam load to the hydroelectric station. Rough figures can be estimated, but it is the lack of that exactness fatal to maximum efficiency and inherent in such guesses that prevents the getting out of the situation all that there is in it both for the customer and for the power company.

Naturally, the contract understandings may play a part in determining the hydroelectric plant design. For example; when steam is available to carry the tips of the load peaks, the additional equipment, as purchased, is designed to carry continuously the full output of the turbines less allowance for governing, instead of being given a peak rating.

In general the loads of the customers at the time of making the power contracts had nearly reached the limits of capacity of the customers' steam plants, but additions have been made since not only in hydraulic equipment, but also in steam equipment. It has not been found necessary for the hydroelectric company to have a steam plant of its own; rather the idea has been to work out a use for the steam plants which the customers possessed at the time of making the power contracts, and since the very lowest flow in the river does not last for a long time, it is possible to figure upon using even very inefficient and out of date steam equipment for these short periods, thus making useful, steam equipment which otherwise would possibly long ago have been scrapped.

Where the load is that of a few large customers having already a certain amount of steam equipment, and where it is not practicable to work out a system of combined primary,

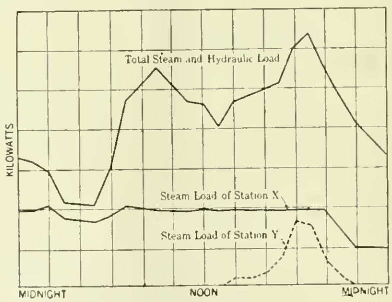


Fig. 4.

secondary, and surplus power supply of general application to all customers, it is believed that by such methods of cooperation between customers and power company, there will be permitted the development, on fluctuating rivers, of large water powers now difficult to handle financially.

Certainly it is felt that in this particular development a still further portion of the river flow will be made use of, as the load demand grows and provision has been made for additions to the present hydraulic installation, awaiting only such load growth for the additions to be gone ahead with; and all this has grown out of the appreciation by the customers and the power company of the advantages of getting together and of each viewing a power contract in the light of a business opportunity and not as the final word in a power deal.

We may look at a power contract somewhat in the light of a transmission gear of an automobile, linking together the driving element and the driven wheels. There is a tendency so to look to the desirable qualities of a strong and firm connection that one is apt to prescribe a bolted coupling rather than that sort of a transmission gear, which will allow some little flexibility to meet the changed conditions of running with which one necessarily meets in practise. It is true that one does not want slackness and that one cannot forsee the change and development which may take place in operating conditions, nor allow for them specifically, but for just this reason it is advisable when drawing up the contract to have this in mind and by permitting, encouraging, or providing for steps towards more effective combined operation make future benefits therefrom not only possible, but highly probable.

Asking for New Franchise

The Sherbrooke Railway and Power Company has written the City Council asking for a new franchise under certain conditions and making alternate proposals. The conditions include the payment of percentages on gross earnings of the street railway, ranging from 2 to 4 per cent. in lieu of payments for road work; re-routing the system, together with such extensions to be operated as will be decided upon by a joint committee composed of representatives of the city and company and a street railway expert to be appointed by the city; the city to finance such extensions for five years, the company paying five per cent. interest and 2.10 per cent. sinking fund for 25 years; should the extensions not yield 7.10 per cent. the city to pay the company the difference between the net revenue of the extensions and the 7.10 per cent. The company, as an alternative, will sell the railway to the city for a price to be fixed by arbitrators, or for $250,000 in 5 per cent. city bonds; or will lease the railway to the city for 25 years for a semi-annual payment of $9,000, the railway becoming the absolute property of the city at the end of the period. The city is to remove all restrictions regarding the sale of power by the company.

The Placing of Street Poles

The Montreal Council has requested the Board of Control and the Legislation Committee to study without delay the question of the placing on the streets of the poles of the public utility companies. The resolution suggested that the Council should have greater power over the placing of the poles; whether the Legislature should be asked to force the companies to place the wires on the same poles and so avoid the duplication of poles; and to force the companies to erect the poles in lanes instead of in the streets. The controllers and committee are also asked to study "what means should be taken by which the city should not have to expropriate overhead equipment at its own cost when underground conduits are established, and to get the delay extended by which the city may expropriate, without paying an indemnity, the poles and wires of certain companies."

New Books

Elevators—by John H. Jallings; American Technical Society, Chicago, publishers. This is a practical treatise on the development and design of hand, belt, steam, hydraulic and electric elevators, written by an author who has had nearly fifty years of actual experience in elevator building and who has been a witness of all the wonderful changes that have taken place during this time, as well as a contributor to the development of many of them. The book is divided into three sections; part one deals with hand-power elevators, belt-power elevators and worm and gear; part two deals with steam elevators, and hydraulic elevators; part three, motor elevators. As the available literature on elevator construction and design is very meagre it is believed that this volume will find a popular place in the elevator field and satisfy a real demand. 217 pages; well illustrated; size 8½ x 5½; bound in red cloth.

The Montreal and Southern Counties Electric Railway has commenced a regular schedule between Montreal and Granby. Express trains make the distance in two hours, while local trains do it in two hours and forty minutes.

New Home of Ontario Hydro Commission

Handsome new structure on University Avenue, Toronto—Quarters befitting this important organization—A model of electrical equipment

Owing to the rapid increase of the business, and therefore of the staff requirements of the Hydro-electric Power Commission of Ontario, it was found that the old quarters in the Continental Life Building were too congested, and the Commissioners decided in 1914 to erect a new office building. The building is situated just below College St., with the main facade facing on University Avenue directly opposite the General Hospital. The architecture is simple classic, Greek design; front elevation, cut stone, with side and rear walls, brown pressed faced brick, cut stone window caps and sills. The feature of the main facade is an artistic portico with an arched roof, with a cast stone plate bearing the commission's name. Surmounting the portico are four large Ionic columns flanked by end pavilions, supporting an extended stone coping, the whole supporting the top or sixth storey.

Immediately under the portico is the main entrance, with its double doors of solid bronze. The entrance hall has a floor of white Renfrew marble with a dado of Bancroft white marble. All doors off this main entrance are solid bronze.

The heating is by the forced hot water system, two large self-feeding Spencer heaters, burning buckwheat coal, supplying hot water. The water is forced up throughout the building by two centrifugal pumps, operating one at a time or both in parallel, driven by two 2 h.p., 220 volts, 3 phase, 25 cycle, motors. Fuel room for the heaters is underground outside the building, and has a capacity for one car load of coal. There is a steel stack on the west side of the building in connection with the heaters.

There is also in the basement a private and a main dining room where lunch will be served for the employees; these rooms are separated by three large sliding doors which may be opened out for banquet purposes. There is also a large sitting-room adjacent to the dining room, and the necessary kitchen, which will be electrically fitted and operated, besides the pantry and refrigerator. Filing and stationery storage rooms, and a large vault room, take up the remaining basement floor space.

First Floor

The first floor, with the exception of the toilet and the switch board booth, is used entirely by the Accounting and

New Administration Building of the Hydro-Electric Power Commission, University Avenue, Toronto.

Filing departments. The accounting department occupy two large rooms to the right and left of the main entrance, and the filing department occupy the rooms in the rear of the building. The files are steel, five files high single with room for doubling, set in rows of eighty. Files may be despatched to any floor by means of an automatic dumb waiter.

Second Floor

The second or executive floor contains the Board Room on the north west corner with a private office connected for the use of the Commissioners, Chairman's office and committee room connected to the Board Room by a private passageway, Chief Engineer's and Secretary's offices, and also a library and conference room. This floor throughout is finished in mahogany-finish, hollow steel doors and trim, with cork linoleum, cemented directly to the concrete, in the main corridors and hall-ways. The Board Room is finished with wall panelling, mahogany dados, oak floors, and beamed ceiling. Chairman's and Commissioners' rooms are finished in solid mahogany with oak floors.

Upper Floors

The upper floors, which are all very similar in floor plan, contain the Municipal, Purchasing, Operating, Railway, Hydraulic, Station Equipment and Building, Line Construction and other departmental offices and drafting rooms, all arranged for maximum efficiency. These storeys are finished in Circassion walnut, hollow steel doors and trim. All floors with the exception of the ground floor have a drinking fountain at the head of the stairs.

Electrical Equipment

Electric power for lighting and power is furnished by the Toronto Hydro-Electric system at 2,300 volts, 25 cycles, which is reduced to 230 and 115 in the transformer room. This room is a cement underground building on the north west corner of the building, and opens into the boiler and switch board room in the basement. There are three 30 kw. 2,200/230 v. Crocker Wheeler transformers for power, and two kw. 2200/115 v. transformers for lighting; besides these are the storage batteries for the telephone system.

From the transformer room cables are led underground through conduit to the switch board in the north end of the basement, which consists of two 18 in. panels 8 ft. high, and 2 panels 24 in. wide, 8 ft. high, black slate. The board has a high tension volt meter, 3,000 volts, a 400 kw. watt-hour demand meter; two ampere meters, one for the total load and the other connected to measure the load on any circuit by simply plugging in the circuit to be read. Two oil breakers and four, single phase, overload relays, complete the equipment on this half of the board. On the other half are the switches for the different circuits—elevators, vacuum motor, pumps, lights, dumb waiter, blueprint room, etc. The switchboard equipment is Canadian Westinghouse.

A vacuum cleaning system, pump operated by 3 h.p. C.G.E. induction motor, has three outlets on each floor. The system is automatically controlled from all floors and may be started from any outlet in the building at the will of the operator, simply by pressing the button beside the outlet which closes the switch on the switch board and starts the motor. There are two bronze elevators, electrically lighted and motor driven.

A novel system about the building is the automatic dumb waiter. This waiter runs in a flue, back and west of the main halls, which contains all cables, wires, pipes and plumbing outlets of the different floors The waiter is automatically controlled from the ground floor by push buttons. On the request for files from any floor, they are put on the elevator and despatched simply by pushing the button corresponding to the floor. The elevator goes up to the desired floor, stops and turns on a bulls-eye light in the door. Opening any door on intervening floors automatically stops the elevator and thus prevents accidents

Lighting Fixtures

Lighting outlets are lavishly installed through the whole building Halls and corridors have semi-translucent, completely closed in, shades, while offices have semi-indirect lighting. The Board Room has a handsome, bronze, candlestick chandelier Every office is equipped with four base board receptacles for electrical appliances. Dark rooms are automatically lighted on opening the doors.

Telephone and Signal System

An automatic telephone system, the Presto-phone, with 100 unit switchboard in the basement operates in connection with the company's private lines over the distributing system and the private lines to the store house and stock room; this system was installed by the Canadian Independent Telephone Company. The offices are also equipped with the Bell system. A signal system is also installed throughout the building; this is operated from a small transformer.

Characteristics of Gas Filled Incandescents

By Mr. J. E. Klein

Probably the most satisfactory way to explain the working of the somewhat new type of metal filament lamps which have the filament burning in an inert gas, is to compare them with the older type in which the filament is burned in a vacuum, with which older type I assume you are all more or less familiar.

The effect of the gas is to hinder vaporization of metal from the filament thus enabling us to burn the filament at a higher temperature with the same vaporization of metal from the filament as would take place in a vacuum at a lower temperature. The amount of light emitted from the filament rises very rapidly with increase in temperature, and as watts input is for small variations in temperature only a little more than proportional to the temperature, it follows that the efficiency in watts per candle power is very much improved by increasing the temperature. The candle power varies as the thirteenth power of the temperature at 4 watts per candle, and as the tenth power of the temperature at one half watts per c.p.

In order to fully understand the gas filled lamps, it is necessary to analyze the causes of failure in vacuum and gas filled lamps. The vacuum lamp, (except in the smaller sizes) owing to metal vaporized from the filament, coats the bulb with a dark deposit, which pretty well covers the bulb. When this dark coating becomes thick enough to absorb over ten per cent. of the light, further deterioration is accelerated by heating of the bulb, due to the energy absorbed, and the lamp is uneconomical compared with a new lamp, and should be replaced. This point should be reached in about 1000 to 1500 hours. A lamp that burns longer than 1500 hours and remains clear, has been burned at an uneconomically low efficiency, while a lamp that burns to the throw out point in less than 1,000 hours is either a bad lamp or has been burned at too high an efficiency. Burning tungsten vacuum lamps over 2,000 hours is not economy, but

*Production Manager, P. H. Klein Co., Montreal.

laziness, unless the replacement involves extraordinary difficulties.

The gas filled lamp however behaves quite differently. In this type of lamp the metal vaporized from the filament is carried by currents of gas to the upper part of the bulb, where the deposit obstructs the light very little; moreover the deposit is generally of a lighter color than the pure tungsten deposit in a vacuum lamp, as it largely consists of nitride of tungsten, which is brownish. A gas filled lamp therefore would not have its bulb obscured in the working portion, the lower two-thirds) at anything like the rate of a vacuum lamp, and generally the filament will burn through before the bulb is dark enough in the working portion to obscure the light more than 10 per cent.

Effect of Size of Filament on Efficiency

While in a vacuum lamp the efficiency depends only on the temperature—filaments of different sizes running at the same temperature giving the same efficiency—the efficiency of a gas filled lamp varies with size of filament at the same temperature, because the proportion of energy lost by conduction through the gas is less with larger filaments. Filaments of vacuum lamps are run pretty nearly all at the same temperature. The larger sizes may be run at a slightly higher temperature, but in general they are all run in the neighborhood of 2050 degrees cent.

Gas filled lamps operate at a much higher temperature, the ½ ampere filament would be run at about 2380 deg. C with an efficiency of 0.9 watts per c.p. A 10 ampere filament at the same temperature would have efficiency about 0.75 watts per c.p. and a 20 ampere filament 0.7 watts per c.p.

But as the obscuration of the bulb is not the determining factor, the total amount of tungsten vaporized may be larger in larger filaments, because it takes a larger amount of metal to reduce a large filament in the same proportion to its diameter as a small filament. The larger wires are therefore run very much hotter, a 20 ampere filament for instance would be run at about 2600 degrees, with an efficiency of 0.4 watts per c.p.

Please notice that efficiency of gas filled lamps can hardly be directly compared with that of vacuum lamps. The distribution of light is very much more advantageous, and the total light is larger compared with the horizontal candle power than in vacuum lamps. A vacuum lamp has a spherical reduction factor of about 78 per cent. a gas filled lamp of 90 per cent. A safe comparison would be to give the gas filled lamp an advantage of 15 per cent. in your calculations. This would not take into account the difference in color where this is an advantage.

A condensed table of practical operating efficiencies on circuits of good regulation, for the different current consumptions, is as follows:—

Ampere	Watts per c.p.
0.5	0.9
1	0.82
2	0.80
3	0.75
20	0.45
5	0.70
6.6	0.68
10	0.60

For circuits of poor regulation it would be better to burn lamps rated a little higher in voltage. Life of lamps at these efficiencies should be about 800 hours for 0.5 ampere, 1,300 hours for 6.6 ampere, 3,000 hours for 20 ampere.

You can see from these figures that the lamps for higher currents are very much better lamps. To get better efficiencies we can either reduce the voltage, using low volt high current lamps, or use larger units and less of them. Reduction of voltage with corresponding increase of current will improve efficiency until about six volts is reached. Then the terminal losses will use up the gain in efficiency.

Street Series Lamps

The fact that gas filled lamps will give a good efficiency at currents used for arc lamps, makes them very serviceable for use in street series constant current circuits. At first they were put into places where the full power of an arc was not required, but they have proven far superior to the arcs on account of steadiness of light and elimination of trimming, and are gradually replacing arcs for this service.

Owing to terminal losses, and losses in the line itself, it is hardly advisable to use street series lamps of less than 100 candle power. For ordinary small variations of current they are no more liable to trouble than the vacuum type street series lamps.

In multiple lamps, gas filled type, the effect of raising voltage on life may be stated, as that 6 per cent. increase of voltage steady will cut the life in half. As the variation of the current in street series lamps brings a double variation of voltage, a 3 per cent. increase of current will have this same effect. Gas filled lamps are however more sensitive to surges in current than the vacuum street series lamps, because they are burned 400 degrees closer to the melting point. 75 per cent. increase of current will burn out the lamp in about 2 seconds, 100 per cent. increase in about 1/5 second.

This surging in street series circuits is generally caused by an ignorant and careless switchboard man. A street series circuit is governed by a constant current transformer, generally with one movable coil, counterweighted. When the circuit is open, the movable coil will drop to the maximum voltage position, and then if the current is switched on, the voltage will be as high as the transformer will give. It will take the coil a little time to rise, and the lamps would be damaged. A careful and intelligent switchboard man will hold the counterweights down while he closes the switch, and let the coil fall gradually. Then the current will start low and rise gradually to the proper value, and no damage will result.

Position of Burning

It is always advantageous to have lamps so constructed that they will burn in any position. Few manufacturers seem to have paid any particular attention to this important point, and I find that there is no make of lamp of which all sizes will burn in any position. Our own lamps are made to burn in any position up to and including the 300 watt size in normal volt, 500 watts in high volt, and 400 c.p. in street series. We expect to adapt other larger sizes progressively as the technical difficulties are overcome.

Heating of Bulb

The bulb of a gas filled lamp runs hotter than a vacuum lamp, and this makes several precautions necessary. It is necessary to make them with a long neck on the bulb to keep heat from loosening the base of the lamp and also from heating the socket which generally has paper insulation. It is also necessary to avoid blanketing the bulb by tight fitting shades and totally enclosed globes. By making the fixtures so that air can circulate upward and out through it, the bulb will be cooled and overheating avoided. The exact amount of ventilation depends on the size of lamp and the amount of heat that must be dissipated. In general, a good rule is "safety first," namely, give them all the ventilation you can.

Concentration of Filament

The filament is concentrated to avoid as far as possible loss of heat to the gas. This shortens it and makes it possible to obtain a number of advantages for special forms of lighting.

Color of Light

The color of the light owing to the higher temperature is much whiter and better for commercial lighting where colors are displayed. It is also more actinic, in fact moving pictures can be taken with two 1,000 watt lamps in suitable reflectors.

Best Methods of Grounding Electric Systems

Effects of grounds to water pipes, driven pipes and plates—Regulations for grounding methods embodied in National Electrical Safety Code

At the Engineering Conference held at Atlanta, Ga., May 4, a paper on the grounding of electrical systems prepared by the Bureau of Standards was presented in which methods for the protection of persons and property against electrical dangers were reviewed. We are indebted to the Electrical World for the following resume of the paper:—

It was pointed out that one of the most important sources of danger is that due to the close proximity between high-voltage and low-voltage circuits in transformer windings, on pole lines, in manholes, and other places where, because of lack of space or for other reasons, it is necessary to place such circuits near each other. The actual hazard in this case arises from the entrance of voltage and current from the high-voltage circuit upon the low-voltage circuit through faults in insulation, contacts between wires and the like. Much can be accomplished when installing such low-voltage circuits to make them safe by grounding the circuits themselves and also the non-current-carrying parts of many forms of electrical equipment. Where low-voltage circuits are fed from high-voltage alternating-current distribution circuits through step-down transformers, leaks in transformer insulation are caused in most cases by lightning striking the line and puncturing the insulation between windings. Contacts between wires result from storms, electrical accidents to cables, and other causes. While improvements in lightning arrestors, transformer insulation and construction of lines and circuits, have reduced the possibility of danger to a large extent, complete protection is not yet obtainable. Where a failure of insulation or where contact between high and low-voltage wires occurs there is danger to persons coming in contact with lamp sockets and other appliances, for if the low-voltage circuit is insulated from earth, or even accidentally grounded through a high resistance, a difference of potential between low-voltage circuit and ground may exist, of which the value may range anywhere up to the full voltage of the high-voltage line, depending upon the conditions of the cross between the circuits involved. Even with the high-voltage line thoroughly insulated at all points except the one where failure has occurred, the current flow to ground, due to electrostatic capacity effects, may be sufficient with a few miles of line to be dangerous to both life and property. These dangers can be practically eliminated by connecting low-voltage circuits and the non-current-carrying parts of electrical equipment and apparatus to earth through a low resistance. That is, a current may easily pass from the low-voltage circuit into the earth in case of an accident to insulation. If the resistance to flow of current is low enough, a dangerous voltage cannot exist between low-voltage circuit and ground.

Grounding to Water Pipes, Driven Pipes and Plates

It was emphasized that the most important question connected with grounding schemes is that of obtaining a low value of resistance for the earth connection. Electric circuits can be grounded, by utilizing water pipe systems, driven pipes or buried plates. However, water pipes easily come first in point of desirability. In the first place, on account of their great extent they offer but little resistance to flow of current away from them into the earth, the resistance of water pipe earth connections being found to be but a fraction of an ohm in most cases. A resistance of 2 ohms would be extraordinarily high. Where these low resistances are found the pipe joints for a considerable distance from the earth connection must give as good metallic contact as will ordinarily be found with lead or screw joints. In the second place, water pipes are easily accessible at service pipes or other places, and in the third place, it can be shown that with certain precautions covered in the wording of the rules of the national electrical safety code all possibility of damage to the pipes, or injury to employees of the water company, can be easily avoided.

With driven pipes or plates, a certain degree of protection may be obtained, and in the case of small transformers or lines of limited capacity the protection thus obtained may even be ample. As the kilowatt capacity of the lines and transformers increases, however, the resistance required of the earth connection must decrease. The practicable limit of decrease of resistance with driven pipes or buried plates is soon reached, and for circuits of large capacity some other means must be found if possible. The most obvious solution of the problem is to use the water-pipe systems, covered by the electrical systems. On account of the fact that water pipes give a much lower resistance than pipes or plates, grounding or secondaries to the water systems is highly advantageous to the consumer and the public.

Effect on Water Pipes of Using Them as Earth Connections

It has been stated that earthing electrical systems to water pipes would cause trouble to the water company in three ways, viz., electrolysis by stray currents from the circuits earthed in this manner; danger to persons who might have occasion to work on the water pipes to which earth connections were made, and complications from allowing a second public service company the use of the pipes.

Experiments conducted at the Bureau of Standards show that the damage due to electrolysis by alternating current is but a fraction of 1 per cent. of the damage done by direct current of the same magnitude in point of quantity of electricity passed. No appreciable electrolytic damage from them need, therefore, be feared by water companies. Danger to employees of the water system can also easily be avoided by the electric company removing earth connections when work is to be done on pipes and replace them when the work is completed. With multiple earth connections, however, even this precaution is hardly necessary. Multiple earth connections of low-voltage alternating current circuits are therefore to be recommended. For direct-current circuits they should be avoided because of the possibility of electrolysis effects.

Effects of Insulating Joints

In connecting a low-voltage circuit to a pipe system at more than one point, it is important where direct-current railway systems are in the vicinity that there be no insulating joints in the pipes that may come between the points of connection. If insulating joints are present the low-voltage circuit will act as a shunt to the joint and heavy current flow over the wires may follow if stray current from street railways are on the pipes. Moreover, if there are insulating joints near a point where an earth connection is made to a service pipe, the joints may so restrict the useful pipe surface in contact with the soil as to cause the resistance to flow of current from the low-voltage circuit into the earth in case of accident to insulation to be so great as seriously to impair the usefulness of the earth connection. In making multiple earth connections care should be taken to see that stray currents from water pipes do not get on the wires, at least to any appreciable extent. The example of the insulating joint given above is one illustration.

Joint Use of Earth Wires

It has been in many cases recommended that to save expense a single earth wire may be made to serve several different classes of apparatus or circuits; for example, a lightning arrestor and a low-voltage circuit. In the event of a discharge of the arrestor, however, a high potential difference is likely to exist between the ground end of the arrestor and ground. This potential is impressed upon the low-voltage circuit, and may be a source of danger to persons or present a fire hazard. For this reason separate earth wires should, in general, be provided for all classes of apparatus, but particularly for lightning arrestors, and where earth connections other than water pipes or other extended electrodes are used the arrestor should also be provided with a separate earth connection spaced at least 5 ft. from those serving low-voltage circuits as required by Rules 95a and 95b of National Electrical Safety Code.

Connections to Gas Pipes

Connections to gas pipes should be prohibited except in special instances as provided in Rule 93. The reasons for this are as follows: In the first place, gas mains are laid with insulating joints which are extremely undesirable in a pipe line to which earth connections are to be made In the second place, if a gas pipe in which even a small current is flowing, is disconnected, a spark may follow and cause an explosion or a fire In the third place, where there are gas pipes there are in nearly all cases water pipes, so connection to gas pipes is unnecessary

Many Water Powers in South America*

The South American continent is, taken as a whole, an especially favorable field for hydro-electrical endeavor. The general scarcity of fuel makes power of all descriptions very expensive This part of the world is favored with the natural fuel resources of coal and oil to only a comparatively insignificant degree. The most important coal mines on that continent, situated in southern Chile, afford only sufficient fuel to supply the demands of coasting steamers and railways. Almost all of the coal used in South America is imported from abroad. The production of liquid fuel in the form of natural oil is practically limited to northern Peru and one district in southeastern Argentina. On the other hand, the three prime essentials in the generation of energy from water power—fall, volume, and continuity of supply—are found in almost every part of South America; the Pampas country and the rainless district of northern Chile being among the few exceptions. The finest opportunities for water power development in the world, so far as physical conditions are concerned are on the slopes of the Cordilleras of the Andes in Peru, Bolivia, and Ecuador, where the water-falls, cascades and torrential rapids of the river exist, abundantly supplied by the moisture-laden clouds from the Amazon Valley dissolving in rain upon the cold slopes of the lofty Andes, pouring their burden of energy down to the sea.

Chile is stated to be the most favorably located country in the world for an easy and comparatively inexpensive hydro-electric development, the only possible exception being Switzerland and Kashmir. The densely populated country between the Cordilleras and the coast presents water-power possibilities, for practical commercial development, equal to those of the Alpine country. But water power development has been slow; although some installations of considerable magnitude have been put in operation. The undeveloped commercial opportunities for the profitable generation and distribution of electrical energy from water power are, economically viewed, in mocking contrast with the losses and sufferings which are continuously endured in Chile from lack of coal and oil fuel.

The Laja River, in Chile, is the Niagara of South America, having a flow of little less than that of the Hudson at Albany, and with falls more than 100 feet high; and the river is ideal for economic hydro-electric installation. In southern Chile there is more undeveloped water power than could be used for several decades. The great Choshuenco river has a fall of 150 feet at one point and presents the practical opportunity for a water power with 1,200 feet fall developing more than 200,000 kilowatts.

Peru has more natural resources for fuel, from coal and oil, than other South American countries; but, for lack of transportation facilities, the price of such fuel is generally prohibitive. The practical opportunities for water power development in that country are nearly as favorable as are those in Chile; and, although there are already in Peru hydro-electric installations developing 75,000 kilowatts, further developments, yet unattempted, are feasible to meet the present unsupplied demand.

Comparatively little has thus far been accomplished in hydro-electric development in Bolivia, Ecuador, Colombia, Venezuela, and Paraguay; but in these countries the retardation of development is due largely to the unfavorable situation of water powers with reference to populous communities creating the demand. In the Argentino-Uruguayan country, feasible water power developments are afforded by the great Mendoza river and its tributaries, flowing down the eastern slope and foot-hills of the Andes to the Atlantic. This river has a fall of 9,000 feet in a distance of 100 miles and presents water-power possibilities, within a comparatively short distance upon a single stream, which are equaled nowhere in North America, except perhaps in Alaska. The population and industries of the surrounding country make, within easy transmitting distance, a demand, yet unsupplied, of over 200,000 kilowatts of power, which is far less than the capacity of the Mendoza.

The greatest center of population in South America, including the great cities of Buenos Aires, Montevideo, La Plata, and others representing nearly 3,000,000 inhabitants, present an unlimited market for power from the Andes. However, intervening hundreds of miles of Pampas between the Atlantic coast and the foot-hills of the Andes present limitations of transmission which are at present practically impossible to overcome.

In British Guiana, on the Potaro river, a branch of the Essequebo, is the highest fall of great volume in the world. Here the river 300 feet wide, drops 700 feet. The immense energy from this great cataract is wasting until further increase in population and in industrial development shall create such a demand for the power that the expense of the long transmission lines required to bring the wasting energy to the market shall become an economic possibility.

But physical obstacles and the lack of appreciation of the opportunities open to commercial development are not the cause in these southern countries of the waste of water power energy, the utilization of which is already commercially feasible. As in the United States, the first requisite for the promotion of water power development, and therefore for the prevention of waste of this natural resource, is encouragement, by legislation, to the investor who must furnish the

* R. G. Brown in General Electric Review.

capital for hydro-electric development. The hazards incident to such investment, even under the most favorable laws and regulations, are very great. But the physical hazards may be overcome or diminished. Before such dangers capital does not show timidity. What capital demands in such investments is certainty of tenure, and security from confiscation, sufficient to warrant dependance upon reasonable returns. Such security can only be afforded by laws, which at the same time that they protect the interests of the public also protect the investments which shall be made in furtherance of the public interest in the utilization of water-power resources.

In none of the countries of Spanish-America are the laws formulated in such a way as to attract private investment. The fact that there are already such investments only indicates the certainty of much greater development in the immediate future in case unreasonable legislative hazards to investment are decreased or eliminated.

Essential to Think Electrically

By A. Jackson Marshall

One of the most influential automobile journals in announcing a series of articles recently, on electrical units in gasoline cars, editorially commented as follows:

"It is essential today to think electrically. This is particularly true with garagemen, with those operating machine shops and all other forms of repair depots where diseased electric starting, lighting and ignition systems are repaired. A few years ago, in diagnosing troubles in the automobile, it was primarily essential to think mechanically—that is, to visualize the mechanics of the machine. Today we have to go a step further and, in addition to visualizing the mechanical systems of the car, also visualize the electrical systems. This latter stage means ability to think electrically.

"Thinking electrically presupposes a clear conception of the elementary or first principles of electricity. It is impossible to think electrically without such knowledge. You cannot diagnose electrical troubles unless you know the alphabet of electricity. Perhaps one of the first letters in the electrical alphabet is the circle, the circuit as termed starting at a point and coming back to that point. The physical path traveled may not be circular; it may be rectangular—in fact, everything except circular; yet the circular concept is there —you start at a point and you must come back to that point. There must be a complete physical path. That path cannot be broken in a single place without trouble. To detect the trouble you must follow the circular concept. It is the first stage in thinking electrically."

It is indeed essential to "think electrically" when considering the modern gasoline car, for the electrical features are numerous and of the first order of importance. In fact without the agency of electricity, the modern gasoline car would not have been possible, for the explosion of gases in the reciprocating, internal combustion, gasoline engine is fired by electric sparks generated by the ignition system, the flexibility and exact control of electric current as used in exploding these gases in the cylinders, is in itself truly marvelous when we consider the nicety with which "timing" is effected.

The modern gasoline car utilizing the rotating dependent electric motor for "turning over" the engine,—starting—has relieved the motorist of the necessity of "cranking", that exasperating bugbear of the motorist of yesterday. It would indeed be difficult to estimate the great influence which electrical equipment has had in popularizing the gasoline car. For lighting the electric lamp now reigns supreme, and the ease and certainty with which this important feature is controlled, further emphasises the indespensability of electricity in gasoline car operation.

In addition to having a complete gasoline power plant with its hundreds of parts, the modern gasoline automobile must also employ a complete electric power plant, which is much more complicated than that used in the electric vehicle to supply the entire amount of energy for both running and lighting the car, the electric vehicle, for this reason, being much more independent and simple than the gasoline automobile. The power plant of an electric consists of a powerful, readily charged battery, a simple easily operated control, and a highly efficient, rotating electric motor which is the acme of simplicity and dependability.

While the electrical apparatus upon which the gasoline car is dependent for operation, is of the very highest order of development yet on account of the numerous and various functions it must render, it may get out of order more easily than the comparatively simple electrical equipment employed in the modern electric vehicle.

Of the equipment of a modern gasoline car, perhaps less is known of the electric features than others, this probably being due to the fact that only recently has the completeness of electrical service been appreciated and employed, and it will therefore undoubtedly be of the greatest value to the users and repairers of gasoline cars to be able to think "electrically."

A knowledge of electricity will serve automobilists, garagemen, and others not only in connection with the operation of the gasoline car, but will emphasise the simplicity, dependability and marked economy of the electric vehicle. "Thinking electrically" will in turn make it more apparent that the ultimate type of motor vehicle will be the electric. Already its economical features are being emphasized and exploited as a result of the soaring cost of gasoline and the uncertainty of future liquid fuel supply. While gasoline costs are steadily increasing the cost of electricity is steadily decreasing, for the means of producing this indispensable current are inexhaustible.

Organization Purposes and Methods of Underwriters' Laboratories

The Underwriters' Laboratories, Chicago, have just issued an interesting booklet describing their organization, purpose and methods. As the purpose of this incorporation is little understood and quite generally misunderstood, we quote the following information from the introductory pages of this publication. Other parts of the booklet, not quoted, deal with the question of charges, samples, labels, offices, etc., etc.

Underwriters' Laboratories, a corporation chartered November, 1901, by the State of Illinois, is authorized to establish and maintain laboratories for the examination and and testing of appliances and devices, and to enter into contracts with the owners and manufacturers of such appliances and devices, respecting the recommendation thereof to insurance organizations.

Underwriters' Laboratories, Inc., is for service—not profit.

Its chief financial support has been received from the National Board of Fire Underwriters, under whose general direction the work is carried on.

The object of Underwriters' Laboratories is to bring to the user the best obtainable opinion on the merits of appliances, devices, machines and materials in respect to life and fire hazards and accident prevention.

The work is undertaken as one means of reducing the enormous and disproportionate loss of life and property by fire and the number of accidents in America.

The casualty features are carried forward in co-operation with the Workmen's Compensation Service Bureau.

Buildings and Equipment

The principal offices and testing station are located at

207 East Ohio Street, Chicago. Branch offices are located throughout the United States and in England and Canada.

The New York office is equipped for the conduct of examinations and tests of all electrical devices under the same conditions as those afforded at the principal office and testing station in Chicago.

The Chicago plant occupies a three-story and basement building of fireproof construction, containing something over 45,000 square feet of floor space, with a frontage of 266 feet. Yard space is provided for huts and large testing furnaces. The main building in Chicago is, perhaps, the best example in America of absolutely fire-proof construction, furnished with fireproof finish and equipment and operating properly safeguarded machinery. Brick, terra cotta, concrete, stone, steel and iron are used exclusively in the structural features. The window frames and sash are of metal with wired glass, the doors are of metal, the desks and filing cases in the main office are of steel. No wood or other combustible material is used in any portion of the finish. In addition, the plant is equipped with automatic sprinklers, and the machines, appurtenances, and lighting, heating and power hazards are safeguarded with every known precaution. In this model building the Underwriters have gone to the extreme in adopting in their own property all the measures they are known to recommend in the property of others. Over one hundred persons are employed in the Chicago plant, which, with its equipment, has a value of approximately $200,000.00.

Conferences

For a number of industries, conferences are established consisting of the proper members of the staff of the Laboratories and representative committees of manufacturers to the end that full information as to examination and test methods may be transmitted to industries served by the Laboratories' systems of inspection at factories and labeling, and the views of the industry as a whole on these items be secured.

Promulgation of Test Results

Summaries of the Laboratories' reports are promulgated on printed cards filed according to classifications, and cabinets containing these cards are maintained at the offices of the principal Boards of Underwriters and Inspection Bureaus in the United States, at many of the general offices of insurance companies, by some insurance firms, certain federal, state and municipal departments, and at the local offices of the Laboratories in larger cities. Much of the information is also freely distributed by means of lists of Manufacturers of Inspected Mechanical Appliances and of Electrical Appliances, and the results of the work in many classes of appliances are furnished directly to building owners, architects, users and all other persons interested, by means of the Laboratories' Label Service, under which goods are inspected at factories by Laboratories' engineers and stamps or labels attached to such portion of the output as is found constructed in accordance with Standard requirements. The Label Service is fully described and illustrated in the booklet.

The aim of the founders of Underwriters' Laboratories was to secure the best and fairest opinion regarding the merits or demerits of every device, system, machine or material, in respect to life and fire hazards, and accident prevention, and to have the work so conducted and reviewed as to secure accuracy and uniformity in its findings. This object has been accomplished to such an extent that the majority of Underwriters in the United States, many state and municipal authorities, plant operators, and a large number of architects, building owners and users either accept or require a report from these Laboratories incident to their recognition of devices, systems and materials having a bearing upon fire hazards or accident prevention.

Underwriters' Laboratories issues no guarantee that its findings will be accepted or recognized in any case. Such assurances can only be obtained from the authority having jurisdiction.

There exists a permanent arrangement between Underwriters' Laboratories and the Bureau of Standards of the Federal Government whereby in the event of a fixed difference of opinion on a technical matter between Underwriters' Laboratories and any of its clients the question at issue may, with the consent of both parties, be submitted to the Bureau of Standards for decision.

Personal

Mr. C. Le Maistre, general secretary of the International Electrotechnical Commission, expects to be in Canada about the third week in May.

Mr. J. G. Smith, Manager of The Mainer Electric Company, Winnipeg, has just returned from a business trip to Chicago and other points in the United States. Mr. Smith reports that the electrical business is very active and that there is great demand on the manufacturers.

Mr. John Ahearn has been appointed superintendent of the Ottawa Street Railway System, succeeding Superintendent Burpee, who is going overseas. Mr. Ahearn has been in the employ of the Ottawa Street Railway Co. for many years.

Mr. K. H. Smith, engineer for the maritime provinces of the Canadian Commission of Conservation, recently addressed the Board of Trade of the city of Halifax on the subject of the water powers of Nova Scotia.

Curve Recording and Analyzing Devices

Among the recent developments of instruments for the solution of engineering problems are a curve recording device and a curve analyzing device known as a "Polar Oscillograph Attachment" and a "Harmonic Analyzer" respectively. These devices are extremely useful to obtain a quick and accurate analysis of any periodic wave, such as the current or voltage wave of a motor, generator or power system. It has been customary for a long time to regard current and voltage as vector quantities, and use these trigonometric relations to express the various phase relations. This, however, is only correct when the waves of current or voltage are sine values. When these waves are distorted, large errors may result by making these assumptions. So the only positive method of solving such problems is to obtain an actual analysis of the wave by means of an adequate analysis device such as the Harmonic Analyzer previously referred to.

These new devices will prove to be valuable additions to any standard oscillograph equipment. The case and the metal parts of the analyzer are nicely finished, so that the instrument has a most attractive appearance and fits in very well with other instruments in a well equipped laboratory. They are manufactured by the Westinghouse Electric and Manufacturing Company and received a bronze medal at the Panama-Pacific Exposition.

Electric Vehicle Convention

At the 39th annual convention of The National Electric Light Association, a number of interesting papers will be read before the Electric Vehicle section, including the following: industrial truck applications; electric truck troubles and how to eliminate them; the relation of tires to electrical vehicle efficiency; passenger vehicle problems and activities, and central station promotion of electric vehicle use.

Electric Railways

An intimate relationship exists between any municipality and the local railway system. Both progress or stagnate together. The B. C. E. R. Company and the Vancouver district

A very interesting review, covering the early history and the present operating conditions on the British Columbia Electric Railway System in Vancouver, B.C., and surrounding cities and towns, is published in the April issue of Brill magazine. This issue also contains a brief biography of Mr. George Kidd, the general manager of this railway. Those who have followed the situation at the coast during the last ten or fifteen years know that the wonderful progress made by the city of Vancouver particularly, has been due to the almost lavish expenditure of money by the British Columbia Electric Railway Company, in extending their lines and opening up new branches of the electrical industry. It is reasonable to suppose that, given a fair chance, the same methods of this company will play an important part in the rapid commercial recovery which Vancouver and other coast towns and cities are expected to make in the next two or three years. The following review taken from the article mentioned, will therefore be read with considerable interest:—

British Columbia's commercial metropolis, Vancouver, in the words of Earl Grey "the recognized gateway between the east and the west," is situated on the Pacific Coast of Canada, in a commanding position on a peninsula formed by the Fraser River and Burrard Inlet. To the south may be seen the waters of the Fraser River, to the west the Gulf of Georgia, and to the north Burrard Inlet and the main harbor, and beyond this the younger sister city of North Vancouver and the mountains of the coast range. This situation is a strategic one, as the city is the terminus of four transcontinental lines of railway and the home port of the Canadian Pacific Railway Royal Mail Steamships to China and Japan, and the Canadian Australian Royal Mail Steamships to Australia and New Zealand.

Vancouver was incorporated in 1886 and is a young city of rapid growth. The population in 1893 was 16,000, and now the number in Greater Vancouver is estimated as more than 150,000. In the summer months the bathing beaches of Vancouver are a daily source of pleasure to all; they are situated close to the best residential sections and reached easily and quickly by electric car. Stanley Park, which comprises a thousand acres of primeval forest, is also within a few minutes of the centre of the business district of Vancouver, with electric cars running to the entrance. The electric car service of Vancouver and its surrounding territory is furnished by the British Columbia Electric Railway Company, Limited.

The sister city, North Vancouver, is placed with a southern exposure facing Vancouver itself, to which there is a frequent service of ferries. By electric car can be easily reached the canyons of the Capilano, Lynn and Seymour Creeks, which are among the scenic wonders of the world.

New Westminster, a city of 15,000, is reached in 45 minutes from Vancouver by three interurban electric railways. This city is situated on the Fraser River, is an important fresh-water port, and has many points of interest, including a million-dollar bridge spanning the river, great lumber mills (one of them the largest in the world) and a number of salmon canneries. Salmon canneries are also to be seen at Steveston, at the mouth of the main arm of the Fraser River. This is the principal centre of the fishing industry in British Columbia and is also easily reached by interurban electric car from Vancouver and New Westminster.

The city of Victoria, situated on Vancouver Island, is the seat of government and the capital of British Columbia. It is the oldest city in the province, dating back to 1846, when it was known as Camosun, a Hudson Bay Company's trading post. The city leaped into prominence during the gold excitement in 1858 and grew rapidly in trade and population. Its population is estimated at 40,000. The street car service in the city is operated by the British Columbia Electric Railway, as is also an interurban line known as the Saanich Division, extending for a distance of 23 miles from Victoria to Deep Bay, and running through the fertile lands of the Saanich peninsula.

An Extensive Interurban System

The interurban system of the British Columbia Electric Railway comprises two divisions, known as the Interurban Division of the Mainland system and the Saanich Division on Vancouver Island; of the total mileage of track, namely 350.65 miles, owned or operated by this company, 180.48 miles is represented by interurban trackage.

On the Mainland, the Interurban Division consists of three lines, connecting the cities of Vancouver and New Westminster, with a branch line crossing the rich farming lands of Lulu Island to the cannery town of Steveston. Another interurban division called the Fraser Valley Line, crosses the Fraser River at New Westminster and runs eastward between the river and the international boundary for more than sixty miles to the town of Chilliwack. The combination of transportation facilities and electric power at low rates has resulted in the location of numerous industries along these interurban lines.

The interurban line connecting the cities of Vancouver and New Westminster was practically the first interurban line to operate in Canada, having commenced service in August, 1891. There is a considerable suburban population along this route. The line is double-tracked all the way, and trains of one or two cars run at twenty-minute intervals, with local trains doubling this service between Vancouver and Central Park during the rush hours of the day. Central Park is situated about half way between Vancouver and New Westminster, and it is between Vancouver and Central Park that the heaviest travel prevails. An average of sixteen cars is employed in this interurban service, and the run of 12.5 miles is made in forty-five minutes, with an average of twenty-six stops. About 5,000 passengers are carried daily on this line.

What is known as the Second District is the Interurban

Line from Vancouver to Eburne, on the north arm of the Fraser River, and thence to Steveston. This is a branch of the Canadian Pacific Railway which was leased and electrified in 1905. From Eburne there is a connecting line with New Westminster, which forms a second route between the two cities. From Vancouver to Eburne Junction, a distance of 6.6 miles, the line is double-tracked and passes through suburban residential districts. From Eburne this line crosses a bridge over the Fraser River and runs for about 8 miles through the Delta lands of Lulu Island, which are remarkable for their fertility and productiveness. At Brighouse, on this branch, ten miles from Vancouver, is Minoru Park Race Track, to which trains of three to five cars are run at fifteen-minute intervals during the race meets. The branch from Eburne Junction to New Westminster follows the north arm of the Fraser River through market gardens and suburban districts, joining the tracks of the interurban line known as District 1, about half a mile from New Westminster Station. From Vancouver to Eburne trains of one or two cars run at half-hour intervals with a fifteen-minute service during the rush-hour periods in the morning and evening, making the trip in twenty-five minutes, with an average of fifteen stops. Beyond Eburne trains run every hour alternately over each branch, giving a two-hour service to Steveston and New Westminster, respectively. Between Eburne and New Westminster the run of 10.6 miles is made in twenty-five minutes, with about eight stops, requiring a schedule speed of more than twenty-five miles per hour with maximum running speed of forty-five miles per hour.

The third interurban route between Vancouver and New Westminster is known as District 4. For the first 2.7 miles the route taken is similar to that of District 1. At the 2.7 mile point the line turns eastward through the Burnaby district, crossing the Great Northern Railway at Ardley, and skirting the southern shore of Burrard Lake to Sapperton, which is the eastern suburb of the city of New Westminster, whence the city line is taken for 2.4 miles to the terminal station. The country through which District 4 runs is only sparsely settled as yet. An hourly service is maintained on this line in the morning and evening and every two hours the rest of the day. The run from Vancouver to New Westminster takes fifty-five minutes, and the 9.6 miles of track outside the cities are covered in twenty-seven minutes, with an average of eight stops.

The Fraser Valley Line

The Fraser Valley Line from New Westminster to Chilliwack is known as District 3. This line is 63.8 miles long. Leaving New Westminster the Fraser River is crossed on a steel bridge about a mile long owned by the Government of British Columbia and used jointly by the British Columbia Electric, Great Northern and Canadian Northern Pacific Railways. The line then ascends the ridge south of the river, passing through heavily timbered country. After crossing this bridge the line crosses the Great Northern Railway tracks at the town of Cloverdale, where there is an interchange with that road, and turns back towards the Fraser River, running through Langley Prairie, a rich farming and dairying district. At Abbotsford, 39.3 miles from New Westminster, is a large freight yard with connections to the Canadian Pacific Railway. From this point to Huntingdon, about 4 miles, large dairy farms are passed, and at Huntingdon are more interchange tracks connecting with the Northern Pacific, Canadian Pacific and Bellingham & Northern Railways, the latter being part of the Chicago, Milwaukee & St. Paul system.

Leaving Huntingdon the line swings eastward across Sumas Prairie till it crosses the low-lying lands around Sumas Lake on a fourteen-foot embankment more than three miles long. These lands are frequently submerged during the summer freshets of the Fraser River, but the rest of the year afford fine pasture land; and an extensive reclamation scheme is being developed to convert the area of 30,000 acres into first-class farming lands. After crossing the Vedder River, the line enters the Chilliwack Valley, which is one of the most fertile and best developed districts in the Lower Mainland. The population of this district is about 6,000, of which approximately one-third are residents of Chilliwack. Farming, fruit growing and hop growing are carried on profitably in this district.

All passenger trains on this district make direct connection at New Westminster with the interurban trains operating between Vancouver and New Westminster, the 63.8 miles on the Fraser Valley Line being covered in two hours and fifty-five minutes, and the whole seventy-six miles from Vancouver to Chililiwack in three hours and thirty-five minutes. On the Fraser Valley Line are six regular stops and, with flag stops, the total is about thirty. The total number of passengers carried on the Interurban Lines during 1915 was 4,022,781, and the passenger car mileage was 1,890,227.

Terminal Stations

In Vancouver there are two interurban terminal stations. The main terminus is in the heart of the business district and occupies part of the ground floor of the head offices of the company in a handsome building erected at a cost of about $500,000. Trains leave here over two routes to New Westminster, averaging about eighty trains daily. The second Interurban terminus in Vancouver is known as the Granville Street Station and is located near the south end of a bridge across False Creek which forms the entrance to the business district from the southwestern section of the city. From this point interurban trains leave for New Westminster and Steveston via Eburne Junction. The regular daily traffic consists of twenty-three trains and thirty-three locals.

New Westminster is the centre of interurban traffic—here the three inter-city lines and the Fraser Valley line converge. The number of trains departing daily from this point averages eighty-five. The station is close to the business centre of the city and occupies one end of a block fronting on the main business thoroughfare. The passenger equipment of the company averages about 50 to 55 feet over the bumpers and between 60 and 70 seated passengers.

The main distributing freight yard is in the west end of New Westminster near the junction of the first and second district lines. This yard contains about three miles of storage tracks and a repair track, and will hold more than three hundred cars. Local freight in New Westminster is handled at a freight shed on the river-front near the passenger terminal.

In Vancouver the central freight yard is two blocks south of the passenger terminal and so situated that when business becomes too congested to be handled by entrance over city lines an independent entrance through the railway yards round False Creek can be effected. At present the yard has a capacity of 130 cars, besides storage and yard accommodation for service and maintenance of way equipment, passenger cars, etc.

District No. 2

On the Lulu Island Line, known as District 2, a large part of the traffic is between the mills and the factories around False Creek and the Canadian Pacific Railway yards, and the electrified interchange tracks will accommodate about one hundred cars. Industrial spurs and sidings are numerous all over the system, with yards and freight sheds at all important shipping points.

A feature which is of special interest, particularly at this time, is the intimate relationship which exists between the Interurban system of the British Columbia Electric Railway and the surrounding transcontinental steam railroads. The operation of the interurban system is conducted essentially on steam road lines, particularly with regard to freight, and standard steam road rules are everywhere in force. Freight interchanges are established with steam lines as follows:—At Vancouver—two with Canadian Pacific Railway, one with Great Northern Railway; New Westminster—with the Canadian Pacific Railway; Cloverdale (Fraser Valley Line)—with the Great Northern Railway; Abbotsford (Fraser Valley Line)—with Canadian Pacific Railway, Huntingdon (Fraser Valley Line)—with Canadian Pacific, Northern Pacific and Bellingham & Northern Railway; Chilliwack (Fraser Valley Line)—with the Canadian Northern Pacific Railway; and at Victoria there are freight connections with local lines operated by the Canadian Pacific and Great Northern systems.

Co-operate With Steam Lines

The fact that these interchanges exist has been taken advantage of and through rates have been published from almost all points on the British Columbia Electric Interurban system to practically all points in Canada and the United States. The freight revenue forms an increasing proportion of the total revenue, and by means of through bookings on freight there is every prospect of an increasing importance attaching to this side of the business. During the year 1915 4,238 foreign cars were interchanged, and the total freight tonnage handled over interurban lines was 224,300, and the total freight car mileage was 763,658. Car-load freight is handled by trains daily over each line, in M.C.B. standard cars hauled by locomotives and in charge of regular freight crews, in some cases operating at night so as to keep clear of the passenger traffic, and by extra locals to clean up cars and siding when necessary to relieve the through trains. The company's freight equipment, in addition to about thirty locomotives, consists of 192 box cars, 200 flat and logging cars, 22 steel gondolas and 33 miscellaneous rock and gravel cars, besides a number of stock cars and cabooses. Express and light freight is handled on motor express trains, some of which operate on time table, making regular trips. On the short lines an express car makes regular trips over each branch.

The Power Supply

The power supply for the electric street and interurban railways and light and power systems of the company on the Mainland of British Columbia is generated for the most part at the company's two Lake Buntzen hydro-electric generating stations situated at sea-level on the North Arm of Burrard Inlet and about 16 miles from the city of Vancouver. The principal storage reservoir for the operation of these plants is Lake Coquitlam; from this lake water is conducted through a tunnel 12,775 feet long to Lake Buntzen, 400 feet above sea-level, thence through pipe lines to the power house. There are two generating stations, one having a capacity of 21,000 kw. and the other 26,700 kw.

Energy from these generating stations is transmitted to the various sub-stations over two two-circuit transmission lines, the more recently constructed lines being supported on steel towers. The two power houses are also tied together by a transmission line. At the present time, the transmission voltage is 34,600, but on the completion of construction of a new transformer station on the outskirts of Vancouver, this voltage will be increased to 60,000. In addition to these generating stations, the company owns a modern steam turbine plant of 13,000 kw. capacity, which is situated in the heart of Vancouver. From these generating stations, the energy is transmitted to the company's sub-stations, which are well distributed throughout the Lower Mainland.

The Chatham, Wallaceburg & Lake Erie Railway Co. recently increased the wages of their road employees by 5c per hour, making the minimum 22c and the maximum 27c.

The "Safety First" Movement on Canadian Electric Railways

In a recent issue we described with illustrations the campaign of the Quebec Railway, Light & Power Company, for the prevention of accidents on their tramway lines, and reproduced among other interesting items Accident Talks, Nos. 1 and 2, which had been distributed by this company, hung at prominent places in the street cars and given all possible publicity in other ways. In the present issue we are reproducing the next two Talks, Nos. 3 and 4. It will be remembered that these are printed in English on one side of the sheet and in French on the reverse side. There can be no doubt that the warnings given to the general public in this way have been the means of bringing this question much more prominently to the attention of the company's patrons, thus making it easier for the motorman to avoid accidents.

We are also indebted to the general manager of the Hull Electric Railway Company, Mr. G. Gordon Gale, for a brief description of the campaign as carried out in that city. Mr. Gale advises that they have been keenly alive to the possibilities of an active "Safety First" campaign ever since the inception of this movement and that the following features have been given special attention. We quote from Mr. Gale's letter:—

Special Features of the Hull Electric Campaign

"1. The distribution of 'Safety First' Calendars in the schools throughout the whole district.

"2. The operation of 'Safety First' Films in Moving Picture Theatres in the city, and in our Amusement Park Theatre.

"3. 'Safety First' Bulletins, including newspaper items, Magazine articles, etc., are posted from time to time on notice boards in the Reading Rooms.

"4. 'Safety First' literature, copies of addresses, etc., are distributed among our employees.

"5. All Rules, Regulations and Instructions are based upon 'Safety First' principles.

"6. 'Safety First' methods and precautions are explained and emphasized whenever an accident or other occurrence arises due to neglect or carelessness.

"This procedure has shown very satisfactory results, particularly, in so far as our employees are concerned. It will however, take years of undiminished effort to educate the general public to exercise care when travelling on, or moving around street cars.

"There is no doubt however, as shown by the results already obtained, that a campaign of this kind is justified. It is therefore, our intention to continue to work along these, and such other lines as seem advisable."

"Old Timers'" Safety First Association

The following letter also shows that the Winnipeg Electric Railway Company have been deeply impressed with the importance of this work. They write:—

"For a considerable time this Company has been conducting a vigorous 'Safety First' campaign. In December, 1914, and during the first few months of 1915, we published a number of advertisements in the daily papers along 'Safety First' lines. A general safety committee of 100 (or approximately 100) of employees who had been ten years or more in the Company's service was formed. These men came from all departments of the Company and adopted as their emblem a button in royal blue and gold, bearing the letters—'W. E. R.' and the words 'Old Timers' Association—Safety First.' They are pledged to do everything in their power to prevent accidents, and to assist and instruct new men whenever possible. From time to time circulars were issued to motormen and conductors along 'Safety First' lines by the traffic superintendent, and in addition, circulars were sent to the Public School teachers throughout Winnipeg, containing brief talks to school children. The campaign has been very successful and we are glad to be able to report a large reduction in preventable accidents."

This idea of an old-timers' association, specially designed to enlist the sympathy and co-operation of the men who have shown themselves through long service appreciative of the necessity of caution, is very timely. The public are all the more likely to use caution themselves when they know that the company's officers are being specially trained and enjoined to do their part.

Accident Talk No. 3

Accidents are Not Inevitable, that is, 90 p. c. can be avoided by the exercising of just a little caution. Most accidents are caused by a careless act. To eliminate carelessness is the purpose of these Talks. The policy of this Company is to PREVENT accidents, rather than sit back, let them happen, and then direct its energy toward proving its freedom from liability. We want to get there with our word of caution in time to avoid suffering, expense and controversy.

Careful

In the next few days you will be obliged to choose between walking or driving just ahead or behind a car. There's only one safe thing to do.

By the way—if that party who stepped out from behind the car and was struck by a team had taken just a second to LOOK, there would have been no accident. LOOKING is a part of CAUTION.

A word of caution from YOU within the next hour may prevent an accident. How much more satisfactory this would be than the righteous feeling that it is none of your business. WARN HIM.

Caution requires that you look down before stepping off the car. Don't step into a hole or an unsafe place. The Conductor will have the car moved for you. Watch out for autos and teams before stepping off car. LOOK BOTH WAYS.

It's just as easy to alight with bundles in the right arm, facing front of car. What is even more important—IT'S SAFER.

Head up when crossing a street. LOOK before you cross and WHILE YOU ARE CROSSING.

HOLD BACK when driving out of side streets. It is always the time you fail to do this that something happens. Figure that a car IS coming, instead of otherwise. YOU are not anxious to be hurt—we are very anxious not to hurt you—so why have accidents at these places. GO SLOW.

A Few Don'ts

Don't take chances—let the other fellow do that. Don't drive or walk on tracks when it can be avoided. Trolleys are obliged to follow the track—no possibility of turning out for you—you who have got the whole street.

Don't drive suddenly in front of a car. Even the quickest motorman is helpless in such cases. LOOK.

DON'T TOUCH FALLEN WIRES. 'Phone the office (605) and don't try to demonstrate that the wire is "dead." TELL THIS TO THE CHILDREN.

"PLEASE DO NOT TALK TO THE MOTORMAN". In doing this you handicap him in his effort to avoid accidents.

Quebec Railway, Light & Power Co.

Accident Talk No. 4

Danger Signals

A red lantern or flag signifies DANGER. It means STOP, LOOK, LISTEN, and was placed there to protect YOU.

When you see a red signal of this kind don't keep right on going until you are in the midst of danger, and then depend upon your alertness to get out of it. Stop at once, ascertain the cause of the signal, and then proceed if it is safe to do so. Compare the few seconds used in taking precaution with the suffering and perhaps sorrow which might follow your disregard of these signals.

Excavations

Street excavations for one purpose or another are always with us. In the day time it is easier to notice dangerous conditions than at night, consequently the increased danger due to darkness must be met by GREATER CAUTION. Even during daylight use great care at these places. Don't step on stones which may roll and sprain your ankle, on soft dirt which might slide, or on planks which a little inspection may show you are unsafe. At night, protect yourself through the most careful investigation. DON'T HURRY AT THESE PLACES.

You are correct in thinking that some responsibility lies with the party making these excavations, to protect you in some suitable way. The purpose of this talk is to induce you to use such care and caution at these places as will avoid injury to yourself, EVEN IF THE PARTY MAKING THE EXCAVATION IS NEGLIGENT in not properly protecting it. In other words, it is the **accident** we are seeking to avoid.

If, when driving, you see a red lantern in the street ahead, at perhaps a dark place where you cannot see the surrounding ground until you get close to it, SLOW DOWN, approach cautiously, and ascertain just how much of the street that lantern is intended to protect. A danger signal of this kind is intended to cover more than the actual ground on which it rests. Here again we say—protect yourself, even if the "Other fellow" is careless.

To Drivers of Vehicles

We want to avoid injury to yourself and property. Please help us. Street intersections are the places which call for the greatest caution. HOLD BACK. Drive into streets having tracks at such a slow speed that you can easily stop before reaching track. DO A LITTLE MORE THAN YOUR SHARE TO AVOID ACCIDENTS AT THESE PLACES. It's worth while.

The Quebec Railway, Light & Power Co.

Northern Canada Power Company Extensions

An order for a water wheel for the Northern Canada Power Company, has been placed with the S. Morgan Smith Company, York, Pa. The wheel is required for further development at Wawatin Falls, Timmins, Ont., and is to be a single vertical spiral case unit, 375 r.p.m., capacity 4000 h.p., working under a 122 foot head. The wheel will be direct connected to a vertical generator, supplied by the Canadian Westinghouse Company.

Orillia Power Problems

A by-law will be submitted to the electors on May 22, authorizing an agreement with the Hydro-electric Power Commission of Ontario, regarding the disposal of the Swift Rapids plant, owned by the town of Orillia, and the subsequent purchase of the necessary power for Orillia's consumption. The town of Orillia is to receive the sum of $13,560.00 a year for thirty years, which is figured as equivalent present value for their plant of $226,000.00 at 4.2 per cent. The cost of power to the town from the commission's plant at the Big Chute now in operation is estimated at $11 15 per h.p., if the total capacity of 6,000 h.p. is used. Under these terms the town retains its transmission lines, paying this rate for delivery at the development station.

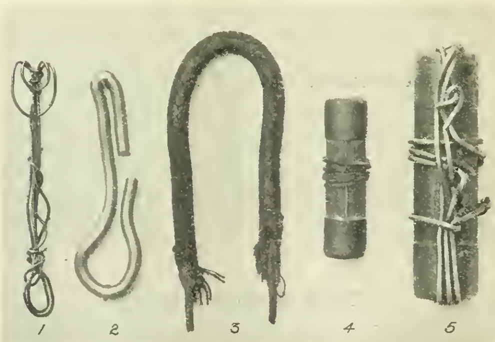
The Dealer and Contractor

The Public Attitude Towards Electrical Inspection—Do Not Understand—In the Interests of Life and Property Rules Must be More Strictly Enforced

The path of the electrical inspector in the province of Ontario is not strewn with roses. One frequently hears it asked of an inspector—Why don't you insist upon the law being obeyed to the letter? Why don't you see that the rules and regulations are carried out? Why should I make this change when so and so's installation is not up to standard?

Laws that refer to electrical installations are much easier to make, in the present stage of the electric industry, than to enforce. The reason for this condition is partly that the public do not understand. No law is easily or can be completely enforced that does not receive the support of the general public and that support is given only when they understand the necessity for the law and realize its value and its justice. It is, therefore, because the general public do not realize the necessity for all the precautions that are being taken in electrical installations, and do not grasp the possibilities of hazard when the rules are broken, that our inspectors are having so much trouble in maintaining that standard in electrical work that is so necessary if electricity is to take its place as the safest, as well as the most useful, servant of mankind.

And, added to the ignorance of the general public there is, we regret to say it, the carelessness, often deliberate, of



Death and fire traps located by Toronto Inspection Department.

the man who ought to know better—and generally does—the contempt that is born of familiarity and, more or less, of knowledge. Quite often these men, by their example, exercise a very baneful influence on others who, naturally, look to them for guidance. It surely is the duty of every man interested in any way, or connected in any way, with electrical matters to see to it that he and his employes in factory, store, household, or what not, obey the rules and regulations to the letter. Yet it is right here that we may often look successfully for the worst offenders.

One has only to follow the average inspector on his regular rounds for a day to become convinced of the often unreasonable attitude of the consumer towards the work of this official. Study the specimen "fuses" reproduced herewith as examples of what one almost hourly runs across. One of these, No. 5, was taken from a large factory where hundreds of thousands of dollars and the lives of hundreds of employes were at stake. No. 1 was "installed" in an office in a large public building. No. 2 "protected" the lines of one of the largest automobile show-rooms and garages in Toronto. An electrical supply house, itself a distributor of fuses, is responsible for No. 3 and the exceedingly clever and inexpensive arrangement, a pin held by an elastic band, was found in a Yonge Street hat store. In at least one of these cases the manager had been advised, within a few days previous to the discovery, of the danger of such contrivances and his attitude was something approaching actual antagonism when the inspector removed the improvised death-trap and replaced it with a proper fuse. The other cases show at least a lack of co-operation that is deplorable under such serious conditions.

While it always seems advisable, where at all possible, that education should precede legislation, it is gratifying to know that the Ontario Hydro Commission have now secured legislation which will enable them to bring the necessary pressure to bear on deliberately delinquent electric users who, by their carelessness and indifference, jeopardize not only their own property but, equally, the property and lives of those who may happen to be located in their neighborhood. It is just possible that education in this case will be best disseminated by a little wholesome punishment in the way of summary convictions and fines. In addition, such cases when they arise should be given the greatest possible publicity both as instruction and warning to other likely offenders. We believe the Ontario Commission and their inspection department have perhaps been over-indulgent in their interpretation of the situation in the past and that they are now quite justified in using greater pressure on those who, whether through ignorance or contempt, fail to observe the rules and regulations. In the interests of the conservation of life and property as well as in the interests of electrical development in general we hope the Commission will now take a firm stand in this matter and give their inspection department a freer hand in carrying out the law.

The Low Cost of Operating Electrical Appliances is not Properly Appreciated—The Tradition of "High Cost" is Dying Hard

A feature of electric fan operation which is rarely appreciated, even by electrical men, is the very low consumption of the operating motor. Some of the smaller types use only from 20 to 40 watts. The higher figure would be pretty close to the consumption of a 10 in. fan. Figuring this amount, and supposing the fan to operate 24 hours a day thirty days in the month, the cost of operation at 1 cent per kw.h., less 10 per cent., (the price obtaining at many points in Ontario and elsewhere) would be 25.92 cents. Operation of such a fan for the whole summer season would, therefore, not exceed $1.00 and for the whole year, if used for ventilation purposes, would only cost $3.00. It is safe to say that the average man or woman would "guess" at least this amount per month, so much are we in the habit of looking upon the continuous operation of any electrical appliance as expensive.

This picture drives home the fact of low cost.

To drive this fact of small consumption of an electric fan home to their customers the Texas Power and Light Company are using the accompanying illustration on their advertising matter. This illustration makes the comparison between a 60 watt lamp and a 12 in. fan and points out that a fan uses less current than a lamp does. It is doubtful if central stations emphasize this fact sufficiently.

Timely Hints to Electricians

The Pennsylvania Department of Labor and Industry, Harrisburg, Pa., of which John Price Jackson is commissioner, has issued a folder entitled "Timely Hints to Electricians," and is ready to supply copies in any quantity. The following useful hints are extracted from the folder by the Electric Review:

An electrician who is not familiar with or does not follow accepted standard practice in his repair and installation work is a constant menace to the safety of any establishment and its employees.

Shield your eyes from electric arcs or flashes. This kind of light frequently causes temporary blindness and in some cases ruins the eyesight. If you ever become so affected, consult the plant doctor or your own physician at once.

Small cuts, bruises or burns should receive treatment immediately and be protected from dirt or mechanical injury. Blood poisoning may set in and must be guarded against.

Keep your eyes on your hand when reaching for electric switches. Otherwise you may touch the "juice."

Before working on electric machines lock the service line switch open and place the key in your pocket. No person can then turn on the current with fatal results to yourself. This has often occurred.

Screwdrivers, pliers and all other handy tools should have insulated handles.

Immediately stop any abuse or misuse of electrical apparatus.

Never work on live circuits unless it is absolutely necessary. If you must work on such circuits, use all the safety devices and methods possible.

Treat all wires as "live" until you are absolutely sure they are "dead."

Unsafe or improperly working electrical apparatus should be immediately shut off and reported to the proper authorities.

In working overhead be careful to place tools so they cannot fall on persons underneath.

If working on ladders or scaffolds see that they are substantially built. If they are not, you may be the sufferer.

Use your safety belt whenever possible. It may be your "life preserver."

Never overload a circuit or use a fuse of too great capacity. Overheating of conductors may occur and the possibility of a fire is thus increased.

Study regulations for the proper installation of electrical apparatus. Never install wiring or other electrical apparatus which is not strictly in accordance with such rules. They have been formulated to prevent fires and accidents.

Do not have soldering torches burning unless you are present. Thoughtlessness in this matter on your part may cause considerable damage.

See that all combustible material is removed from places where a spark from electrical machinery or apparatus could ignite it.

6, 7 and 8

The Electrical Dealers' and Contractors' Association, which meets in convention on Tuesday, Wednesday and Thursday, June 6, 7 and 8, is making preparation for quite elaborate entertainment of the delegates and their electrical friends. One of the items, in connection with which arrangements are practically completed, is a moonlight excursion and buffet luncheon which will probably be held on the evening of the second day of the convention. Entertainment will be provided at this outing and a very enjoyable evening is assured.

Toronto Branch is Active

The Toronto branch of the Ontario Electrical Dealers' and Contractors' Association are now holding regular bimonthly meetings at their offices on 2 College St., at which the contractor members enjoy a social evening and incidentally discuss many matters of vital importance to the trade. At the last meeting, held on May 3, such discussions as, the merits of using switch boxes and loom clips, the prevailing prices of wire and other material, were under consideration; also the possibilities of a cheaper type of installation for the older, smaller class of homes in Toronto. A number of contractors were in favor of making concessions under these circumstances, so that the use of electricity and its consequent advantages may become universal. The electric show and convention was of course discussed by everybody, and the great satisfaction was expressed at the co-operation of all members and classes of the electrical trade. It is understood that all the booths for the show are now taken and apparently many more could have been disposed of. This is due, no doubt, to the feeling that the present time is opportune for a real electric show in Toronto, and also to a very considerable extent to the energetic work of a number of the Toronto members.

At the next meeting on Wednesday, May 17, Mr. F. M Dusenbury, of the Hughes Electric Heating Co., will talk to the members on electric heating.

Electric Water Heating

The Toronto Electric Light Company have inaugurated a special and very complete service for supplying hot water during the summer months. The electrical installation consists of a three wire arrangement, one side only of which is metered. On the unmetered side a 500 watt unit is installed, which operates continuously. For this service a flat rate of $2.00 per month, less 10 per cent. is charged, which it is claimed will maintain the temperature of the water at a degree sufficient for all average household needs. In case of an abnormal requirement, such as a number of baths in succession or on wash days, a second unit, consuming some 2,000 watts, is installed on the side of the circuit that is metered. This is charged at the usual rate, which in Toronto when the ultimate rate is reached is 1c per kw.h. less 10 per cent. This larger unit, it is claimed, is capable of bringing a 30 gallon tank of water to boiling point in one half to three quarters of an hour. The company have completed arrangements whereby they install the system complete for $30.00. This includes the placing of the heating and the lagging of the pipes and tank throughout with 1 in. hair felt jacket, as well as the necessary plumbing and wiring.

It is stated by the company, who have made tests of this system before offering it to their customers, that it is only on rare occasions that the larger unit is required, and that the bills, on account of the very cheap rates given by this company, need not exceed $2.00 per month. Compared with coal or gas used to give a continuous service such as this, the rate being given by the Toronto Electric Light Company appears to be very much lower. Quite aside from the saving in operation, however, is the wonderful convenience of having a continuous supply of hot water without the very slightest effort on the part of the house-holder. There is no gas to attend to, no coal to shovel, no ashes to sift. It is absolutely clean, dependable and odorless—a service that does not require a moment's thought from one month's end to the other.

Richelieu Bridge Lighting

The bridge over the Richelieu River, Quebec province, about 1,500 ft. long, will be lighted by 36 100 watt lamps, 80 feet apart (staggered) and two 5-branch posts at each end of the bridge, supplied with 60 watt lamps. All posts will be of cast iron, the lamps to be enclosed in large glass globes. Contract for installation has been awarded to the Cie J. & S. Bessette, Limitee of Iberville, and contract for power to the St. Johns Electric Light Co. Limited, operated by the Southern Canada Power Co. Limited, having its principal office at 3 St. Francois Xavier St. Montreal.

The Hotel Apartment House

The suggestion being made to hotel keepers that they turn their buildings into apartment houses and fit them electrically, appears to be along the right lines. There are few places where well fitted apartments are not in demand, and the electric range, electric light, electric water heater, and other modern appliances which can now be operated at very low cost, have removed many of the objections to apartment life. Among the central stations that are taking the initiative in bringing this matter to the attention of hotel keepers in Ontario, shortly to lose their licenses owing to recent legislation, is the Toronto Electric Light Company, who print the following notice in their last electric service magazine:—

"It may be that some hotel keepers in Toronto will decide not to continue in business after the present year. Should this prove the case, we would urge upon them to consider turning their hotels into apartment houses, with individual housekeeping flats. Such buildings are admirably suited for the purpose, needing only the installation of electric ranges and the very simple wiring system applicable thereto. Surprising success has attended this utilization of hotel property elsewhere in America. We would especially ask for the opportunity of discussing the matter with those of our customers to which the above advice is food for thought. Our cooking rate for current makes the electric range unapproached for cheapness of operation."

Duncan Electric in New Offices

The Duncan Electrical Company, Limited, has removed from 86 Grey Nun Street to 1665 St. James Street, Montreal. The offices and factory comprise five stories, each 100 ft. x 150 ft., enabling the company to considerably enlarge their output of brass and porcelain sockets, cut-outs, receptacles, tumbler switches, rosettes, etc. The factory is substantially built, is exceptionally well lighted, and laid out. The company has added to its machinery and has improved its facilities for the rapid manufacture and shipping of goods. Mr. C. S. Duncan states that business has improved, and that the outlook is good.

Are You?

Are you an electrical contractor?
Do you believe in "uplifting" your business.
Are you a member of the Ontario Association?
If you're not—join. If you are—boost.

Anticipating Big Improvements Over 1915

W. H. Reynolds, Winnipeg representative of the Eugene F. Phillips Electrical Company of Montreal, and Lawford Grant, general sales manager, visited all the principal cities in Western Canada towards the end of March. A good power cable contract was secured at Calgary, Alta. The cities visited included Edmonton, Calgary, Moose Jaw, Regina, Medicine Hat, Saskatoon, Fort William and Port Arthur. Everywhere, Mr. Reynolds told the Winnipeg representative of the Electrical News, optimism for the future of the electrical business was encountered, and the dealers in the West were anticipating a much better year than 1915.

Canadian Tungsten Open Toronto Office

The Canadian Tungsten Lamp Company have opened an office in Toronto at 166 King St. West. This action has been taken as the result of rapidly expanding business, and because they believe they will be in a better position to handle their Ontario business through a Toronto office than they have been able to do from the head office in Hamilton. Mr. W. F. Kelly will be in charge in Toronto. Mr. Kelly has been with the Canadian Tungsten Lamp Company for a number of years and is well known throughout the province of Ontario, as well as in the West where he recently had charge of the Vancouver office of this company. We are advised that the Hamilton plant is running at forced capacity, 17 hours a day, and that extensions and enlargements are at present well advanced.

Cotton Mill Installing Motor Drive

Mr. R. S. Kelsch, consulting engineer, Power Building, Montreal, is sending out specifications for a 1,000 k.w. generator for the Canadian Cotton Company, Cornwall. The generator is required for the purpose of changing the company's Stormount mill from rope and belt drive to motor drive throughout.

Can You?

Can you afford to miss that three days' educational course—the Electrical Contractors' Convention and Electric Show in Toronto, June 6, 7 and 8? Don't risk it. It will mean good money in your pocket throughout the coming year.

Condit Type "ID" Oil Switch

The increasing use of electric drive in all classes of industrial plants has brought up the problem of suitable protection for the motors, and this has led to a demand for an oil switch with fuse clips or terminals inside the switch frame. The Condit Electric Mfg. Co's type "ID" oil switch with fuse terminals inside the switch frame is especially designed to meet the requirements of this class of service. This type is made for both 250 volt and 600 volt service and is said to be meeting with marked success in the many plants in which it is used. It is especially adapted for the protection of small induction motors whose full-load rating does not exceed 25 amperes. Both the moving and stationary contacts are reversible and renewable, the reversible feature affording long life. The oil tank is securely fastened to the main frame, but it is so arranged as to be readily removable for inspection of the contacts. Entirely distinct and separate compartments are provided for the fuses and the contacts. The operating handle swings close to the switch frame, thereby reducing to a minimum the danger of anyone

accidentally striking against the handle and throwing the switch in or out. Stops on the frame prevent the handle being thrown too far on either the "off" or "on" direction, these positions being clearly marked on the frame. "Shawmut" fuse clips are furnished and are mounted on insulating blocks supported on the top of the switch frame. The cover fits closely over the top of the main frame, thus making the entire switch totally enclosed. The cover is securely held in place, but may be easily removed when it is desired to replace the fuse. The switch is arranged for wall mounting, and mounting holes are provided in the back of the main frame, permitting the switch to be fastened to the wall or mounting surface by means of screws or bolts. This oil switch is sold by the Northern Electric Company, Limited.

Electrifying Terpischore

Each year the cafes in New York's far-famed Lobster Palace belt strive for something new and novel with which to attract their patrons. This year was no exception, and one of the more enterprising, Murrays, at 42nd and Broadway, sprung a surprise on its neighbors and patrons by the introduction of a "revolving dance floor," which is advertised quite extensively. The object of this floor was to add exhilaration and excitement to the disciples of Terpischore, who pursued the intricacies of tango and other popular steps. To provide the motive power for the floor, a Westinghouse type CD ½ horsepower, 1165 r.p.m. motor was secured. When the installation was started, however, it was found that the speed was excessive, even for the patrons of the Great White Way, and a Westinghouse type DA regulator was added to the equipment, which reduced the speed to such an extent that dancing could be indulged in by anyone so desiring, with comfort and pleasure. Each evening the floor twirls merrily with its load of human freight, resembling a human whirlpool, propelled by a small electric motor. The management, it is said, still retains the high speed arrangement, however, in case the constantly increasing desire of the people for more excitement in its hunt for pleasure demands more speed, it can readily be provided.

Standard Underground Change Montreal Office

The Standard Underground Cable Co. of Canada, Limited, announce that their Montreal branch office is now located in the McGill Building instead of the New Birks Building as heretofore.

John Forman & Sons

The firm of John Forman, electrical supplies, 248 Craig Street West, Montreal, has been reorganized under the name of John Forman & Sons. The business is being carried on at the old address.

Trade Publications

Safety Panels—Bulletin 64, distributed by the Canadian Krantz Manufacturing Co, describes, with illustrations, Krantz safety panels.

Difusolite—Booklet issued by the George C. Lynch Co., 236 Fifth Ave., New York, manufacturers of fine and carved wooden turned lamps, and auxiliary equipment. Difusolite is a bowl of specially made glass which is claimed to have unusual diffusing properties.

Lamp Standards—illustrated booklet issued by Canadian Union Metal, Limited, Galt, Ont., describing Union Metal lamp standards for ornamental street lighting. The booklet is divided into five sections, as follows: section 1, description and construction details street lighting standards; section 2, standards for business district lighting; section 3, standards for residential and park lighting; section 4, standards for cluster lighting; section 5, installation views and miscellaneous.

The gross earnings of the Calgary Power Co. for the year 1915 are $289,613.00, an increase of $58,427.00, or slightly over 25 per cent. The net income is $237,158.00, an increase of 31.6 per cent. The surplus available for dividends is $80,192.00, equal to 4.33 per cent. on the outstanding common stock, as compared with 1.3 per cent. the previous year. This showing is particularly gratifying as indicating improvement in Western conditions.

Have You?

Have you made your plans to attend the Convention and Electric Show of Electrical Contractors and Dealers in Toronto, June 6, 7 and 8? Come and meet the boys, and learn something more about your business.

Current News and Notes

Amherstburg, Ont.

It has been decided to erect a street lighting system which calls for seventy-five 140 candle power nitrogen lamps and six 600 candle power, the latter to be used at street intersections.

Edmonton, Alta.

An agreement has been reached with the Alliance Trust Co., of which R. B. Bennett, Calgary, is president, for a temporary supply of power until the new hydro-electric plant of the Edmonton Power Company, Limited, is ready for operation.

Kenora, Ont.

A by-law will be submitted in the near future authorizing the municipality to change the method of charging for electric power, from the flat to the meter system. Plans are being considered whereby a cheaper rate will be given during the daytime to encourage electric cooking and the use of electricity for other household purposes. This rate is mentioned as 2c per kw. h.

Mallorytown, Ont.

The Mallorytown Telephone Company, Limited, have obtained a charter.

Montreal, P. Q.

The registration of Howard Murray as president of the Canadian Electrical Products Company, Limited, is announced.

Crepeau & L'Heureux, electricians, (Georges Henri Crepeau and Emile L'Heureux), Montreal, Que., have registered.

Petrolia, Ont.

Hydro power was turned on for the first time for street lighting and household use on Tuesday April 26. The townspeople are well pleased with the appearance of their streets.

Preston, Ont.

A by-law is being submitted to the electors authorizing a loan to the Electric Fittings and Foundry Co., who will occupy the old Anchor Bedding Company's plant.

Regina, Sask.

The provincial Government Dept. of Telephones and Railways received tenders to May 13 for approximately 25,000 poles for telephone line extension.

St. Come De Beauce, Que.

Joseph L. Boldieu and Honore Poulin will purchase the necessary material for a telephone system.

St. Francois De Beauce, Que.

The Beauceville Telephone Company, A. Dayon, Secretary, are planning to erect a telephone system to cost some $10,000.00.

St. Rose De Watford, Que.

A company is being organized to erect a telephone system in this place.

Sydenham, Ont.

The Rosedale Rural Telephone Co., Ltd., have been granted a charter.

Sarnia, Ont.

The Hydro Committee of the Sarnia city council have made recommendations covering the lighting of the streets of that city. It is planned to install eighty-eight 1,000 candle power lamps on steel poles of a type to be used jointly by the city and the street railway company; 570, 140 candle power lamps on bracket type fixtures; and nineteen 400 candle power lamps. The estimated cost of operation per annum is as follows: 1,000 candle power, $45.00; 400 candle power, $30.00; 140 candle power, $15.00. In certain sections of the city these lamps will be installed on the local improvement plan. The committee were given power to proceed with the installation. According to the last report, good progress is being made on the transmission line of the Ontario Commission, which will supply the city of Sarnia.

Stamford, Ont.

The town of Stamford have approved the purchase of the plant and lines of the Ontario Distributing Co., and a by-law will be submitted to the people authorizing a bond issue of $30,000.00. The plant will be operated as a municipal utility under the supervision of the Ontario Commission.

Toronto, Ont.

The plans of the Hydro-electric Power Commission of Ontario, regarding the Chippewa Creek hydro-electric development, will stand over temporarily as the result of the objection raised by the United States to the diversion of this water from the Niagara River. It is understood that this is merely out of courtesy to the United States, and not in any way as a recognition of the right of that nation to raise an objection.

Truro, N. S.

Tenders for the purchase of the Chambers Electric Light & Power plant have been received and though no agreement has been announced, it is stated that the town's bid of $50,000.00 was the highest received.

Vancouver, B. C.

The gross earnings of the British Columbia Electric Railway Co. for March show an increase of $19,982.00 over the same month a year ago, the figures being respectively $577,117.00 and $557,135. The net increase is approximately the same.

Winnipeg, Man.

The Loomer Electric Co., Limited, has been incorporated for the purpose of carrying on a general electric and electrical contracting business.

Welland, Ont.

The town council has voted $40,000.00 to cover the cost of a new sub-station. Welland is now the Hydro Commission's best customer, bringing in somewhere in the neighborhood of $1,000,000.00 a year to that organization.

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The Electrical Contractors' Convention

As announced in a previous issue, the present number of the Electrical News is given over chiefly to furthering the interests of the Canadian electrical contracting business, having in mind particularly the Ontario contractors, who will meet in convention during the days of June 6, 7 and 8, in Massey Music Hall, Toronto. By this means we are hoping to bring home to electrical contractors generally the increasingly important position their work is occupying in the public eye and in the public well-being, the necessity for careful study and attention to the work as it becomes more intricate and more universal in demand, and, as a necessary consequence, the value of meeting together with other men in the same line of business, not only that they may learn something more about that business, but also that they may imbibe something of the broader conception of the usefulness to mankind in every walk of life, of "Electricity"—the most powerful agent in life to-day for the betterment of the human race.

We recognize to-day what has not been so evident until quite recently, that electricity's place is among the masses, the so-called common people. No human agency that reaches only the wealthier classes can ever expect to achieve far-reaching results. But electricity is reaching down to the very depths of our society, carrying light and health to our lowest slums and exerting a refining and educating influence, the force of which is just beginning to be felt. And it is because the electrical contractor is the connecting link between the customer who buys, and benefits, and the company that sells—and benefits, too, of course, though merely in a material way—that he must now be looked upon as an essential, important element in the electrical business.

It is quite possible that many an electrical contractor has never considered his obligation to his community in this way and that many a central station man and manufacturer does not realize the importance of this link between himself and his customers. We hope all and sundry of these will make a point of attending the coming convention. The contractor will be brought to see more clearly, we hope, the importance of his work, his increased responsibility and the consequent necessity for a revision, upwards, of his ideals. The other members of the trade will appreciate too, we believe, that the development of the electrical industry lies largely with the contractor, and will realize, then, the necessity of co-operating with him in every way; first, to raise the standard of electrical contracting, and, this accomplished, to stand behind the electrical contractor with their loyal support.

Weekly Electrical Luncheon

A very welcome movement has been put on foot in the city of Toronto in the form of a weekly electrical luncheon. To date the scheme has only been in operation for two weeks, but its success indicates that the idea has taken a very firm hold of the electrical fraternity. One of the most noticeable features of the two luncheons that have been held is the varied personnel of those attending, good representation being shown by the telephone, telegraph, and local central station organizations, as well as by manufacturing, jobbing and consulting interests. At the first luncheon, held in the Prince George Hotel on Friday, May 19, some ninety electrical men sat down. The attendance on May 26 was not quite so large, but it was generally noted that the gathering was more representative and especially that many prominent officials of the various electrical organizations in and around Toronto were present.

The credit of the success of this luncheon idea is almost entirely due to the able activity of Mr. Frank T. Groome, sales manager of the Benjamin Electric Company, who is temporarily acting as secretary and chairman. Not only did the idea originate with Mr. Groome, but on his shoulders has fallen so far most of the labor of arranging for these luncheons and for the speakers. The present plan is to take up not more than an hour of time, which will include the disposal of the luncheon and a fifteen minute talk by some prominent member of the trade. Electrical men are requested to keep these dates free and present themselves as promptly as possible at the Prince George every Friday at 12.30. A special room has been provided. If you are interested in knowing,, or being known to, other electrical men, be on hand Friday, June 2.

Latest Practice in Street Lighting

The city of Sarnia, Ont., having made arrangements to take over the plant of the Sarnia Gas & Electric Company, are making certain extensions and improvements, chief of which has reference to the street lighting of the city. The plans for the work are now complete, these having been worked out by the engineers of the Hydro Electric Power Commission of Ontario. The installation is thus of interest, in that it represents the latest practice of the Hydro Commission, which in turn is the result of their several years of experience. As such, it may safely be followed by our larger towns or smaller cities situated similarly to Sarnia.

On the main street there will be installed eighty-eight 1,000 c.p. nitrogen-filled lamps, mounted on combination tubular steel trolley poles, 28 feet long, set in concrete. The main streets in Sarnia to be included in this form of lighting are Front and Christina streets from George to Wellington. The lamps in this section will be installed on every pole on both sides of the street. The poles are approximately 110 feet apart and the lamps will be sixteen feet above the pavement. The lamps themselves will be 20 amp. capacity, a series transformer being installed in each pole to step the current up from 6.6 amperes to 20 amperes Each lamp will be supplied with a special glass reflecting globe, Holophane type, with special distributing features.

There will also be nineteen 400 c.p. lamps on Ontario and Russell streets from Mitten Street to the Grand Trunk tunnel. These lights will be approximately 400 feet apart and suspended from the trolley poles so as to hang above the centre of the street 25 feet high. Each of these lights will be fitted also with special distributing reflectors.

The outlying streets of the town will be illuminated by 570 140-c.p. nitrogen lamps, supported on 30-in. iron brackets, on wooden poles. The lamps will be placed 15 feet above the pavement, enclosed in frosted bowls and installed on every other pole. That is, they will be spaced approximately 220 feet. This latter lighting is on one side of the street only.

The ornamental lighting will be installed on the local improvement plan, the frontage tax to be paid by the householders at 10c. per foot for twenty years. The estimated cost of the lighting system complete is placed at $8,800.

Canadian Electrical Association

The Canadian Electrical Association have made final arrangements to hold an Excursion Convention on June 21-22-23, which will combine business and pleasure for the members of the Association. All the member classes are included in this year's convention. It is planned to leave Toronto at 3.30 p.m. on June 21 per Steamer "Toronto" for Kingston. Prescott will be reached at 9.50 a.m. the following morning and here the Association will be joined by delegates from Ottawa, Montreal and eastern points, and the return trip commenced at 11.55 noon, arriving in Toronto at 7 a.m., June 23. The business of the Convention will be conducted chiefly on the return journey, when all the members shall be present. All meals required throughout the entire trip will be furnished on the steamer. Rates, including berth and meals, from Toronto to Prescott and return will be $10. Wives or other members of the delegates' families are invited. Further information may be obtained from Mr. Alan Sullivan, secretary-treasurer of the Association, 910 Excelsior Life Building, Toronto.

Good Lighting a Commercial Asset

Mr. E. N. Hyde, illuminating engineer of the Northern Electric Company, spoke on the subject of "Illumination" at the Wednesday Electrical Luncheon, held in Montreal, on May 10. He divided his address into four parts, physical characteristics of light, chemistry, architecture, and ophthalmiology, pointing out the bearing which each had on correct lighting. The following lamps, he said, have the subjoined watts per candle: oil, 57; kerosene, 42.8; bat wing gas, 93.2; argand, 68.8; 16 c.p. lamp, carbon, 3.5; metalized filament of carbonized cellulose, 2.5; metal filament tantalum, 2.0; Nernst, 1.3; metal filament tungsten in vacuum, 1.0 for 60 watt; the same in argon or nitrogen, from .8 to .55 watts commercially; arc (open), .8 of a watt; arc (enclosed), .6 of a watt; mercury arc (not tube) .2 of a watt; fire fly and pyrophorus noctilucas .2 of a watt.

The reflecting quality of highly polished silver is 92 per cent., the highest of any material, while black velvet (Priestly's) is the lowest, with .004 per cent. With regard to architecture, it was the business of the lighting expert not only to get the general ideas of the architect, but to design lighting schemes which by the daylight effects, are reproduced under artificial illumination. In this connection a scheme, lending an atmosphere of sanctity appropriate for a church was manifestly unsuitable for a theatre; the illuminating engineer must prepare a plan which would give the correct atmosphere in the building to which it was to be applied. Light had the quality of a pigment, and could be utilized to give the various tints which should predominate. Mr. Hyde also referred to the effect of light on the eye, and mentioned instances of how the power of vision varied in different persons. He stated that, in the case of the Westinghouse Company in the United States, the installation of a new lighting system at a cost of $150,000 had saved 25 minutes per day for each man; reduced the casualties by fifty per cent., loss of tools by 60 per cent., and reduced spoilage of material by 50 per cent., while it increased in some cases the output per man by 10 to 20 per cent., and, strange to say, the life of the boots of the workmen by six weeks.

The Pas Buys Electrical Equipment

The town of The Pas, Man., is inviting tenders for sewage lift pumps with the necessary motors, for the purpose of pumping raw sewage and surface drainage from a chamber with a bottom elevation at 819 feet. Two single stage vertical submerged type centrifugal pumps with a speed of not more than 680 r.p.m., are required, one capable of delivering 500 Imperial gallons and the other of 1,000 Imperial gallons per minute. The sewerage is discharged into the main sewer and then into the river bed; during a portion of the year sewage can be discharged by gravity, but during other months the water level in the river changes, thus increasing the head of the water over the sewer outlet to such an extent that the gravity discharge ceases, and the lift pumps are then required. The elevation of the pumps will be 827 feet. The two vertical type induction motors are to be 3 phase, 60 cycle, 220 volts, with impregnated windings, and with automatic float type controlling devices. The plans also provide for 3 live kw., single phase, 2200 volt primary 110 and 220 secondary volt, oil-cooled transformers or one 3 phase 15 kw. 220 volt secondary with primary fuse cut outs, hanger irons and oil. Messrs. Murphy and Underwood, Saskatoon, are the consulting engineers.

Engineers' Club, Montreal

The Engineers' Club, Montreal, held its annual meeting on the evening of 17th May, when the report for the year was submitted. There are now 342 resident members, 19 of whom are on active service overseas; there are also 173 non-resident members. The finances of the club are in a satisfactory condition and in every way the club shows a healthy activity. The Club premises occupy an ideal situation on Phillips Square and the appointments are excellent. It will interest electrical engineers to know that Mr. R. M. Wilson, of the Montreal Light, Heat & Power Co.; Mr. Lawford Grant, of the Eugene F. Phillips Electrical Works, Limited, and Mr. Julian C. Smith, of the Shawinigan Water and Power Co., are the committee of management, while Mr. Henry Holgate, consulting engineer, is the president.

The Hydro-electric Power Commission of Ontario have notified the Elmira Utilities Commission that a new rate has been devised and approved for rural customers. This rate will apply to all farmers fed from the Elmira hydro station and is as follows: On a basis of three customers per mile a service charge of $3 per month; four customers per mile, $2.50 per month; and five customers per mile, $2.00 per month. The charge per kw.h. will be 6 cents for the first 60 and 3 cents for all additional.

Montreal Engineers are Fighting Hard to Save their City from Unwise Expenditures

The controversy over the enlargement of the Montreal aqueduct and the construction of the proposed hydro-electric power house has reached a new stage. The Council of the Canadian Society of Civil Engineers in July and October last made strong representations to the Board of Control in favor of the project being studied by an independent board of engineers. It was pointed out that the engineers who had reported on the scheme had only done so on isolated parts, and not on the entire scheme. This has been followed up by another petition in which it is stated: The opinion is quite generally held by local engineers having some knowledge of the work, but by no means full knowledge, that the proposed enlargement of the aqueduct and development of hydro-electric power sufficient to do the lighting of the city and to pump its water, is not a project which could be recommended from an economic point of view.

When the council of the Canadian Society of Civil Engineers made its recommendation, many members were firmly of the opinion that:—

(1) No thorough study had ever been made of the cost and economic value of the great enlargement of the aqueduct now proposed and of its attendant works.

(2) No complete design had ever been prepared for the power house and its equipment, or for the intake and controlling works, and only approximate estimates had been made of the cost of these very important and costly portions of the work.

(3) The original estimates submitted by the engineers of the city were inadequate and the work as it progressed was costing far in excess of these original estimates.

(4) The project as a whole had never been studied and reported on by independent or disinterested engineers.

In view of all the circumstances, and particularly because of the fact that all the engineers named by Mr. Cote deny in writing the statement attributed to them that they approved of the project, we, the subscribing engineers, endorse and repeat the recommendation of the council of the Canadian Society of Civil Engineers, and respectfully urge that a commission of prominent engineers, especially qualified to pass judgment on the project, be retained to make a comprehensive study and report upon the cost of the work now being projected, and to advise to what extent, if at all, the project may to advantage be modified or changed. The petition was signed by the following members of the C. S. C. E.:—

Sir John Kennedy, consulting engineer, Montreal; Ernest Marceau, supt. engr., Canals, Province of Quebec; Herbert Wallis, M. Inst., C.E., M. Inst., Mech. E.; K. W. Blackwell, vice-pres. Canadian Steel Foundries, Ltd.; Phelps Johnson, pres. St. Lawrence Bridge Co.; J. A. Jamieson, consulting engineer; Henry Holgate, consulting engineer; M. J. Butler, director Armstrong Whitworth of Canada; G. H. Duggan, gen. mgr. Dominion Bridge Co.; R. A. Ross, consulting engineer, Montreal; C. N. Monserrat, chairman and chief engineer, Quebec Bridge Commission; Walter J. Francis, consulting engineer, Montreal; Arthur Surveyer, consulting engineer; C. A. McLeod, consulting engineer and secretary Can. Soc. Civil Engineers; John B. Porter, consulting engr., and Professor Engineering, McGill University; W. Chase Thomson, consulting engineer; H. M. Mackay, Prof. Civil Engineering, McGill University; E. Brown, Prof. Applied Mechs. and Hydraulics, McGill University; H. O. Keay, Prof. Transportation, McGill University; G. R. Heckle, engineer and contractor; H. P. Borden, member Quebec Bridge Commission; J. M. Robertson, consulting engineer; C. LeLuau, Prof. Laval University, and consulting engineer; Wm. McNab, valuation engineer, Grand Trunk Railway; H. H. Vaughan, 3rd vice-pres. Dominion Bridge Co.; H. M. Jaquays, works manager Steel Co. of Canada, Montreal; W. F. Angus, vice-pres. Canada Steel Foundries, Limited; R. J. Durley, consulting engineer; L. A. Herdt, Prof. of Elec. Engineering, McGill University; Alex. Pringle, consulting engineer.

The engineers of the Montreal power and lighting companies were not asked to sign on the ground that the Mayor had previously suggested that the movement was in the interests of these companies. This was based on the fact that part of the power proposed to be generated will be used for pumping purposes and part for lighting, thus cutting off revenue from the companies.

A petition signed by so many influential engineers could not be ignored, and on its presentation the Controllers promptly invited the engineers to place their views before the Board. A majority of the engineers accepted this invitation. The interview was of the most cordial character; the Controllers present, Messrs. Ross, Villeneuve, and Ainey, requesting the fullest information on the various points. The Mayor and Controller Cote, who have hitherto been strong supporters of the scheme, were not present, and for that reason no immediate decision was possible. Messrs. Ross and Villeneuve, however, declared they were willing to accede to the request of the deputation.

Sir John Kennedy and Mr. Ernest Marceau put the case for the petitioners. The former, who was the chief speaker, handled the matter with great discretion, and in a way to remove any slight bitterness which may have crept into the controversy. The engineers, he explained, were not there in any spirit of opposition to the scheme; they felt that the plans were not fully matured, and in a matter involving such a large expenditure the advice of experienced engineers should be secured in order that the plans should be satisfactory. The engineers would be delighted if the plans were of this character; if they were not, it would be advisable to secure further advice.

Mr. Marceau remarked that the deputation were not able to make suggestions as they were not in possession of all the facts.

Controller Villeneuve pointed out that Sir John Kennedy and Mr. Marceau had made an interim report on the subject, but Sir John answered that this was for a scheme for 3,000 h.p. in winter, whereas the present scheme was for 10,000 h.p. There was the question of frazil to be dealt with, and the deputation desired information on this point.

Cost of Power $700 per H.P.

Mr. T. W. Lesage, superintendent of the waterworks, read a statement giving the history of the project from 1854. In the former year the canal aqueduct was built, and 400 to 600 h.p. developed at a cost of $833 per h.p.; in 1907 an enlargement of the existing aqueduct was planned to develop 3,000 h.p. for pumping at a cost of $733 per h.p. The third project of enlargement was begun in 1913 in order to still further develop the hydraulic power to 10,000 h.p. and supply hydraulic power for pumping 100,000,000 gallons per day, for which 6,000 h.p. will be required, and also supply power for street lighting to the extent of 4,000 h.p. The estimated cost strictly applicable to water power development was about $7,000,000. This would bring the cost of power development alone for 10,000 h.p. to $700 per h.p. Mr. Lesage added that the project of 1913 was an extension of previous schemes, with a somewhat more modern and permanent construction of the sides of the canal which are to be concrete walls, also more elaborate bridge, etc. No criticism of the non-economic value of the projects was heard until the last two years.

The main contract for widening, excavating, and side walls was awarded to the Cook Construction Co., in 1913, for the sum of $2,320,000, this figure being well under the city's engineers' estimate of $2,800,000. When bids were asked for this very important work, in 1913, numbers of engineers figured on the estimates of work to be done, still the city never heard complaints from any of them of the non-economic value of the scheme. Considering the economic value of disbursing $7,000,000 to do the city's water pumping and street lighting, this capital cost represented an annual charge, at 5 per cent., of $350,000.

The cost of these services to the city (in money actually disbursed) in 1914: was cost of coal (fuel for pumping) $170,000; cost of electric power for pumping, $50,000; cost of electric street lighting, squares, etc., $275,000. Total cost, $495,000. There was, therefore, a respectable margin to cover cost of electric installation charges.

After the reading of this statement, Controller Ross expressed an opinion in favor of the project being examined by engineers.

In the course of further discussion, it was remarked that the present work could not be stopped, especially the installation of the head gates.

Sir John Kennedy suggested that one of the city's engineers should be on the advisory board.

Controller Ross thought that the petition of the deputation ought to be acceded to.

Mr. P. Mercier, Chief Engineer, asked Mr. Marceau a question regarding the estimated cost per horse power. Mr. Marceau replied that the estimated cost was rather high, although some allowance had to be made for a corporation plant. On the whole, he would not like to express a definite opinion without examining the whole scheme.

Sir John Kennedy asked that in appointing engineers the Controllers would not overlook the merits of Canadian engineers; Controller Ross said this would not be lost sight of, and they would also consider the engineers of Montreal.

Sir John Kennedy thanked the controllers for the courtesy which had been extended to the deputation.

Ancient vs. Modern Roundhouse Lighting

One of the Large Canadian Railway Companies has Entirely Remodelled the Plan of Illumination and Standardized Throughout the System—Some Marked Improvements.

The following description of a system of roundhouse lighting which has been adopted and standardized by a well-known Canadian railway company, is intended to give an outline of the manner in which this company's electrical engineer handled a problem which presents some rather unique features. The average layman, to whom the inside of a day-coach or Pullman forms the foreground of his mental picture of a railway, thinks of a roundhouse as a stable where the mechanical "horses" that pull the trains over the rails are brought in after a "run," cleaned and fed, rested and groomed, in preparation for the appointed toil of the following day. This is all quite so, and to strengthen the comparison, each engine section is called a "stall"—but there the analogy ends. Such cleaning and feeding and grooming are part of the routine work and are done as a matter of course, but a glance at the engineer's report book shows a surprisingly long "repairs required" list, even after a short run on the road. These repairs frequently call for delicate work among the complicated mechanism of a modern locomotive and must be completed in a limited time in order that the "tractor" may be ready when called.

This work, requiring thoroughness and dispatch, naturally necessitates a lighting system which is as efficient as it can be made.

A roundhouse presents a peculiarly difficult proposition for the illuminating engineer to handle. From the day of its annual whitewashing, its walls, columns, and roof vary in color scheme from a dirty cream to a dull, sooty black by the end of the first month, and so remain for the succeeding eleven. As a light absorber it can't be beaten and its reflective properties give one a very fair conception of "nothing at all."

Up to three years ago the standard method in this company's roundhouse was a row of three drop lights between all pits or stalls, and one drop light opposite the end of each stall at the front of the house. In addition, there were drop lights over the benches, which are located along the back wall about six stalls apart, and extension plug receptacles on the centre column between the pits. The circle, in the centre of which is the turntable, was illuminated (?) by from two to five arc lamps or 4-60 clusters, distributed equally and suspended from brackets attached to the walls. Twelve circuit distribution panels, metal boxed, were placed at the proper intervals along the front wall. The mains were brought through the wall directly above the leads and down to them in conduit. The different circuits were then run in conduit up the wall and along the roof. Such an installation, though put in according to the strictest standard, would be in need of rather extensive repairs within a year from the time of being put into service, while three to four years would bring the necessity of renewing at least 75 per cent. of the conduit. The three chief demons in the railway electrician's nightmare are gas, smoke, and steam. They form a malicious triple alliance that is hard to combat successfully. The gas attacks any kind of metal with such avidity that cases where ¾-in. conduit would crumble in the hand after having been in place in a roundhouse just a little over three years are not uncommon. Pipe clips and the screws holding them would be so weakened by the corrosion that frequently fifty to a hundred feet of conduit would break away and come clattering down on top of the engine without warning. Unless extreme and painstaking care is exercised in spotting the engines exactly under the smoke-jacks, clouds of gas and smoke bellow forth from the stacks and cling to the roof with the persistency of a porous plaster.

Besides all this, drop-lights were found to be very unsatisfactory and unsuited to the requirements. They naturally had to be tungstens, where any regard was had for cost of consumption, and tungsten lamps in such a place necessarily demand lockguards. It is no light matter to clean 150 to 200 lamps when lockguards had to be removed before and replaced after the wiping process. This had to be done at least once a week if any light to speak of was to be obtained, for it takes the combination of smoke, steam, and gas but a very short time to deposit a nice sooty black film over the glass which is not in any way conducive to good lighting. Again, drop-lights were found very costly on account of the high breakage factor due to swinging against engine cabs or tenders and to being struck by long fire-hooks, etc., in the hands of careless workmen.

Such disheartening conditions, in addition to the fact that the actual light given left a very great deal to be desired, surely called for a radical change in the system adopted. This was made and the present one evolved and standardized as described in the following paragraphs.

The first and most important change was that no conduit was to be run along the roof open to the attack of the ever-present gas, and secondly, drop-lights were to be done away with entirely and replaced by reflected lights throughout.

The distribution boxes were placed on the walls at the "front" of the house in about the same relative locations as under the old system, the mains being brought through the wall and down to the box as before. But the conduit containing the circuit feeders was now run down from the box and then along the wall, about two feet above the floor. Thus it escapes the effects of the metal-eating gas. Risers from this run up to pairs of reflectors, bracketted to the wall about seven feet above the floor—a pair to each stall. These reflectors are manufactured by the Crouse-Hinds Company especially for work of this nature and are not dissimilar in size or appearance from the reflectors seen on the front ends of in-

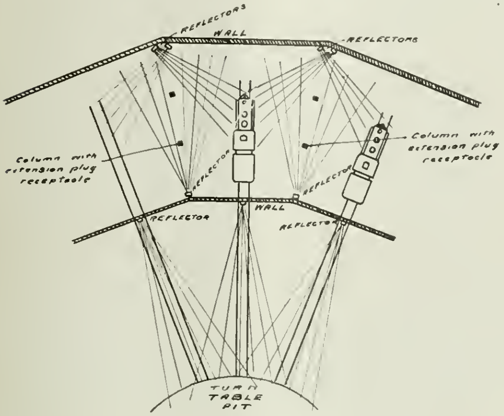


Diagram of arrangement of Roundhouse Lighting

terurban cars. They are dimensioned to accommodate 60-watt tungstens and may he had with either clear glass or semaphore lens. For this work the latter lens is used, as it diffuses the light and cuts out the glare. The reflectors of each pair are placed about eighteen inches apart and at an angle to each other and to the wall. By such an arrangement the beams cross each other and are directed against the side of the farther engine, as shown in diagram.

Eight feet up on the back wall, in the centre of the space between the tracks, is located another series of reflectors, so placed that they direct their light straight down this space toward the front of the house. These serve the purpose of general lighting. The feeders for these circuits are run from the distribution boxes either in the concrete floor or directly up through the roof and above it to the back circuits described and drop down to each light. In either of these ways also is run the conduit for the extension plug circuits. The receptacles (Norbitt fittings) are placed, one for each stall, on the face of the posts in the centre of the spaces between tracks.

Another row of reflectors is placed high up on the outside of the back wall of the roundhouse. They are so bracketted to the wall that they throw their light on the ends of the tracks at the edge of the turntable pit. This makes spotting the table as simple a matter by night as by day and gives good general lighting about the pit, table, and tracks besides.

In addition to the stationary lights, from one to six portable reflector stands are to be provided for each roundhouse so equipped. These are made up of Crouse-Hinds reflector cases, as used throughout, suspended in a saddle in such a manner that they may be tilted to any angle in the horizontal plane. This saddle is supported by 1½-in. pipe about three feet long, through which the leads run up to the lamp in the reflector case. The lower end of this pipe screws into a 1½-in. "C" condulet, below which again is a short nipple threading into a cast iron base 18 in. in diameter. This base is fitted with two small wheels at one edge to facilitate movement and three spikes on which it rests when in use. Through one hole of a two-wire porcelain cover on the "C" condulet comes the reinforced lamp-cord lead with attachment plug at the end and through the other hole is a twenty-five foot extension for general purpose work when the stand is in use. The connection is made inside the condulet.

These portable reflectors have been found extremely useful in cases where particular work, requiring possibly from one to three hours' time, is being done within a limited space on the mechanism of an engine.

The system above described, though not without its defects, has been found a most satisfactory improvement in a great many ways. Though the installation cost is high, the maintenance cost is wonderfully low. It is a matter of only a few minutes to walk along and give the lens on each reflector a rub with a piece of damp waste—no removing and replacing of troublesome lock-guards. Breakage is reduced to an absolute minimum. The light is concentrated on the points where it is required and the whole has an accessibility and neatness impossible to obtain with the use of droplights. The introduction of this system has resulted in a very marked improvement in the thoroughness and dispatch with which the roundhouse work is carried on. A visit to one or other of the roundhouses so lighted has impressed very favorably a number of practical men from other roads and the near future should see this system—with modifications, possibly—adopted by many of the other railway companies.

For King and Country

Major Norman C. Pilcher, who recently resigned his position as manager of the Sherbrooke Railway and Power Company to go overseas, was killed in action on May 19. Major Pilcher was first attached to a unit of mounted rifles, with the rank of captain and received his promotion at Valcartier. He had been in action some eight months.

Major Pilcher was thirty-six years old. He was born in England, though he had spent the greater part of his life in

The Late Major Pilcher

Canada. He was formerly with the Canadian General Electric Company, and is a brother to Mr. J. W. Pilcher, Montreal manager for this company. At the time of the Boer war, Major Pilcher enlisted with a Toronto contingent and saw active service with the Johannesburg Mounted Rifles. After his return he was for some time manager of the Fort William and Port Arthur Electric Railway System, which position he resigned some years ago to accept a similar one in Sherbrooke, Que.

Electric Power in the Lumber Industry

As Applied at the Brunnette Saw Mills at New Westminster, B.C.—Modern Drive has Greatly Increased Mill Capacity.

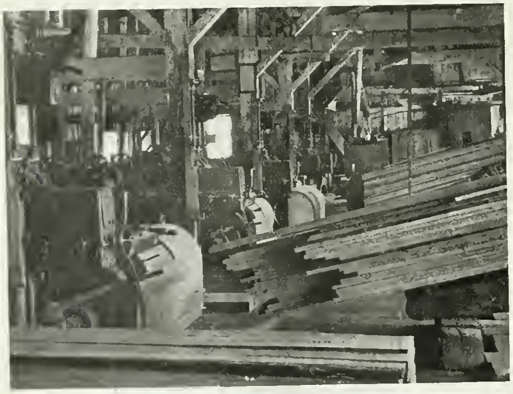
By D. Penzer Dunn, Assoc. A.I E.E.

The Brunette saw mills do a general lumber business, both domestic and export, having commenced operations in the year 1878, as the outcome of a demand for manufactured lumber around the larger towns in British Columbia.

At that time the amount called for was very small as compared to that of the present day, the business having increased considerably up to the present time. The plant now consists of a saw mill with a daily capacity of 100 M., planing mill 100 M., a box factory turning out five thousand boxes per day, and a shingle mill with a daily capacity of 200,000 shingles.

The site chosen was particularly favorable from the point of view of a manufacturing centre, being situated on the Fraser River about 15 miles from the Gulf of Georgia, and within the corporative limits of New Westminster, thus affording a convenient handling of export and import trade. The company owns extensive timber limits, the most important one being on Vancouver Island, where the logs are cut and towed direct to the mills by steam tugs belonging to the company.

The original motive power for the various wood working and planing machines was steam until the year 1910, when the output had increased to the extent that it was found necessary to greatly enlarge the factory in order to



View of Electrically Driven Planing Mill

cope with the increased business; it was at this time that the company seriously considered the economy of maintenance and operation in connection with steam drive, and after due consideration, decided to adopt electric power.

From the first the company decided to generate their own power owing to the waste lumber, saw dust, etc., that could be used for fuel, as had been the case hitherto with the steam power. Three phase induction motors were considered the best applicable to the various mill machines, owing to their constant speed characteristics, etc., and to this end a turbo-generator set was installed of 500 kw. capacity. This machine took care of all the power load of the factory, which consists of 43 induction motors with horsepowers varying from 3 to 75 h.p., making a total of 900 h.p. connected.

A series of tests made on the plant prior to its initial operation, gave the following results: The average power factor was approximately 73 per cent., at full load 76 per cent., at maximum overload 67 per cent.; the drop at the farthest motor was approximately 8 volts. Several motors have been added since these initial tests were carried out and a more recent test of overload showed that it would require a synchronous motor condenser set of 250 kw.a. to correct the power factor to 90 per cent. The question as to the advisability of installing a synchronous condenser as against an additional power unit being brought up at this time with a final decision in favor of the latter.

After four years of service, the installation of an additional power unit of 300 kw. capacity, owing to the fact that the turbo-generator was subject almost continuously during the latter time to an overload of 40 per cent, was discussed. In making the decision as to increase of capacity, however, it was decided to buy from the Western Canada Power Co., the chief reason for this being standby service in the case of a breakdown of the mill power plant and to enable repairs to be made on the 500 kw. unit when necessary without totally crippling the service.

The Power House

The power house for containing the plant is a reinforced concrete building and contains controlling and generating equipment as well as condensers, etc., in the basement, the capacity in all, including transformers, being 800 kw. There are 7 boilers of 513 h.p. capacity total for generating the steam, being of the return tubular type. These are equipped with natural draught and use as a fuel the waste products from the lumber mills; this is fed by means of a conveyor into the boiler room and fired automatically. To feed the various boiler furnaces, the wood shavings, etc., are led through a 30 inch galvanized iron pipe, No. 14 gauge, through which it is drawn by suction fans; the feed water for the boilers and condensers is taken from the Brunnette River.

Turbine

This machine is of Allis Chalmers Parsons type, steam pressure 110 lbs. to the square inch, vacuum 25 inches, having three stages of expansion; B.h.p., 600; speed, 6,300 r.p.m.; governor oil pressure, 30 lbs. to the sq. inch.

Generator

This machine is Allis Chalmers type, being a three-phase, 60 cycle, 480 volt, amperes 602, 3,600 r.pm., two pole machine, delta connected.

Exciters

These are two in number, No. 1 being direct connected through the switch board to the generator, while the other is kept as a reserve and also to supply direct current power and lighting to the factory; exciter No. 1 is driven by a Curtis steam turbine with a speed of 4,500 r.p.m.. It is C. G. E. type, constant current, 125 volt machine, with a full load rating of 120 amperes (15 kw.). Exciter No. 2 is a 125 volt machine of 35 kw. capacity, and is driven by a single cylinder reciprocating engine, 300 r.pm., size 9 x 10, Goldie & McCulloch, Ltd., direct coupled This machine now takes care of the factory lighting, and a small d. c. power load consisting of a crane of 15 h.p. and a 10 h.p. shunt motor connected to a band saw. The lighting load consists of about 15 kw.

Switchboards

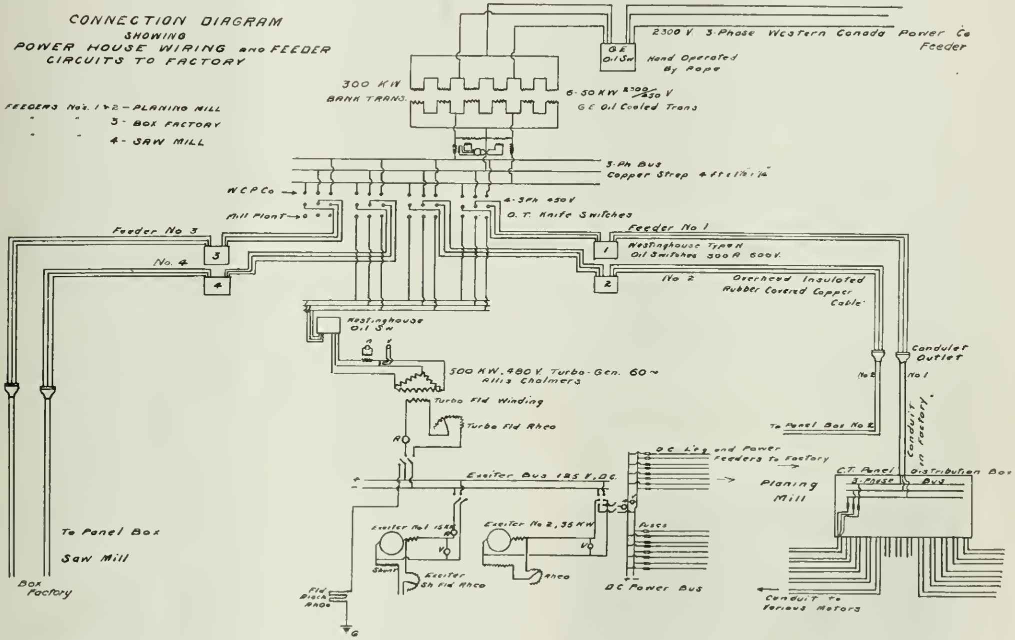
The main panel contains the following: 1 Tirrill voltage regulator, generator and exciter instruments, 1 ammeter and volt meter for each exciter, 1 generator field ammeter, 1 machine a. c. volt meter and ammeter. The main oil switch and field switches are stationed at the base of this panel. The field rheostats regulator handles for generator and exciter are located next to this panel and operate the resistances which are located in the basement. The direct current board is marble, with angle iron supports and was supplied by the Hinton Electric Co., Vancouver, B.C.. It contains one main and 8 feeder switches, and d. c. volt and ammeters. Reference to the connection diagram herewith will make this layout clear. This diagram includes the complete wiring layout of the plant from generation to point of supply.

Transformers

The 300 kw. bank of 3 phase transformers is contained on a built-up wooden platform made level with the engine lumber company's own plant or the power company's mains. (See diagram).

Feeders

These are 4 in number as just mentioned. Each is controlled by a type H Westinghouse oil switch, 3300 amps., 600 volts. Feeders are 19 strand No. 10 B. & S. rubber covered wire; no voltage and overload release equipments are provided with these oil switches. The feeders are run in conduit, 2 in. diameter, ⅛ in. thick, to the outside of the power house wall, where they emerge from condulet outlets onto glass insulators supported on wooden cross arms; these circuits feed the following: box factory, planing mill, and saw mill proper.



Wiring Diagram of Electrical Equipment, Brunnette Mills, New Westminster, B.C.

room and located outside the building. These consist of six Can. Gen. Elec. 50 kw. units of the oil-cooled, out-door type, delta connected on both high and low tension sides, the voltage being 2,200/440 v. They are fed by a No. 4 copper line about one and a half miles long, from the Western Canada Power Co., sub-station. They are run in conduit under ground to the mill company's premises and thence through a pot-head unto a short pole line of about 800 ft. to the factory power house. The transformers may be disconnected from the line by an oil switch outside the building, operated by a rope from the ground below. Reference to the diagram will make this clear. The kw. hour meters in connection with these transformers are mounted on the inside wall of the factory power house together with series and shunt transformers, the power being metered on the secondary side at a reasonably low cost per unit with a guaranteed minimum from the mill company. The secondary leads from the transformers consist of 19 No. 10 B. & S. stranded copper wire, rubber covered, and enter the building in conduit, where they connect with a 3-phase copper bus bar 4 ft. long, 1½ in. deep and ¼ in., mounted at the back of slate switchboard; the front of this board contains four 3-phase change over knife switches, enabling the power supply to be drawn from the

The circuits are run to the centre of distribution in the various buildings where they are enclosed in conduit and enter a distribution panel box. From there the various motor circuits are tapped off a 3-phase bus and run to their individual motors, each circuit being protected by fuses of the required rating. There are 4 of these distribution panels altogether, the greatest number of circuits from one panel being 18 in the planing factory. The motors themselves are Westinghouse semi-enclosed type, with squirrel cage rotors. The control equipment consists of a compensator and disconnecting oil switch in all cases. The compensators are equipped with overload trip coils and in some of the larger machines a no-volt release device has also been added. This apparatus is handled easily by the employes of the factory and has so far given satisfactory service, the only troubles having been due to a few burnouts on the compensator coils. The position of some of the motors is such that they need a protective covering owing to the large accumulation of saw dust within the building.

The distance from the power house to the farthest motor being about 500 ft., this gives a measured voltage drop at full load of 5 per cent. at the motor terminals. One of the biggest motors is in the box factory, a 75 h.p. unit. The compensator has overload and no-voltage control equipment mounted on it, the speed being 850 r.p.m. This motor is direct connected to a box planer.

The following tables include a list of the various motors with the machines attached thereto, giving the speed, output, and location; they may be sub-divided as belonging to the following: (1) box factory; (2) saw mill; (3) planing factory.

Box Factory

H.P.	Speed, r.p.m.	Drive	Use
75	850	Direct	Box planer.
10	850	Direct	Tumbling cut-off saw.
50	850	Belt	Exhaust fan.
50	580	Belt	Roller band re-saw.
30	1120	Belt	Counter shaft running several small machines.
15	1120	Belt	Dovetailing plant.
5	1700	Belt	3 rip saws.

Saw Mill

15	1120	Belt	Conveyor lumber.
50	1120	Direct	Pony edger.
20	850	Belt	Sorting table.
75	850	Belt	Roller band re-saw.
10	1120	Belt	Transfer chain to roller band re-saw.

Planing Factory

50	850	Direct	4-sided timber planer.
30	850	"	Matcher.
40	850	"	Matcher.
30	850	"	Moulding machine.
7½	1700	"	Rip saw.
7½	1120	Belt	Scroll band saw.
50	1120	"	Fast feed matcher.
50	1120	"	Double 50-in. fan.
15	1120	"	Bevel siding splitter.
30	1120	"	Single 50-in. fan.

The motor that works the crane at the mill end is a 15 h.p., 125 v., d.c. machine, with reversible drum controller, Westinghouse type, used for piling and loading timber at the mill end. This crane has a capacity of 10 tons.

A few particulars with regard to the operation of two of the larger machines might be of interest: in the box factory the 75 h.p. box planer is capable of dressing lumber four sided at the rate of 200 lineal ft. per minute, while the 50 h.p. timber planer in the planing factory, is capable of dressing lumber four sided at a speed of 250 lineal ft. per minute.

50 H.P. Motor Installation

The management of the factory is organized as follows: one general supervisor, each department being under a foreman; the labor employed is mixed, there being a number of Japs and Hindoos along with the white men, the latter, of course holding the most responsible jobs. Upwards of 200 men are employed.

The wood chiefly used is fir; spruce and cedar is handled also; the shipping is done by rail and water; domestic and export in New Westminster by rail (C.P.R.). The engineering staff consists of the following: chief engineer, electrician, blacksmith and helper, machinist, and mill-wrights. The company own their own machine shop and repairs are done right on the job. The equipment includes 2 lathes and a shaper, drill press, and blacksmith shop. The average mill cut for 275½ day year works out at 25,723,853, while the maximum for the last 5 years was 29,349,358.

In conclusion, the writer wishes to thank Mr. Duby, general superintendent of the plant, and Mr. Bennett, chief engineer, in supplying the necessary information required in the preparation of this article; the illustrations shown, as well as the information regarding the electrical tests of the plant were supplied by the kindness of Messrs. Mather & Yuill, consulting and electrical engineers, Vancouver, B.C.

Will be Entirely Driven by Electricity

The General Car and Machinery Co., of Montmagny, Que., are erecting a large plant, to be electrically driven. The plant consists of the following buildings: main machine shop, 450 feet long by 80 feet wide; steel foundry, 225 feet long by 60 feet wide; and forge shops, 150 feet long by 80 feet wide. The power house has twin boiler rooms, each containing five 125 h.p. boilers. The equipment comprises two units, one consisting of a Belliss & Morcom compound vertical steam engine, 600 h.p., having direct connected to it one 400 kw. C. G. E. generator, operating at 325 r.p.m., 3 phase, 60 cycle, 600 volts. No. 2 unit is a 100 kw., 3 phase, 60 cycle, 600 volts, C.G.E. generator, direct connected to a Ball & Wood compound engine. The main machine shop is to be electrically driven by motors, varying in size from 15 to 50 h.p. There will be installed in this building approximately 500 h.p. The forge shops, where large pumps will be installed for the operating of the presses to dray the shell blanks, will be operated by 300 h.p. induction motors. The steel foundry will have two 25 ton four motor electric cranes, which will be operated by variable speed, 3 phase 60 cycle, 550 volt motors. These will be required for the handling of the material, which will be supplied by two 25 ton open hearth furnaces. The handling of the scrap steel and iron is to be done by means of a 36 inch electro magnet, operated from the steam locomotive crane. The total of the power house equipment will be approximately 1,000 h.p. The complete plant is being erected and installed by the company and is expected to be in complete operation in about two months. The main machine shops, however, will be manufacturing shells in a few days.

Two Meters to Every Customer

The town of Kenora, Ont., are trying out the method of installing two meters for each customer, one for day load and one for night load. This municipality, in common with most others, has a big surplus of power during the day, and by giving a low rate it is believed this power will be used for household and other purposes in large quantities. The only difficulty with this system seems to be that the responsibility of changing over the meters at a pre-determined time rests with the householder, who, with the best of intentions, may often fail in his duty, just as he often forgets to turn off his lights or to close the furnace drafts. It is an experiment worth trying, however, and will be watched with interest.

Illuminating Engineering Lecture Course

In 1910 the Illuminating Engineering Society, in co-operation with the Johns Hopkins University gave a course of lectures on Illuminating Engineering, which went far toward placing before the public the general principles of the art. In the six years which have since elapsed there have been many changes in methods, improvements in apparatus, and developments in theory, which seem to call at the present time for another effort at education in illumination.

The present series of lectures ought to be of direct and great importance in inculcating the appropriate and wise use of illuminating appliances, and should be therefore especially valuable to those who are dealing directly with the problem. The theoretical side of illuminating engineering will not be neglected, but to increase its practical usefulness to the public is a fundamental purpose of the course.

The following preliminary list of subjects for the Illuminating Engineering Society-University of Pennsylvania lectures has been issued:—

Preliminary List of Subjects for I. E. S.—U. of P. Lectures

Subject	Number of Lectures
(A) General—	
(1) The Principles ot Interior Illumination	2
(2) The principles of Exterior Illumination	1
(3) Color in Lighting	1
(4) Architectural and Decorative Aspects of Lighting	1
(5) Recent Developments in Electric Lighting Appliances	1
(6) Recent Developments in Gas Lighting Appliances	1
(7) Modern Lighting Accessories	1
(B) Special Lectures on Interior Illumination—	
(8) The Lighting of Factories, Mills and Workshops	1
(9) The Lighting of Offices, Stores, and Show Windows	1
(10) The Lighting of Schools, Auditoriums, and Libraries	1
(11) The Lighting of Churches	1
(12) Theatre Lighting (Including Stage Lighting) and the Lighting of Art Museums	1
(13) The Lighting of the Home	1
(14) Train Lighting	1
(C) Special Lectures on Exterior Illumination—	
(15) Street Lighting	2
(16) The Lighting of Yards, Docks, and Other Outside Works	1
(17) Headlights, Search-lights, and Projectors	1
(18) Sign Lighting	1
(19) Building Exterior, Exposition, and Pageant Lighting	1

Order for Large Units

The Montana Power Company, of Butte, Montana, have recently placed a contract with the S. Morgan Smith Company, of York, Pa., for four 15,000 h.p. vertical hydraulic turbine units to operate under a head of 100 feet. These units will be installed in conection with their "Holtzer" Development on the Missouri River near Great Falls, Montana. The S. Morgan Smith Company are also building for the "Great Falls" development, of the Montana Power Company, two 16,000 h.p. vertical units, which, together with the four recently installed, will make approximately 100,000 h.p. in Smith wheels at the Great Falls plant.

It is announced that the Intercolonial Railway System will try out a device for automatic train control. The test to be made on the eight-mile run between Moncton, N. B., and Pinsec Jct.

Montreal Electric Companies Merging

Confirmation of the impending merger of the Montreal Light, Heat and Power Company and the Cedars Rapids Manufacturing and Power Company is contained in the official announcements of meetings of the companies on June 7, when resolutions will be submitted authorizing agreements with the Civic Investment and Industrial Company. These agreements provide for the operation of the two merging concerns by the Civic Investment and Industrial Company, which is really a holding company. Power is given to the latter to assume the name of a company of which it has obtained control.

Personal

Mr. Don. E. Leslie, Sarnia, Ont., has been appointed manager of the Sarnia hydro office.

Mr. R. M. Hannaford, assistant chief engineer of the Montreal Tramways Company, has been elected president of the Canadian Railway Club.

Mr. Edwin I. Williams, late of the Simplex Electric Heating Company, has accepted a position on the sales staff of the National Electric Heating Company, Toronto.

Mr. W. S. Robertson has resigned his position as general manager of the Electric Power Company, recently taken over by the Ontario Government, and goes to the United States to accept a responsible position.

Mr. J. E. Phelps, chief engineer of the Sarnia Gas and Electric Light Company, Sarnia, Ont., has been appointed manager of the Sarnia hydro power plant, to take effect when the Sarnia electric light plant is transferred to the city.

Mr. L. G. Ireland, local manager of the Brantford Hydro-electric Commission, has been appointed engineer to the Hydro-electric Power Commission of Ontario, in charge of the lines in the Trent Valley area, recently taken over from the Electric Power Company.

Mr. T. C. Duncan, E.E., for many years Electrical Superintendent of Public Utilities of the city of Prince Rupert, B.C., has resigned that position to engage in private consulting work. Mr. Duncan shows his faith in Prince Rupert in that he will continue to make his headquarters in that city.

Mr. R. M. Wilson, chief engineer of the Montreal Light, Heat and Power Company, contributed a paper on "Frazil," at the convention of the National Electric Light Association, just held at Chicago. Mr. P. T. Davies, of the power sales department of the same company, was among the Canadian delegates.

Mr. Wilford Phillips, general manager of Winnipeg Electric Railway Company, has returned to Winnipeg from California and resumed his duties after a four months' vacation, which has much improved his health. Indeed the general manager is looking his best. He attributes his general physical betterment to the fact that he spent most of his time out doors, motoring along the beautiful roads in the vicinity of Los Angeles, California.

The Turbine Equipment Co., Limited, Toronto, have secured a contract from the Nova Scotia Steel & Coal Company for a 1,000 h.p. De Laval marine type steam turbine for one of the new boats being built by that company. The speed of the propeller is to be 80 r.p.m. and a set of double helical reduction gears are to be provided to reduce proportionately the speed of the turbine. The same company are also supplying the condensing equipment, bilge and boiler feed pumps.

Generating Plant at the University of Alberta

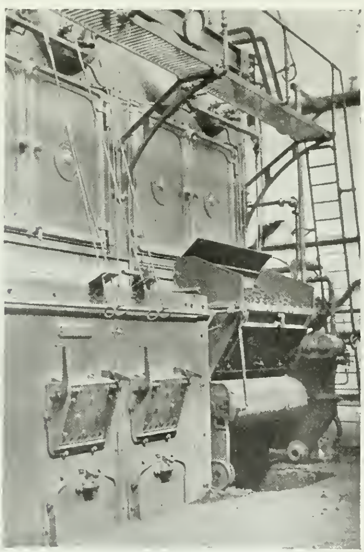
By Arthur J. Cantin

One of the best isolated plants in Alberta is that of the University of Alberta, Edmonton. In the designing of this plant economy of operation was kept in mind so that nothing would be wasted. The coal used in the plant is mine screening, or slack, which is usually burned at the mine, as it is of practically no value and takes too much space to store it. This coal costs 60 cents a ton at the mine, and 55 cents for cartage to the University. The usual cost of coal in Edmonton varies from $2.00 to $4.00 a ton. Previous to the University using this coal there was no market for it and it was destroyed.

The mines in and close to Edmonton are mining lignite coal, having a B.t.u. varying from 7,000 to 12,000; a fair average is 9,000 B.t.u. per lb. A small amount of bituminous coal is imported from the Rocky Mountains west of Edmonton, and from the Crow's Nest Pass, south of Calgary. This coal costs on an average $4.00 a ton.

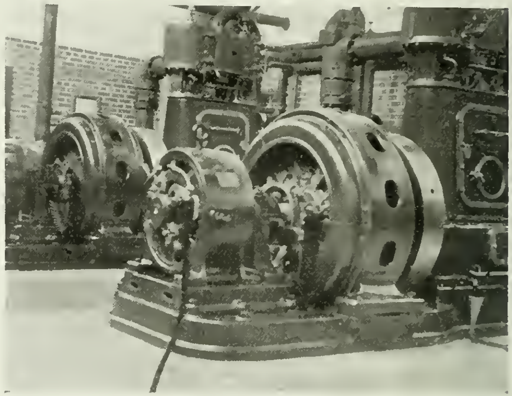
The evaporation with the low grade of coal is 6 to 1, where the Babcock and Wilcox automatic chain grate stoker is used, and 4 to 1 with hand firing. The cost of coal and labor per kw. h. is as follows: cost of coal, .78 cents; cost of labor, .60 cents; or a total of 1.38 cents per kw. h. of output. The load factor in daytime averages 50 per cent.; the power factor is .72.

The boilers consist of three 225 h.p. units, Babcock and Wilcox water tube type. One is equipped with a B. & W. automatic chain stoker, shown in Fig. 1. The water consumption is low. Steam for heating is furnished by the engine operating the generator, and the condensed water is returned to the boiler. The arrangement has been so well worked out that there is practically no loss of water through the heating system. Throughout the winter months, only during the most severe weather, was live steam introduced into the heating system.



Boiler Room, University of Alberta.

The condensed and fresh water from the Paterson water softener is passed through a Cochrane feed water heater, which raises its temperature to 210 degrees F., through the equalizer, then through a V notch recorder. The water is returned to the Cochrane heater by means of 3 small centrifugal pumps direct connected to a. c. induction motors. There is a trap similar to the usual steam trap, with a float, which operates a Sundh tank regulator, which throws the power on, and when the trap is emptied the power is automatically cut off. The city sewer is somewhat higher in altitude than the University and a vertical centrifugal pump is used to handle sewage. The engineer reports that no trouble has been experienced with these pumps. The boiler feed is a G. J. Weir, Glasgow, marine type. There is also an automatic oil feed system which returns all oil that has been used to a tank. When this tank is full it is pumped into a steam separator, where it is boiled until it finds its own outlet



Engines and Generators, University of Alberta.

The Electrical Equipment

The two main generator units are Canadian Westinghouse 100 kv. a., 250 volts, 3 phase, 60 cycle, 514 r.p.m., with direct-connected exciter. These units are direct connected to James Howden Co., Glasgow, high speed vertical compound engines. There is also a Terry steam turbine of 10 kw. capacity, running at 1,800 r.p.m., 150 lbs. steam pressure, direct connected to a Siemens Bros. 10.5 kw., 125 volt, 87 ampere, 3 wire, d.c. generator. The direct current in this instance is used in the testing laboratory.

The switchboard consists of eight blue Vermont marble panels, 90 ins. high (top section 62 ins. and bottom section 28 ins.) mounted on a sill two inches thick. It is of the same general design as ordinary central station switchboards and is equipped with two sets of a.c. bus-bars. The main circuits are controlled by oil switches mounted on the back of the board, the generator and bus-tie switches being non-automatic, and the incoming line and feeder switches being automatic. The small capacity feeders (lighting and power) are controlled by knife switches and enclosed fuses, the latter being mounted on small bases 15 inches back of the board to allow ample room for taking out the feeder cables. Synchronism indicator and a.c. voltmeters are mounted on a swinging bracket at the left-hand end of the switchboard. The board was built and installed by the Canadian General Electric Company.

Electric Railways

Engineers See End of Steam Railways — Electrification of the Mountain Division of the Chicago, Milwaukee & St. Paul Railway Proves the Great Advantage of Electric Power

By A. J. Marshall

Considerable interest has been evidenced recently in the highly successful experiment of the Chicago, Milwaukee & St. Paul Railway in the substitution of electric locomotives for the familiar steam type. Four months of experimenting in the operation of these powerful electric locomotives over one of the most difficult stretches of the Rocky Mountains, has convinced doubting engineers that electricity as a motive force must supersede steam wherever water power is available for generating current at a low cost.

The great experiment was begun on December 9th last, when the fast continental train, the Olympian, was taken from Butte, Mont., to Piedmont. A month later the steam freight locomotives were entirely removed from the electrified division. The mileage of the electric trains for 24 hours is 200 as against 114 by steam engines, and 24 heavy locomotives have been released by the substitution of nine electric locomotives, the work being cheaper and more efficiently performed.

The electric equipment on the St. Paul had a very severe test during the past winter, which, because of the deep snow and extreme cold, was one of the worst in the history of Montana. Electric operation during this period was conspicuous for reliability and freedom from trouble. Two advantages of the new system became especially prominent. One was the superiority of an electric locomotive over steam in very cold weather, as it operates better at low temperature than it does in warm weather. The other was the saving accomplished by electric braking on the steep grades.

The St. Paul is the first road to introduce electric braking with the direct current locomotive, and it has shown great operating benefit. When the motors are driven mechanically, as when a heavy train pushes the locomotive down grade they act as a brake and convert this power into electricity, which becomes available through the trolley system for the up-grade haul.

Aside from the economies resulting from electric braking, which are a possible saving of 50 per cent. of the total power demand, the elimination of the brake shoe and wheel wear, and the easier operation on the track, particularly when rounding curves, the greatest advantage resulting from the use of electric brakes lies in the elimination of the difficulty attending the use of air brakes in holding back long, heavy trains when descending mountain grades. The electric brakes entirely relieve the air brakes except for the stopping of trains, or for emergency use. They provide a duplicate braking system, each one capable of holding a train on a down grade. Under air braking, even on a 2 per cent. grade, it frequently happens that brake shoes become red hot and wheel rims greatly overheated, as practically all of the potential energy stored in the train at the top of the mountain grade must be dissipated as heat in the brake shoes and wheels during the descent.

Gradually but surely electricity is superseding other forms of power, and it is likely that the day will come when electricity will be universally employed to the exclusion of all other forms of energy. Electricity has made good wherever it has been properly employed, and each day sees it making new and permanent conquests.

The characteristics of the electric automobile are not dissimilar to those of the electric features of the familiar street car or the more recent electrically operated railroad train, for the electric vehicle employs substantially the same equipment, only on a smaller scale, thus sharing in the high degree of perfection that electrical apparatus has acquired through study, research, and scientific standardization. It is interesting to realize when reading of the epoch-making accomplishments of the St. Paul's electrification that the modern electric passenger and commercial vehicle possess all the virtues now so generally recognized by engineers in their study of the new electric railway. Furthermore, the electric vehicle, in a non-spectacular and unassuming way, has been gradually but surely gaining recognition by meritorious performance in all classes of city and suburban transportation. The low cost of current which is constantly decreasing with increasing demand, together with the electric's long life and the infrequency of repairs, places the electric vehicle in the front ranks of modern economic conveyors of passengers and merchandise.

Safety First in Winnipeg—A Letter Which Indicates How the Street Railway Company and the Schools Co-operate

Dr. D. McIntyre, Superintendent of Schools, Winnipeg:

Dear Sir,—Winnipeg Electric Railway Co. is endeavoring to prevent accidents to the general public and its own employees, and a strong "Safety First" committee, composed of men who have been 10 years or more in the company's service, has been formed. These men are pledged to do everything in their power to prevent accidents.

In this connection we wish to solicit your co-operation and the co-operation of your staff of school teachers in an endeavor to prevent accidents to children in this city. Where the teachers in other cities have taken this matter up splendid results have been obtained and in some places I am told accidents to children are almost entirely unknown.

Almost daily our motormen and conductors are obliged to warn school children not to play around street cars and not to hang on to the cars.

We enclose a sheet giving particulars of three instances where children were injured on our system, and would greatly appreciate it if you would take the matter up with the teachers and impress upon them the fact that it is in their power to greatly assist us in our endeavor to prevent accidents of this character. We would like them to point out to the children in their charge the fact that accidents to small boys and girls are nearly always caused by these small children trying to imitate the larger ones, and would like them individually to appeal to their classes to set a good example in this respect. By doing this they will be identifying themselves with the great "Safety First" movement which is now sweeping over this country and will be materially assisting us in our endeavor to eliminate preventable accidents.

Yours truly,

(Sgd.) W. Phillips,
Manager.

Street Car Accidents and How They Happen

March 9, 1911, at 4.05 p.m., was clear and cold. There had been a slight thaw in the morning and the streets at 4 o'clock were slippery in a number of places. The pupils were leaving the Somerset school yard on Sherbrooke Street when a William Ave. car passed going north. As the car left McDermot Avenue, a small boy, Jimmy Henderson, said, "Watch me catch the car as it starts up." He ran and caught hold of the car and raced along beside it. As the car gained speed, Jimmy either tried to run faster or jump up on the side of the truck, but his feet slipped and he fell under the side of the car in front of the rear wheels. They passed over his left foot and when he was rushed to the General Hospital, part of his foot had to be amputated. He now has to walk with a crutch. The motorman and conductor could not have prevented the accident because they did not see Jimmy and did not know he was there. It never would have happened if Jimmy had stayed on the sidewalk and not tried to run with the car.

November 14, 1912, about 4.10 p.m., was clear and cold. A little Flemish boy, Arsene de Baecke, 6 years old, was coming home from school, walking along Desmeurons Street in St. Boniface, when a car passed him. He had often seen other bigger boys hanging on to street cars and he ran and caught hold of the side of the car near the front trucks and it is thought that he attempted to put his foot on the axle box at the front wheel. As the car gained speed his foot slipped and went between the two front wheels and was cut off shortly above the ankle. He was taken to St. Boniface Hospital, and after suffering, died there on November 28, 1912. The Coroner's jury said that—"He came to his death by his own carelessness," and they recommended that all children in St. Boniface schools be warned not to hang on or play near cars. They also asked all conductors in St. Boniface to take children found playing near the cars or hanging on to cars to the St. Boniface Police Station.

September 1, 1914, about 4 in the afternoon, a number of boys from King Edward school were playing on Selkirk Avenue, between Arlington and Parr Streets, and were trying to jump on and off a passing car while it was in motion. The conductor warned them not to do this, but one of them, Gabriel Kearsner, who lives at 709 Stella Avenue, did not pay any attention to him and jumped on the lower step and then turned and jumped off again while the car was moving and fell. When the conductor saw the boy was hurt he stopped the car and called the police ambulance. Gabriel was taken to the General Hospital, where it was found that his head was severely injured.

Accidents like these can be avoided in future if you big boys and girls will set a good example to the little ones and always play on streets where there are no car tracks. If you do find it necessary to walk on streets where there are car tracks, walk on the sidewalks and cross at the street crossings. Always look both ways before crossing a street car track.

Greater Efficiency and Safety in Lethbridge

Public Utilities Commissioner, Mr. M. Freeman, of Lethbridge, Alberta, sends the following interesting item:—

"In reply to yours of the 21st, asking for a brief letter telling about any safety first schemes I have introduced lately. I have very little to offer you along this line. Shortly after taking office I found street cars being returned to the barns on account of head lights and sign lights being burned out. I had dummy receptacles placed in the motormen's compartment in which are carried spare lamps. The headlight door was fastened shut with nuts requiring a wrench to open it. These nuts I replaced with wing nuts, so that now instead of having to return to the barns without lights, the motorman can change his lamp with a very slight loss of time and no danger. The burned out lamp is returned and reported.

"I do not know that this is a new idea; in fact, I cannot imagine a car having to go to the barns, or being seriously delayed on account of lights burning out. But as this was the case here, it may be the same in other small places."

Accident Talk No. 5 by the Quebec Railway, Light & Power Company

Saving Life and Limb

Wait Till the Car Stops

Recently a passenger got off a car in motion between stops and fell, and consequently was badly injured. He did not wait for the car to stop before getting off.

Suppose it were YOU? A long time spent in repairing your body. Expense! Perhaps death to-morrow.

What difference would it make that YOU had got off moving cars safely—"over a thousand times?" That fact would not remove your pain, heal your skin, or pay the doctor's bill. It would not bring back health, or comfort to your family if you were buried.

Why not let the "thousand times" be enough?

Once more! It might be the last time! Your fault.

"Wait till the car stops"—**actually stops.**

Say this to your wife or husband, your children, your pupils or employees. If they should meet death because you had not cautioned them, you would blame yourself all your life.

Stop! Look! Listen!

A passenger stepped from a standing car, and walking behind did not stop to see if a car or a vehicle was coming from the opposite direction before crossing the track, was struck by a passing vehicle and seriously hurt.

This company is trying to prevent this accident happening to **you.** YOU **ought to be willing to be careful enough** not to get off a car and walk behind it in front of another, or, where these is a single track, in front of a swiftly moving vehicle. Remember that no one expects to see you dive out from behind a car. The first that is seen of you is when YOU are under the wheels or the horse's hoofs.

Wait a second. LOOK. Open your eyes. Then cross safely to go home without the help of the ambulance. It will surprise you to find out how careless are the women in your family—at least in this matter. Watch them. It will call attention to your own carelessness, perhaps.

Tell the Children

Did you ever tell your children NOT to play in the streets? If you have not—why NOT?

A little child comes out suddenly from behind a tree or wagon and runs quickly across the track—after a ball, perhaps. The child is busy—intent on play. A car is fast approaching. The motorman is straining every muscle in his body to stop the car! But it simply CANNOT be done in time. Not with the best car ever built or the best motorman who ever handled a brake. The wheels go over——. Suppose it was YOUR little boy or girl.

Keep the children from playing in the streets. Tell them EVERY day to look out for wagons and street cars.

The Quebec Railway, Light & Power Co.

The Dealer and Contractor

The Relationship Between the Contractor and the Central Station—Interests are Identical—Best Results Obtained by Harmony and Co-operation

Electrical contractors' troubles are much the same the world over, and one of the biggest of these troubles is the proper adjustment of the relationship between the contractor and the central station. Surely their interests are closely associated, and yet how rarely we find them co-operating. The central station wants to sell current—always more current. The electrical contractor is equally keen to install the means of supplying and using up this current. On the face of it, doesn't it look foolish that there should be lack of cohesion between these two interests. The prime concern of the central station is to sell current. They have been organized and specially equipped for this purpose, and have been given charter rights by the municipalities in which they operate. What need have they, or what right for that matter, to engage in the sale of electrical appliances or the wiring of houses, except as a last resort and in self-defence. The excuse almost invariably given is that the contractors are not aggressive enough, and the central station proceeds to step out of its legitimate sphere and compete with the contractors and dealers. I said "compete," but this is not true in a great many cases. A **fair** competition is good at nearly all times and in nearly every business, but a fair competition means fair prices, and this is just where the central station man fails most inexcusably on his part and shows the insincerity of the excuse he has just given. If he really believed the contractor is not aggressive enough and not handling his business in the proper way, would he not take up the contracting business to run it as an example of the way such a business should be run? He does not do this, however. On the contrary, he takes on this new business on an unprofitable basis, figures on losing money on it, to be made up from profits from the extra sales of electric current. At the same time he makes this business unprofitable for every one else engaged in it. Incidentally he antagonizes, as well as ruins financially, every contractor and dealer affected by his actions.

Of course, it may not be right to lay all the blame on the central station. It is the bigger organization, however, with, generally, superior financial backing. For this reason it seems as if it is the party to which we might look for more aggressive co-operative tactics.

We print below extracts from a story which recently appeared in the Electrical World describing how harmony in these matters was brought about in a U. S. city. The story is by the commercial manager of the local central station company, who thus speaks from first hand knowledge. We hope the suggestions given below may be useful in helping us to work out similar problems in Canada.

A Family of Electric Interests

We have all heard of the numerous attempts that have been made by central stations to eliminate all petty quarrels and price fights from their local family of electrical interests. We have read of many endeavors to weld together by some co-operative plan all the electrical contractors in the districts served, so that the spirit of harmony, peace and friendship might abide throughout the locality and bring with it satisfaction and profit to the contractor as well as increased revenue for the central station.

While this idea has been a goal which all far-thinking managers have had in view, it does not require much search to discover the records of many failures, for rarely has the effort yielded the results expected of it. Disappointment has come either owing to the inability of the central station to realize that an electrical contractor is entitled to very full consideration when prices on wiring or appliances are to be established, or often times because the contractor himself expected too much of the central station, in consideration of the fact that additional revenue is derived from new consumers which his efforts help to put on the company's lines.

These conditions have entered largely into bringing the downfall of many eager harmony plans in many communities. Central station officials too frequently look upon the electrical contractor as a workman who should pay tribute to the company because their service offers him an opportunity to obtain a good return on his investment and work. They forget that to offer him encouragement and try to create an attractive condition will cause others to come into the field and add their efforts to the load, to everybody's benefit.

Here in Wilkes-Barre it is very gratifying to us to be able to state that for the past four years we have had in operation what we feel to be an ideal situation in this respect, for we can honestly say that we now count the electrical contractors in this city as our most effective salesmen.

Read President Earle's letter to Electrical Contractors—then pack your grip.

It has been an interesting development, which began in 1911, when the co-operative plan first presented itself to the general manager of the Wilkes-Barre Company. After giving the matter serious consideration he decided that the apparent merits of the idea warranted giving it a thorough trial. But the outlook at the start was anything but encouraging, for the electrical contractors were not easily persuaded. They ignored the scheme, deeming it a detriment to progress and without good quality; yet in a measure this attitude on their part was natural, for prior to that time salesmen in the employ of the central station had vexed the dealers in many ways. Their methods of salesmanship had not been over-friendly, and frequent cases of underselling and closing deals at any cost had really annoyed and antagonized the contractors in their attitude toward the company.

So the plan seemed destined to be short-lived, for it really looked empty to the majority concerned, since in their eyes the electrical salesmen in the employ of the company were constantly trespassing. A thorough investigation soon revealed this source of trouble, however, and prompted the initial step toward success, and most of the friction went with the change. The entire force of appliance salesmen, who apparently had been responsible for many of the hostile views, were eliminated from the service, while the company's decision not to continue in the business of wiring likewise made a deep impression and brought the first real progress toward the upbuilding of a "family spirit."

In the fall of 1913, shortly after the writer took charge of the commercial department here, we inaugurated a campaign to secure controlled flat-rate lighting, and it was at this point that we were enabled to prove to the entire satisfaction of all the electrical contractors that we desired to encourage the co-operative plan and secure their affiliation to the utmost. Every electrical contractor in town accepted our invitation to attend the meetings which were called to arrange the wiring prices, and the success of this campaign, in which hundreds of house wiring and fixture contracts were secured and all, without exception, turned over to the dealers for execution, thoroughly awakened their enthusiasm and gave this company more than one hundred "galvanized boosters" for central station service.

It has taken four years of patient effort, with not a little discouragement at times, to educate the consumers of our growing community to support adequately the electrical contractors who have had the courage to venture into the retail merchandising business and risk their earthly belongings by displaying "everything electrical" in central city locations. "Watchful waiting" was blackballed from the date of origin, and the increased activity which was substituted gradually began to make an impression on the cash registers of the contractors and the coffers of the company's stockholders. A tour of the electrical shops in the city to-day tells the story of this successful alliance, which now pays big dividends without detriment.

We have within the shadow of our office building seven electrical shops of good size, centrally situated and carrying thousands of dollars' worth of electrical goods, all featuring display rooms unexcelled, I believe, anywhere in America and a credit to our city and the industry. Seven more stores can be found within a mile radius and these likewise specialize in pushing the electrical business. The stores mentioned are all exclusive electrical shops which sell nothing but electrical goods, there being no side lines whatever. Add to these fourteen all the other stores having electrical departments operating at a profit, and some idea of the dividends this proposition pays can be appreciated.

Merchandizing Left to Dealers

Our company has remained steadfast to the original agreement regarding the sale of electrical appliances, and so close has the writer drawn these lines that with the exception of a few domestic lines not a single electrical appliance has been purchased or sold by the company in two and one-half years. All inquiries for appliances and fixtures are in every case referred to the dealers, and the same rule applies to wiring and motor business, where the dealers are called upon to sell the machines as soon as power contracts are closed by our power salesmen. Our sales are limited to a few of the small-size Mazda lamps for residence consumers, when list prices are always maintained, and a few domestic irons. All lamps for commercial or factory use are sold by the contractors.

Many central station officials have always believed that they can procure more profitable returns and increased output by selling appliances at cost, but we feel that we have disproved this theory. For when a central station cuts off the source of income from the contractor by cutting prices, so that the dealer can no longer show a profit on sales, the dealer must do one of two things—either retire from business or compete with the central station. Either of these courses spells a loss to the central station, and nothing would dismay us more than to learn that our fourteen electrical contractors intended to retire from business. If this should come about, nearly one hundred and twenty-five "boosters" for our output would be eliminated, there being about this number engaged at the present time. For us to secure the services of these one hundred and twenty-five men would bring a gigantic increase to our pay-roll, with a loss in volume of new business unless we likewise continued to operate the fourteen showrooms. In other words, fourteen showrooms scattered along our lines can "pull" more business than one central station display room, and each group in its location is able to gather in much new business without cost to the central station.

Joint Use of Display Room

In the last two years we have been able to introduce a few ideas which have added not a little to the success of the plan. In one case we put at the disposal of the dealers one of our spacious front show windows, as well as space in our office for the featuring of their displays and demonstrations where our consumers would see them more quickly when paying their bills. This offer was unanimously accepted, and each week in turn one contractor installs his display, with all joining forces for a joint display and demonstration in the holidays. During these displays we close as many sales as possible, turning in in full all money received from sales for the exhibiting contractors as well as furnishing their representatives with the name of "prospects" which may be developed. In this manner we are always exhibiting in our display room "everything electrical," including the latest thing in electric-heating contrivances, as well as electrical fixtures, portables and other specialties which are certain to appeal to the "hard-to-please" purchaser. We place no restriction on these displays, all dealers being allowed to feature any article using central station output.

Electrical Prosperity Week found us very active, our observance being in the form of demonstrations and instructive displays of appliances by the electrical contractors. Individual booths displaying everything pertaining to electricity attracted thousands throughout the week and aided greatly in adding many revenue producers to our lines. Several hundred dollars' worth of devices were sold. The writer donated the use of an entire building and all the electricity required by each exhibitor to demonstrate and operate his appliances. We also erected booths, which were handsomely decorated, and wired the whole building inside and out, giving the surroundings a carnival appearance decked in mutlicolored lights and bunting. We likewise defrayed all the expense incurred for advertising and all other incidentals. That the capacity of our spacious showroom was inadequate for this event was a tribute not only to the demonstration and exhibit itself, but also to the harmonious agreement we have in vogue; and great credit is due the dealers who are so fast educating housekeepers and business men alike in Wilkes-Barre to use electricity as a means of conserving their time and energy.

Proving the Pudding

I sincerely believe that there is nothing more profitable to-day in central station work than linking forces with the contractors. We certainly can recommend it to all. It gives the busy men in central station life time to devote to other and more urgent matters than trying to straighten out an alleged overcharge for wiring a consumer or adjusting a complaint over an appliance sale. It eliminates many labor troubles between the central station and wiremen, because the wireman is not likely to demand as much from a contractor as he might from a corporation. It lessens operating expense and saves much money in bookkeepers' and collectors' salaries, for many people seem to feel that the central station should be their banker, carrying through everything; the dealer does not give this impression, and therefore his accounts, we have found, are paid more quickly. From a business standpoint it is a good thing all around.

for all. The majority of the contractors here now own the property and buildings they occupy, and the policy has caused the company to double its load since 1910.

That the contractors appreciate our co-operation and its effect in eliminating all friction and bringing about such a pleasant and profitable condition is very apparent, and the officials of this company count most of the contractors as personal friends. We are always invited to their social gatherings, which are frequent, and also are welcome guests at their association meetings, and we are never forgotten when outings, banquets, or smoke talks are arranged. The writer is constantly on the look-out for ideas which might be applied to our mutual benefit, and occasionally we add a link to our strong chain in this way. All summed up, in brief, this plan has proved to be a sensible business deal, carried out by business men in a business way, and it has overcome for us all those perplexing obstacles that heretofore were considered impossible to avoid.

The Majestic Electric Company, Limited, has been incorporated, with head office at Toronto, to manufacture electric heaters, radiators, etc.

Useful Wiring Formulae

The following formulae connecting circular mils, usually expressed CM, the length of wire, D, the current strength, I, the resistance in ohms, R, the line loss in volts, e, the number of lamps in multiple, n, and the current in amperes per lamp, c, are frequently of use to the electrical contractor. A circular mil represents the area of a circle having a diameter of one mil, which is equal to 1/1000 of an linear inch. The area of any surface in circular mils is thus equal to the square of its diameter in mils.

CM = Circular Mils
D = Length of wire, in feet, on one side of circuit only
I = Current (Amperes)
R = Resistance (Ohms)
e = Volts lost in line
n = Number of lamps in multiple
c = Current in amperes per lamp
10.8 Ohms Resistance of one foot of commercial copper wire having a diameter of one mil and a temperature of 75 degrees Fahr.
For multiple lighting circuits only $I = (c \times n)$

$$CM = \frac{2D \times I \times 10.8}{e} \qquad n = \frac{CM \times e}{10.8 \times 2D \times c}$$

$$e = \frac{2D \times I \times 10.8}{CM} \qquad R = \frac{e}{n \times c \times 2D}$$

$$c = \frac{CM \times e}{10.8 \times 2D \times n} \qquad 2D = \frac{e}{n \times c \times R}$$

President Earle's Message to Contractors

To the Electrical Contractors and Dealers of Ontario:

On the eve of our Second Annual Convention and Electric Show, I would like to say a few words to my fellow-contractors and dealers in the province regarding the work of your association, its progress during the past year and its plans for the future.

In spite of the strenuous times in which we are living, the difficulty in getting supplies, and the consequent keenness of competition, I believe we have made considerable headway. We have been the means of bringing more closely together the varied interests that live by the electrical trade. The contractors themselves have been brought to see more plainly, I believe, the value of a mutual understanding and the uselessness and folly of ruinous price-cutting. By their united efforts they have been able to take an active part in certain developments in our business, as, for example, the recent discussions on the question of licensing. Though we may not have got all we wanted, or thought we wanted, we have at least received very reasonable consideration, and we now have the assurance that if the laws, as at present enacted, do not meet the requirements, we shall be again called upon to present our views—which, in all probability, will be met.

Our relations with other branches of the trade have also been improved. For example, we have been able to arrange with certain of the jobbers for a fair measure of protection, and have been assured of the co-operation of both the jobbers and the manufacturers. Our organization has resulted in a number of local meetings at various Ontario points, in which the contractors have not only become acquainted with one another, more aware of the fact that we are all human and pretty good fellows, but in addition we have learned a lot from one another about the electrical contracting business.

I merely mention these items as typical of the lines along which we necessarily move when we are in close personal touch with one another. They indicate the value of organization. But we are not satisfied. I want to say here in all earnestness to the electrical contractors of Ontario, that while we have accomplished something, we have been handicapped because you, in many cases, have not put your shoulder to the wheel and taken your part. It is not my thought—nor have I the right, if I wished it—to criticize anyone's actions, but I cannot too forcibly state my conviction that numbers count tremendously in such an association as ours and that it is the rank and file and not the officers who are the real asset in our organization.

We need the support of every man in the electrical business. If during the past year we have been able to accomplish something worth while with the co-operation of only a portion of the Ontario contractors and dealers, then is it not reasonable to suppose that with everybody helping, we could have done more? Those of us who have been actively engaged in the work of your society believe this to be the case, and we earnestly urge you to let no surmountable obstacle stand in the way of your attendance at the coming convention. Come and see what we're doing, take a hand in the discussions, criticize whatever you don't approve of, come in and be one of us. You stand to profit by this organization as much as anyone else. Why, then, shouldn't you take your share of the load. If you expect to receive dividends, should you not be willing to subscribe to the capital?

Important matters, intimately affecting the electrical contracting business in Ontario, and, consequently, every man engaged in this business, will be brought before the convention. We need your help—you need ours. Tuesday, Wednesday, Thursday, June 6, 7, 8.

Yours faithfully,
(Signed) G. D. Earle,
President.

Correct Lighting as a Factor in Home Making

Almost as necessary as the home itself—Ill-health traceable in many forms to poor illumination

By J. F. Heffron*

Good light is needed in every home. It is necessary to those who read or perform any of the various forms of close work that it is customary to do during the evenings at home, else eye-strain or ill health is apt to result. It is particularly necessary for the tender eyes of young people, whom it protects against premature glasses and all sorts of nervous troubles resulting from eye-strain. It is necessary for the cheer and comfort of the home during the evening hours when family and friends are together. At this time the beauties of architecture, decorations and furnishings should be shown at their best.

Yet it is a fact that we find poor light in the home where it is needed most, more often than in any other place.

It is a difficult problem for the engineer to bring the general public to understand the harm that results from poor light and also just what the term poor light means.

We are not stating an untruth when we say that the great mass of the general public view the Illuminating Engineer's efforts to educate them in regard to good lighting in the same way that the savage views the introduction of civilization's system of sanitation into his vicinity. Neither of them understand the efforts put forth in their behalf. But through continued agitation, education in this direction will eventually result.

Dim light is poor light. Too much light, or too brilliant light, is also poor light—in this age of modern brilliant electric and gas lamps, this form of light causes harsh black shadows from furniture and other objects in the room and is poor light. Bright, glittering light in one part of the room, with darkness in corners or other parts of the room, is poor light. Still another case of poor light is that which causes dazzling reflections from mirrors, polished table tops, or burnished metals.

Let us take nature for our standard. Daylight causes none of these—it is soft, subtle, and even; it seems to come from nowhere, yet it is everywhere. By daylight we do not mean direct sunlight—direct light of any kind, even from a candle, irritates the eyes, and by dazzling them prevents our seeing objects as they really are. Daylight is light reflected from the sky, which in its passage through the atmosphere, has been diffused and broken up into infinitesimal rays, and which may be full and strong, or soft and warm, like the twilight, but never irritating. This is our ideal and model for good light.

Light for the home should be ample, soft and even, but gentle—as is appropriate to the hours of relaxation. The illumination in some places should be emphasized, giving a sense of coziness, and there may well be a careful use of colors suggesting either coolness or warmth. The light should be cheerful, extending a welcome to the householder and his guest. It should be everything that poor light is not. Light like this is easy on the eyes and comfortable to read by, work in, and live in.

It is easy to avoid dimness in this day of tungsten lamps and mantle gas lamps, but such light, unmodified and unshielded, is too dazzling. It must be softened or diffused—toned to the quality of being usable and agreeable. This light must also be directed where it is needed most, not left to waste itself in parts of the room where it is not needed. It is for the proper diffusion, softening, tinting, and directing of the light that right shades and globes are needed.

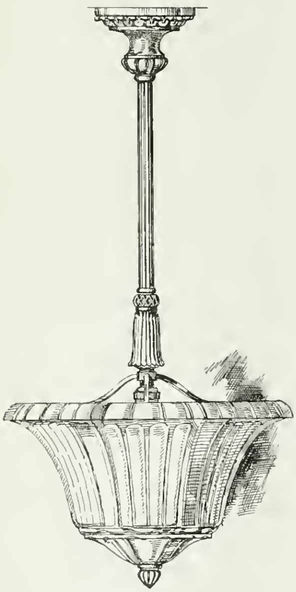


Fig. 1.

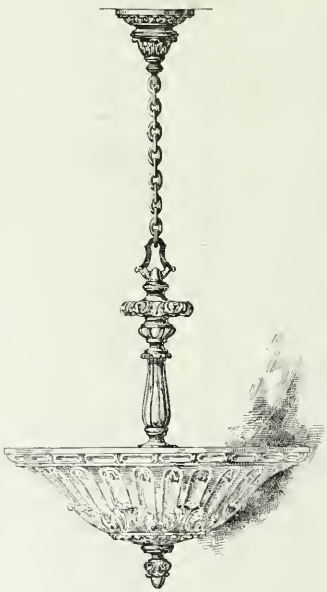
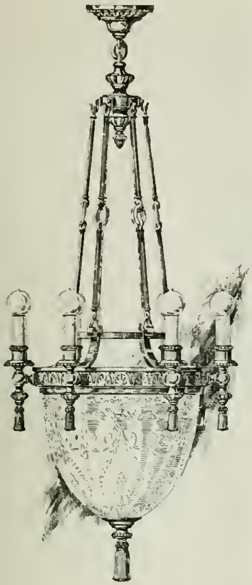
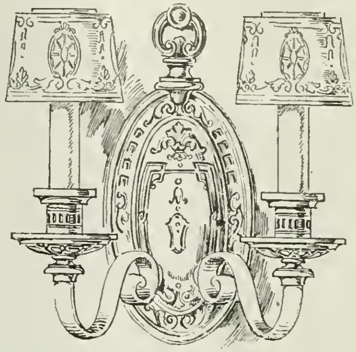


Fig. 2.


Fig. 3.

* Macbeth-Evans Glass Company, Toronto.





Figs. 4, 5 and 6 — For parlors, reception halls and rooms where decorative effects are as important as sufficient light.

For the lighting of the home we present in conjunction with this article cuts of some of the latest and newest suggestions in both fixtures and glassware.

Let us first suggest the ideal lighting for the living room. Subdued daylight is the model for the general illumination. This is artificially produced at its best through semi-indirect lighting by means of glass bowls. See Figs. 1, 2, and 3.

The bowl with its enclosed electric bulbs, is located within a few feet of the ceiling, which should be of a light shade calculated to reflect light perfectly. These bowls send a large part of the light upward against the ceiling, from where it is reflected with perfect diffusion, softly and beautifully, throughout the room. Some of the light shines through the bowl in a soft, warm glow, so that the space beneath is the most amply lighted portion of the room, and this is as you would have it to be. At reading tables, pianos, etc., or wherever nearby work is to be performed, a portable desk or reading lamp should be placed.

Semi-indirect lighting is undoubtedly the most effective method of illuminating living rooms, parlors, music rooms, reception halls, and all rooms where well-distributed general light is desired. The cost of these fixtures is generally somewhat more than the usual lighting equipment, which is very often designed to sell electric current rather than to furnish light, but the effect, the appearance, and saving in bills for current, and the greater comfort and pride in the equipment will quickly repay the cost.

When semi-indirect lighting is not desirable, a chandelier or wall-bracket should be selected which is suited to the particular room in which it is to be used, and suited also to the glassware to be used on it. It should be equipped with such shades as will conceal the brilliant filaments of the lamps from the eyes, no matter in what portion of the room a person may be standing or sitting. In making this selection it is well to bear in mind the fact that some glassware is designed to distribute the light broadcast throughout the room, some to concentrate it strongly upon the spot immediately beneath the lamp, while others obtain any degree between these limits that you desire.

In lighting parlors, reception halls, and rooms where decoration is equally important with the amount of light, glassware may be used as shown in Fig. 4. Figs. 5 and 6 show direct units, with bracket to match, after the exclusive Sheraton design.

For the dining room, do not be tempted to use the cheap forms of so-called "art dome," and especially not the type

Fig. 7.

having the lamp or gas mantel exposed to view when seated. A semi-indirect bowl over the table is ordinarily one of the best methods, with bracket lights by a sideboard or over a serving table.

In bed chambers a light should be placed (wall-brackets, if desired) on each side of the dressing table. If the room is small, this will suffice; otherwise a small and neatly decorated semi-indirect bowl in the centre of the ceiling (see Figs. 7 and 8), or a short shower type of several-lights fixture. Also, it is pleasant to have a small portable reading lamp within easy reach, on a stand beside the bed. A light should be placed in the clothes closet, hung where it will amply illuminate all of the shelves of the closet, and the eyes should be protected by use of a proper shade. Hang it high enough so that it does not interfere with the use of the shelves.

In the bathroom, a bracket on each side of the mirror is desirable. This is particularly welcome to men for shaving. In a fairly large bathroom, get the general illumination from a centre ceiling globe, or short pendant with shade.

The kitchen unit should be selected above all things for efficiency. The light should be placed so that one can see to work at stove, table, or sink. It is poor economy to use a cheap frosted or wrong-shaped shade that wastes light and does not direct it where it is wanted most. A properly designed commercial shade for this place will not only give better light for less money, but it adds greatly to the comfort of the kitchen.

Few shades or globes do their work properly. Those of plain or clear transparent glass, with frosted or etched decorations, only partially direct and soften the light. They are

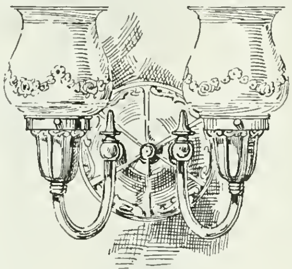


Fig. 8.

very wasteful. The clear glass shades whose surfaces are cut into scores of little reflecting prisms reflect or direct the light economically, but streak it unevenly with beams of dazzling intensity. Dense opal glass shades reflect the light well, but they give harsh reflections, are usually far from being decorative, absorb a great deal of light and heavily increase the lighting bills.

A Suggested Code of Ethics for Ontario Electrical Contractors

The strength of any organization is not unfrequently impaired by the unprofessional acts of one or another of its members. A single selfish or unprincipled man may bring disgrace on the whole profession—and we know there are few large flocks that have not at least one colored sheep. It oftentimes happens, however, that members offend through thoughtlessness, or lack of appreciation of the viewpoint of others. For this reason it is becoming an increasingly common practice for associations, such as that of the Ontario electrical contractors, to draw up a code of ethics. These are not intended to be incorporated in the constitution, but merely stand as a declaration of principles by which the members of the association are morally influenced. They represent the point of view of the association as regards honesty and fair dealing.

A number of members of the Ontario Electrical Contractors' Association have expressed themselves in favor of such a code and there is little doubt that when the matter is brought to the attention of the trade generally it will meet with almost unanimous approval. It is possible they could not do better than consider the code of the National Electrical Contractors' Association, as it stands, which seems to cover the most important points. At any rate, it may well serve as a basis on which to begin to build up something more to the liking of the Ontario contractors. That delegates and members may have a chance to form an opinion beforehand, we reproduce the "National" code of ethics herewith. If the wording should happen to meet the approval of the delegates, it could be used almost word for word:—

CODE OF ETHICS

Adopted for the General Guidance of the Members of the National Electrical Contractors' Association

Section 1. Members of the Association shall regard themselves as being engaged in a business in which there is a well defined duty and obligation toward the public and themselves. The business demands that members use every honorable means to uphold the dignity and honor of this vocation, to exalt its standards and to extend its spirit of usefulness.

Section 2. Every member of this Association should be mindful of the public welfare and should participate in those movements for public betterment in which his special training and experience qualify him to act. He should not, even under his client's instruction, engage in or encourage any practices contrary to the Rules and Regulations Safeguarding Life and Property, for he is not obliged to accept a given piece of work, he cannot, by urging that he has followed his client's instruction, escape the condemnation attaching to his act. Every member of this Association should support all public officials and others who have charge of enforcing safe regulations in the rightful performance of their duty. He should carefully comply with all the laws and regulations touching his vocation, and if any such appear to him unwise or unfair, he should endeavor to have them altered.

Section 3. It is unbusinesslike for a member of this Association to assist unqualified persons to evade or to lend himself in the evasion of any of the recognized rules and regulations governing electrical work.

Section 4. Members of this Association should expose, without fear or favor, corrupt or dishonest conduct and practices of the members of this business, and it is their duty to bring to the attention of the proper authorities the existence of electrical conditions which are unsafe to life and property.

Section 5. Members of this Association owe a duty to the business of refusing to furnish estimates to general contractors who do not regard bids as final and binding upon which they are awarded general contracts.

Section 6. Members of this Association shall not falsely or maliciously injure, directly or indirectly, the business reputation, prospects, or business of a fellow member of this Association.

Section 7. Members of this Association shall not attempt to supplant a fellow member after definite steps have been taken toward his employment or toward the letting of a contract to him. Nor should they offer any interference in the carrying out of said contract or commission to the end that loss or damage may result to the fellow member.

Section 8. Whenever disputes or differences arise between members, it should be the duty of the parties to the controversy to submit the trouble to an arbitration of two disinterested members of this Association, and in the event of a failure to arrive at a satisfactory settlement, then, upon request, the President of the National Association shall appoint a third member of the Commission and the decision of the majority of said commission shall be final and binding.

Spacing Conductor Supports

In tall buildings special provision must be made to support the conductors in the vertical conduits to remove their weight from their connections. The spacing of supports in such cases is prescribed as in the following table. In laying out a conduit job first ascertain the size and number of wires required.

Size of Wire	Distance of Support
14 to 0	100 feet
0 to 0000	80 feet
0000 to 35000 cm.	60 feet
35000 to 500000 cm.	50 feet
500000 to 750000 cm.	40 feet
750000	35 feet

Convention Program—June 6, 7 and 8

TUESDAY, JUNE 6.

(1) Registration, 9.00 to 10.30 a.m.
(2) Address of Welcome: President G. D. Earle.
(3) Appointment of Committee on Organization to consider organization and future action.
(4) Address on Organization: E. A. Drury.

Afternoon, 2.00 p.m.

(5) Report of Committee on Licensing: W. H. Lodge, Chairman of Committee.
(6) "Inspection": H. F. Strickland, Chief Electrical Inspector for Province of Ontario.

Evening, 8.00 p.m.

(7) Formal Opening of Electric Show by Mayor Church.

WEDNESDAY, JUNE 7, 9.30 A.M.

(8) Advertising: J. C. Kirkwood, Advertising Counsel, Toronto.
(9) Re-sale: R. Grant, Peterboro.
C. A. McLean, The Masco Company, Ltd.
Edward G. Weed, Canadian National Carbon Company.
(10) How to Keep the Electrical Business in the Family: Gordon C. Keith, Editor Electrical Dealer and Contractor.
(11) Report of Committee on Organization to consider organization and future action.

Afternoon, 2.00 p.m.

(12) Co-operation: Walter Carr, Electrical News.
J. M. Dusenberry, Hughes Electric Heating Co.
A. H. Winter Joyner, Illuminating Engineer.
R. T. Jeffrey, Hydro-Electric Comm. of Ontario.
A. C. Lyons, Lyons Electric, Brantford.
(13) Cost of House Wiring: C. D. Henderson, Brantford.
(14) Moonlight Excursion in the Evening.

THURSDAY, JUNE 8, 9.30 A.M.

(15) Book-keeping: E. F. Griffith, Cost Accountant and Auditor, Toronto.
(16) Reports of Committees:
Martin Nealon—Architects.
G. T. Dale—Compensation.
M. H. Newman—Elec. Development.
(17) Election of Officers.

Afternoon, 2.00 p.m.

(18) Illumination: T. M. DeBlois, Northern Electric Co.
(19) Practical Talk on the Incandescent Lamp: H. D. Burnett, Canadian General Electric.
(20) Good and Welfare.

The British Columbia Association of Electrical Contractors and Dealers

The above association has now thoroughly completed its organization, and has secured a membership far in excess of the committee's expectations.

At present the membership comprises contractors and dealers in the cities of Vancouver, Victoria, and New Westminster, but it is hoped soon to have members from several other districts.

The association has already taken up many matters of interest to its members, and is now engaged in perfecting plans for a summer campaign for the sale of electrical appliances.

The British Columbia Electric Railway Company, which supplies light and power in this district, has recently offered a substantial reduction in rates to those dealers who maintain stores in which electrical appliances are displayed and offered for sale; the said company has also notified the association of its willingness to co-operate with the dealers in any matters which it may bring forward for the benefit of the contractors and dealers.

Several committees have been formed, one of which has been detailed to take up the question of holding a monster Show in the City of Vancouver, and at the same time calling a convention of the associations in the adjoining provinces.

The secretary-treasurer of this association, E. Brettell, 781 Granville Street, Vancouver, will be glad to communicate with secretaries of similar associations with a view to general co-operation.

When You Are in a Hurry

According to code regulations, conduit must not contain more than four 2-wire or three 3-wire circuits of the same system and must never contain circuits of different systems. No conduit tube having an internal diameter of less than ⅝-in. shall be used. All bends or elbows must be so made that the conduit or lining of same will not be injured. The radius of curve of the inner edge of any elbow is not to be less than 3½ in. It must not be more than the equivalent of four quarter bends from outlet to outlet, the bends of the outlet not being counted. The accompanying table giving the size of conduits for the installation of wires and cables, if cut out and pasted in his notebook, will save the contractor many a weary search:—

	One Conductor in a Conduit Size Conduit, Ins.	Two Conductors in a Conduit Size Conduit, Ins.	Three Conductors in a Conduit Size Conduit, Ins.	Four Conductors in a Conduit Size Conduit, Ins.
Size B & S	Electrical Trade Size	Electrical Trade Size	Electrical Trade Size	Electrical Trade Size
14	½	½	½	¾
12	½	¾	¾	¾
10	½	¾	¾	1
8	½	1	1	1
6	½	1	1¼	1¼
5	¾	1¼	1¼	1¼
4	¾	1¼	1¼	1½
3	¾	1¼	1¼	1½
2	¾	1¼	1½	1½
1	¾	1½	1½	2
00	1	1½	2	2
00	1	2	2	2½
000	1	2	2	2½
0000	1¼	2	2½	2½
CM				
200000	1¼	2	2½	2½
250000	1¼	2½	2½	3
300000	1¼	2½	2½	3
400000	1¼	3	3	3½
500000	1½	3	3	3½
600000	1½	3	3½	
700000	2	3½	3½	
800000	2	3½	4	
900000	2	3½	4	
1000000	2	4	4	
1250000	2½	4½	4½	
1500000	2½	4½	5	
1750000	3	5	5	
2000000	3	5	6	

Accidents in the Electrical Contracting Business

By Wills Maclachlan*

To prove to the average electrical contractor that his employees have accidents seems to be a very difficult matter. This, however, is certainly true, as shown by records kept. There is something about any electrical work that suggests that the only accidents that happen are electrical accidents. The contractor is mainly working on dead conductors and apparatus, and hence assumes that he is in no danger. After a careful study of accidents to electrical workers it is found that there are more accidents due to handling of tools, handling of material and slipping, tripping, and falling, than due to electrical current. It is not my object to belittle the danger from electrical current—for an accident of this nature is usually severe—but rather to draw attention to those numerous accidents from other causes that are not being taken care of.

In these days of keen competition, when time lost on the job may mean the difference between profit and loss, did you ever consider what it would mean if your foreman or skilled workman was laid up for a week or two due to an accident? Possibly you consider this a remote chance, but you insure against things less likely to happen. If the head of a firm is not interested in accident prevention, do you think that his employees are likely to be interested? They will carry out the policy laid down for them, as their jobs depend on it, and men will naturally "take a chance." Do you take a chance in making out an estimate? Then why take a chance in something that may turn the profit in the contract to a loss? Be sure that unless the head of the firm believes fully in preventing accidents these accidents will occur.

In investigating accidents one often hears that the employe broke a rule at the time of the accident. This may be true, but it is usually found, also, that the rule is being broken every day. Rules are useless unless they are lived up to. An investigation into an accident should not have as its main object the placing of the blame, but should rather be to find a means of preventing similar accidents. Rules also that only provide for the placing of the blame and not the preventing of accidents are worse than useless.

Carelessness with tools cause a great number of accidents. Hammers with burred heads should he sent to be shaped up. There is great danger of the burr breaking off and causing an injury. This also applies to cold chisels. In chipping concrete it is well to use suitable goggles. The failure to use goggles in doing this kind of work caused the loss of an eye to an Ontario electrical worker last winter. Broken pliers or wrenches should be repaired or discarded. Most men can remember accidents due to a broken wrench slipping. In general, use only tools in good condition and use them only in the work they are intended for.

In most construction work there is considerable borrowing of ladders. Do you realize that 12½ per cent. of all accidents to electrical workers are caused by ladders? It is certainly well worth while to procure good ladders of your own and to keep them in good condition. Ladders should be examined for split or broken rungs, for projecting nails and sharp corners. Tools should not be left on ladders and undue haste avoided in ascending or descending ladders. Then the most important point of all—see that the ladder is on a sound foundation and not likely to slip.

A great amount of work is carried on by electrical contractors in unfinished buildings. The employees are usually working right after the bricklayers. One electrical worker was killed in Toronto last year by being hit by a large piece of tile thrown from a higher floor. Don't throw all the responsibility on the foreman of the bricklayers. Talk the matter over with him and get a good working agreement as to throwing material from higher floors and then see that a guard is placed over all open spaces under which men are working. Another point in working in unfinished buildings—see that the scaffolds that are used are secure. There is always the tendency to build temporary scaffolds very cheaply. They may be set up at a reasonable figure, however, and still be secure for a man to work on. If the work is well planned, a good substantial scaffold will pay for itself in saving time.

Now, in connection with working on or about live electrical apparatus. One hundred and ten volts may appear very innocent, but anyone who has had a shock from it with wet hands has a very wholesome respect for it. Only skilled workmen should be allowed to work near live apparatus. If there is a chance of making the line dead this should be done. If not, then the standard precautions should be taken. If rubber gloves are to be worn they should be in first-class condition and periodically tested.

Every electrical worker should be able to perform the Prone Pressure Method of Resuscitation. It should be part of his religion. Thousands of cards and booklets on the method have been in circulation for the last few years, but from my knowledge of the industry I can safely say that not one man in ten can perform the work. You cannot become proficient by reading a card or booklet any more than you can become an efficient electrical contractor or worker by reading. You can only become proficient by practice and this practice should be kept up.

In connection with cuts or punctures of the skin—have these attended to at once. If a cut is at once attended to it will heal in a day or so and cause very little discomfort. If it is neglected it may become infected and a bad case of blood poisoning result. Very simple first-aid cases or supplies will be all that are needed and they can be procured at a very reasonable figure.

Three-quarters of the work of preventing accidents is in

This is the result of an analysis by the N.E.L.A. of 5944 accidents during the past year.

* Inspector Electrical Employers' Association.

being careful. This has to start from the head of the firm. Let the head have a talk over matters with his foremen and impress upon them that from now on accidents must stop. The foremen should then pass the word on to the men. Don't talk once only, but **keep everlastingly at it**, and success will result in a decrease of accidents, less danger of a contract being delayed and the workman and his dependants being relieved of much expense and suffering.

HELP, HELP.

Electrical contractors and dealers in British Columbia can help themselves and help the Electrical Industry in their Province by joining the British Columbia Association of Contractors and Dealers, which has recently been formed for the welfare of the business.

The President is C. H. E. Williams, North-West Trust Building, Vancouver, B.C. The Secretary-Treasurer is E. Brettell, Electric Supply Company, Ltd., 781 Granville Street, Vancouver, B.C. Write to either of the above named for Constitution, By-laws, and Application Forms.

Diaphragm Type Pressure Regulators

A pressure regulator, of the diaphragm type, for use with automatic starters on motors. drawing pumps, compressors, and similar machines, is shown in the illustration. These regulators require but two wires to connect them to the starters and are designed for use in connection with compressors for pumps emptying into closed pressure systems containing air, gas, water, or any fluid not injurious to the rubber diaphragm. The regulator can also be used with pressure systems operated by oil or steam if a loop is introduced into the pipe leading to the regulator, to prevent the oil or steam from coming into direct contact with the diaphragm. The regulator consists of four essential parts, the pressure chamber, the operating arm, the switch lever, and the adjusting springs. The pressure cylinder is of cast iron inside of which is a heavy flexible rubber diaphragm. A piston attached to the diaphragm projects through the chamber and engages the operating arm which actuates the switch lever. The operating springs oppose the movements of the piston and operating arms and can be adjusted.

Many-Color Window Display

The Hughes Electric Heating Company has prepared a 10-color, 18-piece, window display, which they are ready to distribute gratis. This elaborate piece of publicity has been worked up specially for central station customers of the Hughes Company, in such a manner that it can be placed in an electrical dealer's window with little effort, but with telling effect. It points out the principle advantages of electric cooking, and contains placards from which strings can be run to the features of the range in the centre of the window.

Standard Lighting Practice

The table herewith lists the latest approved recommendations for various classes of lighing service. In planning a lighting installation the established practice at the moment must be considered the safest guide as to the intensity of lighting to be recommended. This, of course, may be modified to suit the demands of local conditions, as, for example, decorations, personality of the owner, illumination of surroundings, etc. In the table referred to, the watts per square foot of floor area, as given in the third column, are based on incandescent lamps giving approximately one candle-power per watt. For lamps of higher or lower efficiency the values must be corrected proportionately, provided, of course, a similar equipment is used:

Table giving latest approved practices for various classes of lighting service

Room	Foot-Candle Intensity	Watts per Square Foot	Type of Reflector	Size of Lamp. Watts
Armory or Drill Hall.	2.0	.50	Dome Steel or Bowl Glass	200–1000
Armory (Cavalry):				
Tan-bark Floor..	3.0	.75	Dome Steel	200–1000
Ballroom............	2.0– 3.0	......	Special Lighting	
Barroom............	2.0– 5.0	.50–1.25	Bowl Glass or Decorative	25–300
Bath (Public):				
Dressing Rooms..	1.0– 1.5	.25– .40	Bowl Glass	25–100
Swimming Pool..	1.5– 2.0	.40– .50	Bowl Glass or Dome Steel	60–200
Café (General Illumination only)...	2.0– 4.0	......	Ornamental	25–500
Café (Supplemented by Lights on Tables).	1.0– 2.0	......	Ornamental	25–200
Card Room..........	2.0– 3.0	.50– .75	Bowl Glass	25–200
Court Room.........	2.0– 4.0	.50–1.00	Bowl Glass or Ornamental	25–500
Dance Hall..........	2.0– 4.0	.50–1.00	Bowl Glass	100–300
Fire Stations:				
Alarm turned in..	3.0	.75	Bowl Glass or Steel	25–200
At other Times...	1.0	.25	Bowl Glass or Steel	25–200
Garage..............	1.0– 3.0	.25– .75	Bowl or Dome Steel	60–200
Gymnasium..........	2.0– 4.0	.50–1.00	Bowl Glass or Dome Steel	25–500
Handball Court.......	7.0–10.0	......	Angle Steel	60–300
Hotel:				
Lobby...........	2.0– 4.0	.50–1.00	Bowl Glass	25–400
Dining Room.....	(See Café)			
Writing Room....	2.0– 3.0	.50– .75	Bowl Glass	25–200
Corridors........	.6	.20	Bowl or Enclosing Glass	25– 60
Bedroom.........	1.5– 2.0	.30– .50	Bowl Glass	25–100
Lavatory.........	1.5– 2.0	.30– .50	Bowl Glass	25–100
Laundry.........	2.0– 3.0	.50– .75	Bowl Glass or Steel	25–100
Lunch Room.........	2.0– 4.0	.50–1.00	Bowl Glass	60–200
Market..............	3.0– 5.0	.75–1.25	Bowl or Dome Enameled Steel	40–500
Moving Picture Theater........	Approximately 0 2-foot-candles at front of house and 1.0-foot-candles near entrance		Totally Indirect	100–500
Museum.............	2.0– 6.0	.50–1.50	Bowl Glass	25–500
Reading (Ordinary Print)...........	2.0– 4.0	......	....	....
Reading (Fine Print)..	3.0– 5.0	......	....	....
Restaurant (See Cafés)				
Rink (Skating).......	1.0– 3.0	.25– .75	Bowl or Dome Steel or Glass	60–500
Sewing—Hand				
(Light Goods)....	3.0– 5.0	General Illumination		
(Dark Goods)....	4.0– 8.0	Localized General Illumination		
Sewing — Machine				
(Light Goods)....	4.0– 6.0	Localized General Illumination		
Squash Court........	7.0–10.0	......	Angle and Bowl Steel	60–200
Stable..............	.8– 1.0	.20– .30	Bowl or Dome Steel	25–200
Stock Room..........	.5– 1.5	......	Bowl Steel or Glass	25–100
Stores:				
Book............	3.0–5.0	.75–1.25	Bowl Glass	100–500
Baker...........	2.0–4.0	.50–1.00	Bowl Glass	60–200
Cigar...........	4.0–6.0	1.00–1.50	Bowl Glass	60–200
Clothing.........	4.0–7.0	1.00–1.75	Bowl Glass	100–500
Confectionery....	3.0–5.0	.75–1.25	Bowl Glass	60–200
Drug............	2.0–4.0	.50–1.00	Bowl Glass	60–200
Dry Goods.......	4.0–7.0	1.00–1.75	Bowl Glass	100–500
Furniture........	2.0–4.0	.50–1.00	Bowl Glass	100–200
Grocery.........	2.0–4.0	.50–1.00	Bowl Glass	60–200
Haberdasher.....	5.0–7.0	1.25–1.75	Bowl Glass	100–200
Jewelry.........	4.0–6.0	1.00–1.50	Bowl Glass	60–200
Millinery........	4.0–6.0	1.00–1.50	Bowl Glass	60–200
Shoe............	2.0–4.0	.50–1.00	Bowl Glass	60–200
Stationery.......	2.0–4.0	.50–1.00	Bowl Glass	60–200
Telephone Exchange:				
Operators........	2.0– 3.0	.50– .75	Bowl Glass	25–200
Theater:				
Lobby...........	2.5– 5.0	......	Ornamental	25–500
Auditorium......	1.0– 2.5	......	Ornamental	25–500
Warehouse..........	.5– 1.5	.10– .40	Bowl or Dome Steel	60–300
Wharf..............	.5– 1.5	.10– .40	Bowl or Dome Steel	60–300

MISCELLANEOUS INDUSTRIES

Note—It is impossible to cover the different industries in the space available, so only a few typieal illustrations are incorporated.

Factory (General)

General Illumination...	3.0–6.0	.75–1.50	Bowl or Dome Steel	40–500
General Illumination (Supplemented by Localized Light)..	1.0–2.0	.25– .50	Bowl or Dome Steel	40–200
Shipping............	1.5–2.5	.40– .60	Dome and Bowl Glass or Steel	40–200
Stock Room..........	.8–2.0	L–G	Bowl and Dome Glass or Steel	25–100
Warehouse..........	.5–1.5	.10– .40	Dome Steel	40–200

Forge and Blacksmithing

Smithing (Ordinary Anvil Work).....	2.0–4.0	.50–1.00	Dome or Bowl Steel	60–200
Machine Forging	2.0–3.0	.50– .75	Dome or Bowl Steel	60–200
Tool Forging.........	3.0–5.0	.75–1.25	Dome or Bowl Steel	60–200

Paint Shop

Fine Work, Finishing..	4.0–8.0	1.00–2 00	Dome or Bowl Steel or Glass	60–400
Coarse Work, First Coats, etc........	2.0–4.0	.50–1.00	Dome or Bowl Steel or Glass	60–300

Pattern Shop

Metal..	4 0–6 0	1 00–1 50	Dome or Bowl Steel	60–300

Power-House

Engine Room	2 0–3 0	.50–1 25	Dome or Bowl Steel	25–500
Boiler Room.	.8–1 5	.20 .40	Dome Steel	25–500
Supplemented by Individual Gauge Lights				25–000

What They Will Be Displaying

A Brief Note of the Lines to be Featured by Various Exhibitors

Factory Products Limited will display samples of as many as possible of their lines and will particularly feature VV conduit fittings. Mr. Frank Ritz will be in charge of the exhibit.

The National Electric Heating Company will show their complete line of ranges, heaters and small appliances. Mr. Edwin I. Williams, who has recently joined the staff, will be in charge of the exhibit.

The Interstate Electric Novelty Company will have on display their regular line of electric flashlights, batteries, bicycle and carriage lights, incandescent lamps and sockets. Mr. Chas. F. Meyrick will be in charge of the exhibit.

The Canadian Westinghouse Company will display a complete line of heating and cooking devices, including their latest type electric range; also a full line of Westinghouse Mazda lamps. Messrs. C. M. Hopper and W. J. Orr will be in charge.

The One Minute Mfg. Company will exhibit their Maple Leaf electrically-driven washing machine with swinging wringer. The exhibit will be in charge of Mr. F. J. Ehrhardt, manager and treasurer of the company, assisted by Mr. David Carothers.

The Electric Specialty & Supply Co. will have about 6 girls at the convention, manufacturing their supplies. They will demonstrate their full line of supplies at the exhibition, and Mr. Rankin, who is well known amongst all the trade, will take charge; booth No. 15.

The exhibit of the Canadian General Electric Co. will consist of household utilities, general electric supplies, and Hamilton Beach electric labor saving devices, such as sewing machine motors, vibrators, drink mixers, curling irons, etc. It will be in charge of Mr. Frank Mahony.

The Canadian Carbon Co., Limited, intend to exhibit their new water and weatherproof batteries, both X Cell and Green Seal, their Three Volt Lightor battery, complete line of flashlights, multiple batteries, hand lanterns, etc. Mr. H. F. Meredith will be in charge of this exhibit.

The Hughes Electric Heating Co. will exhibit in Booth No. 27, where they will have a display of several types of ranges ready to demonstrate. Mr. H. E. Doty will be in charge. Mr. F. M. Dusenberry is on the programme to give an address on "Co-operation Between Dealers, Contractors, and Manufacturers."

The Northern Electric Company will display a line of material of their own manufacture, including copper wires and cables, lamp cord, interphones and telephone material, police signal and fire alarm devices, lighting specialties; also the Bryant Perkins line of wiring devices. Mr. Jos. J. Whelan will be in charge of this exhibit.

The Norton Telephone & Supply Co. will exhibit in booth No. 13. They will show telephones for every purpose, including a limousine telephone that is a brand new idea. They will also exhibit a signal system, and a fire alarm system. As they are Canadian agents for Beake Insulated Staples, and the T. J. Cope underground electrical tools, they will have a complete demonstration of the uses of these various articles.

The Canadian National Carbon Company will exhibit a complete line of Columbia and Ever-Ready products, including dry cells; arc projector and searchlight carbons; railroad signal batteries; non-sulphating storage batteries; flashlights and flashlight batteries; automobile and decorative miniature lamps; electrical testing instruments; waterproof fibre battery boxes and numerous other specialties. The exhibit will be in charge of Mr. E. G. Weed.

The Benjamin Electric display will consist of Benjamin Factory and Motor Horns, Starrett Panel Boards, Benjamin Knife Switches, and some of their regular specialties. The exhibit will be in charge of the sales manager, Mr. F. T. Groome. The lines will be of special interest from the contractors' point of view, as being of a character which will help them in solving some of the difficulties of installation work and other problems, and also give them some new ideas.

The Economy Fuse and Manufacturing Company's exhibit at the Electrical Contractors' Show will consist of one large exhibit board carrying various sizes of Economy renewable fuses and parts from 600 amp., 600 volt, down to 3 amp., 250 volt. Complete fuses, sectional fuse, and turn-down fuses will be shown. A similar exhibit board will carry a few S. & C. Extra High Potential fuses, ranging from 44,000 volts down. Mr. J. S. Painter, Toronto representative, will be in charge and will have some extra material with which to demonstrate to interested parties.

The Clements Manufacturing Company, Limited, will demonstrate their Big Ben vacuum cleaner for cleaning churches and public buildings; also their Cadillac and Reliable cleaners for use in the ordinary home. Another feature of this company's show will be the giving away of a Model D Cadillac cleaner complete with attachments. Every person registering will have an opportunity of drawing for this cleaner. It will be on exhibition at the booth and after the close of the convention will be given away to the lucky party absolutely free. Mr. S. L. Harman, sales manager, will be in charge of the booth.

Re-lighting Champ de Mars

The city of Montreal has made a grant for reorganizing the lighting of the Champ de Mars. Owing to weather conditions, the wire of the previous installation had deteriorated, and the opportunity is now being taken to replace the tungsten lamps with nitrogen-filled lamps. The present lighting scheme consists of five-cluster standards, and it is now proposed to install 100 watt nitrogen-filled lamps at each of the four points with a 300 watt nitrogen lamp in the centre. Arrangements will be made so as to use only a portion of the lighting during certain portions of the night. Armoured cable will be substituted for the present wire. Mr. A. Parent is the lighting superintendent.

Standardizing Symbols

An almost endless variety of troubles would be avoided if it could be arranged between architects and contractors to use uniform symbols to indicate the various electric outlets and equipment. These would then quickly become standardized. At the present time there are practically as many symbols used to indicate any one type of outlet as there are architects, and especially is this so with some of the rarer outlets and equipments. This matter of standardizing has been pretty well settled on the other side of the line by the National Electrical Contractors' Association, which drew up the list reproduced herewith. These have also been accepted by the American Institute of Architects. If each member of the Ontario Electrical Contractors' Association would take this matter up with the architects in his district there is little doubt but that there would be complete unanimity of opinion on the general use of these same symbols in Canada.

Standardized Symbols for Architects and Contractors

Ceiling Outlet; Electric only. Numeral in centre indicates number of Standard 16 C.P. Incandescent Lamps.

Ceiling Outlet; Combination. 4 2 indicates 4-16 C.P. Standard Incandescent Lamps and 2 Gas Burners. If gas only, circle all black.

Bracket Outlet; Electric only. Numeral in centre indicates number of Standard 16 C.P. Incandescent Lamps.

Bracket Outlet; Combination. 4 2 indicates 4-16 C.P. Standard Incandescent Lamps and 2 Gas Burners. If gas only, circle all black.

Wall or Baseboard Receptacle Outlet. Numeral in centre indicates number of Standard 16 C.P. Incandescent Lamps.

Floor Outlet. Numeral in centre indicates number of Standard 16 C.P. Incandescent Lamps.

Outlet for Outdoor Standard or Pedestal; Electric only. Numeral indicates number of Standard 16 C.P. Incand't Lamps.

Outlet for Outdoor Standard or Pedestal Combination. 6 6 indicates 6-16 C.P. Standard Incand't Lamps; 6 Gas Burners.

Drop Cord Outlet.

One Light Outlet, for Lamp Receptacle.

Arc Lamp Outlet.

Special Outlet, for Lighting, Heating and Power Current, as described in Specifications.

Ceiling Fan Outlet.

S^1 S. P. Switch Outlet.

S^2 D. P. Switch Outlet.

S^3 3-Way Switch Outlet.

S^4 4-Way Switch Outlet.

S^D Automatic Door Switch Outlet.

S^E Electrolier Switch Outlet.

Show as many Symbols as there are Switches. Or in case of a very large group of Switches, indicate number of Switches by a Roman numeral, thus S^1 XII; meaning 12 Single Pole Switches.

Describe Type of Switch in Specifications, that is, Flush or Surface, Push Button or Snap.

Meter Outlet.

Distribution Panel.

Junction or Pull Box.

Motor Outlet; Numeral in centre indicates Horse Power.

Motor Control Outlet.

Transformer.

Main or Feeder run concealed under floor.

Main or Feeder run concealed under Floor above.

Main or Feeder run exposed.

Branch Circuit run concealed under Floor.

Branch Circuit run concealed under Floor above.

Branch Circuit run exposed.

Pole Line.

Riser.

Telephone Outlet; Private Service.

Telephone Outlet; Public Service.

Bell Outlet.

Buzzer Outlet.

Push Button Outlet; Numeral indicates number of Pushes.

Annunciator; Numeral indicates number of Points.

Speaking Tube.

Watchman Clock Outlet.

Watchman Station Outlet.

Master Time Clock Outlet.

Secondary Time Clock Outlet.

Door Opener.

Special Outlet; for Signal Systems, as described in Specifications.

Battery Outlet.

Circuit for Clock, Telephone, Bell or other Service, run under Floor, concealed. Kind of Service wanted ascertained by Symbol to which line connects.

Circuit for Clock, Telephone, Bell or other Service, run under Floor above, concealed. Kind of Service wanted ascertained by Symbol to which line connects.

Heights of Centre or Wall Outlets (unless otherwise specified):

Living Rooms	5 ft. 6 ins.
Chambers	5 ft. 0 ins.
Offices	6 ft. 0 ins.
Corridors	6 ft. 3 ins.

Height of Switches (unless otherwise specified) 4 ft. 0 ins.

What About a Quebec Contractors' Association?

By a Montreal Contractor

Is not the time propitious for a live electrical contractors' association for the Province of Quebec, or at least for the city of Montreal? There is in existence, or is supposed to be, an association which bears the name of the Province of Quebec Electrical Contractors' Association, but unfortunately it is, to put it mildly, in a state of suspended animation. For some years it did a certain amount of work, but gradually interest diminished, and the members have not been called together for many, many months. During its declining period, efforts were made to put some life into the proceedings; the result, however, was not encouraging, and several of the more active members practically withdrew.

One great obstacle was undoubtedly the language difficulty. The French-Canadian contractors are the majority in Montreal, but they did not readily respond to the invitation to become members, and even when a majority of the officers were French-Canadian, there was a disinclination to support the association. Some of the larger contractors who were of this nationality did their best to make the society of real benefit, but they could not overcome the disinclination to join.

The Association, in a word, did not meet with that general support, either from French or English, which is essential if a society is to exert an influence in furthering the interests of its members, and protecting them should occasion require it.

Some questions of importance to electrical contractors were discussed, and committees appointed to deal with them, but they remain to-day in exactly the same position as they were before consideration was given to them. Take the matter of the licensing of electrical contractors. It was alleged, and is no doubt true, that many incompetent men trade under the name of electrical contractors; some of these have but an elementary knowledge of wiring, have little or no financial resources, and are content to do work on a basis which is impossible to a man or a firm with a reputation to sustain and capital to conserve. Such men cut prices, and in many cases do very poor work in consequence of incompetency or to offset the low prices quoted for the jobs. During the days of the building boom men of this description started up by the dozen, though during the days of stress they have disappeared to a large extent. The scamping of work by such people is injurious to contractors as a whole, and the association discussed means of putting an end to these bad practices, which lowered the standard of work and made a living profit difficult. Licensing by the city was regarded by many as the most practical method of putting the business on a sounder footing. The city licenses plumbers, who are not allowed to work unless they can give evidence of their capacity, and it was argued that a similar plan would be in the general interest of the public, as well as of electrical contractors and of their competent workmen. Nothing, however, came of the many discussions.

Another matter which was debated was the rules of the Canadian Fire Underwriters' Association—a subject on which there is, and always will be, a wide difference of opinion. Electrical contractors sometimes feel that the decisions of the inspectors are arbitrary; the interpretation of the rules is open to more than one construction, and it is only human nature to suppose that firms will generally construe their rules to their own advantage. The presence of the chief electrical inspector at the meetings is therefore of mutual advantage, as tending to remove friction where there are so many opportunities for it to arise. Certainly this part of the work of the association was of value, and from that point alone the suspension of its meetings is to be regretted.

The Montreal Builders' Exchange have made efforts to form an electrical contractors' section, but it was found almost impossible to get firms to pull together—there was apparently an undercurrent of jealousy which did not make for union.

The need of such an association is recognized and notwithstanding the past history of the movement, it may be asked if steps cannot be taken to revive the association, or failing that, to start an organization which will be on such a basis as to secure the co-operation of a large number of bona fide electrical contractors? One does not need at this time of the day to point out the many advantages of co-operation in dealing with questions which affect the trade as a whole; they are admitted; what is lacking in too many instances is cohesion, a want of interest on the part of those who should be the first to defend their means of livelihood, for that is, after all, what it comes to.

Surely Quebec will not be behind Ontario, which is showing what can be done if the question of organization is taken up with a determination to make the association a benefit to its members?

The success of the Wednesday Electrical Luncheons is an example of what can be accomplished by well-directed effort. The committee is representative of several branches of the electrical industry, and without any elaborate machinery has been able to inaugurate a weekly luncheon which has brought together in an informal way men who previously were unacquainted. While the object is mainly for social intercourse, the luncheons have their business aspect, and this has proved to be a factor in the success of the weekly meetings.

Some Formulae for the Electrical Contractor

Familiarity with Ohm's law will solve the majority of simple problems for the electrical contractor. It is an expression of the relationship between the electromotive force (volts), the current strength (amperes), and the resistance (ohms). Where direct current is under consideration the formulae given below are applicable. If the formulae are required for indirect (alternating) current, the electromotive force, E, must be replaced in each case by EP, where P equals the power-factor.

I = Current (Amperes)
R = Resistance (Ohms)
H.P. = Horse-power
E = Electro-motive Force (Volts)
W = Electric Power (Watts)
K = Efficiency of Machine

$$I = \frac{E}{R} \qquad R = \frac{E}{I} \qquad E = RI \qquad W = IE$$

$$W = \frac{E^2}{R} \qquad W = I^2R \qquad W = 746 \times HP \qquad HP = \frac{W}{746}$$

$$E = \frac{746 \times HP}{I \times K} \qquad I = \frac{746 \times HP}{E \times K}$$

Comparative Cost of Wiring

A recent booklet issued by the Society for Electrical Development gives the following figures for the comparative costs of wiring. Owing to varied costs of material and labor, as well as different restrictions required by authorities at different points, the table gives only comparative figures:

Knob and tube	$1.50 to $2.50
Flexible steel and armored conductors	2.00 to 5.00
Flexible steel conduit	3.50 to 5.50
Rigid metallic conduit	4.00 to 7.00

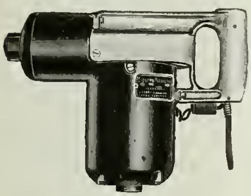
The Mallorytown Telephone Company, Limited, has been incorporated with $20,000, to operate in the township of Elizabethtown.

The Latest in Electrical Devices and Fittings

Brief Illustrated Descriptions That Tell Contractors and Dealers What the Manufacturers Are Doing

Electric Hammer with Universal Motor

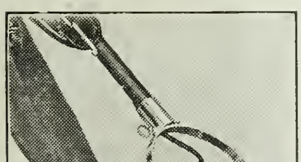
The illustration herewith shows an electric hammer manufactured by the Electro-Magnetic Tool Company, and distributed in Canada by R. E. T. Pringle. In making a comparison of the amount of work that may be accomplished by an electric hammer, it has been estimated that a man with a hand hammer strikes 40 to 80 blows per minute, and that with an electric hammer he strikes from 1,000 to 3,000 blows per minute. It is also pointed out that in the second case the workman does not tire nearly so quickly. The U-6 is equipped with a universal motor which will operate on d.c. or a.c., any cycle from 25 to 60. This machine may be obtained for 110 or 220 volts, consumes 240 watts per hour, has a drilling capacity up to 1-in. diameter and weighs 27 pounds.



Electric Hammer with Universal Motor

A Light Weight Vacuum Cleaner

The vacuum cleaner shown herewith is manufactured by the Frank Ridlon Company. The machine has a number of attachments which enable the user to perform every conceivable cleaning operation about the home. The points of superiority of this cleaner, as claimed by the company, are as follows: twelve-inch suction nozzle; has behind its manufacture pioneers in the electrical business of over thirty years' experience, extremely low clearance above floor; no metal to touch the hands; always in a wheeling position while hose is attached; thread remover, positive and guaranteed; it has four adjustments of nozzle height; operated by powerful General Electric motor; no boards for clamping up suction nozzle; a pistol grip-handle switch; less than nine pounds in weight.

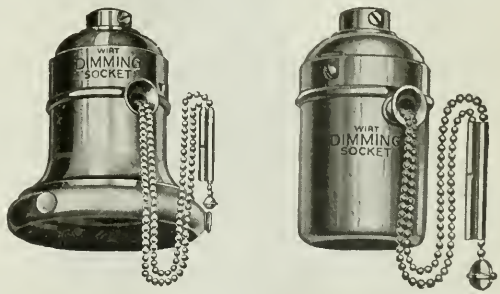


A Light Weight Vacuum Cleaner.

Wirt Dimming Socket.

Through the development of dimming sockets an additional impetus is being given to electric lighting, particularly in residence service. Ceiling fixtures, wall brackets and portable lamps can now be supplied with sockets which enable the consumer to obtain every advantage of electric lighting together with ability to regulate the amount of light by a small dimming arrangement. Thus, such dimming sockets enable the light to be turned up or down as readily as with a gas lamp and, therefore, meet the only advantage which gas lighting has heretofore possessed over electric lighting.

These sockets are shown in the accompanying illustrations. Each of them gives five changes of light, namely, full, half, dim, night light, and out. They are controlled by a convenient double chain, of which one portion has the ordinary ball end and the other has tubular part through which the former passes. One of these chains is used for increasing the light step by step and the other is used for turning it down. Included in the socket is a very compact and durable resistance, which is introduced in series with the lamp when the light is turned down, thus effecting a saving in the current of from 30 to 80 per cent., depending upon the degree of dimming. These sockets, of course, can be used for any type of Edison base lamp and are designed to be attached permanently to the fixtures with thread and set screw, the same way as ordinary sockets are attached.



Dimming Sockets No. 31 (left) and No. 32 (right).

One of these sockets (No. 31) is supplied with 2.25-inch holder and is intended for use on lighting fixtures in hallways, bathrooms, bedrooms, nursery, etc. Another socket (No. 32) is designed especially for use in portable, table, piano, and floor lamps, special brackets, etc. Both these sockets may be used on any fixture where direct control of light is desired. Their use dispenses with the need for the ordinary pull-chain or key socket with an additional dimming device. In addition to convenience and economy these sockets lend themselves to very artistic effects when installed on ornamental fixtures. All Wirt material is handled in Canada by the Benjamin Electric Co. of Canada, Ltd.

The outline of a scheme for a union station to cost about $35,000,000 has been laid before the Montreal Council by the Montreal Central Terminal Company. It is suggested that all the lines coming into the city should use the station, and that these lines should be electrified.

The Capacity of Snap Switches

Editor Electrical News:

The writer, in carrying out an inspection of electrical installations has for some time been under the impression that some of the types of snap switches now on the market are very much over-rated as to their carrying capacity.

Owing to the lowering of the prices of electric current in this city during the past few years, and which I think has also occurred in Eastern Canada, there has been a very extensive use of electric heating and cooking devices. It is natural that inspectors do not look upon the use of the ordinary knife switch with favor owing to the risk of shocks and accidents when these are placed under the control of persons inexperienced in these matters.

Then we have to also remember that in the case of electric ranges a communicated heat from the operating of the heating elements affects the switches mounted on the body of the range, so that if an insufficiently safe carrying capacity is present to begin with, that capacity is still further reduced by the communicated heat; the consequence being that the temper of the metals is affected and deterioration sets in.

I would be glad of an expression of opinion from inspectors in other parts of the country as to how they view this matter and what troubles they have found, as, if the troubles we have met with in this city have been met with elsewhere —and it is likely that such will be the case—the matter calls for prompt and adequate treatment, otherwise the reliability of electric service may be seriously prejudiced.

Yours truly,

F. A. Cambridge,
City Electrician.

Winnipeg, Man., May 18, 1916.

Delta Electric Company Has New Factory

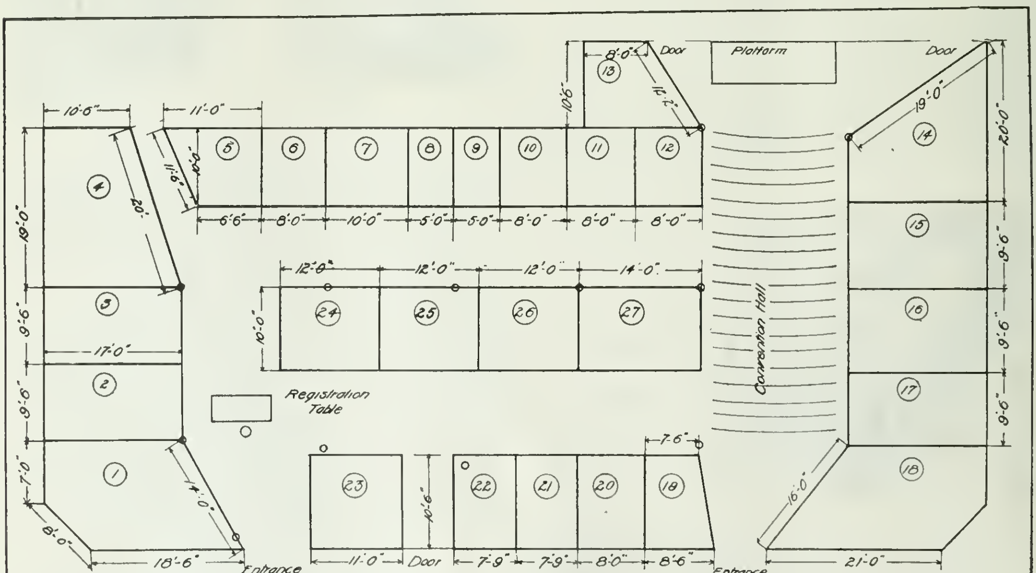
A most modern and complete factory for the manufacture of electric lanterns, lamps and flashlights has recently been completed by the Delta Electric Company, of Marion, Indiana. This company has been planning and constructing this building for some time and they report having moved into the new quarters and that their entire equipment is in full operation.

Veluria Glass With Rozelle Colored Decorations

Whether amateur or professional, the interior decorator is looking for new and refined means of utilizing color. In the modern scheme of appointment, flowered chintzes and cretonnes are made into curtains, cushions, and spreads, and wall papers follow the same design. For lighting such surroundings the Canadian General Electric Co. offer something entirely new, namely Rozelle decorated glass ware. Rozelle is the result of careful experiment at the Ivanhoe-Regent Works and is pre-eminently fitted for this purpose.

Shawinigan Water and Power Company will issue new common stock to the value of $1,361,250 at 115 on the basis of one share of new stock for each 10 shares of old. While no official announcement is made of the purpose for which the new capital is required, it is evident that it will be applied to the later developments of the company. These include the construction of a transmission line to Quebec, consequent on the acquisition of the Dorchester plant, the purchase of the Gres Falls water power from the Union Bag & Paper Company, and the important extensions of companies dealing with carbide and electro-metals in which the Shawinigan is interested.

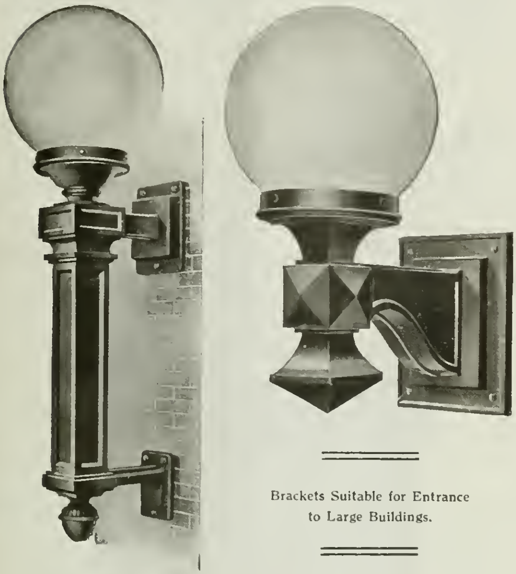
The Exhibitors and Where to Find Them



1—Crouse-Hinds Company.
2—Detroit Fuse & Mfg. Company.
3-4—Can. General Electric Co.
5—Jefferson Glass Company.
6—Clements Mfg. Company.
7—National Elec. Heating Co.
8—Interstate Novelty Company.
9—Volt Lamp Company.
10—Can. National Carbon Co.
11—Flexible Conduit Company.
12—Metropolitan Engineering Co.
13—Norton Telephone Co.
14—Northern Electric Company.
15—Hydro Elec. Specialty Co.
16—Canadian Westinghouse Co.
17—Factory Products Limited.
18—One Minute Washer Co.
Canadian Carbon Company.
Tuec Vacuum Cleaning Co.
19—Benjamin Elec. Mfg. Co.
20—Kinetic Engineering Co.
21—Economy Fuse Co.
22—Can. Chuck & Drill Co.
23—Conduits Limited.
24—Renfrew Electric Mfg. Co.
25—Rogers' Electric Company.
26—1900 Washer Company.
27—Hughes Elec. Heating Co.

Ornamental Doorway Brackets

At the entrance to public buildings, as well as private structures of imposing character, such as schools, hotels, club houses, and other institutions, in which the architect has been given considerable freedom of design, it has been regarded as being very appropriate to install ornamental lighting brackets of a design to harmonize with the architecture



Brackets Suitable for Entrance to Large Buildings.

of the building. The design and manufacture of such equipment, as well as other fixtures for outdoor lighting, has for some time been made a specialty by the Herwig Art Shade and Lamp Co. This firm manufactures a very large line of ornamental brackets of all kinds, pillar and pedestal lamps, lanterns, etc. In the accompanying illustrations are shown two recent designs of brackets, of which Fig. 1 shows a pattern with a shaft portion three inches square. The entire height of the bracket to the top of the holder is 28 inches. The centre of the lamp is brought 7½ inches from the wall. Another design, Fig. 2, brings the centre of the lamp 10½ inches from the wall. The height of this fixture to the top of the globe holder, is 10½ inches. In each of these brackets a six-inch holder is provided for the globe.

Electric Light for the Summer Home

In the summer homes and other isolated points where electric current supply from some central station is not available, the need has been apparent for some time for an electric generating plant of small capacity at a price not too large for the average house-holder. There does not seem to be any question that if a dependable plant at a suitable price could be placed on the market, the summer homes and farms of Canada would very quickly avail themselves of the opportunity to light up as we do in the cities and towns. The people who go to summer resorts for two or three months each year are accustomed to the convenience and safety of electric light at the turn of a switch and so do not adjust themselves readily to the coal oil lamp. Even the farmer, who now hears so much about "electricity on the farm," has become impatient of the old-time methods of illumination, or non-illumination, and is now looking for something in keeping with his ideas of what such a plant ought to cost.

Like many other lines along which the use of electricity has been developed in the last few years where the demand at first has been very small, manufacturers have been unable to reduce the cost of the equipment until the field had been somewhat extended. For this reason the cost of an isolated electric plant, calculated to do little more than a couple or three coal oil lamps, has represented an initial expenditure of anywhere from $500.00 to $1,000.00, with maintenance charges comparable with the cost of coal oil. If the price of this equipment could by any means be reduced to one-half, or, better still, one-quarter of this price, we have no doubt the equipment would meet with a very ready sale. Is it not possible the manufacturers are maintaining too high a standard to meet the requirements?

We illustrate herewith a small plant which has been placed on the United States market by the Main Electric Mfg. Co. This company has been manufacturing plants for many years, anywhere from 50 to 20,000 lights capacity, but they are now placing on the market a 37-light plant, a 12-light plant, and a 7-light plant. The smaller one is illustrated herewith. It consists of a 15-cell, 35-amp. hour battery enclosed in hard rubber jars, a 40-volt, 175 watt dynamo, a slate folding type switch board equipped with double-pole,

A 7-Light Generating Outfit.

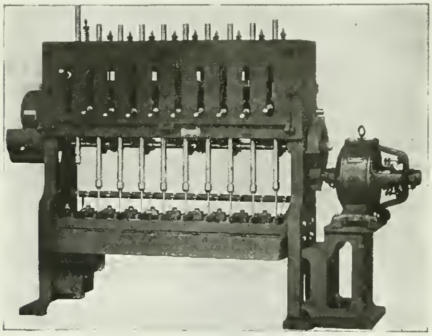
double-throw switch, single-pole, single-throw switch, cartridge fuses, rheostat, automatic circuit breaker, double reading ammeter, all completely wired up. This is mounted, as shown, on skids, and may be moved from place to place at will. The price of this equipment complete with 1½ h.p. engine, is in the neighoorhood of one hundred dollars.

The annual statement of the Montreal Light, Heat & Power Company for the year ended April 30, 1916, shows an increase in gross revenue of $260,062, the figures for the past and previous years being $6,877,167 and $6,617,105. The year's surplus was $987,248, as compared with $759,242 in the previous year, after all charges, including dividends, had been deducted. This year an allowance of $10,000 is made toward a pension fund and the war tax consumes $204,729, which leaves the general surplus $772,518. The total liabilities of the company are placed at $41,483,872, including a surplus account, which now amounts to $5,742,872. It is now understood that arrangements have been completed whereby this company is merged with the Cedars Rapids Manufacturing & Power Company, on a basis of three shares of Montreal Power to one of Cedars Rapids, the operations of both companies to be controlled by a holding company.

National Tapping Machine

In the National ten-spindle automatic nut tapper the National Machinery Company of Tiffin, Ohio, offers a machine that will handle hot pressed nuts as readily as cold pressed ones. Furthermore, there is no chance of the nuts sticking as is usually the case with entirely automatic nut tappers. In this machine the spindles are raised and lowered automatically by cams, the sole duty of the operator being to feed the blank nuts into the machine and to empty the taps.

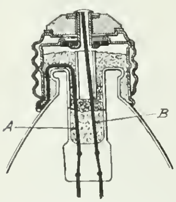
The illustration shows one of these machines geared to a

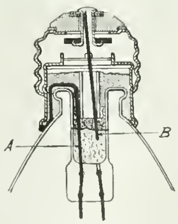


Westinghouse adjustable speed direct-current motor. By means of a drum control the speed of the motor operation, the cam shaft may be adjusted from 550 to 1200 r.p.m., making the machine suitable for tapping nuts from ¾ to 1½ inch size. This control allows the revolutions of the tapping spindle to be varied to suit the number of threads on the tap used, thus obtaining maximum production from the machine. These speed changes can be made while the machine is running.

Locking the Lamp In

We illustrate below the new Hubbell locking lamp. The base of the Hubbell lamp consists of two parts, an outer or rotating shell and an inner shell cemented to the lamp. The filament of the lamp is attached in the usual manner. Fig. 1 illustrates a cross sectional view of the lamp base ready for use, showing the leading-in wires, A and B, soldered to the inner shell and to the centre of the contact, respectively. A lamp equipped with the Hubbell locking base may be screwed into any standard Edison base socket, but cannot be re-





moved therefrom by turning the lamp in the opposite direction. When a lamp is burnt out or broken it may be removed by first giving it a slight downward pull, which breaks the leading-in wire, B, connecting the centre of the contact to the lamp filament, as shown in Fig. 2. In this lowered position the outer shell of the lamp base engages a reverse ratchet and the lamp may then be unscrewed. When a lamp is removed from the socket the electrical connections in it become permanently destroyed and the lamp is valueless. The advantage of this device, over many others on the market, is seen in that it removes the element of human forgetfulness. They are specially recommended by the manufacturers for public buildings, railway stations, hotels (where sockets are frequently used for heating devices unknown to the proprietor), and any places where it is not desired to remove the lamps except for replacement. The lamps are manufactured in Canada and may be secured through R. E. T. Pringle, Limited.

Normalair Humidifier

A novelty in the shape of a motor driven humidifier is announced by the Normalair Co. It is designed for use in places where a certain degree of moisture in the atmosphere is necessary to keep materials in satisfactory condition. The humidifier may be mounted on the wall or columns of a room or suspended from the ceiling. The control apparatus is provided with a deflector which is in the regulator chamber, and when atomspheric conditions require it the deflector deflects the entering water into the overflow. The water enters from above and passes in the regulator chamber, whence it flows directly to the centre of a rapidly revolving

Motor Driven Humidifier.

disk from which it is thrown by centrifugal force against the teeth of a copper grid at the circumference of the disk where it is pulverized. The revolving disk is 16 in. in diameter and the horizontal drip pan 24 in. Every Normalair humidifier is equipped with an automatic humidity control, which prevents the production of too much water vapor, and keeps the relative humidity of the room within a very few points of the desired percentage. This control is easily set, and at any setting it is sensitive.

The Hawley Telephone Company, Limited, have obtained a charter in South Fredericksburgh Township, Ont.

A New Eraser Cleaner

For years school people have been endeavoring to find a satisfactory method of removing chalk from blackboard erasers. The Wisconsin Electric Company is putting on the market a specially designed cleaner that meets the requirements of the school which has electric current. This outfit is, in fact, a small sized vacuum cleaner plant. Suction is produced by a 1/25 h.p. universal motor that operates on direct or alternating current. The outfit not only removes chalk by means of strong suction, but it also has a power-driven bristle brush that brushes the surface of the eraser

to be cleaned. No chalk escapes into the room. It is all drawn into the box and the air is filtered through a fine muslin separator. All metal parts of the outfit are nickel plated, and the cabinet work is of hardwood, mahogany finish.

The cleaner may be operated from any convenient socket. The manufacturers are guaranteeing the cleaner for one year and are prepared to send one on trial to any school authority who may desire it. R. E. T. Pringle, Toronto and Montreal, are Canadian agents.

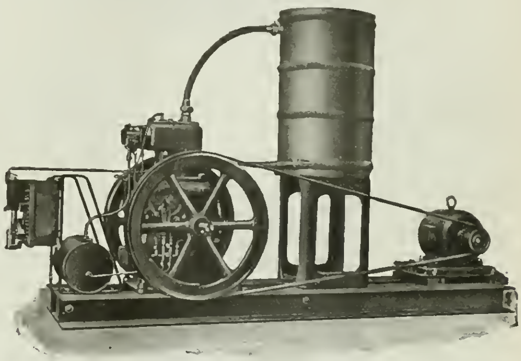
Automatic Light and Power System

It is a frequent practice with isolated electric lighting and power plants to use dynamos driven by means of internal combustion engines working in conjunction with a large battery of storage cells. This within certain limits has been satisfactory. The chief drawback is the amount of attention required, especially in the winter, to keep the battery in good condition, and the expense of renewing these large batteries when necessary.

The Lister-Bruston automatic system combines the advantages of the large accumulator system with those of a direct lighting installation. When the whole of the lighting is done through a battery of accumulators there must be a big loss, as it is not possible to get the same amount of current out of accumulators that you put in. The average storage batteries lighting country houses do not give an efficiency of more than sixty per cent. The Lister-Bruston system was invented, amongst other things, to overcome this defect. The principal items which go to form this plant are a gasoline engine, driving a generator, an automatic switchboard, a controller and a comparatively small storage battery. The storage battery is sufficient to supply up to approximately ten per cent. of the capacity of the plant without starting the engine. When, however, more lights are switched on, the extra current demanded by the lamps causes a relap or automatic switch to operate and the current from the battery then passes through the controller and is delivered to the dynamo, which in turn operates as a motor while the plant is starting itself, thus causing the engine to turn over in the same direction as when running. To reduce the current taken from the battery during the period of starting up, the exhaust valve on the engine is held open, thus relieving the compression until full speed is attained; full compression is then restored and automatically the engine takes over the load, then the dynamo supplies current direct to the lamps without passing through the battery and at the same time recharges the battery to replace what has been taken out by the lamps which were in use before the plant started and also what was used while the plant was starting. Assuming the number of lamps in use to be less than is required to start the plant and that such lamps are used for long periods, the voltage of the battery will drop and it can be arranged that this drop in voltage shall start up the plant and the engine continue running until the battery is brought up to a pre-determined point.

The method in which the plant starts automatically has been explained. Now the automatic stopping is just the reverse. When the lights are sufficiently reduced, the relay opens cutting off the current from the controller solenoid and the engine will stop.

In the case of large installations it is advisable that the plant be divided into two units, the units being connected in such a manner that a light load will start up one plant and when this unit is fully loaded, a second plant will start up



and both will run. On the load being reduced to within the capacity of one unit, the second plant will stop.

This system can be used for either lighting or power, and although only a small storage battery is used, a larger one can be installed to work in conjunction with the plant if required.

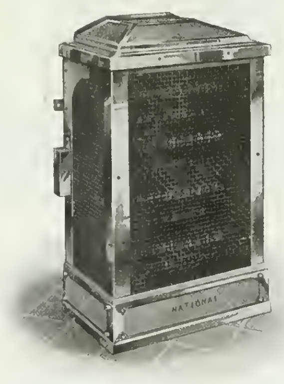
It will be seen that with this system a twenty-four hour service is obtained, and that light is always available, night or day, by simply turning the switch, no attendant being required for the starting, stopping or running of the plant. The only attention required (and this can be given by an inexperienced person) simply consists in filling a gasoline tank, filling a lubricating oil reservoir and wiping dust and oil from the plant occasionally to keep it in a reasonably clean condition.

The Simplex Wire & Cable Company are distributing a very useful celluloid wiring computer, with complete directions for reading. On the back of this computer are tables giving a quantity of useful information with regard to solid copper wires, their sizes, area, carrying capacity, etc. This device should be in the vest pocket of every electrical man interested in construction work of any kind whatever, from electrical contracting to high tension transmission.

Large Electric Heaters for New Sub-Station of the Toronto Hydro-Electric System

The National Electric Heating Company, Limited, of Toronto, recently completed for the Toronto Hydro-Electric System a number of heaters of unusual size and design. The floor plan of the station made necessary two designs of heaters, wall and open floor types. The dimensions of the operating room are 75 x 90 x 30 feet; this room is now provided with six 24 kw. wall and two 24 kw. open floor type

heaters. The combination office and show rooms is 50 x 20 x 12 feet, and is provided with three 10 kw. heaters of wall type. Special provisions have also been made for humidifying the air. The designs and specifications were drawn by



the engineers of the Toronto Hydro-Electric System and the National Electric Heating Company, Limited. The finish of the heaters is black nickel for the operating room, and polished nickel for office and show rooms. Two heat control is provided.

New Westinghouse Range

Many rapid advances have been made by the Westinghouse Company in the manufacture of electric ranges. The features of automatic switches to turn current on and automatic thermostats to cut it off, which have distinguished Westinghouse ranges in the past, are still furnished, with a further addition of three-heat control for each heater in the ovens as well as on the stove top. The fireless cooker principle is also employed in connection with the ovens. The latest range, shown in the accompanying illustration, has two fireless cooker ovens, either at the left or at the right as desired. The large oven is for roasting, baking, broiling, or boiling, and has two heaters, one at the bottom and another at the top. The small oven is principally for boiling and has one heater. Three heaters are provided on the stove top.

All parts of the range are of metal, and while so constructed that parts cannot work loose, every part is quickly accessible for thorough cleaning and repairing. Even the rack holders can be removed from the ovens and the surface flushed with water without the slightest injury. There are no inaccessible places where dirt or grease can collect.

The fireless cooker feature is furnished in order that cooking may be done automatically. The food may be prepared as far in advance of the time wanted as desired. When ready for cooking it is placed in the oven; a clock on the range is set for the hour at which it is required to have cooking commence, and a thermostat set to cut off current when heat reaches a certain predetermined temperature. No

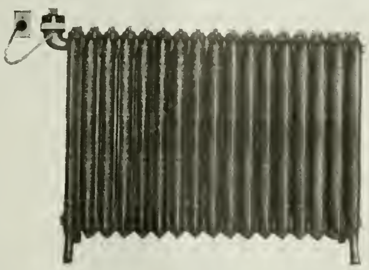
further attention need be paid to the cooking operation; at the proper hour the automatic switch turns on the current and cooking begins. When the predetermined temperature is reached, requiring from ten minutes to half an hour, depending upon the temperature required, the current is automatically cut off by the thermostat and from then on cooking proceeds as in a fireless cooker. The heavy heat insulation about the walls of the ovens—two inches of rock wool—causes the ovens to retain their heat for hours.

This fireless cooker feature not only makes the range particularly convenient for the user, but makes an exceptionally desirable load for the central station, inasmuch as the peak of the range load comes an hour and a half to two hours before meal time. The consumption of current averages between 75 and 100 kilowatt hours a month.

Cooking processes that do not require much time and for which the food cannot be prepared in advance, are performed on the stove top. For this purpose a 10-inch and two 8-inch radiant heaters are provided.

Electric Heating

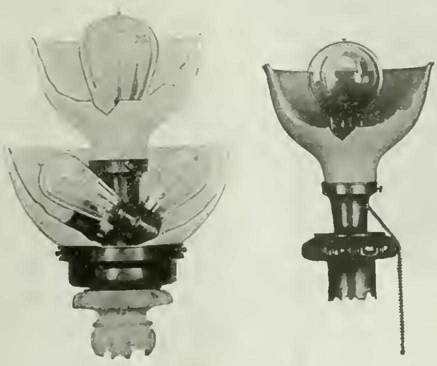
The heating system, illustrated herewith, consists primarily of an ordinary radiator, such as is used for hot water heating, completely filled with an insulating circulating medium, with a heating element inserted through the bottom and top connections of the radiator. This heating element is divided into several sections and connected to a multiple pole switch, which can either be attached direct to the radiator, as indicated in the illustration, or (as is the case with the indirect and direct-indirect systems of heating) the switch can be placed at any convenient point desired, and the radiator placed in a recess or underneath the floor. The manufacturers claim there is no burning out of the heating element. Oxidation has been overcome by eliminating all air from the heating element, and by surrounding the element by an insulating medium. The energy consumption based on a square foot of radiating surface, is 30 to 35 watts on the high heat, 15 watts on the medium heat, and 7½



watts on the low heat. This will give a radiating temperature, under normal conditions of approximately 200 degrees Fahrenheit on the high heat. Three heat connections control each radiator, and automatic thermostats control the entire system by the use of solenoids and remote control switches, permitting the maintenance of a constant given temperature in every room of the building, or the maintenance of constant different temperatures in each room of the building. This equipment is manufactured by the Electric Sales Corporation.

Difusolites

Difusolites are designed to give four gradations of illumination, the light rays being controlled not only as to direction but also as to volume. There is no glare from unshaded clear bulbs. The single Difusolite consists of a single bowl of specially made glass containing a single electric bulb of any required power. This equipment can go on any table or floor lamp; it throws a soft radiance both up



and down, and is operated by a single pull chain. The double Difusolite consists of a double bank of light enclosed in two bowls of specially made glass. It gives a directly diffused down light; a soft upward semi-indirect light, or both forms of light together. It is operated from a switch in the base of the lamp. The double Difusolite Rheo is the same as the double Difusolite except that by means of a special device the light can be turned up or down as can a gas or oil lamp.

Electric Plate Warmer

A new application of electric service in the butler's pantry, kitchen and dining room is illustrated by a plate warmer which has just been placed on the market by the Simplex Electric Heating Company The apparatus is compact and light enough to be useful in the bungalow no less than in larger establishments, and consists essentially of a nickel-plated Russian iron cylindrical drum 12 in. in diameter, 9.5 in. wide and 17 in. high over the handle, with heating coils in the lower portion and equipped with a slide and plate rack holding ten plates. The latter rest on their edges and any one can be removed without disturbing the others. With

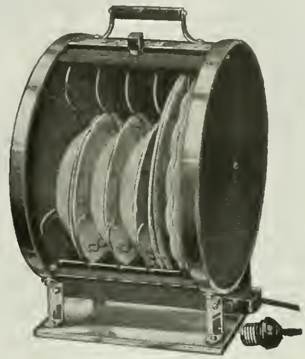
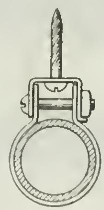


Plate Warmer for the Dining Room.

an expenditure of from 250 watts to 300 watts the drum full of plates can be warmed in ten minutes and it will retain its heat about an hour after the energy supply is cut off, provided the drum is closed. The plate warmer can be connected to any lamp socket, and as it weighs but 10 lbs. it can be utilized on the sideboard or even on the main dining table. The use of this equipment affords a decided contrast with the ordinary method of warming plates, in which the bottom of the pile is usually so hot as to preclude handling, while those at the top are still cold.

Cronk Pipe Clamp

What the makers claim to be the easiest, most practical and most economical way to support pipes is provided by the pipe clamp patented and controlled by the John W. Cronk Co. This clamp consists of two parts, a base and a strap. The base requires but one supporting screw. This insures great saving when fastening to marble, brick, or tile. The same base takes any size of strap, so they may

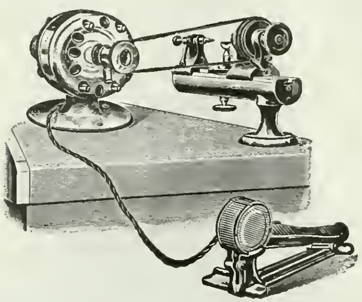


Economical Support for Pipes.

be put in place first, the pipe being put up later. There is no projection beyond the pipe, the strap presenting a smooth surface, making it neat in appearance and not likely to tear clothes. The points are shown clearly in the attached cut. Contractors and wiremen who are on the lookout for contrivances to simplify their work, and to make installation less expensive, are recommended to investigate the merits of this clamp.

Jeweller's Lathe Motor

The fractional horse power motors built by the Hamilton Beach Mfg. Co., have proved so successful that the company have just added another to its long list of applications of electric power. The jeweller's lathe motor shown in the illustration, mounted and ready for use, is a universal motor and the speed regulation is controlled by the small foot-pedal



self starter. A light pressure starts the motor slowly and heavier pressure brings it up to full speed. The position of the carbon brushes can be changed in order to reverse the direction. These motors, sold by the Canadian General Electric Co., are light, convenient, efficient and as nearly trouble proof as it is possible to make them.

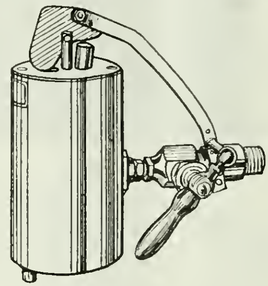
Electric Ranges

The illustrations below show two designs of ranges manufactured by the Hughes Electric Heating Co., known as the type "C." The Hughes "C" range has all the high essential qualities of the Hughes "A" ranges—all the service qualities. The popular price demand is met by a plainer, but equally serviceable, finish—angle iron construction and dull enamel instead of nickeled castings. The type "C" ranges are the C-18, made in low oven type as per the cut; C-2, with

two top burners and a 12 x 12 x 18 oven; C-3, with three top burners and a 12 x 12 x 18 oven; C-4, with three top burners and an 18 x 18 x 12 oven.

Water Heaters

The K. D. Manufacturing and Sales Company are marketing an instantaneous water heater which we illustrate below. This heater is very simple and ingenious in construction consisting of an upper chamber in which is the electric switch, and a lower chamber through which the water passes. A lever controls both water and electric supply, but a switch is also installed so that water may be drawn without heating. Three heaters are made in capacities of 33 amp. 110 volts; 20 amp. 220 volts, and 25 amp. 220 volts. The weight is less than 4 lbs.; the length approximately 5½ in. The manufacturers claim that boiling water is supplied in 10 seconds, and that sufficient water for the ordinary bath

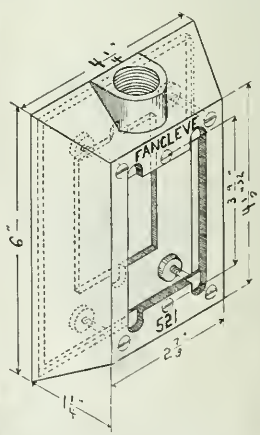


Heating water by electric current.

may be had in from 10 to 20 minutes. They claim never to have met conditions where less than 1 gallon per minute of boiling water could be supplied. The same company also make a 660 watt heater weighing 1 lb. which may be attached to any faucet and current supplied from any illumination socket.

Switch Box Adapter

In the accompanying illustration is shown a fitting developed by the Fancleve Specialty Company, Boston, Mass., and designed for use with a concealed switch box. The back of this adapter, as it is called, may be fastened to the box



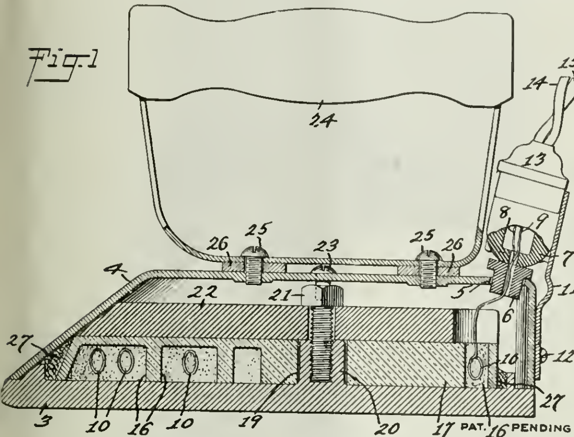
Adapter for use with concealed switch box.

with the same machine screws that are used to fasten the original switch or receptacle. The original switch or receptacle can be remounted on the face of the adapter and the wires taken off to some new location.

A New Electric Iron

There is now being placed on the market by The Flexible Conduit Co., Ltd., of Guelph, an electric iron which is different in all respects from any ever manufactured heretofore. The object of the improvement is to overcome the liability of the heating element short circuiting and burning out, and also to eliminate the connection plug trouble that is so common in the old method of attaching the cord to the appliance. Patents are now pending on this new electric iron. The merits are easily comprehended by the accompanying cuts and the following description:—

The main object of this new invention is to provide an electric iron with an absolutely positive insulation for the



resistance wire heating element; also a connector plug that will not become corroded by the changes in temperature and moisture, thereby losing its primary efficiency, which, finally, results in the contacts failing to have the proper conductivity and in the iron not heating properly .

In the "New Canadian Queen" electric iron the heating element wire is placed in a heat resisting porcelain plate as shown by Fig. 2. The channel is then filled in with a special cement, composed of materials that tend to preserve the element from oxidation; this being accomplished, the element should last indefinitely.

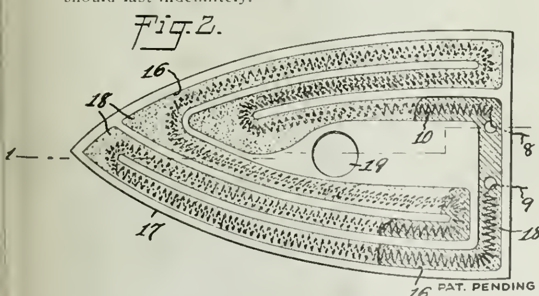


Fig. 1 is a section of the iron, showing clearly the method of assembly. The metal base (3) is highly polished and plated on under surface, having a rabbet at the upper outer edge for the reception of the cover, (4) having a central opening (5) in the rear end for the porcelain bushing, (6) connecting with plug base, (7) containing terminal binding screws and posts for the ends, (8) and (9), of the resistance wire (10), and which ends pass upward through bushing (6). The plug base (7) is held to the cover (4) by means of a plate (11) detachably secured to this cover by screws (12), and the plug base (7) is adapted to receive the plug (13) of the lead wires, (14) and (15), which are attached to lamp socket, or other electric fixture. The resistance wire (10), coiled, is laid in channel (16) of porcelain plate (17) and channel (16) is filled with the cement (18) which protects and preserves the element (10). This cement can be easily dug out in case access is desired to the wire (10). The porcelain plate (17) is provided with a hole (19) for the passage of a

boss (20) cast integral with base (3) and the height of which exceeds the vertical thickness of the porcelain insulator (17). Held on top of boss (20) by a cap screw (21) is weight plate (22) and the cover (4) is held in place by means of a screw (23) threaded into cap screw (21). Note that this method of assembling is very simple and substantial. By having the boss (20) extend above porcelain plate (17), the weight plate (22) does not touch or bind on the porcelain insulator (17), we thereby eliminate the possibility of breaking the insulator (17) by the expansion of metal bodies, (22) and (3), when heated.

The methods of construction and principles involved in the New Canadian Queen Electric Iron are claimed to be entirely new and the series of tests that have been carried on since the first of the year by the manufacturers, show that the principles are correct in every detail.

Renfrew Electric Making Additions to Plant

A further addition to the already large plant is being made by the Renfrew Electric Manufacturing Company, Renfrew, Ont., makers of the Canadian Beauty line of electric heating appliances. This is the second extension within eight months, and will double the capacity of the plant. The first addition provided large stock rooms and facilities for nickel plating; the addition now being made is to provide accommodation for presses and special machinery for drawing the metal parts for all kinds of percolator bodies, grills, tea pots, etc. The building will also provide facilities for the manufacture of electric stoves, holders, etc., on a very large scale. The company are now designing a number of new electric appliances which will very shortly be placed on the market.

The Renfrew company will be represented at the coming Contractors' and Dealers' Convention and Electrical Show, on June 6, 7, and 8, at Toronto, the exhibit being under the personal charge of Mr. C. E. Breckenridge, the general manager.

The 1500 employees of the B. C. Electric Railway are to receive one day off in eight, the change to come into effect on June 15.

New Insulating Varnish

Griffiths Bros. & Co., England, (Spielmann Agencies, Canada), have produced a new insulating, impregnating varnish which has some remarkable properties not possessed, it is claimed, by any other varnish now on the market. An independent test, made before placing this new specialty on the market, by the National Physical Laboratory (the Government Testing Institution) gave the following results:—

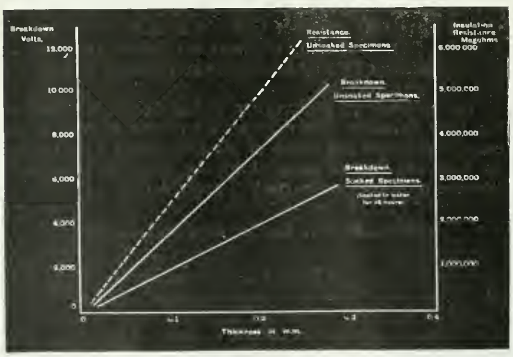
Insulation Resistance—The graph herewith shows that the insulation and resistance lines are practically straight lines, indicating that there are no weak points and that even a very thin coating can be relied upon to give substantial insulation; the liability to break down through bad workmanship being thereby minimized. Attention is specially drawn to the similarity in shape and direction of the curves for the insulation resistance and di-electric strength as, for an ideal insulator, these should run parallel. As the stoving temperature of the varnish is 250 F., soldered articles will not be injured, the melting point of soft solder being 350-400 F.

Tendency to flow at high velocities—Tests were made to determine whether the varnish would tend to be thrown off from a body rotating at a high velocity. A coil of 30 to 40 turns of No. 16 cotton covered wire was wound on a form 15 inches in diameter and capable of rotation. The coil was then dipped in the varnish and stoved to instructions. The tests were carried out in an oven at a temperature of 212 F., and consisted of a five-minute run at various speeds. The following observations were made:—

After five minutes' run at a peripheral speed of 4,700 feet per minute—no change.

After five minutes' run at a peripheral speed of 5,890 feet per minute—no change.

After five minutes' run at a peripheral speed of 6,360 feet per minute—no change.



Insulation resistance and breakdown tests.

After five minutes' run at a peripheral speed of 7,070 feet per minute—no change.

A further run of fifteen minutes' duration at the peripheral speed of 7,070 feet per minute was made, but no evidence of flow could be observed. The surface layers of the coil showed no tendency to open and the varnish remained firm at all points.

Penetrative Power—A series of similar coils were made up of No. 20 S. W. G. double cotton covered wire, the external diameter 7.0 cm., and internal diameter 2 cm. The coil was dipped in the varnish and stoved. It was then unwound and examined. The penetration was good.

Heat Radiation Tests—A similar coil impregnated with the varnish was joined in series with an undipped coil of similar dimensions. The maximum temperature obtained under various leads measured by the extent of the resistance change is as follows:—

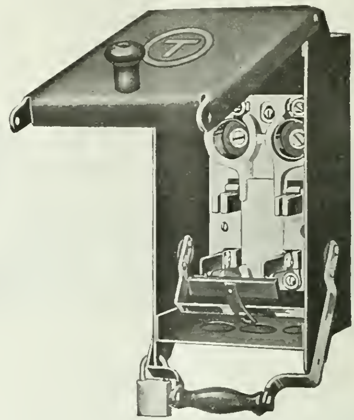
Temperature rise C.

Current	Dipped Coil	Undipped Coil
1 amp.	16.5	17.5
2 amp.	70	77
2.5 amp.	110	123

Flexibility—Strips of copper foil were coated and stoved. The specimens were then doubled back on themselves and submitted generally to severe bending. The copper foil broke before any cracking of the varnish was observable.

Switch in Safety Box

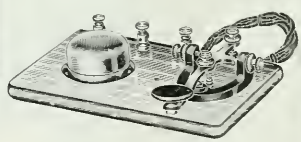
The figure herewith shows the new Trumbull combination switch in safety box. This switch is externally operated. The box cannot be opened without breaking the switch. Note

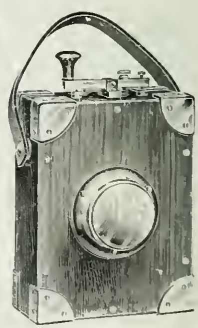


that the throw of the handle which holds the cover closed also connects the switch. A padlock or wire for sealing the box can be placed through the hole in the side of the handle and the locking lug in either or both sides.

Electric Signal Work

Spielmann Agencies are handling a reliable, but inexpensive, practice buzzer outfit, which enables the owner to practice the Morse code as used on the field telephone, buzzer, or



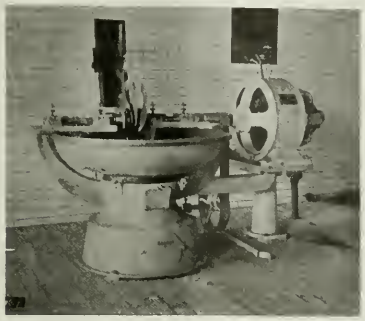


Figs. 1 and 2.—Practice buzzer and electric sign lamp outfits.

the Marconi apparatus. This is shown in Fig. 1. The second illustration shows a type of electric signal lamp that has been supplied to a number of overseas regiments and home battalions.

Crescent Silent Cutter

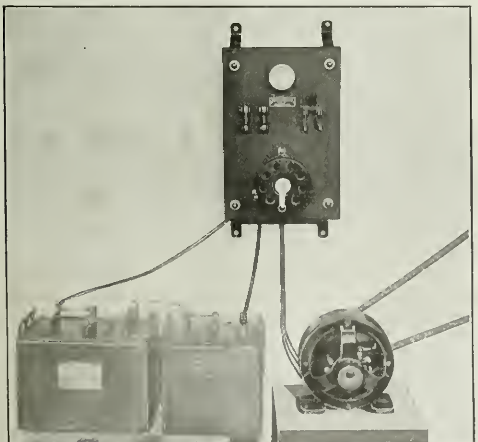
The meat cutter illustrated, the latest improved Crescent Silent Cutter, made by the Brecht Company, St. Louis, Mo., has been developed to meet the demand for a smooth, silent running machine, suitable for cutting sausage meat, mincemeat, pickles, cabbage, fruit, and other products. The illustration shows the No. 1 machine which has 6 knives, a ca-



pacity of 250 lbs., and a bowl 43 inches in diameter. It is operated by a 30 h.p., 230 volt, 1,150 r.p.m., constant speed, commutating pole, direct current Westinghouse motor, direct connected to cutting shaft, which in turn is belted to a countershaft geared to a worm mechanism for turning bowl. In operation the knives and the bowl revolve simultaneously.

Battery Charging Set

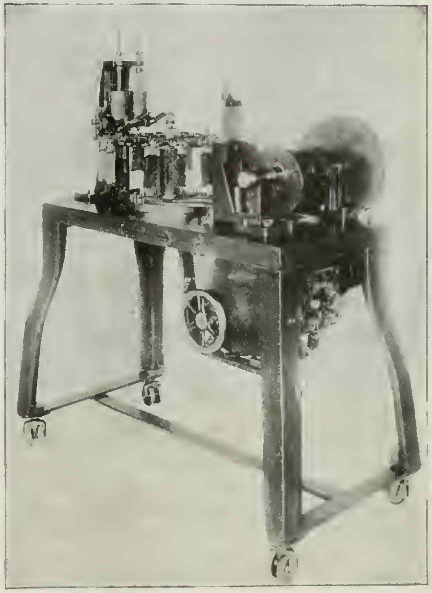
The Main battery charging set, shown herewith, operates from a line shaft or gas engine, and consists of a small generator which generates its own electricity by belt drive, and a small charging board of slate having mounted a double reading ammeter, necessary knife switch and fuses, together with a regulating rheostat to control the charging



rates. It operates independent of city current and is especially adaptable to the small garages where central station current is not available, as well as in the garage where there is a line shaft in operation or a gas engine which it can be belted to and thus be operated at a very low operating cost and makes battery charging a very profitable item in connection with the garage. The set will charge from one to five 6-volt batteries at a time, or two 12-volt and one 18-volt at a time, one 6-volt and two 12-volt at a time, or one 18-volt and one 12-volt at a time, or one 6-volt and one 24-volt at a time. The range of voltages is such as to accommodate all voltages of batteries of any description which do not exceed 30 volts. The generator has a capacity of 300 watts and comes complete with switchboard and proper leads.

Motor Application to Bottling Machine

The Standard Automatic Machine Company of Rochester, N.Y., has developed a machine to fill and cork bottles in one operation. In the machine shown in the illustration, one operator places the bottle in the jaws on the dial of the machine. The dial moves the bottle under a pump which delivers a fixed amount of liquid to the bottle. The bottle is then carried on past another operator who places a cork in its neck and this is driven into places by a mechanism through which the bottle passes. The jaws holding the neck



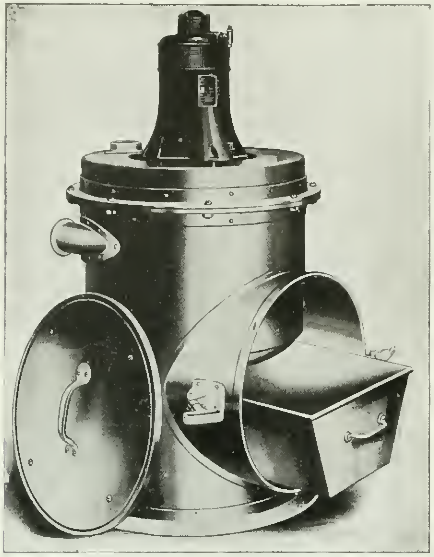
of the bottle are then opened and the bottle drops into a chute or conveyor on which it is carried away. The machine is equipped with a one horse power direct current adjustable speed motor manufactured by the Westinghouse Electric & Mfg. Company of East Pittsburgh, Pa. The motor, which is of the enclosed type designed to operate in damp places, is shown mounted under the table of the machine. The variation in speed is obtained by either automatic or hand control.

The C. & C. Electric and Manufactnring Co., Garwood, N. J., announce that they have designed a new line of motors, which will be furnished in ratings up to 10 h.p. The new machines are bi-polar motors with commutating poles. They are described in bulletin 103 published by this company.

The city council of Vancouver are considering the advisability of substituting 400 c.p. clear glass nitrogen lamps for the 350 c.p. frosted tungsten lamps now in use. City electrician Fletcher estimates that under the new agreement being entered into with the B. C. Electric Railway this will effect a saving of $3.00 per lamp per year, and at the same time provide considerably more light.

Universal Motor in Vacuum Cleaner

To meet the demand for a vacuum cleaner for use in the home, that will suck all dirt, dust, germs and foul air out through a tube to a receiver in the basement, with no machinery or germ laden exhaust air in the rooms, the Spencer Turbine Cleaner Company of Hartford, Conn., has developed the Steel Turbine Central Home Cleaner. The illustration



shows the cleaner equipped with a ½ horsepower Universal vertical motor manufactured by the Westinghouse Electric & Mfg. Company of East Pittsburgh, Pa. The motor will operate successfully, within its capacity and without the use of any external resistance on circuits of 110 volts direct or alternating current of any frequency up to and including sixty cycles.

In Louisville, Ky., there is an ordinance which requires every owner of an electric sign to keep it lighted on both sides from dark to 10 o'clock six nights a week. The city holds that since it gives permits to erect electric signs it is justified in exacting a condition.

New Books

The Electrical Contractor—by Louis W. Moxey, Jr.; McGraw-Hill Book Company, Inc., New York, publishers; price $1.50. This book is the result of Mr. Moxey's accumulated experience of twenty years in the practical operation of an electrical contracting business. The need of a better method in both the commercial and technical phases is evident to anyone who comes in contact with the average electrical contractor's organization and work and the author has written his book hoping that the material contained in it will be of very practical value. The following chapters will indicate the scope of the book: Profit and Overhead Expense; Book-keeping; Cost-keeping; Estimating; Calculating Wire Sizes for D. C. Currents; Calculating Wire Sizes for A. C. Currents; Illumination Calculations; General Data. 80 pages; size 6 x 9; standard green cloth binding of the McGraw-Hill company.

Trade Publications

Indicators and Detectors—Bulletin No. 46022, by the Canadian General Electric Co., describing, with illustrations, electrostatic potential indicators, synchronism indicators, and ground detectors, glower type.

Service—A booklet issued by Pass & Seymour, Solvay, N.Y., entitled "The Gateway of Electric Service," being a brief exposition of the importance of various factors that produce satisfaction in the use of electricity.

Outdoor Lighting—Bulletin No. 43405 by the Canadian General Electric Co., describing with illustrations the lighting of outdoor playgrounds with Edison Mazda C lamps. The illustrations show courts for various games very perfectly illuminated.

Ornamental Street Lighting—An attractive booklet, prepared by Charles L. Eshleman for the Union Metal Manufacturing Company, Canton, Ohio, describing and illustrating the products of this company. R. E. T. Pringle, Limited, are Canadian manufacturers.

Automobile Lamps—Booklet issued by the Canadian General Electric Company describing Mazda automobile lamps for 1916, 1915, and 1914 cars. The feature of this booklet is an assortment of types and sizes recommended as an ideal stock for automobile supply dealers, electric supply dealers, hardware dealers, or garages.

Semi-indirect Lighting—Catalogue No. 108 by the Canadian General Electric Co., describing with illustrations some recent semi-indirect bowl designs for decorative and commercial lighting. Some of the illustrations are in color. The range includes Veluria glass, Druid, and Sudan. The appendix also furnishes a quantity of valuable installation data.

Safety Switches—bulletin 69 by the Canadian Krantz Electric Manufacturing Company, Limited, describing their Safety Auto-Lock switch; well illustrated. The same company are also distributing bulletin 62, describing Safety and Live Faced Panel-Boards, Switchboards and Switches, which is in effect a short review of switch history.

Illuminating and Wiring Devices—Catalogue C. 22 by the Benjamin Electric Mfg. Co. of Canada, describing, with profuse illustrations, illuminating and wiring devices, knife switches, C-H push button devices, Wirt Dim-a-lites, and other dimming devices, Starrett panels, and other specialties. A very complete catalogue of 126 pages.

D. C. Motors—Bulletin by the C. & C. Electric Co., of Garwood, N.J., presenting their well known direct current motor, known as the Old Reliable. The motors are of the four pole, interlope type, built in sizes from 1 to 125 h.p. The bulletin illustrates and describes the details of construction of the parts and contains a complete table of adjustable and constant speed ratings, with full dimensions of all frames.

Railway Line Material—Bulletin No. 44006, "Railway Line Material for Catenary Construction," just issued by the Canadian General Electric Co., illustrates the special devices as employed in the most advanced types of catenary construction. Two of the most notable items are the C V hanger and trolley pull-off, as employed in the electrification of the Chicago, Milwaukee & St. Paul R. R. Valuable tabulations are given of material required for various hanger spacings and deflections for both pantograph and wheel operation.

Oil Filters—Bulletin N. 5, recently issued by the Richardson-Phenix Company, Milwaukee, Wisconsin, describes a complete line of filters for purifying lubricating oil, having capacities of from 25 gallons per day to 50,000 gallons per hour. This is claimed to be the most complete oil filter catalogue ever issued and describes some exceedingly interesting large size filters for use in purifying lubricating oil from water wheel thrust bearings, large gas and steam engines in steel mills, and also for purifying cutting lubricants. Well illustrated.

Current News and Notes

Acton, Ont.

Mr. Blackhall has resigned his position as town electrician.

Berlin, Ont.

The Berlin Light Commission are making considerable extensions to their ornamental street lighting system.

Cameron, Ont.

The Cameron Telephone Company, Limited, have obtained a charter.

Campbellford, Ont.

The electors have carried a by-law authorizing a loan of $30,000 to the Northumberland Paper and Electric Company to rebuild their paper mills recently destroyed by fire. It is understood that the new plant will be much larger than the previous one. Kerry & Chace, Toronto, are consulting engineers.

Edmonton, Alta.

Superintendent Ormsby, of the City Electric Light and Power Department, has completed arrangements with R. C. Megaw, manager of the Western Canada Flour Mills Limited, for the electrifying of the mills at Edmonton South, until recently owned and operated by the Brackman-Ker Milling Company. These mills have been acquired by the Western Canada Flour Mills Limited, and considerable alterations, extensions and improvements will be made at once.

The Canadian Pacific Railway Company have established a new ice crushing plant near the C. P. R. station, Edmonton South. This will be operated by electric power from the city service.

The Western Foundry and Machine Company, Edmonton, Alta., are remodelling their foundry and replacing the original gasoline lighting installation with electric lighting. The municipal plant supplies all power for the complete electric drive.

The revenue of the Edmonton City Electric Light and Power Department, although affected by the general business conditions, continues to give a satisfactory surplus. For the year ending December 31st, 1915, this surplus amounted to approximately $36,000. The first three months of 1916 show a proportional amount. The rate schedule is to receive attention at an early date, when it is possible that certain reductions may be made.

Grantham, Ont.

The Grantham township council has approved a proposition to extend their hydro-electric power lines into Louth township and supply a number of the residents there. The Louth township council is to provide money for transformers, meters and general equipment.

Hamilton, Ont.

At a recent meeting the Hamilton Hydro-Electric Commission decided to make application to the city for power to issue debentures to the amount of $180,000, for general equipment and maintenance expense.

Ingersoll, Ont.

A resolution has been adopted by the Ingersoll town council authorizing the water, light and sewer commission to proceed with the laying of conduits, erection of standards and other work in connection with an ornamental lighting system in certain sections of Thames and King Streets.

Milverton, Ont.

Connections were recently made with the main hydro line at Sebringville, Ont., to supply an electric lighting and power service to the village of Milverton. Street lighting is supplied by eighty-five units each containing one 100 watt lamp.

Moncton, N.B.

The report of the New Brunswick Telephone Company for the year ended March 31, 1916, showed a net revenue of $117,611 and an increase of 912 subscribers. This is the largest year in the history of the company.

Montreal, Que.

The Montreal Tramways Company have let the contract for the new a.c. switchboard for the Hochelaga power station to the Canadian General Electric Company. The board is of the vertical type and is planned for a double busbar lay-out.

Provided that a bond issue of $200,000 can be floated, the city of Verdun, P. Q., will construct a system of underground conduits. The proposal is that all cables should be laid in the conduits, and that the various companies should pay a rental for their use.

Arrangements have been concluded with the various railway companies whereby delegates to the Electrical Contractors' Convention will travel at reduced rates. Delegates will purchase regular single fare tickets to Toronto and at the same time secure standard convention certificates from the ticket agent at time of purchase. These certificates may be exchanged at the Convention rooms for return ticket at reduced rate.

The Montreal Council recently suggested to the Bell Telephone Company that the telephone directory should be printed in English and French. The company have replied that the matter is one of pure business, and that they were willing to meet the city by quoting the special price of $2.50 per line for duplicating their entries.

The Jenckes Machine Company, Limited, Sherbrooke, P. Q., have been awarded a contract for a duplicate turbine unit for the Rock Forest plant of the Corporation of Sherbrooke. When the work of reconstructing the plant is completed, each unit will deliver 1,450 horsepower.

Martel Limitee, electricians, etc., Montreal, Que., have taken out a charter.

The Montreal Council has accepted an offer of the Tramways Company to purchase, for $19,400, the overhead material removed from St. Catherine and Bleury Streets. The material was discarded on account of the conduit system.

Montreal manufacturers and firms dealing in electric motors report a very active demand for their goods. This followed the equipment of the many shops for shells and explosives, and has continued in a more or less degree since that time. Some of the orders have been quite extensive. The supply of stock motors is exhausted, and immediate delivery is not guaranteed. There is also a large demand for second-hand motors.

Niagara Falls, Ont.

The city council have granted the request of the municipal Hydro-electric Commission for the sum of $12,000 to cover the cost of further extensions to the street lighting system.

Orillia, Ont.

A by-law to enter into an agreement with the Hydro-electric Power Commission of Ontario to dispose of Orillia's electric power franchise and equity in the new dam at Swift Rapids on the Severn River was defeated by an adverse majority of 438. An accompanying by-law to purchase electric energy from the Hydro-electric Power Commission was also turned down. The rejection of the Hydro proposals involves the town in further capital expenditure of some $80,000 to install machinery in the new power house at Swift Rapids. The present plant at Ragged Rapids generates 1,700 h.p., but is insufficient for the town's requirements. The new equipment at Swift Rapids will consist of two units of 1,600 h.p. each with provision for additional units to generate up to 6,000 h.p. The Orillia Water, Light and Power Commission have made three rate reductions in the past eighteen months and as the surplus still continues to grow a further reduction is contemplated.

Parkhill, Ont.

The Parkhill Rural Telephone Company, Limited, have been granted a charter.

Preston, Ont.

The Electrical Fittings & Foundry, Limited, Preston, Ont., have secured letters patent and have taken over the business of the Electrical Fittings Company, Limited. They will carry on the business of manufacturing and handling electrical fixtures and supplies of every description.

Prince George, B.C.

It is stated that tenders will be called soon for the equipment required for the Prince George power plant.

Regina, Sask.

The city council recently approved a reduction in light rates to 7 cents for the first 20 kilowatt hours, 6 cents for the next 280 kw., and 5 cents for all in excess.

Rodney, Ont.

A by-law, recently carried, authorized the expenditure of $7,000 on an electric distributing system to link up with the Hydro-electric Power Commission of Ontario.

St. Emelie, Que.

Evangeliste L'Epicier is calling tenders on a 250 kw. capacity turbine and generator.

St. Foie, Que.

The municipal council are considering the expenditure of some $15,000 on an electric lighting system during the present season.

Saskatoon, Sask.

The Coleman Light Company, Limited, have been succeeded by the Western Agencies Company.

Stamford, Ont.

The Stamford council recently adopted a resolution favoring the plan of the Ontario Hydro-electric Commission to purchase the plant of the Ontario Distributing Company and operate same pending the enactment of legislation that will give urban municipalities the right to take over public utilities. The matter will be put before the voters in a few weeks.

Stratford, Ont.

The Stratford Hydro-electric Power Commission have decided to install, at a cost of $35,000, three more transformers with necessary equipment, so that an extra 3,000 h.p. of energy will be available. The Stratford sub-station also supplies Sebringville, Mitchell, Seaforth, Clinton and Goderich.

Toronto, Ont.

The contract has been awarded by the Board of Control for an extension to the municipal car barns on Christie St.

Electric Talking Signs, Limited, Toronto, Ont., have been granted a charter.

The Canadian Niagara Power Company, who export all their power into the United States, are applying to the Ontario Government for permission to go on with the work of extending an ice shield 30 feet further out into the Niagara River at their plant, to protect their machinery during the ice jams. Permission was given to build the first section some time ago. The Ontario Hydro-electric Power Commission will be consulted.

Vancouver, B. C.

The B. C. Copper Company have awarded a contract for an electrical transmission line some twelve miles in length from their cement plant at East Princeton to Copper Mountain. The line will follow the course of the Similkameen River and Wolf Creek.

Weyburn, Sask.

Tenders are received up to June 1 for a 500 kw. steam turbo-generating unit with auxiliary.

Woodford, Ont.

The Blind Line Telephone Company, Limited, have obtained a charter.

Wainwright, Alta.

The town of Wainwright has had under consideration for some time past, the granting of a franchise to T. A. Weekes, of Vegreville. Mr. Weekes proposes installing part of the equipment which was at one time used in Vegreville. Wainwright is a town of approximately 1,000 population, and is the first divisional point on the Grand Trunk Pacific. It has a number of good buildings and electric light will be a great improvement to the town.

Wyoming, Ont.

A by-law, recently carried, authorized the expenditure of $6,500 on an electric distributing system to link up with the Hydro-electric Power Commission of Ontario.

Yorkton, Sask.

Municipal bonds to the amount of $47,000 have been sold by the town of Yorkton, Sask., for the purpose of installing a second 500 h.p. unit in the local power house. The plant will then have a capacity of 1,150 horsepower.

Electrical News
Generation Transmission and Application of Electricity

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Will Not Accept Independent Opinion

After considerable manoeuvring, by reason of local politics, the Montreal Board of Control have, by the casting vote of the Mayor, declined to appoint independent engineers to report on the hydro-electric development in connection with the enlarged aqueduct. The appointment was requested by several prominent Montreal engineers.

The following motion was moved by Controller Villeneuve, seconded by Mr. Controller Ross:—"That Mr. J. G. Sullivan, engineer of the Canadian Pacific Railway Company, and Mr. A. St. Laurent, deputy minister and engineer-in-chief of the Public Works Department of the Dominion of Canada, be invited to act with the Chief Engineer of the city to make a comprehensive study and report with the least possible delay upon the aqueduct project as a whole. Said report to show the estimated amount required to carry out the undertaking in its entirety and also separate estimates for the different branches thereof, and to advise to what extent, if at all, the project may to advantage be modified or changed.

The votes of Controllers Ainey and Cote were against the motion. The opposition of the former was based on the ground that there were suspicions that the lighting companies were behind the objection to the scheme, while Controller Cote declared that the city was threatened with an electric trust, which would make the city pay more for its lighting if there were no civic plant

Prior to the decision, Messrs. G. W. Fuller and J. H. Gregory, consulting engineers, of New York, were asked as to the probable capacities of the proposed plant. Mr. Fuller stated that in the summer season 15,000 h.p. should be developed; in the winter, this would be lessened. The dyke which the city will build at a cost of $100,000, would reduce the frazil ice to a small factor. Taking into consideration the cost of coal, etc., or the cost of power at present prices, as compared with the cost of the plant and its adjuncts, he was of opinion that the project was feasible from an economical point of view. He advised that the city's chief engineer should be given full power to deal with the scheme and to call in expert advice when it was needed.

Electrical Equipment of Hazelton Hospital

The new hospital erected last fall at Hazelton, Prince Rupert district, is well equipped electrically. The plant consists of one 10 kw. Fairbanks-Morse, type "M," three wire, direct current generator, 115-230 volts compound wound, 300 r.p.m., direct connected on sub-base, and driven through flexible coupling by one 15 h.p., type NB Fairbanks-Morse horizontal special electric oil engine, equipped with Sumter built-in magneto. A storage battery of 100 cells, Edison B2, 40 ampere hour, is also installed, which keeps voltage at normal for lighting purposes when battery is charging, thus avoiding damage to lamps from over voltage. This apparatus is controlled by a potential coil in such a way that when the voltage rises a contact is made and a small motor starts, cutting in resistance until voltage falls to normal, when it stops.

The plant is controlled by a two-panel switchboard having ammeter in both generator leads, and a voltmeter which may be plugged into generator or battery leads at will. All instruments are Weston make, Model 24. Circuit switches are provided for lights, X-ray machine, 7½ h.p. 230 volt Fairbanks-Morse compound wound motor for sawing wood, etc., also for a small ½ h.p. motor geared to a little power pump for drainage purposes. This latter may be operated either off one side of the generator or off the storage battery, and is automatically controlled by a sump switch.

A "no voltage" circuit breaker is provided in the battery charging circuit, and the battery charging rheostat is of the compression graphite disc type, having a constant radiating surface at all loads as distinct from the ordinary step-by-step resistance, in which the radiating surface decreases as the load increases. Very fine adjustment is also possible, and once set the rheostat requires no more attention. A double-throw switch is provided to enable lights to be operated either direct from the generator or off the storage battery. The plant has now been in operation for over half a year and everything is most satisfactory.

Electricity on B. C. Farms

Mr. Geoffrey T. Porter, chief electrical engineer of the British Columbia Electric Railway, is enthusiastically promoting the use of electricity by the farmers of the Fraser Valley, which is covered by a network of power lines. Not alone is the farmer's wife being offered relief from many forms of drudgery by the installing of labor-saving electrical devices—the farmer himself is being shown that electricity is applicable to many operations connected with the cultivation of the soil and the care of live stock.

It is most gratifying to be able to record that the leading agriculturists and dairymen of the Valley have justified Mr. Porter's efforts in their behalf by manifesting a keen and growing interest in his work. At their request a meeting of the Fraser Valley Development League, held at New

Westminster on the afternoon of May 26th, was turned into an electrical session, which was attended by many of the prominent farmers of the Valley, whose curiosity had been whetted by the announcement that Mr. Porter would deliver an address illustrated with lantern slides. The treat proved even better than had been anticipated, because at the Edison theatre during the noon hour a number of interesting motion pictures and lantern views of electrical installations in the Valley were shown for the benefit of farmers who could not remain for the afternoon session in the board of trade rooms.

New Telephone Exchange at Nelson

Tenders have been called by the British Columbia Telephone Company for the construction of a new office building at Nelson, on a site almost immediately opposite the company's present exchange on the west side of Stanley Street. The plans call for a one-storey building of brick and stone or Kootenay marble, with concrete foundations, the frontage being 30 feet and depth 90 feet.

The Stanley Street entrance will open into a spacious well-lighted office with ample room for the staff and public. Behind the general office will be located the operators' room, with three large windows facing north so that the light will fall directly on the switchboards. Opening off this room will be a rest room for the operators, suitably equipped. The private offices of the district superintendent and district traffic chief will connect with the general office. The building will be heated by a hot water system, and will have both electric light and gas.

It is believed that with the erection of the new home for the company in Nelson the central energy system, to which the citizens have been looking forward for some time, and which is the system used in all large cities, will be installed.

The city council of Nelson at a recent meeting decided to instal the new 100-candle power tungsten filament, gas-filled, electric light bulbs, in place of the old three carbon lamp clusters long in use. City Electrician Thomas explained that the present three-light clusters burned 180 watts of current per hour and gave but 50 c.p., whereas the new lights would each give 100 c.p. for a consumption of 100 watts per hour. Under the present system it had been found cheaper to keep the lamps burning day and night than to employ men to turn off each cluster separately, but under the new system groups of 40 lights will be under control of a switch operated from the sub-station, whereby a saving of about 3240 watts of electric power per day can be effected.

Civic Investment and Industrial Co.

The amalgamation of the Montreal Light, Heat and Power Company and the Cedars Rapids Manufacturing Power Company is now an accomplished fact, the shareholders of both concerns having passed resolutions to this effect at special meetings held on June 7. In the words of the directors of the Cedars Rapids, this means the organization of one of the most complete electric generating and distributing systems in existence. The merger was carried through by means of the Civic Investment and Industrial Company, a holding company, which will have a capital of $75,000,000, of which $65,300,000 will be issued to provide for the entire capitalization, while the balance of the authorized capital will remain in the treasury for future requirements.

The basis of exchange is, stock of the par value of $300 in the Civic Investment and Industrial Company for stock Company; and stock of the par value of $100 in the Civic of par value of $100 of the Montreal Light, Heat and Power Investment and Industrial Company for stock of the par value of $100 of the Cedars Rapids Manufacturing and Power Company. The agreement also provides that the Civic Investment and Industrial Company shall operate the merging concerns for a period of 98 years, and also guarantee 8 per cent. annual dividends on the stock of the Montreal Light, Heat and Power, and 3 per cent. on the stock of the Cedars Rapids.

It is understood that the name of the new company will be the Montreal Light, Heat and Power Company. The management of the Civic Investment and Industrial Company will consist of the following officers: Sir Herbert S. Holt, president; J. S. Norris, vice-president; C. S. Bagg, secretary-treasurer; G. R. Whatley, assistant secretary-treasurer. The full board of directors will be as follows: J. E. Aldred, New York, N.Y.; Sir H. Montague Allan, C.V.O., George Caverhill, Montreal; Arthur V. Davies, Pittsburgh, Pa.; Sir Rodolphe Forget, M.P., Sir Herbert Holt, G. R. Hosmer, Hon. Robert Mackay, J. S. Norris, Hon. Narcisse Perodeau, Hon. H. B. Rainville, Montreal.

It is pointed out in the circulars issued to the shareholders that the Montreal Light, Heat and Power Company will, by the amalgamation, be assured of ample power to meet its requirements at a low cost, while the Cedars Rapids will obtain a reliable market for its power. It is also anticipated that considerable economy will result from the unification of the two companies.

At the annual meeting of the shareholders of the Montreal Light, Heat and Power Company, also held on June 7, Sir Herbert Holt, the president, referred to the steady growth of the company since 1901, net earnings having increased from $900,000 to $4,000,000 in 15 years. The company during that period had reduced the price of its electric light from 12¾c. to 5c. per kw. hour.

Toronto Electrical Luncheon

There is no apparent abatement of the enthusiasm over the Toronto Electrical Luncheon which still happens every Friday at 12.30 at the Prince George Hotel. At the last two meetings there have been respectively 78 and 72 electrical enthusiasts present and two splendid addresses have been delivered—the first by Mr. Charles E. Davis, chief engineer, G. N. W. Telegraph Company, who spoke on multiplex automatic telegraphy and printing by telegraph. The address last week was by Mr. H. D. Burnett, chief engineer of the lamp department of the C. G. E. Co., who gave a most interesting description of tungsten and tungsten lamps.

A distinctly noticeable feature of these luncheons is the general representation from practically every section of the electrical business. For example, representation up to as high as ten members have been noted from one or other of the more prominent companies, including G. N. W. Telegraph Company; C. P. R. Telegraph Company; Ontario Hydro Commission; Toronto Electric Light Company; Toronto Hydro Commission; Bell Telephone Company, etc. Mr. Dunstan has been a regular attendant from the start. This week's luncheon will be held at the usual time and place. Reserve an hour and come and swell the crowd.

Personal

Mr. Alex. Wilson, distribution engineer of the Montreal Light, Heat and Power Company, has been appointed Lieutenant in the 244th Battalion, now being raised by Lieut. Col. F. M. McRobie.

Mr. James McNamara, superintendent of the local Hydro system at Chatham, Ont., has been appointed to take charge of the construction of the hydro system which is about to be installed at Sarnia, Ont.

Water Powers of Northern B. C.

By T. C. Duncan, Mem. A. I. E. E.

Within the last few years a great deal has been published on the water powers of British Columbia. With the exception of the Prince Rupert Hydro-Electric Company's undertakings, the subject has been treated only in a general way, at least in what is known as Northern British Columbia. The Government of British Columbia has spent considerable sums of money collecting data on the water powers of the southern part of the province and have published a very useful and interesting book on the subject. The investigations, however, have so far been limited to Southern British Columbia. I am not in a position to give information regarding the water powers of the northern district in the complete form that the government has covered the southern part; but I propose mentioning some of the streams which have prospects of development within the near future in connection with the mining industry of this district.

To begin with, at a point about 120 miles south of Prince Rupert on Princess Royal Island the Belmont-Tonapah Mining Company are now building a dam and have the plant on order for developing 1,000 kv.a. of electric power for use in the development of their mining property 7½ miles distant. The plant is to consist of two 900 h.p. low head turbines and two 500 kv.a. generators.

Travelling north along the coast in what is called the Inside Passage numerous inlets extend far back into the coast range of mountains, and all of these inlets have streams flowing into them which are suitable for hydro-electric development of a more or less extent. While this country is not yet opened up it is in the line of the coast mineral belt and undoubtedly will be developed as more money comes into the district.

On the Skeena River

When we reach the Skeena River we find two large water powers, on the Oestall and Khatada rivers, which have been held by the Prince Rupert Hydro-Electric Company and undoubtedly have been well exploited. Unfortunately, the war put a temporary damper on the development of these powers, because they were depending on Prince Rupert's development for their market. The city of Prince Rupert is now operating a plant of 1125 kv.a., situated on a small stream 5½ miles from the city. This, however, is only a start in the hydro-electric development of the city. They have a power on Thume River in the North Arm of Work Canal, which is large enough to produce power up to 30,000 h.p., and which can be developed at a very low cost. The machinery can be landed on the power house site from the slings of coastal boats and the pipe line will only be about 1,000 feet long. Within two and a half miles from this power and flowing into the opposite side of the Arm is another power of even greater size, but more expensive to develop. The mineral belt is less than 20 miles from these powers and although there are plenty of small powers close to the mineral belt these larger powers may be developed to supply the surrounding country.

Syndicate Holds Nass River

A little to the north of this inlet the Nass River empties into the Pacific and on this river a Winnipeg syndicate holds the water rights of one of the biggest water powers in the country. Two views of this power are shown herewith. This power is in close proximity to the coal district known as the Groundhog Country, and through which the proposed new road to Alaska is destined to pass, and also the road now under construction from the Peace River through the Omineca country to the coast. This Nass River power is of such capacity that when the time comes for electrifying the railroads of this northern country the power is there and well located for distribution.

Leaving the Nass River country and coming back to the coast into the Portland Canal district we enter a rich section of the mineral belt and a possible field of hydro-electric development on a smaller scale. The Granby Mining and Smelting Company are now operating a hydro-electric plant, which, of course, is well known to the outside world. A new camp has been started at the head of Alice Arm, an inlet about 15 miles from Anyox, the Granby headquarters. There are three properties working in this district now. One of them is building 18 miles of road from the salt water to their mine at the present time, and building a road in this country is no light undertaking. Within a radius of four miles from the head of this arm there are four small high head water powers and one fairly large one. The large one has been taken up by the owners of a group of mineral claims which take in the power house site. These claims will not require all the available power for their own working and they are negotiating with Southern capital in connection with a transfer of their rights. In conversation with one of the principals of the Southern company recently I was told that their intention was to develop power enough to supply the town and other mines in the inlet as well as their own property which is being opened up.

A Prime Factor in Development

While quite a number of powers have been mentioned, I have picked out only a few which have prospects of being utilized within the near future. This northern country is undoubtedly on the eve of a substantial development, and in that development the water powers will be a prime factor. At present many of the schemes seem visionary, but one by one they will come to pass and the country will reap the full benefit of its great heritage.

Nass River, Northern B. C. First Falls.

Nass River, Northern B. C. Second Falls.

Vancouver's New Street Lighting

For several months the power and light committee of Vancouver city council have been conferring with City Electrician Fletcher relative to the adoption of a better system of street lighting, the old contract entered into with the British Columbia Electric Railway Company being due to expire on June 4th. Since it was signed some years ago better and more economical lights have been adopted by many up-to-date cities and towns, and it may be said the citizens of Vancouver have awaited with some impatience the time when it would become possible for their representatives to make a move in the same direction. Their hopes are now about to be realized, and there is every reason to hope that as a result of the decision arrived at, Vancouver will no longer have to rest under the stigma of being one of the most badly lighted cities on the American continent.

On May 21st the city council approved a new three-year contract with the B. C. E. R. under the terms of which the present inefficient carbon arcs used for street illumination will be replaced with brilliant arc lamps of the nitrogen gas-filled type, as recommended by City Electrician Fletcher and members of the lighting committee after convincing tests of the superiority of the new style lamps, several of which had been installed on Hastings street viaduct and elsewhere, for some months. Three sizes of these new nitrogen lamps are specified in the new lighting contract—600, 400 and 250 candle-power respectively. The arrangement provides for the use of the 600 candle-power type on car line streets, the 400 candle-power size on other residential streets, and the 250 candle-power in the ornamental lighting standards and such other places in civic buildings as are deemed best. The saving by the new nitrogen system is estimated by the city electrician to amount to about $6,000 per year.

What the New Contract Offers

The new lighting agreement went into force June 4, and expires, unless renewed in the interim, on February 11, 1919, in which year the company's street railway franchise also expires. It will take considerably over 2,000 arc lamps to light the city's streets, to say nothing of the number required for the ornamental standards and the lighting systems of the three big bridges.

For these new lights, which give a much whiter and brighter light than the ordinary carbon arc lamp, the city will pay at the rate of $38 per lamp per year for the 600 candle-power size, $35 per year for the 400 candle-power size, and $33 per year for the 250 candle-power lamp. In the case of the ornamental lighting systems already installed by the city, the B. C. E. R. will deliver electric current at the rate of two cents per kilowatt hour as measured by the company's meters. The city is to maintain everything necessary in connection with these ornamental standards, but the agreement provides that the city may cut down the number of standards kept lighted between midnight and dawn by one-half. The usual penalties amounting to 25 cents per lamp per night are provided for any lamps that are defective or are out more than two hours during any one night.

Underground installation is also provided for in the new contract. Upon notification by the city, the B. C. E. R. must, within two years from the date of such notice, place all its wires underground in such underground area specified and suspend lamps from neat iron poles which will meet with the approval of the board of works. But this clause shall only be taken advantage of if the city compels all other wires to be placed underground in the same area.

New Equipment Will be Costly

The change from arc to tungsten will involve a large expenditure of money on the part of the B. C. Electric Railway Company, as much of the equipment now in use will have to be scrapped, it having been superseded by the more modern type of apparatus. As mentioned, there are approximately 2,000 arc lamps in the city, and about 300 will be replaced by 600 candle-power nitrogen lamps and the rest with 400 candle-power lamps. The actual work of changing will cost the company approximately $5,000, and there will in addition be the cost in throwing away the old equipment. Much of the mechanism and "insides" of the present arc lamp must be removed to make way for the socket for the nitrogen lamp and practically all of the material taken out will be useless. This will represent between $40,000 and $50,000. The arc lamps were installed ten years ago and were then the most modern type of illuminating agent, but there have been such advances in electric lighting since, that they are now out of date.

In addition to the cost of the change and the value of the scrapped material, there is the initial cost of the globe itself which amounts in the case of the 600 candle-power lamp to $6.50, and in the case of the 400 candle-power lamp to $4.15 each. For the 2,000 lamps, therefore, an initial expenditure of more than $9,000 is necessary, but other lamps must constantly be required for renewals, as the nitrogen lamp is fragile.

The same rate for the 600 candle-power lamp will apply as applied in the case of the arc lamps, that is, $38 a year, while the rate for the 400 candle-power lamp will be $35 a year. This rate is believed to be the lowest on the continent, for in the tabulation of rates in cities where the current is distributed by a private company, there is none lower.

What Other Cities Pay

Some of the rates in well-known Canadian and United States cities follow: Portland, $51.60; San Francisco, $67.525; Los Angeles, $75.60; Oakland, $64.80; Sacramento $66; San Diego, $60; San Jose, $51; St. Boniface (Man.), $58.40; Assiniboia (Man.), $73; Halifax, $62.50; Montreal, $72.70; Quebec, $46.51; Birmingham, $54; Boston, $87.53; Minneapolis, $60; St. Paul, $57.50.

In every case the type of lamp is not the same as that which will be used in Vancouver, but the consumption of current for the amount quoted is similar. In some cities a different rate is quoted for lamps fed by underground circuits but the figures are for lamps fed by overhead wires.

City Electrician Fletcher expects to have a large percentage of the new street lamps installed within the next two months, but as the change over will be gradual it is unlikely that the entire system can be covered before September 1st, when the dark nights of the fall season will make the greater brilliancy of the new lamps most welcome to citizens.

Activity in Eastern Canada

Mr. R. S. Kelsch, consulting engineer, Montreal, is preparing plans, estimates and specifications for the following work: new power plant for Belding, Paul Corticelli, Limited, Montreal; new hydraulic power plant for the Ogilvie Flour Mills Company, Limited, Montreal; new dam and power plant for the Crabtree Paper Company, Crabtree Mills, P.Q.; new sub-station and steam plant for the Pembroke Electric Lighting Company, Pembroke, Ont.; extension to the power house of the Galetta Electric Power and Milling Company, Arnprior, Ont.; extension of power plant for the Howard Smith Paper Company, Beauharnois, P.Q.; and dam and hydro-electric power plant for the Dominion Textile Company, Magog, P. Q.

"Don't worry when you stumble—remember a worm is about the only thing that can't fall down."

Influence of Ice on Hydro Developments

Some Interesting Phases of Ice Trouble Prevention Discussed Before the Recent Chicago Convention of the N.E.L.A.

By Mr. R. M. Wilson*

Hydro-electric developments in northern latitudes are subject to conditions during the winter season which are likely to have a considerable bearing on the output of the plants.

The formation of ice in one of its several forms may cause a decrease in the cross-section of the power canals or penstocks used for supplying the wheels with water, or cause high tail water, resulting in a diminution in effective head if not taken care of when the plant is designed.

The ice formation causing the trouble may be one or a combination of sheet ice, frazil ice, or anchor ice.

Sheet Ice

Water loses its fluidity and becomes filled with multitudes of needle-like crystals when sufficiently cooled, which increase and interlace until the whole mass becomes solidified. The formation of sheet ice begins at the shores, and upon shoals, boulders, or other obstructions, and is usually known as "bordage ice." This ice pushes outward and thickens as the weather becomes colder, and unless broken by wind, or prevented from forming by the velocity of the water, gradually covers the whole surface of the river or the power canals.

Frazil Ice (Cinder Ice)

Frazil is a French-Canadian term, from the French for forge-cinders, which it is supposed to resemble. It forms in large quantities upon the surface of open water under a moderate degree of cold. It is of various degrees of fineness, depending on the degree of agitation of the surface at time of formation. With a temperature of 20 deg. Fahr. or even higher, and with sufficient wind of high velocity to create surface agitation, large quantities of this troublesome ice will be formed.

When frazil ice and anchor ice are found floating in open water, they have a dull leaden hue like saturated snow and float in patches of varying area and thickness, in the interior of which may be found unfrozen water in tiny lakelets, or thin sheets or scales of transparent ice; while in some may be found ice of shore origin, which has been collected by the open water formation in its transit down the streams.

The first trouble usually experienced with ice at the plants is during the period before the surface ice forms permanently on the forebays. The temperature of the water gradually lowers until it reaches 32 deg. Fahr., the temperature of the air drops to between 16 and 25 deg. Fahr., and a high wind causing considerable agitation of the surface water in the forebay, result in the formation of frazil. When the frazil is freshly made it adheres to all metal surfaces with which it comes in contact, such as racks, wheel guides, wheels and gates, unless these have been previously heated. The metal parts will remain coated until the temperature of the water surrounding the ice covered parts or the metal parts themselves has been raised a fraction of a degree, either by artificial means or by the influence of the sun's rays.

The effect of this ice-coating of the racks and wheel parts with a spongy mass is to prevent practically all water from getting to the wheels. Once the surface ice has formed this difficulty is overcome, as frazil or anchor ice which flows down under the surface ice has not the same affinity for metal parts unless these are exposed to the action of air currents.

*Montreal Light, Heat & Power Co.

Trouble often occurs by the upper portions of racks being in contact with the cold air. This can be overcome by removing the racks during the winter, but it is a dangerous practice, as damage to the wheel installation may result from timber, roots of trees, etc., being brought down by the anchor ice. Another cause of trouble after the surface ice has formed is the clogging up of the wheels by frazil or anchor ice brought down under the surface ice. This ice adheres to the wheel parts owing to these being chilled to the proper temperature by air-currents coming in contact with the metal draft tubes. This difficulty is easily overcome by shields to prevent the air from coming into contact with and circulating around the tubes.

Shoals, boulders, or other obstructions in rivers or channels above the plant are the cause of considerable variation in output during the winter season. On these obstructions ice is formed, damming or backing up the water and causing some variation in flow. This trouble, however, can be reduced to a minimum by the removal of the principal obstructions.

Another source of loss in output is the reduction of the effective head by the backing up of the tail water, due to ice blocking the discharge. This can usually be overcome by having a tail race of proper design and free from all obstructions.

Once the surface ice has formed on the forebay the trouble from frazil will disappear, but with the appearance of surface ice other difficulties may occur if the canal or forebay is not of sufficient cross section to allow the formation of ice from eighteen inches to three feet in thickness, the bottom of which may be very rough due to bordage ice in the forebay at the time of freezing up.

Where developments have been made by damming the whole of a river, and at a point some distance above the plant there exists a series of rapids, difficulty will be had with the flow of water, owing to the decrease of area under the surface ice below the rapids from the formation of frazil, and anchor ice in the rapids which attaches itself to the surface ice. Where possible dams should be installed to drown out the rapids, and the impounded water drawn from the bottom of the dams by means of sluices or other such openings.

Cutting Channels in the Ice

If it is not feasible to construct protecting works, it may be possible to overcome the difficulty by means of channels cut in the surface of the ice of a width sufficient to allow the frazil and anchor ice carried down under the surface ice to rise and discharge through special openings provided in the dam, or through openings in the power house. It is better where possible not to use the openings in the power house, as all of the floating ice may not come to the surface in the open channel; some will get under the surface and find its way to the wheels on each side of the opening and may cause trouble.

Plants, the design of which is such that only a portion of the river is dammed for power purposes, are liable to considerable variation, due to the floating ice in the main portion of the river which remains open during the whole winter. The floating ice is greatly influenced by wind conditions. With the wind in the right direction the floating ice in the main channel is held against the outside edge of the surface ice formed on the power canal or forebay, at the entrance. The floating ice is drawn under the surface ice and there arrested by friction and cemented by frost to its under surface. The ice which becomes attached to the under surface gradually builds down until in places it may reach to the canal bottom, depending on the velocity of the water at the entrance, which may vary considerably due to the variation in the depth. The power canal or forebay may become blocked to such an extent that the pipe formed by the surface ice, bed of the canal and the banks, will pass only a small quantity of water.

In order to overcome this trouble the velocity of the water entering the power canal should be very low, the cross section at the entrance and for a distance away from same should be uniform, and the surface of the river bed should be free from all obstructions. Provision should also be made to have sluices cut in the main dam at proper locations to permit of channels being cut from them in the surface ice at angles of from 45 to 55 degrees. It is not advisable to have these channels too wide; a width of from 24 to 30 feet will be found sufficient to allow the frazil and anchor ice floating under the surface ice to rise and be discharged out into the main body of the river.

Under certain conditions it will be found very useful to keep a tug at work in the channels where these are of fair length, to assist in discharging the floating ice and keeping the channel open in extremely cold weather.

Dams with submerged openings may be found very useful in the development of low heads using considerable water. It is also advisable to have the power canal deep and wide, as it will then take care of a certain amount of ice floating under the surface without interfering with the operation of the plant. This also assists the formation of surface ice at the beginning of the winter season by having a low velocity in the power canal. The power canal may be protected from entering ice by dams properly located in the main river channel above the plant, thus throwing the major portion of the ice out into the main channel of the river.

In plants of medium to high head where penstocks are used, care should be taken to see that the penstocks are protected from the action of the cold air by having a housing over the pipe lines at a distance of about 2 to 2½ feet. This will prevent the formation of ice in the penstocks.

These have all the principal operating wheel-gate mechanism above water and in a warm location, together with their consequent large openings in the runners and speed rings. The trash racks also are placed inside the power house or gate house. A curtain wall reaching down into the forebay closes off all cold air from the racks and the racks are designed to permit of easy removal in sections by means of a power-operated crane. No trouble in operation can be experienced which may not be immediately and quickly handled, since the advent of large single-runner units for low and medium head developments capable of driving large generators.

In plants that are liable to be affected by ice, it is very essential to keep accurate records of the formation of the surface ice and the condition of anchor ice and frazil underneath, as it is from knowledge thus obtained that the proper measures may be taken to successfully overcome the difficulties which arise.

Electric and Water Operations in Stettler

The Power and Waterworks Plants of a Typical Western Town—Winning the Battle Against Heavy Costs

By Mr. H. Baron*

The town of Stettler is situated at the crossing of the C. P. Ry., Lacombe to Coronation branch, and the C. N. Ry., Vegreville to Calgary line, in the midst of what is perhaps the best mixed farming country in Alberta.

It is a typical prairie town of some 1,700 inhabitants, springing up about eight years ago. In September, 1911, the town started its own waterworks, having built a small pumping station within a short distance of the crossing of the C. P. and C. N. Rys.

This pumping station consisted of a deep well dug 4 ft. in diameter, and bricked in to 68 ft. deep, and then drilled with a 10 in. hole for 190 ft. further. At 68 ft. so much quick sand was found that a cement bottom had to be put into the well, and the 10 inch bore hole taken through it.

This was cased until rock was encountered when the casing was discontinued. Water is pumped from this well continuously into a reservoir of 50,000 gals. capacity, placed outside the power house, 32 ft. in diameter, and dug down 10 ft. into the earth. It is lined with concrete and has a wood roof.

From this reservoir the water is pumped by a duplex pump into the town mains and water tower. A horizontal return tubular boiler supplies the steam.

This boiler and pumping plant was supplied by the J. MacDougall Co., of Montreal. The boiler is 16 ft. x 72 in., working at 125 lbs. per sq. in., and rated according to Alberta Boiler rules at 100 h.p. The duplex pump is of Worthington make, compound, and with cylinders 10 in. x 16 in. and 10½ in. x 10 in. This pump is designed to pump water from the reservoir into the water tower at 50 lbs. pressure for domestic supply, or in case of fire, when a higher pressure is required, the valve leading to the water tower is closed and the pump then delivers the water to the mains at 110 lbs. pressure.

In ordinary pumping the steam from the h. p. cylinders goes into the low pressure cylinders, but when required for higher pressures steam is admitted direct to the l. p. cylinders through a by pass.

The deep well pump has a cylinder 12 in. in diameter, water cylinder 8 in. diameter, and 18 in. stroke. This pump is of Blake & Knowles make and has never been repaired or adjusted in any way since it was installed. For the last 12 months it has only stopped for a few hours each fortnight while the feed water heater was cleaned.

The well when first operated gave considerably more water than it does now, as the following comparison will show:—

Since 1911, water delivered per hour, 1,333 gallons.

Since 1915, water delivered per hour, 640 gallons.

Also it will be noticed that the water consumption has increased very considerably:—

1911.		1915.	
Sept.	175,917 gallons	Sept.	296,787 gallons
Oct.	93,269 gallons	Oct.	321,831 galolns
Nov	197,193 gallons	Nov.	398,931 gallons
Dec.	137,708 gallons	Dec.	381,100 gallons

This will be even greater this year, as up to last fall the mains were only in the main streets, and except for a few business places were kept for fire purposes only. About September, last year, the mains were extended into the residential parts of the town and the water laid into the houses; therefore, this year will see a large increase even on last year's consumption. Realizing this, the town is about to put

*Superintendent Electric Power and Waterworks.

down another well, tenders having been invited for the work.

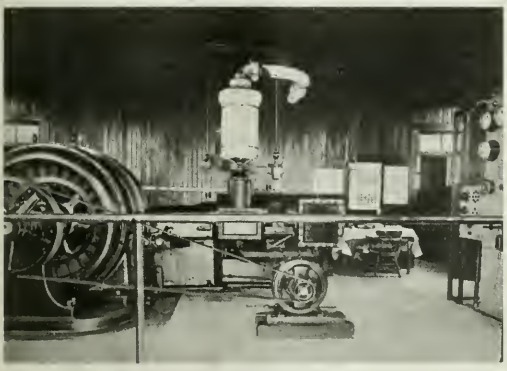
The electric light plant was added shortly after the pumping plant was installed and a new boiler of similar size and type, but of Waterous make, was added.

The generator is a 3 phase, 2,200 volts, 60 cycle 125 kv.a., direct driven, made by the Swedish General Electric Co., excited by a small 110 volt, 45 amp. machine, belt driven off the main shaft. The engine is a Robb tandem compound, horizontal, running at 260 r.p.m., and of 200 h.p.

So far the loads have not been heavy enough to warrant the l. p. cylinder, and the engine has always run as a simple h. p. engine. Two generators of 100 h.p. would have been much more economical and provided against breakdown, and by having vertical engines could have been put into the same space. Last winter's heaviest loads just reached over the 100 h.p. limit, so that next winter it may be necessary to couple in the l. p. end.

Except for a breakdown at the very first, this plant has run uninterruptedly for 4 years. Previous to last Oct. 15th, the service was only supplied from dusk to daylight, thereby depriving those people who could use an electric day service of its advantages. On the above date, however, the day service was commenced and the motor load in 6 months' time was over one-third of the lighting load.

Besides this, electric stoves and irons are coming more and more into use, and the various stores where oil lamps



Interior electric power plant, Stettler, Alta.

had to be used during the day in basements, are now using electricity to their own and the town's advantage.

The way this day service is run with only one generator is to shut down on Sunday from daylight to dusk for cleaning and repairs, and from 12 to 12.30 at noon each day for examination and oiling.

The switchboard is of marble, contains the usual instruments and their transformers, and was supplied by the Swedish G. E. Co. A small lighting panel has been added for the street lights. This controls the Westinghouse transformer, the secondary of which has several tappings giving different voltages. The street lights are run in series, 40 incandescent lamps of about 200 watts being in service.

There is no condenser connected with the engine, all the steam blows into the air except what is used in heating the feed water. As there is a steam laundry near, arrangements may be made later on for them to buy the exhaust steam.

The feed water heater is of 200 h.p. capacity, made by Blake & Knowles, and of the open type. Water then flows by gravity to the two boiler feed pumps. Beside the feed pumps, 2 injectors are installed to take water from the town's mains if necessary, and water can be taken direct from the reservoir should the town's supply be cut off.

The town tank is 22 ft. high by 19 ft. diameter, and holds 50,000 gals., so that when both tank and reservoir are full, there is a reserve of 100,000 gallons of water. The tank is mounted on 4 girders and has a balcony around the bottom. This balcony is 100 ft. from the ground.

A float working an indicator shows the approximate depth of water in the tank, and at night a set of lights placed at various distances, and which are hidden or exposed according to the position of the indicator, enable the engineer at the power house to gauge the amount of water in the tank. A red light is placed so that it goes out when the water reaches 6 inches below the overflow, and the white light placed at the 17 ft. 6 in. level, indicates the safe capacity for winter.

The electric overhead equipment and distributing system consists of primary wires, No. 8 B. & S., carried on ordinary cross arms and insulators mounted on 35 ft. poles, set 5 ft. in the ground and spaced 100 ft. to 150 ft. apart.

The lines are carried down the lanes behind the main streets, and transformers of suitable capacities installed. The primary wires are carried on the top cross arms and the secondaries of No. 6 gauge on the lower. The lightning arresters are at the power house, there being none installed along the lines.

The street lamps are mounted on the poles 20 ft. above the roadways, and consist of simple gooseneck brackets 4 ft. long, with a lamp holder that contains a shunting device that keeps the other lamps alight in case any burn out.

The figures given in the issue of 1st May, 1916, Electrical News, by Mr. A. J. Cantin, relating to the electric light department, were those got from the auditor's report at the end of the financial year. As there had been no records kept of the output of electricity, the only course open was to take the output for 8 months (the time records had been kept) and estimate a year's output from that.

Further, it was extremely difficult, if not impossible, to arrive at an accurate idea of the cost of generating electricity, seeing that it is impossible to check off the steam used by the well and duplex pumps, without the use of a steam flow meter—an expense the town would hardly sanction. Further no ammeter or voltmeter is provided on the street light circuit, so we have no check on the power consumed in this direction and have to go by the wattage of the lamps.

The town pays the Electric Light Dept. $4.00 per month per lamp for street lighting and the Waterworks Dept. pays the Electric Light Dept. $100 per month for pumping. Previous to December, 1915, the Electric Light Dept. had never charged for the water it consumed, but since the present engineer took charge and began checking off the water used, the Waterworks Dept. have begun to charge them with $65.00 per month. To make a present of what is practically $780 per year besides paying $1,200 per year for work done, made the waterworks account look poor in comparison with the electric light accounts.

No Records Had Been Kept.

As no records had been kept of the operation of the plant previous to the present engineer coming last spring, it is impossible to gauge how the output is increasing compared with other years. In fact, until last spring the main electric meter had never been made to work and therefore any figures, if such were needed, were all conjecture, and the kw. hours arrived at by dividing the total yearly revenue by 18c, the price per kw. hr. Obviously, this would be very haphazard, as there are a great many consumers who are on the flat rate of $1.50 per month, and others, who, through using large quantities of current, get theirs at a lower rate.

The Electric Light Dept., however, is making a profit, as last year a new 80 ft. x 4 ft. stack was put up to replace the two original stacks, which had become rusted away, and smoke boxes were put in to connect the boilers to the stack. Shaker grates were put in the furnaces, the coal bin was enlarged to half 120 tons, or twice its original capacity, and other minor repairs to the total sum of $1,500, undertaken. Yet the surplus was over $3,000.

Various economies have been made, but it is difficult to figure what saving has been effected on the coal, as it comes in carload lots at irregular intervals, and unless the engineers make a special test, there is no way of checking the amount burnt per day.

The oil and waste bill, however, was reduced from $350 to $160 in 8 months, and is still being reduced. The decrease in coal consumption was also noticeable, but this will always remain high until a condenser is installed.

The town grant free electricity for verandah lights, limiting users to one 25-watt lamp. The rates for current are as follows:—

Power Rates—Up to 100 kw.h. per month, 9c., less 5 per cent.; 100 to 200 kw.h. per month, 8c., less 5 per cent.; 200 to 300 kw.h. per month, 7c., less 5 per cent.; 400 kw.h. per month, 6c., less 5 per cent.; 500 kw.h. per month, 5c., less 5 per cent.; 1,000 kw.h. per month, 5c., less 20 per cent.

Lighting Rates—Up to 40 kw.h. per month, 18c., less 10 per cent.; 40 to 250 kw.h. per month, 15c., less 10 per cent.; 250 to 500 kw.h. per month, 14c., less 10 per cent.; 500 to 1,000 kw.h. per month, 13c., less 10 per cent.; 1,000 kw.h. per month, 12c., less 10 per cent.

The water for boiler purposes seems remarkably good, leaving them in good shape with very little mud and no scale, and as yet no signs of pitting. A recent analysis has been made of this water and a copy is appended, as well as that of an analysis taken soon after the well was bored.

1911 Analysis—(Expressed in parts per million)

Total dissolved solids	1,257
Hardness	80
Alkalinity	124
Free Ammonia	392
Albuminoid Ammonia	156
Chlorine, as Chlorides	11

1915 Analysis—(Expressed in parts per million)

Total Solids	1,060
Loss on Ignition	85
Alkalinity	600
Hardness	197.3
Sulphates	192
Chlorine	6
Nitrates	Absent
Free Ammonia	.042
Albuminoid Ammonia	.026

The feed-water heater gets made up after a fortnight's run, with a kind of sandy deposit which has to be scraped off the plates, etc., and until the idea of blackleading the plates was tried, this deposit would fasten on to them like cement and give a lot of trouble.

The coal costs, laid down at the plant, $2.85 per ton of 2,000 lbs., made up as follows: price at mine, $1.50; C.N.R. freight for 70 miles, $1.00; hauling from track to power house, 35c. The town has its own team and does the hauling. The track that would join the C. P. and C. N. Rys. has never yet been laid, so there is no spur whereby cars can be switched and unloaded direct at the plant.

The buildings are of wood throughout, faced with metal shingles and so designed that considerable expense will be incurred should extensions ever be necessary. The roof is flat and extremely low, so low, in fact, that the men have to bend almost double when working on the boilers, and up to last year no ventilation was provided in the roof. The firing floor is too narrow for easy working at the fires and the impression given is that of boxing the plant in as if land was so high priced that a $10 bill would only buy as much as it covered when standing on edge.

From remarks made in this article, and others in Mr. Cantin's article of 1st May, it will be readily surmised that in previous years the plant has been run in a "blind" sort of way. No records except a few scanty ones at the start, have ever been kept of the water supplied and none of electricity generated, so that it is impossible to tell how the load is increasing or whether any further economies could be effected in the running of the plant, or its maintenance. To remedy this the present engineer designed a log sheet, on which is given a complete record of each day's run and oil and stores consumer, with other information.

Metagami Pulp Company

The Metagami Pulp Company, Limited, organized in February, 1916, for the purpose of manufacturing pulp for high grade writing paper, have practically completed the erection and the equipment of their plant on the Metagami River near Cochrane. Mr. McDermott, the company's engineer, was formerly engineer in charge of the Montreal Light, Heat & Power Company—up to 1914. From 1914 until his appointment as engineer for the Metagami Pulp Company, he was engaged with the Bathurst Lumber Company.

The plant of the Metagami Lumber Company is located near the National Transcontinental Railway about 31 miles west of Cochrane. It is 3½ miles from the main line and the company have built a spur line to connect it with the main line. The plant will be a bleached sulphite process, and is designed for a present annual capacity of about 255,000 tons, with provision for future extension. Power for the operation of the plant is generated at Smooth Rock Falls on the Metagami River, a short distance above the plant. A power house with a 12,000 h.p. development has been built with provision for a future development of an additional 10,000 h.p., a short distance further up the river. The timber limits of the company consist of 846 square miles of government concession land, on the Metagami River and 125 square miles of freehold land. These limits are practically all spruce. A small town will be built by the company for the accommodation of employees, who will number about one thousand men, including the woods employees.

The power development scheme at Smooth Rock Falls consists of the usual dam, penstocks, power house, etc. The available head at the dam, which is a reinforced concrete pier dam, with stop locks, is 45 feet. The power house machinery consists of three I. P. Morris vertical turbines, each with a capacity of 4,500 h.p., equipped with Pelton governors; three C. G. E. vertical generators, 3125 kv.a., 2,300 volt, 3 phase, 60 cycle, direct connected exciters and one spare motor-generator set, large enough for the excitation of one machine. The switch board equipment has not yet been installed. The different units in the power house are independently operated from the forebay to the busbars. Current is stepped down from 2300 to 550 volts by single phase transformers in the power house.

All the different units in the pulp mill will be driven by separate motors operating at 550 volts, with the exception of the larger pumps, which will be driven by motors operating at 2,200 volts. In order to determine the proportional distribution of the cost of power in the various parts of the mill, the various departments will have separate circuits with integrating watt meters to measure the power consumed.

The boiler room installation consists of six 500 h.p. B.&W. boilers equipped with chain grate stokers and superheaters, operating at 175 lbs. pressure with 150 degrees of superheat, and one 250 h.p. boiler burning wood refuse around the plant.

One feature of particular importance is the electrolytic bleaching plant, which, when cheap power is available, forms by far the best means of obtaining the necessary bleach. The pulp mill equipment throughout is the most modern obtainable.

The Dealer and Contractor

Second Annual Convention of the Electrical Contractors and Dealers Association and Ontario's Biggest Electric Show are Both Great Success

The second annual convention of the Ontario electrical contractors and dealers and the Electric Show, held at the same time in Massey Hall, Toronto, June 6, 7, 8, were a very decided success. Indeed, considering the strenuous times in which we are living, the officers who had the matter in charge have every reason to be gratified at the very considerable attendance and the marked enthusiasm of the delegates. The attendance from the more distant points was not heavy, but the interest of contractors who were unable to attend was indicated by numerous letters of explanation and good-will stating the difficulties in the way of leaving their business at the present time due to labor shortage; this shortage affecting, oftentimes, outside and office staff alike.

Of the convention proceedings and the Electric Show one cannot speak in too glowing terms. The paper and discussions were of an unusually high order and the show was decidedly the best electrical display under one roof that Toronto has ever seen. This is all the more satisfactory when we consider that the electrical business in Canada is by no means booming, and it indicates that jobbers and manufacturers are freely accepting their responsibilities to "keep the home fires burning." It also indicates, without doubt, the growing feeling that the worst of our trade depression is behind us and that, from now on, there will be business to be had in increasing volume.

The New Officers

Mr. G. D. Earle, president of the association, was untiring throughout in his efforts to sustain the enthusiasm of the delegates, and in this was ably seconded by the secretary, Mr. M. S. Soules. Unfortunately, Mr. Soules would not consider this office for the next year as he felt a Toronto man would be of greater value through being in touch at all times with the central organization. Since taking over the office of secretary, following the resignation of Mr. R. D. Earle, who joined the 116th battalion, Mr. Soules has shown apt ability and a very real enthusiasm for the work, and his resignation is a distinct loss to the association. However, he remains as treasurer and the association is to be congratulated that a man of the ability and experience of Mr. E. A. Drury, Toronto, was available and willing to take on the work. Mr. G. D. Earle was fortunately prevailed upon to retain the presidency for another year, and a strong list of general officers was named, which undoubtedly assures a vigorous prosecution of the work of the association so well begun. The complete list of officers follows:

G. D. Earle, Earle Electric, Toronto, president; J. H. Miller, Alexander & Miller, Peterboro, 1st vice-president; J. McLinden, Owen Sound, 2nd vice-president; E. A. Drury, 45 Moutray Street, Toronto, secretary; M. S. Soules, Soules, Smith Company, Oshawa, treasurer.

Chairmen of standing committees: W. H. Lodge, Toronto, Licensing; E. Etherington, Stratford, Development; Geo. T. Dale, Toronto, Re-sale; W. R. Fellows, Jr., Blenheim, Inspection; A. C. Lyons, Brantford, Organization.

Have Severed Connection With R. M. A.

One of the most important developments of the convention was the decision of the association to sever all connection from the Retail Merchants' Association. This step was taken after due consideration and careful recognition of the value of the larger organization, but it was felt that any advantages were offset by counter advantages to be gained by independent and an absolute control of their own organization.

Change of Name

Another decided advance was made in changing the name to the Electrical Contractors' and Dealers' Association of Ontario, replacing the former name—the Electrical Dealers' & Contractors' Association of Ontario. This change was due, as we understand, to the unanimous feeling that the contracting element in the association was so decidedly predominant that any arrangement of nomenclature which gave any other name prior place created a wrong impression in the minds of outsiders. In the United States they call it simply the Electrical Contractors' Association. The recently formed association in British Columbia is named the Electrical Contractors' and Dealers' Association of British Columbia. In all probability this practice will be followed generally by the local associations formed throughout the Dominion. At no distant date there will be, let us hope, an Electrical Contractors' and Dealers' Association of Canada.

A number of the various standing committees appointed at the last annual convention submitted valuable reports and chairmen of these committees were again appointed and given power to enlist the co-operation of such members as may be necessary.

List of Exhibitors

The following list of manufacturers and jobbers occupied booths in the exhibit, showing their regular lines: Crouse-Hinds Company; Detroit Fuse & Manufacturing Company; Canadian General Electric Company; Jefferson Glass Company; Clements Manufacturing Company; National Electric Heating Company; Interstate Novelty Company; Volt Lamp Company; Canadian National Carbon Company; Flexible Conduit Company; Metropolitan Engineering Company; Norton Telephone Company; Northern Electric Company; Hydro-Electric Specialty Company; Canadian Westinghouse Company; Factory Products Limited; One-Minute Washer Company; Canadian Carbon Company; Tuec Vacuum Cleaning Company; Benjamin Electric Manufacturing Company; Kinetic Engineering Company; Economy Fuse Company; Canadian Chuck & Drill Company; Conduits Limited; Renfrew Electric Manufacturing Company; Rogers' Electric Company; 1900 Washer Company; Hughes Electric Heating Company; W. H. Spencer & Company.

Below we print a number of the papers presented. Special mention must be made of the addresses presented by Mr. Lyons and Mr. Henderson, of the Brantford Electric Club. These are reproduced in full. The address of Mr. Strickland of the Hydro Inspection Department also, as usual, helped to clear up a number of contentious points. Mention must also be made of the remarks of Mr. R. T. Jeffrey, of the Ontario Hydro Commission, who spoke on "Co-operation." Those who heard Mr. Jeffrey were particularly gratified with his judicious treatment of a somewhat difficult and contentious matter and especially so with his assurance that the Commission had no thought outside of the closest possible working relations between the electrical contractors and themselves. Mr. Jeffrey made some valuable suggestions as to the lines along which this co-operation might be developed. His address, as well as a number of others, are not available as we go to press, but we hope to be able to give them to our readers in our next issue.

Co-operation—As the Contractor Sees It

Down in Brantford All Classes of the Electric Trade Work Together — How They Do It.

By Mr. A. C. Lyons

In dealing with co-operation from the standpoint of the Electrical Contractor, I would divide the electrical business into six sections: first, the Central Station (Hydro, etc.); second, the manufacturer of electrical supplies; third, the jobber, who is supposed to stock those supplies; fourth, the electrical contractor who buys and is supposed to pay for these supplies; fifth, the Inspection Department, who passes upon the quality, and their installation; sixth, and very important, the customer from whom the preceding five sections get their revenue.

The first three sections are almost always highly organized business corporations, in violent contrast to the contractor whose lack of organization and co-operation with his fellow-contractors, coupled with his poor bookkeeping methods and lack of knowledge of costs, has forced him to be whip-lashed by all five sections, his own included.

In every line of business there is some branch which has to be the goat. In the electrical business I certainly consider the contractor is the goat, and I think all will agree with me there.

In a technical and practical way I have been connected with electrical matters since 1890, but for the past seventeen years I have been contracting in Brantford, and in dealing with my subject I shall base my remarks on things as I found them in a city of that size (25,000 population). I have seen many contractors there come and go, probably 40 at least. Those who went were practically forced out by financial difficulties due entirely to lack of co-operation, organization, and knowledge of costs, rather than lack of ability, those who stayed are still more familiar with pliars, tape and solder than the cushions of a limousine.

Just here I would like to tell you about our Electric Club in Brantford, of which some of you have heard.

Up to a year ago the contractors and wiremen in Brantford were not only sore on each other, bitterly so at times, but there were grievances with the Hydro and Western Counties, and their employees, and misunderstandings with the Inspection Department. Nearly all were sore on the business generally but saw no way out. Finally, one contractor, Mr. McLean, after many rebuffs, succeeded in getting the contractors together for another meeting. Those who attended were bored and considered it a waste of time. I know I did, and said so.

The Average Contractor's Books

The average contractor is indifferently financed, and if he keeps books at all, they are indeed marvels of how not to do it. He is preyed upon by all the other interests from the Central Station to the public, until he can hardly be blamed if when he gets a chance to soak a customer, he does it, and if he can put one over the Central Station, jobber, or inspector, he has no conscientious regrets, but believes it is coming to them on general principles.

Now all this is wrong, and at this meeting I stated my belief, that the only way the contractors could get together and stick was to form a club, and take in on equal standing with the contractors, local representatives of the Central Stations, local electrical manufacturers, and the District Hydro Inspector. I suggested that nice quarters be secured and furnished and regular meetings held, where on neutral ground, all grievances and differences of one member with the other could be thrashed out in full detail candidly, but not offensively, and in the presence of all members, the object being to have a definite understanding of each other's rights.

At first it was not apparent to the Central Stations and the Crown Electric Co., a local manufacturer, just why they should become mixed up with what was apparently regarded as a sort of contractors' combine, possibly illegal in its aims, neither could the Inspector. On behalf of the contractors, it was explained that the Club was intended to be a sort of clearing house for the adjustment of the grievances and misunderstandings and the imparting of information concerning the rights of the other fellow, so that all could work in harmony and understanding, and devote the energy consumed in worrying about your competitor to business proper, viz.—pushing the use of electricity. They saw the point and came in.

Organization

We counted up our members in prospect, estimated our annual expenses, levied a sum to cover furnishings for the Club Room, and arranged an annual membership fee sufficient to pay expenses. We adopted a constitution and by-laws, and proceeded to get down to "brass tacks." The "brass tacks" consisted, first, in each member who was a contractor going over his time sheets and records on house wiring, and turning in an exact list of the quantity of each item of material and labor on different classes of houses. The actual net cost per outlet and other interesting information was thus secured by striking an average on many similar houses. Our secretary-treasurer, Mr. Henderson, who is down for a paper on house wiring costs, will go into this in detail, and I can assure you we learned a great deal from these records.

Our next plan was to submit these records to the Central Stations, such as the Hydro, Western Counties, etc., and have their representatives go over our books and invoices to verify our costs. This may seem peculiar to some of you, but our plan was to add a fair overhead plus a percentage profit, which would be recognized by the Central Stations as a fair price to charge the public and based on sound business principles. We expected the Central Stations then to back up our charges per outlet, and we would co-operate with their solicitors in boosting business generally. The suggestion was further made, and approved, that the Central Stations' solicitors be furnished with these details, and thus be in a position to leave with the prospect an exact estimate of what his house wiring would cost, and on the back of this, of which a copy would be kept, would be printed a list of contractors who would do the work for that price; thus the public would not be overcharged and the contractor would get a fair deal, and would have no excuse for putting it over on the Inspector. The jobber, knowing the contractor was working on a sound basis, would be sure of his money, and one customer would not be soaked for losses incurred on another customer's job.

In submitting our wiring costs to the Central Stations, we lay ourselves as contractors open to severe criticism. What the blank business is it of the Central Station what our costs and charges are? Right here is where I wish to make and substantiate my claim that the Central Station is very vitally concerned. They have made a very heavy investment in generating equipment and street construction to sell "juice," and if the contractor overcharges the public, less connections will be made, and if he undercharges the public he will put himself out of business, and become sore on the Central Station and things electrical in general. If a new contractor does not take his place less wiring is done, and in either case the Central Station is forced to stock appliances and do wiring.

Not in the Wiring Business

Now I do not believe, and all the enquiries I have made back me up, that the Central Station **does not want** to do wiring or carry supplies or appliances providing there are plenty of contractors capable and willing to assume this work, and push it at a reasonable rate of profit. This is the kernel of the nut we have to crack. It is up to us as contractors to demonstrate to the Central Stations that we are both capable and willing to do wiring and sell appliances on a reasonable margin, and I claim, and believe, that the Central Stations are willing, yea, anxious, to have us do this work on a basis of cost plus percentage overhead, plus percentage profit. We have got together in this way in Brantford, and have the support of the local Hydro and the Western Counties in our proposed wiring schedule, and in the sale of appliances. So long as we do not overcharge the public they will not butt in, and once or twice each year we will get together and go into the matter of cost and charge, so that the public are protected. Now, this is fair and right.

It may be remarked that this is a combine, and that this class of co-operation eliminates legitimate competition. Not so. If we base our charges on cost of material and labor, plus fixed percentages for overhead and profit, as agreed upon, the man who has the most brains and ability to handle men can do a better job with less material and labor than his competitor.

Our idea in Brantford is to get the electricians all over the country organized into distinct clubs working in harmony with the Central Stations and each other, on a definite and approved schedule of charges fair to the public. Let the members of the clubs be licensed after first proving their ability either by past performances or examination. Let the floating wireman, who cuts prices and refuses to join the nearest club be denied a license, for we know that the man who will beat an approved schedule will sooner or later put himself out of business, and in the last stages of his business career he will be a menace to the public, to the Inspector, who cannot always see everything, and to the dealer from whom he buys his supplies.

Renting Display Spaces

Another matter we took up in our Club—our walls are burlapped and panelled in mission style. There are twenty spaces, 6 ft. x 3 ft. We rent these spaces at a small annual fee to manufacturers and jobbers who send us not only plenty of printed matter, but live samples of their wares, which we receive, insure, and hang up in their space until such time as they wish them returned or changed. Dealers could not afford to send these samples to every contractor, but here in the Club Room the contractor may, before and after the meetings, or at any other time, inspect and discuss the merits of the goods, the good points of which are not always evident on circulars. It saves the dealer mailing charges and gives his goods a chance to speak for themselves. The revenue derived helps out on our running expenses. We supply the travelling representatives of all firms who have sample boards up, with a key to the Club Room, so that their representative, when in the city, can enter and make himself at home.

We also have a grievance committee to deal with the grievances which may develop between one of our members and some manufacturer or jobber, wherein the latter will not make good defective goods or is somewhat arbitrary in his attitude. Full details are laid before the Club by the member, which go on our minutes, and the dealer in question receives a full memo from our Secretary, with a request to state his side, as it is our desire to deal fairly with all. Should the dealer not comply, we as individual members certainly make it a point to remind his representative about the delinquency any time he calls.

It is our local intention to take in as associate members electricians connected with local factories, as we believe much good and business can be done by working harmoniously with them, particularly in inducing them to order their supplies from the local contractor on a percentage on cost basis. This relieves the manufacturer and jobber from the necessity and expense of having his traveler call on local factories, and puts the business through the proper channels. In Brantford one factory buyer delights in stating that he can buy direct cheaper than the contractor can. This is not right, and we are quietly lining up those dealers and jobbers who sell direct in hopes that we may be able to put this business through the local contractor, and yet not have it cost the factory concerned any more. The factory would not have to carry a stock or buy in quantities, and the jobber would save his traveller's expenses.

Along the Right Lines

Perhaps my remarks may sound not only Utopian and optimistic, but bordering on the illegal, and in some respects impossible of accomplishment. Perhaps this is so, but I wish it understood from the standpoint of the Brantford Electric Club, that we are seeking light, and believe we are working in the right direction. We have only started and have much to learn, and we realize that there are many things to correct and amend before we adopt them finally, and at all times we will welcome from any quarter suggestions and information, which we will freely pass along. We also extend a hearty welcome to any manufacturer, jobber, contractor, Central Station man, or Inspector, to attend any of our meetings, which are held every other Tuesday. We have nothing to hide; we are out to do wiring and sell appliances, on a cost plus overhead, plus percentage profit basis, and we are willing to have those percentages supervised by the Central Stations on any fair basis. Should, however, the Central Stations refuse to co-operate with us on a fair proposition of this kind and declare their intention of doing wiring at any price they see fit without according the contractor any consideration, the sooner we know it the better, and I can assure you most positively that a remedy is available to the contractors of this Dominion which is sufficiently powerful to jar even the mighty Hydro-Electric, and the same remedy will bring the manufacturer and jobber speedily to his knees, but it will require considerable co-operation on the part of the contractors. But why talk of all that? The electrical field is yet enormous, and there is ample room for all the Central Stations, contractors, jobbers, and manufacturers, if they will all bury the past and expend their fighting energy in helping each other to get the people to **do it electrically.**

It can be done, and if in the employ of any Central Station, manufacturer, or jobber, there are men so narrow-minded that they cannot co-operate for the general advancement of the electrical industry, these individuals should be dispensed with at once. The contractors individually simply must start anew, forget past soreness and disputes and make one mighty effort to get all competitive interests together, and possibly form a club similar to our own. Again I say, it can be done, and those in the employ of any of the interests who decry efforts along this line should be severely disciplined by those in authority over them, and remember that no man is so high and mighty that he cannot be reached, and if the offender's career is systematically delved into there is no doubt he can be made to see light.

Unity of purpose on the part of those present can accomplish it all, and the task is not as great as might be thought.

One very vital detail must first be settled and very little give and take is necessary, if representatives of the different sections mentioned at the opening of my remarks approach the subject in the proper spirit. The Central Stations absolutely and positively must not do wiring or sell appliances. The manufacturer must not sell to anyone but the jobber, the jobber must not sell to anyone but the contractor, the contractor must be on his job and be prepared to do electric wiring with accuracy and despatch, and at an approved rate of charges he must also sell supplies and appliances of all kinds on a narrow margin, and he must show himself a live wire in maintaining an up-to-date stock.

These last remarks mean a whole lot, but they are vital to the whole idea of co-operation and they spell success or failure according as representatives of the different interests can meet and distinctly define the territory each interest has a right to, which likewise will indicate with great exactness when one section is trespassing in the territory allotted to another.

I fondly hope that my remarks as above, which are somewhat rambling in their nature, may be the means of pointing the road to a great prosperity, coupled with a great friendliness among all the electrical interests.

The Elements of Interior Illumination

A Vast Difference Between Much Light and Good Lighting—Some Simple Engineering Suggestions to Assist the Practical Man

By Mr. T. M. DeBlois

In dealing with the subject before us of the Interior Illumination of Buildings, we are speaking of a branch of science that while greatly varied in its application and dependent upon a great many varying quantities, yet presents principles which are fundamental, and upon these fundamental principles of light we depend for our development of the science of illumination. However, this deals with only one side of the problem, for as electricians and electrical engineers we may devote our energies to produce the greatest quantity of light with the least consumption of energy, which spells efficiency, yet our efforts will result in utter failure if we overlook that most important element in all lighting schemes, namely, the human element.

The final court of appeal of any system of lighting is the eye. Does the color of the light produce an unpleasing sensation to our eye? Then no matter how efficient, we will have none of it. Does the location of the sources of light produce a strain upon that most sensitive member? Again it does not satisfy. And again, should the nature of the lighting scheme offend our aesthetic sense (which is one of our credentials to being civilized) we will endeavor to so re-arrange our system so that we can secure the maximum amount of light with the least energy consumption and at the same time produce a sensation that will be a source of comfort and satisfaction. We thus come to the conclusion that when we speak of efficiency in illumination it does not necessarily refer to "Energy Efficiency," but as a matter of fact our work is efficient when, with a minimum of means, we succeed in accomplishing what we set out to do. Effectiveness is our goal and our illumination engineering may soon be classed as a "Fine Art."

The Two Extremes

And so at one extreme we have the intensive method of illumination where as much light as possible is concentrated on a limited area by a metal reflector, and at the other we have the beautiful drawing room fixture with varied colored shades which is highly pleasing to our sense of the beautiful and artistic, and between these two we have the innumerable applications where the incandescent light is called upon to light the interior of our various types of buildings. I have purposely used the words incandescent light, for, with the advent of the so-called high efficiency gas-filled incandescent lamps we find that even in factory lighting the arc lamp is rapidly giving place to its rival the incandescent lamp, and it does not need a prophet to predict that we are still in line for further developments; and while we now proclaim the lamp that gives us light at the energy expense of somewhat more than half a watt per candle power, we will barely have ceased congratulating our good fortune when we will be told of a new development that may cut this expenditure in two. This, however, is by the way.

Let us return to our consideration of the problem of interior illumination from the point of view of effectiveness, bearing in mind that every lighting problem presents individual considerations.

First let us consider the purely elementary and fundamental principles with which you are all more or less familiar, but which will bear repetition at this time.

The Physiological Element

Light is a physiological rather than a physical quantity, and cannot be measured in terms of any absolute system of measurement. The standards that we have adopted are, therefore, purely arbitrary. And so we have the unit standard of light measurement which we call one candle power being the light giving power of one candle made according to certain specifications. However, as the candle power of all illuminants varies considerably at different angles, as shown by the familiar photometric curves, neither candle power nor watts express a very definite meaning, and so the unit of quantity of light or light flux has been adopted, which is called the lumen. One lumen denotes the quantity of light which will be given to one square foot arc at a distance of one foot from a source of one candle power intensity, when the rays of light are at right angles to the surface illuminated. The surface of a sphere of one foot radius is equal to about 12½ square feet, and therefore, according to our definition, if at the centre of such a sphere there exists a spot of light of one candle power, there will be given off 2½ lumens, and if the sources of light be greater or less it follows that we need but multiply it by 2½ to obtain the total lumens emitted. So, to repeat, our unit for quantity of light or light flux is the lumen, and briefly is the product of light intensity or foot candles, and the area illuminated in square feet, a foot candle being the intensity of light produced by a source of one candle power at a distance of one foot.

Having now defined the common units of illumination, let us again proceed, recalling our goal of "effectiveness." Suppose we are given an interior space to illuminate, this space having a certain architectural refinement. What are the points we must consider? It is of first importance that a careful study be made of all the architectural details, attention being given to colors, various heights, and shadows produced. Colors, in order that our lighting arrangements will not warp or destroy the color treatment and ornamentation; for the intensity of our light, as also the color of our illuminant will have marked effects on colored pigments. The heights of the ceilings must also be noted, for the illumination should be emphasized on the proper areas. Too much light must not be thrown on the ceiling as in many cases of indirect lighting; for, as we desire to approach as near as possible to day light effects, where the daylight streams through windows from the sky above the horizon, the natural result is that the best effect is produced when the brilliant illumination is near the floor. This result is of importance for the reason that it is the part of the room we occupy, and also preserves our sense of proportion.

Fixtures

This brings us to the question of fixtures. Here also the final judge of success is the eye. Fixtures that produce strain, fatigue and other injuries must be avoided. Our fixtures must not be of too intense intrinsic brilliancy. The maximum intensity of light must be concentrated at the proper points, and lesser intensity at other points in order that the muscles of the eye will have relief after a concentrated effort. As in the case of the incandescent lamp the development of the illumination fixture for the distribution of the light has been equally rapid and the two have gone hand in hand. At first, when we discovered ourselves in possession of that new source of light, the Edison incandescent carbon lamp, we were content to change our old gas chandelier into an electric fixture by replacing the gas burner with a 16 or 32 candle power lamp, and also, by the way, carry our wires in cleats and knobs on our walls and ceilings. Then, as the demand for the new type of lighting grew so rapidly, investigators gave more attention and study to the laws of light and color. As a rule these investigators gave more attention and study to the laws of light and color. As a rule these investigators were scientists and engineers with whom the watchword was then, as now, efficiency. And consequently, we see a great development in the science of efficient illuminating fixtures, marked especially by the prismatic glass reflectors. Using the principle of the reflection of light rays in a prism we are able to distribute our light to get any intensity desired with a high efficiency, speaking in terms of energy.

But for many obvious reasons this system, even with its efficiency, was not a great success, and because the judge of all illumination schemes—the eye—decreed for the sake of its own comfort that there must be a minimum intrinsic glare, the pendulum swung in the other direction and we have our inefficient indirect and semi-indirect systems. But who shall say that these systems are necessarily inefficient? If by the use of indirect and semi-indirect lighting we are able to produce an effectiveness that could not be obtained by prismatic reflectors, even at the expense of a relatively much greater amount of energy, can we not, as stated earlier, rate efficiency in terms of effectiveness or success in accomplishing what we set out to do?

Next Stage a Compromise

However, as in most cases where there is a swinging of the pendulum from one extreme to another, the next change will likely conform more or less to a compromise and endeavor will be made to produce a fixture that will give us the effect of diffusion that we demand in semi-indirect or indirect lighting, and produce that effectiveness we require as regards shadows, colors, and so forth, but at the same time accomplish this result with a smaller expenditure of energy.

The great disadvantage in indirect and semi-indirect lighting systems are, first, that they are dependent for their success upon the color and nature of their surrounding ceiling and walls. Second, they as a rule produce a greater intensity of light on the ceiling than on the floor, an effect that is opposite to our daylight effect, and one that is undoubtedly an undesirable one. And for a third reason the height of the ceiling is a problem that enters into indirect lighting and in many cases makes it one very difficult of producing the desired effect.

And so we come to a later development in the evolution of illumination fixtures, the combination in the one fixture of the principle of diffusion and also efficient reflection, and as the extensive development of the prismatic glass reflector marked the advent of the tungsten filament lamp; in a similar manner the principle of the fixture combining diffusion and reflection marked the advent of the gas-filled high efficiency lamp.

This system exists to-day in many well-known and familiar types of commercial fixtures, and having the development of the artistic indirect lighting system to work upon has resulted in utilizing this latest principle to almost any design and effect that it might be called upon to produce, and this at an actual saving in energy of 50 per cent. over indirect system, in the case of one make of this type of fixture; for it must be pointed out that in order to get the proper results there are many important points that have to be accurately worked out. The proper shape of the reflector, the nature of the reflecting surface, the proper shape of the diffusing bowl, the distance that the bowl should be suspended from the reflector, the nature of the glass composing the diffusing bowl and also the method of suspension of the bowl. All these are items that, while certain of them can be mathematically or graphically ascertained, yet as is so generally the case in illuminating problems, experimentation by trial and error gives the most satisfactory results.

Having now referred to the fixtures that may be used to distribute the light, it remains still to consider that most important consideration, that of the proper intensities.

Proper Intesities

From the utilitarian standpoint we must again consider the eye. While various intensities are desired for various interiors, the following suggestions will apply generally:—

Arrangements which produce strain, fatigue and other injuries must be avoided.

Low intrinsic brilliancy of exposed light sources and shading of sources possessing high intrinsic brilliancy are imperative.

The maximum intensity of light must be concentrated upon places of work and by variations in intensity between light on the work and on surrounding objects the muscles of the eye are given opportunity for exercise.

The color of the diffused light may also be considered as it might have a marked effect upon the comfort of our visual organs.

While these are some of the points to be considered, they will serve to show the nature of the problems to be considered in laying out a well-lighted interior. Fortunately, the matter of the proper intensities to be used in various interiors is one that has received a great deal of attention, and we find various suggestions from investigators along this line. However, it is impossible to lay down any fixed law even here, for different variables may enter into each problem, such as variation in color, the proper relative value of directed and diffused light, shadows cast by structural or architectural parts, etc. Only after making a study of the individual case can the proper intensities be decided upon, and the proper location of the light sources determined. These having been fixed, the amount of light flux to be generated can be calculated fairly accurately. The method most generally adopted, although there are several, is known as the point by point method. This method employs the idea of intensity and its direction.

For instance, take a point directly under one of the lighting units. The total illumination in foot candles at this point will be approximately the candle power taken from the photometric curve of the lamp and fixture divided by the square of the distance, plus the contribution from the surrounding fixtures calculated in the same manner by dividing the candle power at that angle by the square of the distance. Adding all these together will give us our total illumination at this point.

This method will give the illuminating intensity using a certain size lamp, and must be varied accordingly as the intensity is too great, or, on the other hand, too small. However, our calculated results will be more or less increased, due to reflected light from walls and ceilings, which can to a certain extent be ascertained from information easily obtainable, giving the percentage of light reflected from various materials. This method, of course, is not the best for every condition, but will serve to show the manner and nature of the points that should be determined.

This, then, will suggest in a general way the manner in which an illumination scheme should be attacked. When one considers the innumerable types of interiors that all require to be illuminated for their special purpose, the extreme complexity of the subject is obvious. Hardly any reference has been made to the systems in use for the lighting of various types of factories, machine shops and foundries. We have confined ourselves to the incandescent lamp as our source of light. It must not be inferred from this, however, that the arc lamp has yet been entirely replaced in its application to industrial lighting. Our high efficiency gas-filled incandescent lamp must still show a greater saving in energy before it can rival the flaming arc lamp with its efficiency of less than one-third watts per candle, or the intensified arc lamp with an efficiency of from 1 to 1½ watts per candle. However, as stated at the outset, the last word has not yet been said, and it is along the line of incandescent lighting that we still must look for our greatest achievements.

In closing let us emphasize a few points that are well worth bearing in mind in considering any problem of illumination.

First. Remember that the brightest lighted space is not necessarily the best lighted. In our desire to produce a well-lighted interior the mistake is often made of having an intensity that is very trying to our eyes.

Second. It is all important that the incandescent filament does not come within the line of vision; and the more perfect the diffusion the better—within, of course, obvious limits.

Third. It is just as impossible to produce a well lighted interior, and a result that will be pleasing in every respect without careful investigation to every detail, as it would be to construct the building without careful investigation as to architectural and structural details.

Fourth. Use a duster. The collection of dust and dirt on a lighting unit will cut off the light in some cases to a surprising extent. Cleanliness is next to Godliness, and in illumination engineering, cleanliness is next to luminescence.

Report of Standing Committee on Resale

Bona Fide Contractors and Jobbers Should Have Fair Measure of Protection—Solution Rests With Manufacturer

By Mr. R. Grant

I cannot help thinking that a great deal more might have been accomplished had this "Problem of Resales" been left in the hands of a committee composed entirely of Toronto contractors, or of contractors situated within a reasonable distance of one another who would have no difficulty in getting together frequently and who would be always in close touch with the central executive. As it was, the men who kindly consented to act on my committee, were scattered over the province, and it was found almost impossible for the whole to be together at any one time, with the result that correspondence was the only resource, which, I regret to state, had no tangible result further than an expression of the different views of my colleagues on the subject of resale. A resume of these, together with our own observations, let us venture to hope might possibly be of assistance in any future action that the association might deem it advisable to take. Personally, we have never yet had any argument adduced to turn us from the conviction that this problem can only be solved by, and with, the co-operation of the manufacturers.

There are already many manufacturers in the electrical trade, who have established resale schedules that are consistently lived up to, but the trouble is that at present protection is only afforded to the jobber, but in no manner, so far, are the interests of the retailer considered. These conditions of resale, established by the manufacturers, ensure to the jobber a reasonable living profit, but there, unfortunately for us, the matter ends. The jobber is therefore left in the happy position whereby he either sells to the dealer at a reasonable and well defined profit, or to the public direct, without any restrictions whatever, and, strange to say, openly and without the fear of antagonizing the trade.

In other lines of business investigated, we find that any protection afforded either the jobbers or the dealers, is provided by the manufacturers. In the wholesale grocery trade they are consistently maintaining the selling price of almost all the popular brands of food products, thereby securing a legitimate living profit. The tobacco trade in this country was, until recently, becoming demoralized by price cutting, in an endeavor, as claimed by the manufacturers, to overcome a shrinkage in sales due to slackening of demand through a temporary depression in general trade. A few months ago the Imperial Tobacco Company got busy, with the result that offending dealers are being cut from the list, thus saving a situation that would have brought inevitable disaster if allowed to continue.

The jobbers no doubt fill a useful sphere in the distribution of electrical products, the importance of which is fully acknowledged by the electrical dealers and contractors. Ultimately, however, their function in the business should be strictly confined to selling to the trade only, but as this ideal is manifestly remote, and perhaps impossible of accomplishment in our present state of organization, our efforts should be directed towards an arrangement whereby it would be made difficult for anyone not legitimately in the business, to purchase any article at a price that would not allow a fair living profit to the small dealer.

It has been suggested by a number of the members of this organization who are under the impression that the jobbers have some kind of a big brotherly interest in our welfare that they might be induced to make such resale arrangements as would protect our interests. Not only is this suggestion wrong in principle, not only are we asking for something that we have no right to expect, but the course would be unworthy of us as an organization as well, for what we are not in a position to demand, we have absolutely no right to have.

It must not be forgotten that the jobbers are gentlemen who are in this business to make money and their policy will be shaped simply towards that end. The fact that the dealers are not now adequately protected, simply means that the existing conditions are acceptable to the jobbers and are tolerated by the others concerned. Any other view of this matter neglects the monopoly of ability for organization undoubtedly possessed by the jobbers which is effectively safeguarding their own interests and which perfection of organization should not only call forth our admiration, but also point the way to our salvation, as well.

On the other hand, many of the manufacturers are ready to meet our demands. Indeed, we have had, unsolicited, from among others, the Detroit Fuse & Manufacturing Company, offers to co-operate with a view to safeguarding our interests, and it is from this source that we feel the solution must come.

On December 6th I wrote to members of the committee suggesting that a letter somewhat as follows be sent to all the principal manufacturers of electrical goods in Canada and also to manufacturers in the United States of lines which are being regularly sold here, making a request at the same time to one of the executive that an appropriation should be made to cover stationery, multigraphing and postage—this, unfortunately, without result. The letter referred to above, reads as follows:—

"At a recent convention of the Electrical Dealers' and Contractors' Association held in Toronto, a committee was authorized to take up the problem of resales. Judging from the replies to Mr. Dale's letter on this subject, to the jobbers, as reported in the proceedings of the last convention, it may be assumed that generally speaking there is either no protection or no adequate protection afforded the dealers and contractors as may be gathered from the following excerpts, from statements made by representatives of the jobbers at that convention.

1. "We find it necessary, in order to meet existing competition, to quote practically the same prices for equal quantities to everyone having a satisfactory rating."

2. "We have but one set of prices, which vary according to quantities, and **until the contractors take steps in this matter themselves,** we cannot see how any difference can be made in the present conditions."

"On the other hand, it is conceded by all the jobbers fide contractors and dealers should have a reasonable protection, provided the great difficulty could be overcome of establishing definite and satisfactory rules governing such protection. It must be admitted that these conditions are deplorable, and notwithstanding claims to the contrary, as brought forward by one of the jobbers, and reported in the proceedings of the convention, we hold with Mr. Dale that no such conditions exist in any other business. Blame cannot be attached either to the jobbers or to the manufacturers, but only to the dealers themselves, who through lack of organization have allowed these conditions to continue. We have carefully considered the matter and we have come to the conclusion that our only hope for remedy is in getting the manufacturers to include conditions in their terms of resale to the jobbers that would protect the legitimate dealer and contractor; that is to say, conditions that would preclude the jobber from selling anyone outside the trade except on an arranged basis.

"It is unnecessary meantime to go into details, but we are merely sending a copy of this letter to a number of the manufacturers to find out whether they would be agreeable to co-operate with us along the lines suggested.

"We quite realize that there are difficulties which have not been touched upon and which would have to be overcome, but we do not consider that these are insurmountable, provided we had the earnest co-operation of the manufacturers whose interests we feel are identical with our own. Naturally the whole power and force of our organization would be exerted in favor of the manufacturers who come to our assistance.

"We should be glad to hear from you, therefore, as to whether you would be willing to include in your terms of Resale to Jobbers, such conditions as might be mutually determined upon to protect the dealers."

This, then, is as far as we have gone in the matter, and we would respectfully suggest that, if it is to be taken up further, an appropriation should be made by the central executive of at least $100 to cover any expenses that would necessarily be incurred.

I must again express my regret at being unable to be present, but if it is at all possible, yet, I may have the pleasure of being with you before the convention closes. Meantime, I wish you all every success in the good work ahead.

Keep These Figures By You

Electrical contractors will often be saved an hour's loss of time on a job if they will cut out the following table and paste it in their notebooks. It gives the carrying capacity, size and weight of insulated copper wires and cables for interior conductors, all voltages. The size of standard B & S wires is also given in circular mils:

		National Electric Code						
		Single Conductor Rubber Insulated for 600 Volts					Triple Braid Weatherproof	
Size B & S	Circular Mils	Allowable Current Carrying Capacities	Braided		Leaded		Weight per 1000 ft.	Allowable Current Carrying Capacities
			Weight per 1000 ft.	Overall Diameter	Weight per 1000 ft.	Overall Diameter		
18	1,624	3	17	.19				
16	2,583	6	20	.20	210	.29	19	10
14	4,107	15	35	.21	228	.31	25	20
12	6,530	20	46	.23	253	.33	35	25
10	10,380	25	63	.26	288	.35	53	30
8	16,510	35	86	.29	335	.38	75	50
6	26,250	50	139	.37	512	.47	110	70
5	33,100	55	165	.40	565	.49	137	80
4	41,700	70	197	.42	618	.51	164	90
3	52,630	80	240	.45	694	.54	209	100
2	66,370	90	289	.51	770	.57	255	125
1	83,690	100	381	.59	935	.65	310	150
0	105,500	125	464	.63	1055	.69	400	200
00	133,100	150	563	.67	1202	.73	490	225
000	167,800	175	683	.72	1372	.78	625	275
0000	211,600	225	835	.78	1583	.84	765	325
Cables	250,000	238	1032	.87	2100	.98	937	350
"	300,000	275	1218	.93	2303	1.00	1120	400
"	400,000	325	1548	1.03	2753	1.10	1445	500
"	500,000	400	1888	1.12	3487	1.22	1781	600
"	600,000	450	2275	1.22	4021	1.38	2113	680
"	700,000	500	2619	1.30	4474	1.41	2445	760
"	800,000	550	2959	1.36	4912	1.44	2778	840
"	900,000	600	3400	1.43	5340	1.53	3128	920
"	1,000,000	650	3624	1.48	5752	1.59	3478	1000
"	1,250,000	750	4496	1.65	7300	1.79		
"	1,500,000	850	5319	1.77	8343	1.91		
"	1,750,000	950	6394	1.90	9355	2.02		
"	2,000,000	1050	6958	1.99	10367	2.13		

The Electric Specialty & Supply Company, recently occupying offices and factory at 20-22 Adelaide Street West, have sold out to the Hessco Company, 210 Adelaide Street West, where the new company will have their warehouse from which all goods will be delivered. The new company have a large factory at 1363 Dundas Street, West Toronto, where they will manufacture electric supplies.

Some Cost Figures on House Wiring

Averaged from Data Covering a Number of Contracts Completed Recently by Members of the Brantford Club

By Mr. C. D. Henderson

I am not posing as an expert on either cost accounting or house wiring, but am always on the lookout for new ideas that are going to increase my efficiency or the earning capacity of my business. If I fail to make this subject interesting, please put it down to my inexperience on platform work.

I have prepared this paper principally as a result of an investigation into the cost of house wiring as conducted by the Brantford Electrical Club, of which I am a member. Mind, I am not holding Brantford up as a shining light where conditions in the electrical trade have been all milk and honey—not much; we have had the same troubles to contend with there that have demoralized the business in other sections of the country.

Instead of intelligent co-operation with the object of bettering our conditions, the sole aim of each contractor seemed to be, **get the business,** profit and overhead expense were forgotten. There was no intelligent basis of figuring work and no idea of what it was costing us. We were simply pounding away, getting a job to-day—losing one tomorrow and using up all our energy in cut-throat competition.

The natural result was that we were doing house wiring at a loss and depending on our store trade and other branches of the business to carry a white elephant, instead of making each part of our business stand on its own feet.

The Brantford Electrical Club

The first question tackled was house wiring, because that branch of our business seemed to be the most troublesome. We decided to establish a uniform price to be charged for this class of work, based on a price per outlet, plus price for service, plus price for switches. That meant dividing the job up into three sections. There were to be no restrictions, except a distinction between old and new houses and cottages.

We realize this is not a new system by any means, but if it can be worked out on an intelligent basis, it certainly has many points in its favor. For instance, when giving a price on a house, instead of measuring each room and going into details, it is only necessary to count up the outlets, then add your service and switches. Furthermore, when the public realize that there is a standard price, there is not the tendency to peddle figures all over town, and yet another point is the fact that lighting companies' solicitors can get out after business with more confidence, knowing that they may talk to their customers on a definite basis.

Of course, you might say that this method will not work out profitably on account of the difference in construction of houses. Naturally, there is a variation as our cost records showed clearly, but considering the many advantages of this system, we decided unanimously to adopt it and allow for any variation in basing our figures on the law of averages.

To accomplish this, we investigated a number of contracts done recently by each member of our club. One of these forms was used for each job to show the actual cost on the different parts of the work. That is, the wiring, the service and the switches separately. They were then divided into separate classes of houses, such as old houses, old cottages, new houses and new cottages. After this had been done it was then a simple matter to figure up the average cost on which to base our retail price.

It would take too much of your time to give in detail the results of our findings, and as my object is only to deal with the subject in a general way and to show the basic principle on which we were working, I will simply give you an outline of the system.

For instance, on old house wiring, the cost per outlet, based on the average, proved to be $1.46 for wiring only, and the average cost of a No. 12 service was $8.00.

Any of you gentlemen who have been taking work at $1.50 per outlet, make a mental note of this $1.46, and don't run away with the idea that you have been making a profit of 4c. an outlet—not a bit of it. That $1.46 was only the cost of labor and material and did not include a cent for overhead expense.

By way of illustration, I have had printed this enlarged copy of the form we used with a sample job figured out. (See schedule herewith). By referring to the left hand side of card, you will note that this is an old house containing twenty outlets and including four flush switches, one snap switch and a No. 12 conduit service. Now let us see what this job has cost. First, we have 750 feet of No. 14 wire, which is carried into column No. 1, as it belongs to the wiring proper. Next, we have 50 feet of No. 12 wire, used on the service, this is carried into column No. 2; also conduit, condulet and cover, service box, locknuts and bushings, fuse plugs and grounding clamps. All are carried into column No. 2, as they are used in connection with the service. Loom, knobs, tubes and inspection are put in column No. 1. Switches are carried into their respective column. Clips, nails, screws, asbestos, solder and tape are divided up into columns No. 1 and 2. Next we come to labor; according to our time sheets, 40 hours was put in on the wiring, 5 hours on the service, and 2 hours on the switches. These amounts are carried into their respective columns. All that is necessary now is to total up each part of the work. We find that the wiring cost us $28, the service $7.80 and the switches $2.80.

How About Profit?

This gives us the cost of our labor and material, but we are not through. Let us see what our profit was. For example, I am using a retail price of $2 per outlet for the wiring, $11 for service and $4.35 for switches, or a total of $55.35. By subtracting our first cost from these amounts we get the following result:—gross profit on wiring of $12, $3.20 on service and $1.55 on switches, or a total of $16.75. Bear in mind, gentlemen, I said gross profit. This does not mean that we have made $16.75 actual profit, for there is another part of the cost of the job which we have not yet considered, that is overhead expense. In this case, I am using a very conservative rate of 25 per cent. on sales which figures out $13.83, so you will see that our $16.75 of imaginary profit has actually shrunk down to $2.92, or a little better than 5 per cent. on the contract price.

If any of you gentlemen have fostered the idea that $2 per outlet was too much to ask for wiring old houses, or if your conscience has ever bothered you when taking work at this basis, just get down to brass tacks and figure it out for yourself.

Allowing that my figures are right, here is a little problem. Suppose I do one hundred just such jobs, as I have illustrated here, within a year, and that I am fortunate enough to keep the cost down to this basis, I make the magnificent profit of $292, and yet I have done about two of these jobs a week and tied up two or three men. $292; just think of it; not enough to buy a Ford with, yet I will venture to say that there are very few men in this room who are getting these prices for their work and keeping the cost down to this point.

Of course, we sometimes hear a man say that he has not any overhead expense. Think of it—he intimates that he pays no rent, no insurance, no workmen's compensation, has no stationery or postage expense, gets his goods delivered to his jobs free, lighting companies give him his juice gratis. He never loses any tools or materials, never has any bad debts, never spends any time figuring work or collecting, is never approached for donations, never advertises, has no telephone and all the way through he is a wonder.

A Standing Offer

If there is such a man in the business who can prove that he is getting work and making a living without any of these expenditures, I will give him $100 for his formula. Of course, none of us pay much attention to wild statements such as these, but let us be fair to ourselves. Aren't there a lot of us who, although admitting that we have all of these items that I have mentioned and a good deal more to account for, persist in playing ostrich and repeatedly take work in which we know there is not enough allowed to cover our overhead expense. We are not fooling the public, we are not fooling the wholesale house, our banker or anyone except ourselves.

The point I want to convey is that overhead expense is just as much a part of the cost of your job as wire, loom, switches or inspection, and the sooner we realize it the sooner we will begin to get a fair return on our business investment.

As a proof of this, here is a concrete example: Supposing I make a bargain with a wholesale house to buy all my material from them and that in return they are to pay all my overhead expenses and charge it back to me by including a certain percentage of it in the invoice price of my purchases. You get my idea? I would be paying the invoice price of material plus a certain percentage for my overhead. Now, gentlemen, would there be any danger of me making a charge for material or taking a contract without making allowance for this overhead expense? Certainly not, I would be forced to because the cost of my goods would include overhead.

This, of course, would not be a strictly businesslike arrangement, but it serves to illustrate the necessity of adding overhead expense. The only difference between that arrangement and the way we are now operating is that instead of paying for these items along with our purchases, we make out a separate check as it were, to the land lord, the telephone company, the government, the insurance man, and so on.

That Overhead Expense

If there are any contractors here who have neglected to keep accurate track of their overhead expense, I would strongly recommend that they start in now and list every expense that is not charged directly to a customer, at the same time keeping track of the amount of business they do. When these two amounts are known, they will reveal wonders to you and for future figuring you will have something definite to guide you.

You might ask what percentage you will add in the meantime for overhead. This is a big question to answer, and I hope we will hear some interesting discussion on the subject before this convention closes. For my part, I might say in the past six or seven years I have followed with a great deal of interest many different investigations on the cost of doing business, both in the United States and Canada, not only in the electrical business, but in other lines, and I cannot recall a single instance where any firm proved that their cost of doing business was less than 18 per cent. on their sales, and I believe that 80 per cent. of these businesses investigated report their overhead as ranging from 25 per cent. to 35 per cent.

Realize what that means; twenty-five to thirty-five cents out of every dollar taken in goes towards paying overhead expenses.

You might think that I am taking up too much time on this overhead matter, but in my opinion it is the most important part of costs, for material and labor are seldom omitted, but overhead, like the poor, is always with us, and is not given proper consideration.

Gentlemen, before closing, let me urge that we all leave this convention with a firm purpose:—

First—To co-operate with the jobber, manufacturer, the central stations and our competitor to the general betterment of the electrical trade.

Second—To keep an accurate set of books, for this is the business man's compass.

Third—To know our costs and overhead and apply them intelligently.

Fourth—Have the backbone to demand a decent profit.

Fifth—Educate the public to do it electrically.

Enforcing Electrical Code in New York

The license of Joseph Boritz, an electrical contractor, of 121 Columbia Street, Manhattan, was suspended for thirty days from April 15 by Commissioner Williams, of the Department of Water Supply, Gas and Electricity, for repeated failure to solder and tape splices and for other serious electrical defects appearing on work recently performed by him.

This is the first suspension under the Electrical Code enacted in July, 1915, by the Board of Aldermen. The code not only contains detailed provisions in reference to the installation of wires and appliances for electric light, heat and power calculated to reduce the number of accidents to property and persons through fire and to persons through electric burns or shocks, but it also wisely provides the commissioner with a means of control through requiring electrical contractors to obtain licenses from the department and giving the commissioner power to suspend or revoke such license for cause. The revoking of this contractor's license will, the commissioner hopes, serve as a warning to others who are guilty of similar offences. In this work the commissioner has the cordial support of all reputable contractors.

Annual Banquet and Smoker

The Century Engineering Club, an organization of the employes of the Century Electric Co., St. Louis, Mo., held its second annual banquet and smoker Tuesday evening, May 2nd, at the Mercantile Club. Over 185 plates were reserved for the members and the officers of the company. Mr. D. S. Kramer, special representative of the Century Electric Co., the principal speaker of the evening, gave an illustrated talk on his experiences in the various foreign countries which he recently visited.

In order to provide better telephone connections with the lower Fraser Valley, Victoria, Seattle, and other points, the British Columbia Telephone Company recently laid a new cable across the Fraser River at New Westminster, to augment the service provided by the existing cable and to serve as an alternative in case of a breakdown. The new cable is 2,200 feet long and contains 48 wires.

Licensing of Electrical Contractors

Report of Standing Committee—Real Progress has been Made—An Appeal for Support of Contractors as a Body

By Mr. W. H. Lodge

Immediately after receiving my appointment at our first convention held last September, I commenced gathering together all the various acts, by-laws, etc., relating to the licensing of electrical contractors. I then asked our president, Mr. J. W. Commeford, our secretary, Mr. R. D. Earle, and Mr. Geo. T. Dale, of the Toronto Branch, to act on this committee with me. After several very arduous meetings we drafted our proposed licensing act. We then submitted this proposed act to the Toronto Branch and received the endorsation of that body. Your committee then had a private interview with Mr. W. K. McKnaught, of the Ontario Power Commission, who after a lengthy discussion, gave the proposed act his tentative approval.

Feeling reasonably satisfied with the real start we had made, and the good reception we had met with, we decided to ask for the support of the Electrical Section of the Board of Trade. They extended to us the right hand of fellowship and gave us all the assistance they possibly could. We then secured an interview with Mr. F. A. Gaby, chief engineer of the Ontario Power Commission. Our committee, with representatives of the Electrical Section of the Board of Trade and of the Electrical Contractors' Association of Toronto, presented and thoroughly discussed the license question with Mr. Gaby. We feel that it is necessary to act with the Hydro Commission, because legislation of this nature will undoubtedly be referred to them. We succeeded in impressing Mr. Gaby with the necessity of some form of control over electrical matters which will not only protect the public from the dangers of unsafe work of irresponsible contractors, but also protect the legitimate contractor against such unfair competition. Mr. Gaby stated that the Commission had legislation in course of formation and after comparing the results they expected to achieve with those our bill was designed to cover, it was decided that it would be better to try out the Commission's proposal since it was so far advanced and was expected to accomplish the same object.

Your committee was successful in impressing upon the Commission the advisability of co-operation with us in matters relating to our business. If we had had more backing in numbers, that is, if the electrical dealers and contractors had come forward as they should have and banded together I believe our proposal would have been adopted. As it is, we have agreed to try the Commission's scheme for one year. We hope it works. Any legislation which will raise the standard of electrical work will always be acceptable, but your committee are of the opinion that a license is the only satisfactory legislation we can get.

After our last Convention some 500 reports of the proceedings of the convention were printed and distributed. In the report was printed a report by Mr. F. C. Whatmough, of Stratford, of what the license had done for the contractors of Stratford, and what it has done there it can do for the whole province. We have until next February, when the Legislature meets, to make ourselves so important, in numbers and influence, that we will be able to get our proposed act before and through the House.

It costs a great deal of money to investigate the question and to push it before the Commission and the House. This can only be accomplished by the electrical dealers and contractors coming forward in a body as members. The fees you pay are spent in your interests. I can only say in conclusion that it is up to every one of you to put your shoulder to the wheel and push.

Resales—From the Jobbers' View Point

Manufacturers Slow to Appreciate Advantages of Fixed Prices —Market at Present Disorganized

By Mr. C. A. McLean

The natural law that water seeks its lowest level has a parallel case in the business world; but for water is substituted prices. And the lowest level in prices is always below the cost of doing business. Hence it becomes necessary to bolster up this unstable medium by various expedients, or as we phrase it, to "keep up the price." The most effective of these is to establish a fixed resale price to the consumer.

Undoubtedly, were the trade generally capable of accurately estimating their costs of doing business, the fixed resale would pretty much establish itself. It is here, gentlemen, that your association may do a great work. If you can educate the electrical trade of this province so that they may figure, simply yet accurately their cost of doing business, you will have rendered the manufacturer, the wholesaler and yourselves the greatest possible benefit.

Meanwhile the enterprising individual who believes that the same general principles which go to make a successful day at the Woodbine or the bucket shop, will also run an electrical business, is still here. If he knows the article or articles to be sold have a fixed consumer's price he will ask that price, or at the most a fraction below it. If he doesn't know the fair resale price he may ask double the same or he may add but ten per cent. to his own cost—and either way it is bad for the general reputation of the trade. Again, the fact that a certain article has a fixed resale, which is, say, fifty per cent. above the trade cost, means a constant incentive to the irresponsible dealer to mark up other articles to the same percentage.

Again, the fixed resale is a protection to the consumer. It gives him a feeling of confidence and security to find two houses quoting the same figure for the same article. To get the confidence of the community, gentlemen, is a bigger thing than a good line of credit because when you have the former the latter is bound to follow if you cultivate it at all.

The manufacturers of electrical appliances have been very slow to see the advantages of the fixed resale price. In general they forget the great essential fact that their business reputation depends on a square deal to the consumer, and no type of device which periodically appears on the bargain counter gives a square deal to the purchaser of the same at the regular price.

The wholesalers and the trade can co-operate to advantage in bringing this to the attention of the electric appliance manufacturer. He is largely dependent on our united efforts for the distribution of his goods and will usually be glad to comply with our suggestions in this respect. Moreover, we have in your association and the wholesalers' committee of the Electrical Section of the Toronto Board of Trade, the necessary machinery to handle all matters of this nature.

Departing from the discussion of the fixed resale on appliances, heaters, motors, batteries, lamps, etc., and coming to the question of resales on construction materials, we have a different problem. The cost to the trade varies with the quantity purchased and with general market conditions. From the experiences of the last six months you realize the impossibility of maintaining resale prices that would shift with the market and yet cover the entire line. A fixed percentage addition to the corresponding trade cost would perhaps be the easiest solution and would provide a resale sufficiently close for all practical purposes.

At the least it would be an improvement on the present situation and the easiest method of calculating resales until the markets have come back to normal.

The wholesalers indicated some time ago their willingness to co-operate with the trade in this matter. Since the markets became so disorganized this has never been discussed to a definite conclusion. Might I suggest that if you desire to adopt resale prices to the consumer on construction material that you decide on the method to be followed and then request the co-operation of the jobber in maintaining it. I am sure, from the discussions on this subject, that every legitimate jobber will support you as far as he can.

Resale—A Manufacturer's View Point

The Honest Manufacturer Has Many Enemies—The Dealer Who Cuts Prices—The "Just-as-good" Competitor

By Mr. E. G. Weed

What is Resale? Resale is the art of getting more money for a piece of merchandise than you pay for it—enough more to pay a good rate of interest on the money tied up in it and to pay for storage, the time consumed in selling and a certain amount charged against it to cover running expense, or fixed expense called "overhead." Usually, there are at least three parties vitally interested in every resale—the manufacturer, the jobber or wholesaler and the dealer or retailer.

The manufacturer is interested because of that evasive, intangible something called "good will" which is involved in every transaction of which his product is a part. There are two classes of manufacturers. One is making a product which bears his name, or a trade name, which he is proud to place on every piece of merchandise turned out of his factory. He is continually spending money in experimenting and in various ways to make his product better, always with the thought and hope of ultimately producing the best of its kind. When he has produced an article which will stand the "acid test," the critical requirements of a particular purchasing public, he proudly advertises his goods. He tries to tell the jobber, the dealer and the consumer, in an honest, straightforward, conscientious manner that he has a product that possesses merit. He puts a price on that product which represents his cost plus a reasonable profit for the men who handle it on its way to the ultimate consumer and will give that ultimate consumer his money's worth and a satisfactory service which will cause him to continue to purchase and to recommend that article to his friends. He acquires "good will" by giving good value, and "good will" can be acquired in no other way.

The Unstability of Good Will

Now when he has, through years of hard work, by making a good product, by advertising and by fair dealing, attracted to his goods and to his business this popular interest and approval, this "good will" which is not easily built and is very easily destroyed, he is confronted with one of the most important problems in marketing. For the manufacturer, this problem is that of price maintenance.

If all manufacturers were like the one I have described, this problem might not assume such serious proportions. But there is another manufacturer, who perceives possibilities in a fruitful field. The business is established The market is made. No years of slow expensive experimental work. The model is ready for him—the machinery for making it has been perfected. He launches the "just as good" brand and by cutting the quality a little here and a little there, together with his ready-made market, is able to offer his article, which being made in duplicate of the standard article, looks "just as good," at a price enough lower than the standard brand to make it look attractive to some jobbers and to some dealers. But we cannot obtain something for nothing, and if the goods are sold cheaper by the manufacturer, they must be re-sold cheaper by the wholesaler and the retailer. Their profit is proportionately not as good and the great increase in sales looked forward to because of the reduced price, fails to materialize because the goods lack merit and you cannot continue to sell poor goods to the poor public indefinitely at any price. So this condition, while it disturbs the market for the time, eventually rights itself automatically.

The manufacturer may for a time find a market for his goods through glowing advertisements, but even advertising will not keep an inferior article on the market.

Happily we have another protection from the inferior "just as good" article in the fact that our reputable journals who depend upon advertising for their financial success will not long continue to accept advertising from a firm who promise that which they cannot fulfil. He must put that minus quality in his goods, which necessarily brings the price to its proper level or he must quit through sheer lack of market.

Another problem which the manufacturer of a standard article has to contend with, and one which has been in evidence since the first day of merchandising, is the dealer who tries to attract trade by offering well-known articles at prices under the market. When an article is widely advertised, universally known and in constant demand, some retailers think it good policy to offer it at an unusually low price in order to attract customers to their store. Advertised goods are frequently the subject of cut prices offered by dealers who wish to accomplish this purpose.

Usually the object of cut prices on well-known goods is to attract the trade to his store and sell them other goods at a price that will make up his loss on the advertised article. This is where the consumer's interest in price maintenance appears. He is not helped by this practice and he is beginning to realize that price maintenance is actually his protection. He has learned that standard advertised quality brands seldom return more than a fair profit to the dealer and he is willing to pay that profit. He has found that the price-cutter cuts solely as a method of advertising. What he loses on the cut he must make up on some other article. Lines of merchandise on which the price is maintained have helped to standardize merchandising and have helped the consumer to buy easily and safely and have gone a long way toward educating him in the value of good merchandise.

Can price cutting be stopped? It may be that in the not far distant future, the courts will uphold the rights of makers of patented goods to fix the prices at which such goods shall be sold. This would not mean higher prices necessarily. Prices must be kept within a reasonable limit to encourage sales. It might easily mean lower prices, as it would eliminate a certain amount of expense that a manufacturer who tries to restrict prices on his product is continually put to and which must be charged to his cost.

The real remedy for this evil would seem to be the recognition by the dealer of the fact that his best interests lie in the purchase of goods of a reputable manufacturer who has established a price to the wholesaler, the retailer and the public, to maintain that price, thus assuring himself a fair profit, a satisfied customer and the knowledge that every sale will make a resale.

What Is New In Electrical Equipment

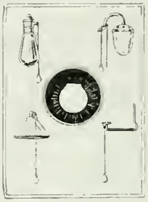
Electric Power Unit for Use in the Kitchen

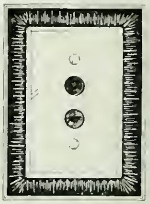
Since the use of electrical devices is meeting with rapidly increasing popularity in the home, as well as in offices and shops, there has arisen a demand for an electric power drive which can be used with labor-saving kitchen appliances of various kinds. In the accompanying illustration is shown a device of this kind, known as the Reco electric kitchen power unit, which is so arranged that it can operate any of the well-known hand-driven kitchen utensils, such as bread mixer, meat grinder, coffee or spice mill, ice-cream freezer, raisin seeder, cherry pitter, potato slicer, cake mixer, egg

whip and other devices. It has in addition a buffing and grinding-wheel attachment. This unit is so constructed that it will drive any of the above mentioned appliances without reconstruction whatsoever. The driving arm may be raised or lowered to suit any height of appliance. There is a horizontal as well as a vertical drive. The drive shafts are equipped with a chuck and crank. The chuck is used where the handle of the appliance can be easily taken off, while the crank is used where the handle of the appliance cannot be removed. The shelf is for supporting appliances which have table clamps. There are holding hooks provided to hold appliances in position while being driven. The motor is one-sixth horsepower and is furnished in both direct current and alternating current in all voltages and cycles. This unit is manufactured by the Reynolds Electric Company.

Luminous Switch Plates and Chain Knobs

Finding an electric light switch in the dark often resembles the much talked of search for the needle in the haymow. With the new Pioneer "Eradium" luminous switch plate or pull-chain bulb the trouble is eliminated. This composition will emit first a blue light which gradually changes into an intense white light at night, if the switch plate or bulb is where light is available in the day time. The switch plate can be attached anywhere that a wall plate is used, and the bulb is made so that it will fit over the knob on the end of a pull chain. Everyone has probably from time to





time had some irritation and perhaps barked a shin or sustained other minor injury in an attempt to find a light switch or pull chain in a dark room, so such an invention as the "Eradium" switch plate and pull chain socket will prove of great assistance and remove a great deal of that uncertain fumbling for a light. The "Eradium" specialties are made by the Pioneer Corporation, whose line of conveniences, made from the "Eradium" composition, embraces clock figures, house numbers, etc.

Motors Requiring Low Starting Current

A new line of fractional horse power motors specially designed to meet the objection of excessive starting current which is frequently raised has been put on the market by the Canadian General Electric Company. Pumps, air compressors, shoe machinery, coffee grinders and jig saws are frac-

Type SA

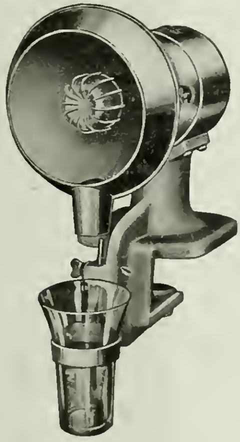
Tyye RSA

tional horse power motor applications that put the driving motors to a severe test. Such applications require motors with high starting torque to start and bring the machines up to normal running speed. It is generally required that the motor shall give this high starting torque without taking excessive current from the line which would affect the incandescent lighting service. The type RSA fractional horse power motors built in sizes from 1/12 to $\frac{3}{4}$ h.p. are particularly adapted to the driving of the machines listed, for they develop high starting torque with low starting current, this feature being obtained by having the motor start as a repulsion motor. Bearings are vital part of all machines that operate under severe service conditions. The Type RSA motors are supplied with ball bearings. These ball bearings eliminate practically all bearing friction and bearing wear, and therefore maintain accurate alignment of the motor in the air gap. No auxiliary device such as starting box or starting resistance is required with this type RSA motor. This is the ideal fractional horsepower motor to use on any machine where the starting load is heavy and the incandescent lighting service must be kept normal.

The type S.A. alternating current motor is built in sizes from 1/30 to $\frac{3}{4}$ h.p.

Electric Lemon Squeezer

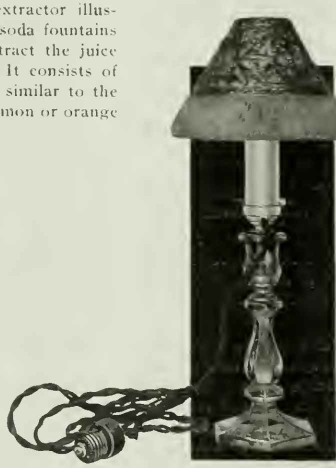
Thomas Mills & Brothers, Company, have recently developed the electrically operated fruit juice extractor illustrated. This outfit is suitable for restaurants, soda fountains and other places where it is necessary to extract the juice from large numbers of lemons and oranges. It consists of a motor-driven hemisphere provided with ribs similar to the ordinary hand-operated glass extractor. The lemon or orange



is halved and held against this semi-spherical part. The juice is caught in a deflector at the back and runs down through a spout at the bottom. A clamp is provided for attaching the outfit to a table or counter and a ring is attached below the spout to support the glass. The outfit is equipped with a 1/10 horse-power universal a.c.-d.c., 3,000 r.p.m. motor made by the Robbins & Myers Company.

Candle Type Lamp Sockets

As a result of greatly increasing use of candle-type fixtures the development of new candle-length sockets, shown herewith, by the Cutler-Hammer Manufacturing Company, is of interest. In these sockets the standard screw shell for receiving the lamp is placed at the top of a 4-in. candle, while, as shown in the phantom view, the usual push-button mechanism and binding screws are at the bottom, this portion being identical with that used in the standard-type sockets made by the same manufacturer. In place of the brass shell a tube of fibre is employed which fits securely into the cap. This type of candle socket is neat in appearance, and is very easy to wire, the conductors being secured under the binding screws in the regular way. No other wiring from switch mechanism to screw shell at the top is required. This shell is mounted on substantial supports which also act as conductors. The whole device is in one piece, and therefore the need of stocking and handling the various parts usually required is eliminated, and the amount of work necessary in constructing the fixtures is reduced. The screw shell at the top is of standard type and regular Edison screw-base may therefore be used. Two styles of candle-length sockets are made, one being suited for ceiling or wall fixtures, and the other being adapted for use with portable fixtures. The latter style has an extra outlet in the side of the cap. In the position of the portable lamp shown in Fig. 2, the extra outlet and the method of bringing the cord out of the outlet are shown. The push-button operation is claimed to have several points of advantage; the buttons are inconspicuous; they operate by a slight pressure of the finger tip, and with portable fixtures there is no tendency to pull the lamp over. When desired these sockets



C-H candle length push socket, with extra inlet for conductors; installed on ordinary glass candlestick.

Phantom view C-H candle length socket.

are furnished without operating mechanism. The sockets have ratings of 660 watts at 250 volts. They are handled in Canada by the Benjamin Electric Manufacturing Company.

Cadillac Vacuum Cleaner

We illustrate herewith the latest type of Cadillac Vacuum Cleaner with pistol grip and control in the handle. Its most noted feature is the friction driven brush for picking up lint and threads. It has a six-blade steel fan, claimed to be the largest of any portable vacuum cleaner. This machine won the Gold Medal at the Panama-Pacific and Panama-California Expositions in 1915 against eighteen competitors. It is the same type that was given as first prize at the ladies' drawing contest held at the recent Electrical Contractors' and Dealers' Convention and Electrical Show. It is manufactured and sold by the Clements Manufacturing Company.

Current News and Notes

Addison, Ont.

The Addison Rural Independent Telephone Company, Ltd., have secured a charter.

Agincourt, Ont.

Township officials have had a conference with Ontario Hydro-electric Commissioners relative to the installation of a light and power line to Agincourt, along the Don and Danforth Road, from the point where the city and township join.

Almonte, Ont.

The Town Council recently passed a resolution authorizing improvements to the local power plant according to plans prepared by the Ontario Hydro-electric Commission.

Brandon, Man.

A new telephone exchange, costing, including price of land, $60,000, is to be erected in Brandon, Man.

Eganville, Ont.

A charter has been granted to the Mink Lake Rural Telephone Company, Limited.

Galt, Ont.

It is stated that the Bell Telephone Company are to build a new exchange building in Galt this summer.

Guelph, Ont.

At a meeting of the Light and Heat Commission of Guelph, Ont., recently, it was decided to install another 750 h.p. transformer in the Huskisson Street plant.

Halifax, N.S.

The Halifax Board of Public Utilities have authorized the Halifax Electric Tramway Company's application for a reduction in rates to consumers. Electric current for lighting purposes is to be 10 cents per kw. hr. Special rates are to be given on five year contracts. Electric current for power purposes will be 8 cents per kw. hr. The usual discounts will be allowed for prompt payment.

An offer of 51½ per cent. on the million dollar common stock of the Cammaguay Electric Company, Halifax, N.S., made by Montreal interests, has been withdrawn. It is supposed in some quarters that a new offer will be made, but it is a matter for conjecture whether negotiations will be carried further.

Hamilton, Ont.

Forty electricians in Hamilton, Ont., quit work on June 1, following the refusal of employers to grant an increase from 40 to 50 cents an hour. A compromise was offered of 45 cents, but as it did not apply to all the men, the strikers refused to accept it. Several demands were made, one of which was that apprentices should be under the control of the journeymen instead of the employer. This the employers refused.

Montreal, Que.

The Empire Electric Company (Jas. C. Sherriffs and Charles H. Levesque), manufacturers' agents, Montreal, have registered.

Niagara Falls, Ont.

Extensive extensions are being made to the forebay of the Canadian Niagara Power Company's plant at Niagara Falls, and work on the installation of three new units in the south section of the plant is progressing rapidly. Each of the new units will develop 12,500 h.p., and when put in operation the total output of Canadian Niagara power will be approximately 112,500 h.p.

Orillia, Ont.

Negotiations are under way between the Orillia Water, Light and Power Commission and the Hydro-electric Commission for the use of the surplus power developed at the Swift Rapids to supply towns served by the Hydro. If an agreement is arrived at it will likely take the form of a general co-operation in making use of the surplus power at the various plants on the Severn to the fullest extent possible, each plant helping the other as occasion may arise and circumstances dictate.

Ottawa, Ont.

Promoters have been granted permission to construct a water power project at Grand Rapids, on the main Saskatchewan River. Power will be used to operate a pulp and paper mill near the site. $150,000 must be spent on the plant within two years and at least 5,000 h.p. is to be developed. If any power is sold the Government reserves the right to control the rates and also exact a rental.

Palmerston, Ont.

Hydro power is now being supplied to the town of Palmerston by the Ontario Hydro-electric Commission.

Sarnia, Ont.

The city of Sarnia has taken over the power plant and lines of the local electric company and will operate them until Niagara power arrives in a couple of months. The plant cost the city $180,000 and will be changed from 60 cycle power to 25 as soon as the Hydro arrives. The Hydro transmission line is now nearing Sarnia, the poles being erected to within a few miles of the city.

Toronto, Ont.

The Electrical Fittings Company, Ltd., have been succeeded by Electrical Fittings & Foundry, Limited.

Members of the Ontario Cabinet and the Provincial Hydro Commission recently met to discuss development at Niagara, consequent on the increased demands for power. It was pointed out that according to treaty rights, 36,000 cubic feet a second might be taken from Niagara River for Canadian use. Three companies already have concessions, using in round figures, 27,000 or 28,000 feet of the 36,000, leaving only 7,000 or 8,000 feet more water power available at Niagara Falls for the people of Ontario.

Warwick, Ont.

A public meeting was recently held in the village of Warwick, Ont., at which a general desire was expressed by the farmers present for Hydro service and petition forms were distributed throughout the township calling for the submission of estimates.

Winnipeg, Man.

Fire Alarms, Limited, have been incorporated.

Trade Publications

Flatirons—Pamphlet No. 601, by C. G. E. Co., describing and illustrating "Kitchener" and "Colonial" electric irons.

Feeder Voltage Regulators—Bulletin No. 45402 by the Canadian General Electric Company, describing, with illustrations, the general principles of induction, single-phase, and polyphase feeder voltage regulators manufactured by that company.

According to statistics furnished to the provincial government there were 39,798 telephones in British Columbia at the end of 1915, these figures showing a decrease of 3.3 per cent.

Electrical News
Generation, Transmission and Application of Electricity

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Universal Service Supply

In a recent address before a gathering of engineers, Mr. Samuel Insull, President of the Commonwealth Edison Company, of Chicago, referred at length to a matter which has nowadays become a favorite topic where engineers are met together and allow their imaginations to soar in the realms of future possibilities—universal service supply. Gradually this idea is growing in the engineering mind as a possibility of the not too distant future. At least it is felt that a start has been made, and little by little we are adjusting our old ideas on the electricity supply business to include this greater and higher conception of its possibilities.

Mr. Insull, of course, looks at the question almost entirely from the administrative and economic side and some of the figures he quoted are very convincing. For example, he compares electrical supply conditions in the cities of Chicago and London. Chicago has a population of two and a half million people, all of whom are supplied with electricity from the one source—the Commonwealth Edison Co. The maximum demand in Chicago has reached 338,000 kilowatts, or something over 1 kilowatt to eight persons. The total number of kilowatt hours generated in 1915 was 1,200,000,000, or 480 kw. h. per capita.

In comparison with these figures, the city of old London, with its population of something more than three times as great, only had a maximum demand of 225,000 kw., or 1 kw. for every 35 inhabitants. The total consumption was 571,000,000 kw. h., or slightly over 70 kw. h. per capita, as compared with 480 for Chicago, i.e., about one-seventh.

* * *

Mr. Insull says the great difference lies, of course, in the selling price, which is lower in Chicago on account of the centralized organization, whereas in London there are 64 separate and different electricity supply organizations. Then, too, much is attributable to the diversity of demand of the larger organization. As an example of this, the speaker estimated the saving that could be made in his own district under still further centralized organization of diversified interests. He estimated that if all railways within the Chicago area were electrified, their maximum demand would amount to 125,000 kw. The isolated power plants in this area he placed at 264,000 kw. These two items added to the present Chicago maximum demand of 338,000 kw., makes a total maximum demand, under different managements, of 727,000 kw. The energy demands of these different classes of requirements are so diversified, however, that the coincident maximum demand only amounts to 577,000 kw. Thus with the energy all supplied from the same source in this case, there would be a saving in demand of 150,000 kw. This, Mr. Insull figures would effect a fuel economy of 6,000,000 tons of coal a year, to say nothing of lower operating costs, lower initial investment, consequent reduced carrying charges, and so on.

* * *

What Mr. Insull preaches and practises in his own city is, we believe, equally applicable over much larger and more sparsely settled areas. Indeed the really basic principle underlying the operation of the Ontario Hydro in western and the Electric Power Company in central Ontario utilizes the same conception. With the requisition of the Electric Power Company's system by the Ontario Government, that province will now have much the largest area of linked up electric generating and distributing systems in the world, and the successful service this organization has been able to provide over such a tremendous area is the best proof of the soundness of the principle. With further developments in long distance transmission, the idea will, may be, extend till finally the towns and cities of Canada are all linked up to our grand water powers, and the remotest corner of the Dominion is given a guarantee of "service" only now enjoyed by the more favorably located areas. Such a realization will mean not only cheaper electric rates, but practically uniform rates, will enable factories to locate in the most favorable surroundings, and, in general, will allow of a uniform and fairly competitive development of all our national resources.

Cooking By Wire Costs Less

If the citizens of those Canadian municipalities where electric current is now so cheap should suddenly realize the advantages and economies of the use of electric ranges, the demand for ranges, and current to operate them, would overtax the capacities of the manufacturers and the central stations. Here is a sample "bill" in a locality where current is supplied at low rates, for the month of May 14 to June 14, in a family of four, where an electric range (total capacity, 5,600 watts), toaster, percolator, iron, electric vacuum cleaner and a 1,500-watt air heater, are all in use, in addition to the lighting:—

36 kw. h. at 4c. =	$1.44
36 kw. h. at 2c. =	.72
73 kw. h. at 1c. =	.73
Total 145 kw. h. =	2.89
Less 10% =	.29
Net amount =	2.60

The net bill for the previous month had been $2.59. These work out at an average rate of 1.8c. per kw. h., and are probably 50 per cent. less than the average gas bill for a family of the same size. A consumption of 143 kw. h. in a family of four is even, according to statistics, somewhat above the average, which is placed around 30 kw. h. per capita. However, it is worth noting that if the consumption in this case had been twice as much, the bill would still have been remarkably low, reading as follows:—

36 kw. h. at 4c. =	$1.44
36 kw. h. at 2c. =	.72
218 kw. h. at 1c. =	2.18
Total 290 kw. h. =	4.34
Less 10% =	.43
Net bill =	3.91

The chief trouble seems to be that, aside from the few who have been chiefly instrumental in bringing it about, even electrical men do not appreciate the tremendous strides that have been made in the reduction of electric current rates in the last five years. Not so very long ago in a city where current was 16c per kw. h., a water heating equipment was installed in the home of a well-to-do citizen, and the first monthly bill was $74.00. To-day there is at least one city in Canada where the same service is given for a flat rate of $1.80.

A man of continental reputation in the electrical industry recently said that, "Nothing, except possibly transportation, has so much to do with the well-being of the people as a whole, as the production and distribution of cheap electric energy to all classes of our population and to all communities, whether they be large or small." We have this wonderful instrument in our hands. Are we sufficiently enthusiastic in its use?

New Bell Telephone Exchange in Sherbrooke City

The Bell Telephone Co. of Canada, have recently completed the erection of a new office and exchange building on Strathcona Square, at the corner of Terrace Street, in the city of Sherbrooke. The building has a frontage of 40 feet on Strathcona Square, and a depth of approximately 75 feet on Terrace Street. It is 3 storeys and basement high, and provision is made for a future additional storey and also for the ultimate extension of the building to the extreme end of the lot.

It is designed and built according to the most modern practice applied to this type of telephone buildings; and in relation to fire resisting constructional methods. The structural floors, beams, columns, exterior wall, interior main partitions, are of reinforced concrete, brick, stone, cement, terra cotta, etc. Wood is practically eliminated throughout the construction. The Terrace Street front and the east side, looking towards Wellington Street, are built of Queenston limestone, carried on a Stanstead gray granite base beneath.

The treatment is simple and dignified and was designedly made to harmonize with the adjacent buildings facing on Strathcona Square. The main entrance in the centre of the front, looking over the square, is approached from either side by a stone terrace finished with a granite parapet, on the balustrade of which are two handsome electric lamp posts, which efficiently illuminate the front of the building.

From the main entrance vestibule to the operating room on the third floor there is a continuous corridor and staircase hall, separated from the adjacent offices and other apartments in the most fire-resisting manner possible. The doors from it entering into these other premises being Underwriters' hollow steel, 3 point lock pattern. The windows throughout are Underwriters' pattern, made of hollow metal and glazed with heavy wired glass. On the right hand of the ground floor corridor, at the top of the vestibule steps, is a commodious public office and pay station, giving direct access to the Division Superintendent, business office, and telephone booths.

Special provision is made in the entrance vestibule, so that it can be used by the public to telephone after offices are closed for the day. Behind the public and business offices are those of the Local Plant Department, and lavatories for men and women, finished with impervious floors, marble trim, and high-grade type of basins and sanitary fittings; and on the left hand side of the main corridor, directly opposite the Bell Telephone Co.'s public office, are the offices of the Eastern Townships Telephone Co. The terminal and battery rooms are arranged across the front of the first storey, while the operators' cloak, lunch, retiring and toilet rooms occupy the balance of this floor at the rear.

The whole of the second floor will be used for the operating room. At the rear from the operating room to the yard level is an iron fire escape communicating with each floor, and so arranged that it is almost impossible for it to be obstructed by smoke from the adjacent doors or windows. It is really a complete exterior staircase, as efficient and easy to go up and down as the main interior staircase; differing entirely in this respect from the fire escapes very generally seen.

In the basement are linemen's and inspectors' quarters, furnaces and coal rooms, fireproof stock and general store-

rooms. At the rear of the property is a 2-storey brick stores shed, 30 feet long by about 16 feet wide, for the storage of cable reeds, wire, and other heavy supplies. The offices previously mentioned have been in possession of the departments using them for some time past, while the installation of the new telephone equipment has been proceeded with in the terminal and operating rooms on the first and second floors. One very special feature of the building is what is termed its flexibility. Should more office accommodation be required on the ground floor, it is only necessary to extend this floor backwards.

When the telephone service grows to such an extent that the present operating room will not accommodate sufficient switchboards, it will mean necessarily that it and the first floor beneath will be extended backwards to provide additional operating room, terminal room, operators' accommodations, and the consequent extension of the space required on the ground floor for commercial or plant offices. This can be done at any time, or from time to time as required, to the limit of the rear end of the lot, without at any time disturbing the existing service or business conditions which may have accommodations in the building at the time that any such extension may be required. The building was designed by Mr. W. J. Carmichael, and constructed by Anglins, Limited, Montreal.

Electricity on Our Western Farms

The Pacific Coast Keeping Pace with the East in Supplying the Rural Districts with the Advantages of Electric Power

By Geoffrey T. Porter

Since the dawn of history necessity has been the mother of invention, for man has always been forced to invent various labor-saving devices in order to insure his existence and to reduce the drudgery of life. As the human race increased in numbers its needs became more complex, and man was forced to replace or supplement inefficient and expensive manual and animal labor with various implements and labor-saving devices. It is for this reason that we have railroads in place of stage lines, the telephone and telegraph in place of messengers, and various automatic machines in place of expensive and inefficient manual and animal labor.

But this progress has not been confined to cities. The farmer, upon whom the prosperity of the nation is largely dependent, has devised from the very beginning of the farming industry various implements to aid him in reducing the manual and animal labor involved in farm work. Until very recently, however, these implements were of crude construction, and as a consequence the amount of labor required of the farmer for a given output was very great and his working hours were necessarily long. Most authorities consider the year 1850 to be the beginning of this transition period.

Since then, successive years have seen continuous improvement in the design and manufacture of agricultural power machinery, and its adoption on farms of appreciable size has been practically universal. The substitution of machinery for hand and animal labor has resulted in many notable reductions in both time and cost of producing and handling the output of the farm . Not only has the use of farm machinery reduced the cost of farm products, but it has also been an aid in improving their quality, due to the more scientific methods of planting and harvesting which it has rendered possible.

Electric Lighting

As a source of light, electricity surpasses all known illuminating agents. It is now generally recognized that electricity furnishes the safest, cleanest, most effective and convenient system of artificial lighting. Electric lamps may be used without the slightest fire risk in hay lofts, stables, grain bins, henneries, etc.

Electricity eliminates the drudgery and danger of filling and cleaning oil lamps, and is always available at an instant's notice by the simple turn of a switch. When desired, the electric lamps can be arranged to be turned on and off at a distance, from several points, by the simple push of a button or turn of a switch.

Not only may electric lights be used in farm buildings, but in the barnyards as well. When necessary, harvesting can be done by using portable arc lamps. Luminous arcs and flaring arcs are especially adapted for the illumination of large areas, while for the lighting of buildings the tungsten lamp is recommended.

Electricity in the Farm Home

There are many other uses to which electricity can be put in the farm house, besides illumination; in fact, the drudgery of housework may be practically eliminated by means of the many labor-saving devices which the use of electric current renders available. Electric heating and cooking devices generate heat with absolute reliability, but, unlike most heating and cooking devices, they do not appreciably increase the temperature of a room unless they are designed for that purpose. They furnish heat only where needed and consume current only when in actual use. The advantages of electric cooking and ironing without ash, soot, small flame, or gas of any kind, is apparent to all. Most of the household devices, such as electric irons, small stoves, toasters, chafing dishes, water heaters, percolators, washing machines, small water pumps, electric fans, sewing machines, meat grinders, bread mixers, refrigerating machines, and buffing and grinding outfits, can be attached to any electric lighting outlet. Some of these may require special power circuits, in which case customers obtain the reduced rates granted to power users.

Advantages of Electric Motors

The electric motor is the ideal source of farm power, as it can be readily applied to all classes of farm and dairy

Fig. 1.—Robert Kelly's farm installation.

machinery. They may be mounted on the machine itself, or on the floor, wall, or ceiling, being either belted or direct connected to the machines which they are to drive. In no case will the adoption of electric drive involve any radical change in the existing machinery, and even hand-operated machines may be driven by small motors by simple substituting a pulley.

In order to reduce the first cost of the motor equipment, it has been the practice in some instances to provide a portable motor which can be moved from building to building and belt-connected to the various machines, or transported about the yards for the operation of threshers, ensilage cutters, grain elevators, and other machinery. Outlet boxes are located about the farm wherever power is required, and the wires run permanently to them. Several hundred feet of cable can be used, which is permanently connected to the motor and is attached to the outlet boxes by means of plug switches, which are not only safe, but fool-proof.

Electricity in the Dairy

Considering now motor applications in detail, we shall first show how electricity may be used to advantage in the dairy. The requirements of modern sanitation have brought the vacuum process of milking into common use, and in numerous installations electric motors are utilized to drive the vacuum pump.

Fig. 1 illustrates a vacuum pump which is electrically driven by means of a 5 h.p. electric motor mounted on the wall transmitting power to the vacuum pump by means of a belt. Note the manner in which the wiring for the motor is installed. All the wires are neatly brought down the wall in a steel conduit. The main switch is usually contained in a fireproof steel cabinet. The wires leading from the main switch are also contained in a steel conduit and are brought out at the starting switch through a porcelain condulet. Although this class of installation costs more in the first place, its adoption is true economy in the end, for such an installation is first-class in every way and is not only exceedingly safe, but is permanent, which is not a feature of cleat and open wiring.

Each milking machine is capable of milking two cows at one time, and one man can tend two machines at a time and thus milk about six cows per hour. According to extensive tests by the New York Agricultural Experimenting Station, no injurious effects are produced by the use of mechanical milkers.

In addition to vacuum milking, there are many other uses for electricity in the dairy. In cases where the dairy machinery is compactly arranged, it can be economically driven in a group by a single motor and shafting, but greatest economy is obtained when each unit is provided with a separate motor.

Cream Separators and Pasteurizers

Motors are well adapted for the operation of cream separators and pasteurizers. As they take little power, they may, in most instances, be operated direct from an incandescent lighting circuit.

Operating Churns

Another use for the motor in the dairy is for driving either the barrel or factory type of churn. The size of motors used for driving churns ranges from $\frac{1}{8}$ to 3 h.p.

The Water Pump

One of the most important power applications on the farm is that of the water pump. Usually a 1 or 2 h.p. motor will supply all the water necessary for both the farm and dairy, depending somewhat on the lift and the distance the water is to be pumped. The pumping equipment can easily be made automatic and no attention need be given it, as a switch operated by a float or pressure governor will keep the water at a pre-determined point. Outside of oiling every few months, the whole pumping equipment is entirely self-operating.

Barn and Field Machinery

Outside of the dairy there are over thirty applications of electric drive for barn and field machinery, the more important being the electric drive of feed grinders, corn shellers, ensilage cutters, grain elevators, grain threshers, grain graders, bone grinders, hay hoists, hay balers, and clover hullers.

An important advantage which barn and field machinery, operated by means of electric motors, possesses, is that they have a large overload capacity, and in addition, the operation of the machines can be safely and effectively controlled at all times. In operating feed grinders, oat crushers, corn crackers, alfalfa mills, etc., the feed can be economically ground for use as it is needed, thus preventing a possibility of a decrease in food value.

Feed Grinders

Feed grinding is done electrically on the farm of Mr. Samuel Leman, for example. This is only one of the many operations carried on electrically on this farm, there being also a wood saw, cream separator, washing machine, and tool grinder, all of which are motor driven. The house and barn are lighted by means of seventy-eight 16 c.p. incandescent lamps. Both the feed grinder and wood saw are driven by a 5 h.p. motor, while the other machines referred to are ground-driven by means of a line shaft belted to a $\frac{1}{4}$ h.p. motor. Tests on a feed grinder capable of grinding 11 bushels of corn per hour and driven by a 5 h.p. motor, show that it takes .433 kw. h. (.57 h.p. hrs.) to grind a bushel of Dent corn,

Ensilage Cutters

There are other machines which require larger motors, one of the most important of which is the ensilage cutter.

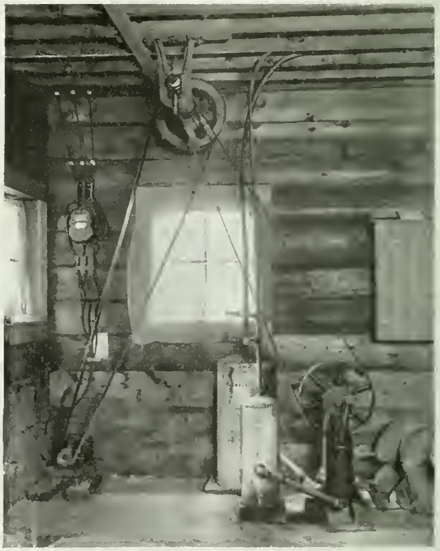


Fig. 2.—Shannon Bros.' 5 h.p. equipment for milking machine.

A farmer who has electric service can cut his ensilage at any convenient time, which is not always the case when a custom machine is used. Motor-driven ensilage cutters can safely be set near combustible material, and operated under these conditions without fire risk. The switch can be so arranged that the motor can be instantly started or stopped by the man who is feeding the machine, for no engineer or expert attendant is required. Ensilage cutters are almost always belted to the motor. It is therefore generally mounted on a truck and can be moved to any part of the farm for use on large corn shellers, huskers, shredders, threshers, grain elevators, etc.

Grain elevators are also rapidly coming into universal use, the size of the motor required ranging in size from 1 to 5 h.p., depending on their capacity. A grain elevator capable of unloading 25 bushels of ear corn in three minutes will elevate 45 bushels 19 feet at a power cost of only one-half cent, with electricity at 5 cents per kilowatt-hour.

On Mr. F. D. Stephens' farm on the Vye Road, is a 15 h.p. motor to drive his ensilage cutter and blower used for the filling of his 220-ton silo. In the milk house Mr. Stephens operates a De Laval separator direct connected to a small motor. The water is lifted from an 80 ft. well to a tank by means of a 3 h.p. motor-driven pump.

Near New Westminster, the Shannon Bros.' farm at Cloverdale, well known to all in that district, is shown in Fig. 2. The vacuum pump of the milking machine and the electric motor driving it are seen in this illustration.

Another important installation, Fig. 1, has been made recently by Mr. Robert Kelly, at Kensington Prairie, three miles south of our railway line near Sullivan Station. Mr. Kelly's power plant consists of three individual motors, one driving a shaft from which is operated the hay cutter, root cutter and crusher, by belts going through the partition. At the left of the picture is seen the electrically driven water pump feeding the main tank supplying the farm with water. The machine at the right hand side of the picture is the vacuum pump of the milking machine.

In the East Delta, near Mud Bay, the majority of the farms, both dwellings and barns, are electrically lighted, and on a few of the farms small motors are being used for various purposes.

Fig. 3 shows some of the equipment on the farm of Charlton Bros., in East Delta, near the Trunk Road to Ladner, on which electricity is extensively used. This picture shows the power equipment inside the same barn; it consists of a 5 h.p. motor, driving a shaft, from which are operated the grain crusher and hay cutter on the upper platform, and the root cutter in the root house below. Charlton Bros. also have lighting wires throughout all their barns and outhouses.

Another installation may be found near Woodward's Landing, where Mr. R. W. Doherty's farm is electrically lighted throughout; also a 5 h.p. motor drives, through a countershaft, the hay cutter and grain crusher on the upper platform and the root cutter on the ground floor.

One of the old-time farmers, well known in the Lower Delta and also throughout the whole Fraser Valley, is Mr. D. M. Webster, who has recently installed electric light and power. Mr. Webster already operates a motor-driven hay cutter and intends to apply electric drive to additional machinery in the near future.

Councillor William Oldfield's installation on No. 3 Road, Lulu Island, includes a 7½ h.p. motor, which, through a countershaft, drives a grain crusher, a hay cutter, and a root cutter.

The question now naturally arises, "what is the cost of driving machinery by electricity?" I have already given you some idea of the sizes of motors required for driving the different machines around the farm; these motors range in size mostly from ⅛ h.p. to 5 h.p. If the aggregate capacity of all the motors installed at a farm is small they will generally be supplied from the lighing circuit, and no spe-

Fig. 3.—Charlton Bros., East Delta, 5 h.p.

cial meter will be provided. The cost of operating motors of various sizes for one hour under these conditions would be about as follows: ⅛ h.p., 1.1 cents; 1 h.p., 8.8 cents; 2 h.p., 17.6 cents; 5 h.p., 44.0 cents.

In cases where the total power of the motors installed is considerable, a special power meter is installed and a cheaper rate is charged. The cost of operating motors of various sizes for one hour under these conditions is as follows: ⅛ h.p., ⅝ cent; 1 h.p., 5 cents; 2 h.p., 10 cents; 5 h.p., 25 cents.

As regards the cost of making connections to farms, every case is different, and no general figures can be given.

The Electric Lighting of Pullman Cars

The general public, who are continually demanding the use of electric lighting on all steam passenger equipment, do not realize the numerous difficulties to be encountered and overcome before any system employing electric energy as an illuminant can be considered wholly satisfactory.

It should be borne in mind that provision must be made for supplying light regardless of whether the train is in motion or at rest, and, in the latter case, during stoppage of short or long duration. Another, though less obvious, difficulty, is the necessity of providing means of automatically compensating for the various demands for light occasioned by the changes in the length of the day at different seasons, of meeting the variation in conditions of service under which a car may be running and of providing against sudden dark weather at any time of the year. The problem has been studied by many authorities, and attached in many different ways, each of which has purported to eliminate some special difficulty of other methods, though not infrequently introducing drawbacks of equal or greater weight in some unforeseen direction.

Electric lighting lends itself more freely to combined scientific and artistic illumination of passenger equipment. A light source can be controlled by artistic and effectively designed reflectors to govern any condition from the baggage room to the parlor car.

Many engineers have worked on the railway lighting problem for the past 25 years and only within the past five years could it be stated that electric lighting was satisfactory. The improvement has been due not a little to the increased efficiency of incandescent lamps, as well as improved train lighting apparatus, such as generators and regulators. The methods used for the electric lighting of passenger equipment to-day can be classified under three different heads, straight storage, head end, and axle generators.

Straight Storage

The straight storage system, as ordinarily installed, consists of 32 cells of 300 ampere hour batteries, which are generally arranged in groups of two cells in double compartment lead lined tanks, the batteries being arranged under the car in special compartment boxes. It is impractical to change the batteries in a car at the end of each trip except in case of absolute necessity. The cars, therefore, must lay over in the terminal yard a sufficient length of time to charge the batteries. An elaborate and expensive yard wiring system is required in order that the charging circuit can be plugged to the batteries regardless of the position occupied in the yard. Another disadvantage is the fact that a lead storage battery is subject to temperature variations, the capacity dropping off approximately 5/8 per cent. for every degree drop in temperature below 70 degrees. It is obvious, therefore, that in extremely cold weather the battery capacity may drop to such a point that sufficient capacity is not available to care for the lighting over a very long trip. With carbon filament lamps, the possibilities of the straight storage battery method of lighting were exceedingly limited, but the advent of the high efficiency mazda lamp, which requires approximately one-third the amount of current consumed by the carbon lamp, had the tendency of raising the number of straight storage battery equipments on the various railroads.

There are other disadvantages of the straight storage system, such as a car not being placed on charge at the terminal yard promply, which introduces the possibility of leaving the batteries standing in a partially charged condition. Again, a car going on to another road is subject to the possibility that it will not be properly charged or not charged at all, with the result that the battery is returned badly sulphated. Under these conditions it is often necessary to discard the plates altogether. Another disadvantage is that voltage variation on straight storage battery systems is considerable. A battery of 32 cells, when fully charged, will give a voltage of approximately 67 volts, falling to 57 on discharge, but as the decrease is gradual, it is seldom noticeable to the passengers.

Head-End System

One head-end system in use consists of using automatic lamp regulators on each car to maintain a constant lamp voltage. The generator equipment consists of a 20-kw., 100-volt compound wound Curtis turbine generator, operating at a speed of about 4,500 r.p.m. at 80 pounds steam pressure.

Switchboards with the necessary instruments and overload no-voltage reverse current circuit breakers are provided which, with the generator equipment, are located in a separate compartment at one end of the baggage car, and operated by steam from the locomotive. Steam piping is so arranged that either end of the turbine car may be operated towards the locomotive. The batteries consist of 32 cells of 300 ampere-hour capacity, and are carried on all the cars of the train except the coaches and express cars. These generally average five batteries on a seven or eight car train.

Each car is provided with an automatic lamp regulator identical with that used for the axle-drive type generators, with a slight modification to adapt it to the larger voltage range met in this service. The regulators are adjusted to maintain 63 volts on the lamp circuits, 63 volt mazda lamps being used.

The generators are operated at voltages varying from the lamp voltage to 90 volts, depending upon the amount of charging the batteries require. Normal train line voltage is maintaining between 70 and 85 volts, thus insuring that the batteries are being charged at all times. When turbines are operating during lighting hours with batteries in a fully charged condition, the voltage is reduced to about the floating point, thus carrying the lamp load entirely on the generators and at the same time preventing overcharging of the batteries.

Axle Generator Systems

The axle generator system has been greatly improved in the last four or five years, and while still the most expensive system to install, by reason of a generator being required on every car, it has the advantage of being a self-contained unit and therefore the car can be operated on any road with small chance of a lighting failure, as practically all roads have train lighting men who understand the various systems and maintain not only their own but foreign cars passing over their lines.

Furthermore, the axle system does not require the elaborate yard charging facilities that are needed for cars operating on head-on systems, or specially on straight storage systems. There are numerous axle- generator systems both in this country and abroad, but time will not permit a description of all of these various types.

The one which is in common use in Canada is that manufactured by the Stone Company, of London, England. It is one differing in fundamental principles from the equipments built on this continent, in that the generator is suspended from under the body of the car instead of from the truck. The slipping belt principle of controlling the generator output is used as against some form of resistance regulator for varying the strength of field current, as is common in the American type. This gives an advantageous feature in that the generator does not require to follow the speed of the train, thus permitting of a lighter generator with reduced bearing and lubrication expense. By means of output indicator either attached to dynamo in the form of a spirit level or other indicating device, the carman in examining dynamo can readily adjust the output of generator for the particular service or time of year for which service is required. Although this may seem to be a disadvantage in that manual attention is required, there is very little disadvantage found in practice, as the yard electricians very quickly learn what is necessary. By this attention the more intricate control feature, consisting of a generator regulator, is obviated.

At first sight it would appear as if there would tend to be an extensive belt renewal due to the slipping, but this has not been found to be the case, as output of machine is obtained with an extremely low belt tension.

Lamp Voltage Control

With the Stone equipment the standard battery capacity is divided into two equal parts. The chief reason for this arrangement is to eliminate the use of an electrically controlled lamp voltage regulator. When the lamps are switched on, and the generator is operating, one-half of the battery receives a charge while the other half is connected directly in parallel with the lamps and serves to stabilize the lamp voltage. The lamp current, however, is supplied from the generator through a suitable lamp resistance. As the train slows down, the two batteries will automatically take up the lamp load in parallel, and in this manner the full storage capacity is available for lighting purposes when the generator is inoperative.

An automatic battery change-over switch alternates the two battery units as regards their electrical position in the system every time the train starts. This insures that a newly charged battery is always floating across the lamps with the result that the lamp voltage is kept at its constant and proper value. By means of this automatic battery change-over switch an equal state of charge of the two battery units is insured. In the daytime the switching off of the lamps short circuits the lamp resistance and the generator charges both batteries in parallel.

When the train starts up, the generator voltage builds up and at the pre-determined value, usually 32 volts, the automatic cut-in and out switch closes the circuit between the generator and external circuits, consisting of batteries and lamps. The current from the generator is kept in uniform direction by a mechanically operated pole changer.

The other axle systems furnished in this country by the Gould, United States, and Safety Car heating and lighting companies, consist, briefly, of a dynamo suspended from the truck frame, although these companies have recently developed a machine for suspension from the under body, the generator and lamp regulator, the former consisting of a voltage coil connected across the generator brushes which operates a solenoid which, by means of a lever, reduces the pressure in the carbon pile in series with the field of dynamo. The generator voltage is thus held constant irrespective of the speed. The lamp regulator consists of a carbon pile inserted in the lamp circuit, the resistance through carbon being regulated by means of the solenoid connected across the lamp circuit. In this way, the voltage across the lamps is kept constant with variation in lamp circuit.

In order to prevent the overcharging of storage batteries, it is common practice to-day for an ampere-hour meter to be connected in series with the batteries, and when they are being discharged, the indicating hand travels over a circular dial in clockwise direction. The tip of the indicating hand operates a contact with meter, shows full charges, which, by means of a relay or direct connection, reduces generator voltage to the lamp voltage, thus keeping down the charge of the batteries. The meter is so constructed that it reads 20 per cent. slower on charge than discharge, thus allowing for the battery efficiency.

The most important feature of a car lighting equipment is the battery. Due to the improvement in design of generating equipment, a life of five years is now considered an average one in car lighting service. The state of charge in battery is usually determined at car terminal at various intervals, depending upon the service in which the car is operated and from readings obtained with a hydrometer, the necessary adjustment is made by which charge to batteries is proportioned correctly for the service. The principal cause of trouble to-day with batteries which must be guarded against is preventing leakage of current to earth, through containing box. Recent practice shows that by the use of a heavy roofing paper in bottom of containing box, this trouble can be practically eliminated.

The Edison storage battery is recommended highly for car lighting service by several railways who have now had from three to five years' experience with them, and if initial cost could be further reduced, there would probably be a much larger installation of this type of battery for car lighting.

The subject of train lighting has now become such an important feature in railroad operations, affecting, as it does, the comfort and safety of the travelling public, that there has been formed the Association of Car Lighting Engineers, whose members have ample material for discussion. This organization in conjunction with the Master Car Builders' Association, has formulated specifications and standards to increase the efficiency, reliability, and economy of car lighting and mainly through their efforts during the past five years, the subject has been so completely solved that electric lighting is now practically standard for all new passenger rolling stock. The regulation of voltage and reliability of service given by the various makes of equipment, is equal, if not superior, to that of the average central station service, and the annual cost is now less than that of previous gas systems.

Experience and Recent Developments in Central Station Protective Features

By N. L. Pollard and J. T. Lawson*

The entire territory served by The Public Service Electric Co. comprises three principal divisions: the Northern, Central and Southern, which include the more densely populated sections of the State of New Jersey.

The Northern Division consists of eight generating stations having a combined capacity of 148,000 kw. and feeding 33 sub-stations.

The Central Division consists of five generating stations having a combined capacity of 17,800 kw. and feeding 13 sub-stations.

The Southern Division consists of four generating stations having a combined capacity of 32,000 kw. and feeding 17 sub-stations.

In the larger stations current is generated at 13,200 volts, 3-phase, both 25 and 60 cycles, and in most cases is distributed at that voltage between the various stations and substations, through 260 miles of underground cable and 425 miles of overhead lines.

In the smaller stations, current is generated at 2,400 volts, two-phase, 60 cycles, and distributed locally at that voltage. That part of the current not consumed locally, is stepped up to 13,200 volts, three-phase, by means of Scott-connected transformers.

In certain sections our loads have increased so rapidly that it has been found impracticable to take care of any additional load and maintain the proper service at these points. In order to take care of these sections it was found necessary to change some of our transmission lines to 26,400 volts, and to install step-up and step-down transformers with a ratio of two to one.

The method of operation is to run all stations in multiple, which necessarily means that the largest and most economical stations deliver the most output. The older and smaller stations are used at off-peak and as stand-by stations.

Six years ago, in the Northern Division, there were too many cable failures in relation to the mileage. The following table shows the number of shut-downs in the Marion zone since 1910, and a classification of these shut-downs for 1913, 1914, and 1915. A few of the cables are operated either as spare cables, 25 or 60-cycles, and these are included in the total mileage of both the 25 and 60-cycle cables. The total number of line and cable interruptions since 1913 has decreased while the mileage has increased. This was brought about by eliminating as rapidly as possible all equipment that was proved defective and by the use of

CLASSIFICATION OF TROUBLES.

Classification	1913				1914				1915			
	25~		60~		25~		60~		25~		60~	
	No	%	No.	%	No.	%	No.	%	No.	%	No.	%
Insulator failures	12	22	30	20	15	19	14	13	3	6	6	5
Cable failures	2	4	21	14	4	5	12	10	14	26	18	15
Central station app.	3	5	4	3	1	1	5	4	5	10	3	3
Sub-station app	2	4	7	5	20	26	11	10	12	23	10	8
Secondary feeders	5	9	23	15	8	10	16	14			6	5
Operating mistakes	2	4	10	7	2	3	4	4			5	4
Storms	9	17	16	11	11	11	15	13	8	15	22	19
Outside interference	9	17	22	15	7	9	27	24	5	10	19	16
Mechanical breaks	0	0	0	0	0	0	0	0	0	0	0	0
No apparent cause	10	18	15	10	10	13	9	8	5	10	25	22
Miles cable	83		90		83		121		83		141	
Miles overhead	54		123		54		133		54		144	
Miles total	137		213		137		254		137		285	
Insulator failures per mile		22		24		28		105		055		042
Cable failures per mile		024		23		048		.099		169		125

* Before A.I.E.E., Cleveland Convention, June 27 '30.

such safety devices and connection schemes as are described later.

Aluminum Cell Arresters

While the installation of aluminum arresters has made the apparatus trouble disappear almost completely, and as the table shows, the failures of cables have decreased, it has, as might be expected, not given all the desired protection to the cables. The reason for this is probably due to the fact that the surges on the cables are in the form of distributed charges and the potentials rise locally in the cables entirely beyond the protective influence of the arrester.

Upon analyzing these cable failures, it was noticed that the majority of them were caused by faults to ground which later developed into short-circuits. At this time, due consideration was given to the question of grounding the neutral of the system, but after taking all the factors of the problem into account, such as continuity of service, etc., the idea of grounding the neutral was abandoned and it was decided that, as far as the system was concerned, the best remedy was the arcing ground suppressor.

Arcing Ground Suppressor

An arcing ground suppressor was installed in our largest generating station and numerous aluminum cell arresters on different parts of the system, believing that they would be the remedy best adapted to meet our requirements.

The arcing ground suppressor has now been in service about five years and the records show that it has operated in every case where a fault to ground occurred, by extinguishing the arc, and preventing an interruption to service.

In addition to preventing service interruptions caused by single-phase grounds, it has the great additional advantage of protecting life. There are at least six cases on record where actual contact with the 13,200-volt wires was made by workmen, which did not result fatally. There is no question but that each of these cases would have been fatal if the suppressor had not been in use. This conclusion is based on experience with the rest of the system not equipped with a ground suppressor, and also on the system before the suppressor was installed.

The arcing ground suppressor consists of three single pole independent motor-operated oil switches, electrically and mechanically interlocked, to prevent more than one operating at the same time. Each switch is connected to ground on one side and to the bus on the other. The suppressor is controlled by a balanced three-phase potential relay, which remains inactive while the system is balanced, but when unbalanced, due to a ground on one phase, it operates the corresponding phase of the suppressor, which, in turn, grounds the same phase of the bus; thus shunting the current and extinguishing the arc. In cases of short-circuit, an extra precaution is taken to prevent possible operation of the suppressor by the addition of an overload relay which opens the control circuit of the suppressor.

Faulty Cable Localizer

Working in conjunction with the suppressor is a device known as the faulty cable localizer, which serves the purpose of indicating the particular feeder on which an arc to ground occurs.

This device consists of a relay connected in series with the neutral of the feeder current transformers. When a ground occurs, the secondary current of the transformers becomes unbalanced, and causes the relay to operate. This in turn, rings a bell and lights a pilot lamp which indicates the faulty feeder. It takes about 0.15 of a second for the localizer and 0.3 of second for the suppressor to operate.

There is one record of a 15-minute interruption to the service in the Northern Division caused by a cable end bell short circuiting on an armature lead of a generator in one of our stations, before the suppressor and localizer were installed. Shortly after the suppressor and localizer were put in service, the same thing occurred again and the situation was handled in such a manner that no one outside of the power station was the wiser. A number of instances are on record where a ground has occurred on sub-station buses without an interruption to service.

Cable Testing

As a further means of reducing our cable troubles to a minimum we made a careful investigation of the possible causes of failure.

For the first few years, all cable was installed by the manufacturer, but we finally took over this work ourselves, with the idea of improving the factors entering into cable installation as much as possible.

A thorough study was made as to the best method of making cable joints and particular attention was given to such factors as:—

(1) Favorable weather conditions; (2) elimination of impurities, air and moisture; (3) application of insulating varnish between each layer of tape; (4) careful and even winding of tape; (5) improving the human element.

Aside from installation precautions, we have made it a practice to inspect cable during the process of manufacture, and to see that our cable specifications are strictly adhered to.

All cables are tested with 26,000 volts for three minutes before putting them in service, but we do not make a practice of testing them periodically. In case there are indications of trouble on a cable while in operation, it is cut out of service, given a test of 26,000 volts for three minutes and returned to service in case no failure occurs.

In our opinion a 13,200 volt cable should not be tested at a voltage higher than 26,000, since our experience has shown that too high a testing voltage often weakens the insulation at some point, which weakness finally manifests itself in a complete breakdown, even under normal operating voltage.

High-Potential and High-Frequency Tests

Our line insulators used a number of years ago consisted of many different types, no one type having been standardized. The old insulators not only spilled over during trouble, but also became punctured frequently. The insulator creepage surface was then increased and the insulators tested with high-potential 60-cycle current, but without satisfactory results.

About two years ago, we started testing with high-frequency and were soon convinced from the results obtained that the insulators were not capable of standing this test. Various types of insulators were then experimented upon and a design finally adopted having a ratio of puncture to flash-over of about 2 to 1. Now, every insulator before being placed in stock or used on the lines is given a 15 second high-frequency test. Although these insulators are previously tested at 60 cycles, about 2 per cent. fail to pass the high-frequency test.

Generator Bus Connection Scheme

Station capacities have increased so rapidly in the last few years that the bus arrangement has become a matter of vital importance in the protection of both apparatus and service. The ideal arrangement is one that secured the greatest amount of protection to the apparatus, and at the same time localizes and minimizes the effect of trouble.

Two years ago, before beginning work on the new Essex power station, a thorough study was made of various bus schemes and after analyzing those used by the large power plants of this country, it was decided that none of them would be satisfactory. A bus arrangement was then designed which, in our estimation, would approach the nearest to the ideal, and called the "selective" bus scheme, which is shown in Fig. 1.

The considerations that governed in deciding on this bus layout are as follows:—

Flexibility.

Simplicity.

Limitation of abnormally high currents.

Continuity of service.

The scheme is made for six generators and consists of one loop tie bus, six generator buses, and six feeder group buses of ten feeders each. This arrangement of connections is a new application of the old arc board scheme and is the most flexible layout known. By means of the feeder selector oil switches, the feeder oil switches can be connected to one or the other of two given group buses; for instance, the twenty feeders on group buses A and B can all be connected to group bus A or group bus B or part to each group by twos.

The maximum flexibility in operation is obtained due to the fact that each generator may be connected directly to any part or parts of the load desired. The generators are

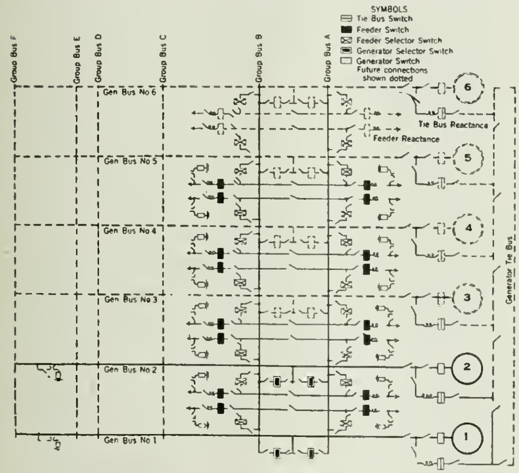


Fig. 1—Selective bus scheme.

connected to a loop tie bus through tie bus reactances and can be operated in parallel at all times, if desired.

Exciter Connection Scheme

The exciter connections are fully as important as the main a-c. bus connections, inasmuch as the maintenance of the a-c. generator voltage depends upon the reliability of the excitation. In order to secure a dependable excitation service, several sources of supply should be available. The bus should be so arranged that a failure of one source cannot affect the others, except through its effect momentarily on the main bus voltage.

Each generator has a direct-connected exciter, three spare exciters and a battery being available for emergency use. Each source of excitation has its individual bus. In case of voltage failure of one of the direct-connected exciters, a low-voltage relay instantly closes the battery breaker, thus connecting the battery to the affected exciter circuit. Immediately after, the breaker of the exxciter in trouble opens, due to reserve current. An emergency exciter may then be started up and paralleled with the battery and the battery disconnected and left ready for emergency service again. A contact-making voltmeter is provided for maintaining the exciter battery voltage automatically at operating value at every instant.

Reactors

Bus Tie Reactors.—At the present time, generators of such large capacity are being used that it is necessary to protect them from the effects of disastrous short circuits by means of internal or external reactance. Where several generators are operated in parallel, it is essential that bus tie or bus section reactors be used in order to prevent the combined capacity of all the generators from feeding into any one point of short-circuit. Bus section reactors will limit the current on any one section but take up valuable space in the bus, complicate the connections, and in cases where parallel feeders are connected to different sections of the bus, it is difficult to obtain balanced currents in these feeders.

In the selection of reactance coils best adapted to meet our requirements, we were governed by the following factors: cost, low losses, space occupied, temperature rise, ability to stand short circuits, freedom from inflammable material.

The use of tie bus reactors has none of the disadvantages of the bus section reactors, and does limit the amount of short-circuit current on any one section to any value desired, depending upon the amount of reactance used. For this reason, tie bus reactors will be used.

Feeder Reactors.—Two years ago the generator capacity in our Marion station had increased to such an extent that the oil switches, in some instances, were unable to rupture the excessive short-circuit current. This unsatisfactory condition compelled us to install reactance coils on all the 60-cycle feeders. Aside from the short-circuit limiting feature of the reactance coils, we believed that a better selective action of relays would result, if reactance coils were installed on both ends of the tie feeders connecting the Marion and City Dock stations. After studying the conditions then existing, reactors were also installed on the City Dock end of the 60-cycle tie feeders.

Five per cent. reactance was chosen as the amount best suited for the radial feeders and two and one-half per cent. at each end of the tie feeders. (As a matter of fact, we installed five per cent. reactance coils and used the two and one-half per cent taps.) There were at this time, seven tie feeders between Marion and City Dock and five or six of these operated in parallel at all times. Each feeder consisted of 2.5 miles of cable at the City Dock end, three miles of aerial line and one-half mile of cable at the Marion end. If a fault occurred on one feeder there would be a 2.5 per cent. reactance between either station bus and the fault and an additional 5 per cent. reactance between the unaffected tie feeders and the faulty one. As anticipated, this arrangement gave the very best selective action of our relays in case of trouble.

About one year after the installation of the reactance coils, the tabulated records of failures on tie feeders showed that instead of being faults to ground as formerly, they were, in most cases, short-circuits. Shortly after this, five sets of aluminum cell arresters were installed 2.5 miles from the City Dock station at the point where the underground cables connected to the aerial lines, with a hope of relieving the local potentials in the cables, but satisfactory results have not been obtained up to the present time.

By a comparison with the 25-cycle system, where no reactors are used on the feeders, it seems evident that the change in the nature of the faults on the 60-cycle system might surely be attributed to some unknown result of the combination of the inductance of the reactor and the distributed capacitance of the cable. To overcome rises of potential at the terminals of the concentrated inductance in the reactors, aluminum arresters were installed on the buses, which, with the arresters already installed on the feeders, placed protection on each side of the reactance. Even with this protection, all the sources of trouble have not been reached, as indicated by the continued failures of cables, and two cases of internal failure of reactors which might properly be attributed to a local rise of voltage internally in the reactor.

It is evident that these troubles are of a deeper nature than would appear on the surface and we are laying plans to make a further study of the surges both from the standpoint of localization of potential and natural frequency.

It seems proper to attribute these troubles to surges. If the troubles were due to weak insulation, they should occur as frequently on the 25-cycle system as on the 60-cycle system, which, as already recorded, is not the case.

Relays

During the early days of the electrical industry more attention was given to the protection of apparatus than to maintenance of service, and therefore, the aim of the operating man was to remove the short-circuit as quickly as possible. In short, the old idea of protection was one of adjusting relays and circuit breakers to protect apparatus against overloads. Later, with the improvement of station apparatus and its ability to withstand short-circuits, the thought gradually took root that the function of the relay should be primarily to protect against interruption of service to the customer. The result is that the modern idea with reference to relays, is to insure continuity of service. It is only in recent years that this idea has developed and central-station men to-day do not fear breakdowns in apparatus as much as service interruptions.

Carrying out the idea of service protection, operating companies of late years have gone to considerable expense in electrical features related to the transmission system. The best insurance against interruptions has demanded the use of duplicate feeders over more than one route, such as by means of tie lines, parallel feeders, ring connected feeders, etc. This means a larger and more complicated system, an increase in liability of breakdowns, and therefore a more serious problem as far as relay protection is concerned.

It is obvious, that practically all interruptions in a transmission system will be minimized if faults are easily and quickly removed before they have had time to cause serious trouble.

In order to determine the proper setting of instantaneous overload, inverse time limit and inverse definite time limit relays which are more commonly used on a system of distribution, it is necessary to know the characteristics of the system as well as the characteristics of the generators, automatic apparatus, circuit-breakers, regulators, etc., before anything can be done along these lines, and before the time elements of relays can be adjusted, the following information is necessary:—

1. The instantaneous short-circuit value of current through each conductor to which the relays may be applied.
2. The sustained short-circuit value of current through each conductor.
3. The time in changing from 1 to 2.
4. The time required for various automatic circuit-breakers to open the circuit after application of current through the trip coils.
5. The safe current-opening characteristics of various circuit-breakers.
6. The time characteristics of the various relays.
7. The probability and amount of flow of energy in the case of circuits operating in parallel.

If these seven items were known with any degree of accuracy, it would enable one to accurately set relays, but as a matter of fact, it is almost a physical impossibility to arrive at these seven conclusions with any degree of certainty. For instance, the values of short-circuits depend particularly upon the characteristics of the generators and also upon the impedance of the circuit to the point to which the relays are connected. The further the point of the short-circuit from the generator, the less will be the difference between instantaneous and sustained short-circuits, or between item 1 and item 2, providing the same apparatus is included between the short-circuit point in question and the generator.

Again, operating companies whose growth extends over a period of years, must necessarily operate generators of different internal characteristics. For this reason, the results obtained from setting a relay for values 1 and 2 for a machine purchased several years ago, will not be the same for a generator installed recently.

Assuming for the moment that the seven items listed are known and an attempt is made to accurately time relays for selective action, the accuracy of current values required to trip a relay can be left as a matter of small concern, for when a short-circuit occurs, the current setting of relays is usually exceeded by at least several hundred per cent. This applies equally well to inverse time or definite time relays. It is an impossibility to get selective setting with the inverse time limit relay because it has the unfortunate characteristic of being instantaneous with a heavy overload. This characteristic prevents the use of this type of relay for selective action because a short circuit of sufficient magnitude will cause all the relays from the fault to the source of supply to become instantaneous, and thus any or all of the relays are liable to trip out instead of only the ones nearest the fault.

Better results can be obtained by the use of an inverse definite time limit relay, the time setting of which depends upon the damping action of a permanent magnet on an aluminum disk, giving as great a degree of accuracy as can be obtained in the calibration of watt-hour meters used in connection with a torque compensator.

This type of relay is more accurate and allows closer setting than any other type, and when once set, remains the same, but in an extensive system, the results obtained from its use are nevertheless disappointing. The reason for this is simple, when it is considered that the time interval between successive circuit-breakers should be equal to the time taken for the circuit-breaker to open its arc, plus a margin of safety to include variation, and if there are several feeder sections in series and the trouble should be near the generating end, the short-circuit may not be cleared for several seconds, which means, of course, a loss of all synchronous load on the system, or in other words, a complete interruption to the service.

From the foregoing, it can be seen that irrespective of the character of the distribution system, it is practically impossible to isolate faulty cables or lines by the relays most commonly used, and therefore the records of most operating companies show that faulty feeders usually interrupt a large area and a great many more consumers than is necessary.

With the relays more commonly used, the most satisfactory results are obtained by using them with a radial distribution system; or, in other words, most operating companies get the best results by adapting their systems to meet the faults in the relay rather than design a relay for a minimum cable outlay.

A well designed transmission system is one which has the following characteristics:—(1) Safety in operation for employees and the general public; (2) suitability of supply for the purpose required; (3) freedom from interruption. Therefore, the question resolves itself into one of design, as has been shown.

Failure of supply is usually caused by breakdown of transmission and the primary precaution is therefore careful attention to design, manufacture and maintenance of the various parts of the system, but since no apparatus can be made absolutely immune from breakdown or external damage, the secondary precaution is to make arrangements so that the effects of a breakdown to any part of the system are localized as much as possible.

In some cases, such precautions may mean increased capital cost, but undoubtedly result in a net economy.

Fortunately, however, well designed apparatus does not necessarily cost more than badly designed apparatus and it is possible to so cheapen the system by closer localization of breakdowns.

Balanced Selective Relay.—In connection with the seven tie feeders between City Dock and Marion, mentioned elsewhere in this paper, so much trouble was experienced due to the lack of a selective action of the relays, that a new type of relay known as the "balanced selective relay" was finally installed at each end of these feeders.

The relay coils are connected in series with current transformers of the tie lines. This causes the current in each coil to be proportional to the current in the cable to which it is connected. Only a single phase of each cable is taken care of by a single relay and there are as many coils on the relay as there are cables. For instance, with seven cables on a three-phase system there are three relays with seven coils per relay.

Each coil on each relay is mechanically balanced against each other coil. The effect of this is that any strong coil can overcome any weak coil. In case a short-circuit occurs on one cable, the current in the faulty cable will of course be greater than the current in any other cable. Therefore, the coil connected to the current transformer on the faulty cable will have the strongest pull and will close the tripping circuit of this oil switch.

However, if none of the parallel cables are short-circuited, but trouble occurs on some radial cable, the relay will remain balanced and none of the good cables will be erroneously tripped out. The relays operate simultaneously at both ends of a faulty cable and their operation is not effected by fluctuations in voltage due to trouble or change of phase angle between voltage and current. With this particular type of relay, it is necessary to have not less than three feeders in service, in order to secure perfect operation under all conditions. It should be further borne in mind that reactance coils are installed on both ends of the tie feeders in order to secure the best selective action of the relays. It is questionable whether the relays would operate as satisfactorily in all cases without the aid of these coils. The successful operation of these relays is limited to three or more feeders, therefore they cannot be used on other parts of our system where there are but two parallel cables between stations.

Since the installation of the balanced selective relays, we have had no case of cable failure on the tie feeders where the relays have not operated properly and there have been more than fifty cases of trouble.

Our operating conditions are such that at times there are but two tie feeders in service, therefore on these occasions it is necessary to disconnect the balanced selective relays and depend on overload protection.

(To be Continued)

Montreal Aqueduct Work to go Ahead

The Montreal aqueduct scheme, including the hydro-electric development, is to proceed, the council having agreed to this by 13 to 6. A deputation from the Canadian Society of Civil Engineers, the Board of Trade, and the Canadian Manufacturers' Association, headed by Sir John Kennedy, appealed to the aldermen to appoint an independent board of engineers to examine the plans, but, as appeared at a subsequent council meeting, the appeal was without effect. Controller Ross stated that three members of the board had supported the proposal of engaging outside advice to re-examine the plans, but as the board could not agree on the choice of engineers, the matter had fallen through.

Western Canada Financing

Shareholders of the Western Canada Power Company, Limited, will meet in Montreal on July 15 to consider a plan to place the company on a better financial footing. The earnings for the year ending December 31st last, were $226,927, which is insufficient to meet the interest on the first mortgage bonds and other charges. In order to carry out a compromise made with the holders of notes and of first mortgage bonds, and to avoid the sale of the company's properties in foreclosure proceedings, it is necessary that the holders of the $2,495,000 par value of the shares of the company, now issued, shall subscribe for a sufficient number of a proposed new issue of preferred shares to realize $374,240 in cash. A portion of the issue will be underwritten in New York. The plan includes other changes, the Board stating that if the plan is successfully carried out, the second refunding bonds will be cancelled; the current liabilities will be paid off; interest on the first mortgage bonds will be paid until January 1st, 1918; and the company will have funds sufficient to complete the installation of a third generating unit, and to carry on its business for two years.

Weekly Electric Luncheon

Interest in the Toronto electric luncheon, being held every Friday at the Prince George Hotel, is as keen as ever. The capacity of the present dining room, which normally is about 75, has been considerably overtaxed and on the last two occasions overloads up to about 35 per cent. have been carried for one hour—without developing anything but the most complete harmony, however. On June 16, the members were treated to a delightful little sketching entertainment by Mr. Lou Skuce, of the Toronto World, whose clever work was the subject of unanimous comment. On Friday, June 23, Dr. A. C. McKay, Principal of the Toronto Central Technical School, enlightened the electrical men on the various phases of the work in which he is engaged.

Be on hand next Friday, June 30, at 12.30. This will probably be the last gathering until after the holidays.

Personal

Mr. E. W. Clayton has been appointed local manager for the Canadian Pacific Telegraphs, Victoria, B.C.

Dr. L. A. Herdt, of McGill University, recently underwent a minor operation at the Royal Victoria Hospital, Montreal.

Mr. J. G. Davies, formerly local manager for the Canadian Pacific Telegraphs, Victoria, B.C., has been appointed chief operator for the same company at Montreal.

Mr. E. W. Sayer, of the Sayer Electric Company, Montreal, has been elected by acclamation a member of the Protestant Board of School Commissioners at Outremont.

Mr. Cyril G. Savage, who resigned the position of secretary-treasurer to the Canadian British Insulated Company, Montreal (which has ceased business in Canada), to go overseas, is reported as being among the wounded.

Mr. A. C. Towne has resigned his position with the Johns-Manville Company, Montreal, to take charge of the engineering department of the Electrical Equipment Co., Montreal. He has been succeeded by Mr. S. G. MacDermott.

Mr. C. W. Knighton, general manager of the Canadian Hart Accumulator Company, St. Johns, P.Q., is on a visit to Winnipeg, to open a western office and to develop the company's business as manufacturers of electric storage batteries. Mr. Knighton has just returned from a visit to England, where he conferred with the directors of the parent company, the Hart Accumulator Company, Limited, London. This company is exceedingly busy on batteries for submarines, the factory being now what is known as a controlled establishment.

Electric Railways

Experience on the Chicago, Milwaukee & St. Paul Railway where 220 miles have been operating for 6 months at 3000 volts.

It is extremely gratifying to note the satisfactory operation of the pioneer high voltage electric railway systems in the United States, especially in view of Canadian requirements and endeavors along the same lines. There now appears to be little doubt that higher voltages than 3,000 d.c. are feasible if, or when, they are found desirable, and we understand 5,000 volts is now being considered. A recent issue of the Electric Railway Journal contains an interesting article by A. E. Armstrong, Chairman Electrification Committee of the General Electric Company, in which he points out some of the favorable features in the operation of the Chicago, Milwaukee and St. Paul Railway, where some 440 miles have been operating for about six months at 3,000 volts. We reproduce this paper in full:—

During the past six months electricity has replaced steam on 220 miles of track on the Chicago, Milwaukee & St. Paul Railway. This mileage comprises two steam-engine divisions, and, in war terms, the new facilities thus introduced have been "consolidated" since the territory was occupied.

Naturally, any such radical change as the substitution of electricity for steam gives rise to equally great operating changes just as soon as the capabilities of the new type of motive power become understood and fully appreciated. Not until a complete change in motive power is made can it be realized how many of the previous rules and regulations are, in effect, only the traditions handed down from generations of steam-engine practice. Very many such rules reflect dearly-bought operating experience and apply equally to the operation of any type of motive power, but with the electric locomotive, the greater tractive power at higher speeds, the independence from the individual efficiency of the operating crew, the freedom from any restrictions of coal and water supply, the higher speeds on down grades made possible by the use of electric brakes, and the many other operating advantages must result in radical changes from previous steam operating methods. An often-used phrase best describes the original method of operation as "steam railroading subject to all the limitations of the steam engine," and in the future, railroad transportation will undoubtedly be conducted on a broader basis with the greater facilities and flexibility provided by electric locomotives.

Saw Inside of Tunnel

A story is told of an engineer making his first trip on a St. Paul electric locomotive run between Deer Lodge and Three Forks. He had full charge of the running of the locomotive, under the direction of an instructor, and he handled his train over the Rocky Mountain Divide without giving any outward expression to his thoughts until reaching the tunnel at the summit, when he exclaimed: "This is the first time I ever saw the inside of this tunnel." Having ridden through tunnels in the cab of an engine, the writer can fully appreciate how it affected an old steam engineer to ride on an electric locomotive for the first time and to be free from the gases, steam and smoke that make tunnel operation with the steam engine hazardous, as well as most uncomfortable for the crew.

On the Chicago, Milwaukee & St. Paul the operation of the electric locomotives has been taken over by the regular steam engine crews after proper instructions, and it is interesting to note how smoothly the change from steam to electricity has been accomplished. Of course, the handling of the air brakes is identical with steam-engine practice, although in this matter of braking the use of the air brakes is restricted to the stopping of trains, as the electric brakes are used exclusively to hold the trains at constant speed on the down grades.

Regenerative Braking

Perhaps there is no feature of the St. Paul electrification that is more impressive than the operation of this regenerative electric braking. In the early consideration of plans for the electrification, electric brakes were considered, and they were finally insisted upon by the railway officials when their full advantages became apparent. The perfection of regenerative electric braking with series direct-current motors called for considerable development work, as nothing of the kind had ever been done on a scale approaching the magnitude of 282-ton locomotives equipped with motors aggregating 3,400 h.p. The direct-current locomotive, however, offered so many advantages for main line service in this instance that it was considered of the greatest importance to adhere to this type, especially if electric braking could be made operative with the series-wound direct-current motors operating from a fluctuating trolley voltage. Fulfilling the promise of early experiments made at Schenectady, direct-current motor regenerative braking was successfully developed and put into service without losing the ruggedness in operation of the series-motor characteristics. The result has been a locomotive of remarkable flexibility, with speed and tractive power admirably suited to train haulage over a broken profile and, withal, of an extremely simple mechanical and electrical construction that has been patterned closely after well-known designs of proven superiority and reliability.

On these locomotives, the motors are of practically standard design and they present no features of special interest except the large continuous capacity of 375 h.p. and the fact that each has a potential of 1,500 volts across its brushes, operating two in series on 3,000 volts. The motors are geared to the axles through twin gears, an arrangement that has proved so successful on the Butte, Anaconda & Pacific, Detroit Tunnel, Baltimore & Ohio, Cascade Tunnel, and other electrifications having operating records of several years with this method of drive. In the St. Paul locomotive construction, the motors are spring suspended on the bolster, and also drive through springs in the twin gears, thus providing great flexibility, cushioning all shocks and eliminating all noise of grinding gears. The high efficiency, simple construction and low cost of twin-gear drive were fundamental facts of importance influencing its adoption on the St. Paul locomotive, and the results of six months' operation fully justify the preference for this design.

The efficiency from trolley to the rim of driving wheels approximates 89 per cent., including all motor and gear losses when delivering full rated tractive effort. The construction is simple, rugged and well able to withstand the strains incident to heavy train haulage over mountain grades of 2 per cent., one such grade on the St. Paul extending unbroken for 21 miles over the main divide of the Rocky Mountains. During six months of operation no failure or delay of any kind has been due to the twin gear drive, and all indications are that in this item cost of upkeep will be small.

The St. Paul freight locomotives are rated at 2,500 tons trailing load on a 1 per cent. grade, and this calls for a tractive effort of 72,500 lbs., and a current input to the motors of 860 amp. at 3,000 volts, the speed being 15.75 m.p.h. Such a large current could readily be collected from a third-rail, but the problem of current collection presented some difficulties with existing forms of overhead construction and pantograph collector. Elaborate experiments were made at Schenectady with different methods of trolley suspension and roller and pan collectors, and these formed the basis for the adoption of the current-collecting facilities on the St. Paul. In this case the trolley consists of two No. 0000 wires side by side and alternately suspended from the same catenary by the usual loop hangers. The construction offers great flexibility in the overhead conductor, provides for contact with at least one wire at all times with consequent elimination of flashing, and permits the collection of heavy currents at high speeds. Pan collectors with copper contact surfaces are used and lubrication is successfully depended upon to reduce wear. This construction has already been described in previous publications, but is worthy of additional comment, as it has solved the question of collection of large currents at high speed. Tests made at Schenectady and Erie have demonstrated that it is perfectly feasible to collect 2,000 amp. at speeds as high as 60 m.p.h. with this construction, and subsequent operation on the St. Paul has resulted in no flashing or even sparking under the conditions of daily service.

Possibility of Higher Voltages

The electrification of the Butte, Anaconda & Pacific Railway provided valuable experience upon which to base plans for the larger work on the St. Paul. The increase from 2,400-volt to 3,000-volt direct current, was found to be possible without sacrificing anything in the simplicity and ruggedness of the twin-gear drive on the locomotive and it offered certain advantages in reducing feeder copper and providing for greater advantages in station spacing. Taken in connection with the improvements in overhead construction and pan collection, 3,000 volts are sufficiently high to insure the satisfactory collection of current under all possible conditions of service operation. At the same time this voltage did not involve anything beyond conservative design in the case of single-conductor, 1,500-volt motors operating two in series on 3,000-volt supply, thus permitting the use of the simple twin-gear drive. Experiments with direct-current apparatus with potentials as high as 6,000 volts demonstrated the possibility of higher voltages, but also indicated the necessity of adopting some form of freak mechanical drive of doubtful reliability and poorer efficiency. Hence the adoption of 3,000-volt direct current for the St. Paul electrification offered reasonable advantages in the distribution and conversion system, and yet the voltage was not so high as to demand any departure from the understood principles of sound and conservative engineering which should govern in such a huge undertaking as the immediate electrification of 440 miles of trunk line railway.

The electrified divisions of the St. Paul are all single track, but nevertheless the 3,000-volt direct-current supply is obtained from only fourteen substations feeding 440 miles of route, making an average substation spacing of 31 miles. Maximum trolley drops of 20 per cent. are obtained with 2,500-ton trains midway between sub-stations, but the average voltage drop with the variable tonnage of passenger and freight trains of all classes will be less than 10 per cent. This reasonable distribution loss is obtained with trolley feeders of 500,000 circ. mil. cross-section extending over 85 per cent. of the entire route mileage, or where the ruling grade is 1 per cent. or less. Heavier feeders up to 1,400,000 circ. mil. section are used on higher gradients up to the 2 per cent. ruling grade. The entire cost of this feeder copper, figured on a 20-cent basis, amounts to less than 8 per cent. of the total cost of electrification.

It is as yet too early to expect any operating figures as to economies effected by the electrification. Full electrical operation of all freight trains, and all passenger trains except one on a local run, is now in effect on two steam engine divisions totalling 220 miles of track. These two steam engine divisions have been consolidated into one electric locomotive run, crews being changed midway at the old division point. An additional 220 miles of track will be in operation by the end of this year, and here also two steam engine runs will be combined into one electric division.

A Physical Success

Partial operation for six months has proved the physical success of the undertaking and the general fitness of the locomotives and distribution system for this very severe mountain service. The high-voltage direct-current system offers special advantages for the conditions obtaining in the Northwest with its abundant supply of 60-cycle power and the broken profiles of the railroads. In the sub-stations, synchronous motor generator sets, which have a combined efficiency at full load of approximately 92 per cent., and automatically providing a power factor of 100 per cent. or a slightly leading current at all loads permits feeding the St. Paul sub-stations from the general transmission networks of the Montana Power Company without causing interference with the industrial and lighting loads supplied from the same lines. In fact, this ability of utilizing any frequency of power supply without interfering with the commercial load connected to the same transmission circuit, constitutes one of the chief advantages of the high-voltage direct-current system. In other respects, also, direct-current construction is well adapted to the work in view. The profile calls for crossing three mountain ranges with long stretches of level and low grade track intervening. Freight trains mount the ruling grades at approximately 15 m.p.h. with two locomotives, and run on a level track at double this speed with one locomotive, an accomplishment readily achieved with the flexible characteristics of the direct-current motor. Moreover, the locomotive speed is automatically proportioned to all intermediate gradients, thus resulting as nearly as possible in a constant-output locomotive and minimizing the load fluctuations due to the very broken profile. As a matter of fact, a variable speed characteristic for the locomotive is pre-eminently adapted to general railroad operating conditions, as questions of alignment of tracks and peak-load power supply place limits on the speeds up grades while it is desirable to operate on level track and on the lesser grades at as high speed as the track alignment and condition of rolling stock will permit.

Two Novel Features

Much of the engineering success of the St. Paul installation is the result of the gradual development of a direct current motor for locomotive construction and the advance in the art of generation, transmission and conversion of alternating-current power. Two novel features, however, stand out conspicuously as being introduced for the first time and completing the development of the 3,000-volt direct-current system. These are, first, the twin conductor flexible overhead construction, with lubricated, copper-pan collectors, and, second, the regenerative braking control of the series-wound, direct current locomotive motors. The first has made possible the collection of current far in excess of operating requirements and has settled for all time any claims for higher trolley voltage based upon the question of current collection. Thus, it is perfectly feasible with the St. Paul construction to collect 2,000 amp. at practically any speed and this makes it possible to receive 6,000 kw. at 3,000 volts through one pan collector, more than enough to slip the wheels of the 282-ton locomotive at 30 per cent. coefficient of adhesion. Then, too, the introduction of regenerative braking control with direct-current, series motors, greatly broadens the field of the locomotive and permits placing a proper value upon this one feature of electric operation, because it is not secured at the expense of sound and conservative engineering in other respects. Regenerative electric braking undoubtedly has an important value in electric railroading by adding to the safety and economy of operation, and it is a welcome addition to the other advantages of the direct-current-motor locomotive.

In general, the St. Paul electrification extends over such a length of track, 440 miles, that no restrictions need be placed upon the free operation of the electric locomotives. The Mallet locomotives previously used over the mountains are being transferred to the adjoining non-electrified division as fast as they are released, with a view to handling the heavier tonnage trains delivered to that division by the electric locomotives, thus resulting in raising the weight of trains moved over the road and effecting material economies.

Accident Talk No. 6.—by the Quebec Railway, Light and Power Co.

Saving Life and Limb

A man who has lost his left hand by letting it hang out of a car window always is careful to keep his right hand inside. Unfortunately he only has one HEAD. A wise head was never broken while it was thrust out of a car window.

Some persons never can be convinced that a wagon, or fire engine, of some moving or stationary object is sure to appear sooner or later and spoil the view.

At least tell the children to keep their heads and arms inside. MAKE them do it.

Discomfort and Danger

There was room inside the car—even on the platform—out two men wanted to ride on the steps. It was risky for them to ride on the steps, anyway. When the conductor told them to get inside the car, they refused and commenced to bully him. At this time a passenger wanted to get off in the narrow space, without a chance to reach the grab handles; this passenger tripped forward, falling on the roadway and was hurt. It happened exactly that way. These two men refused to give their names and addresses as witnesses and jumped off the car. Of course, the company had to pay the damages, not the two men who stood on the steps, and were the cause of the accident.

The steps are put on the car so that people can get on and off. When you stand on the steps you cause the company some ANXIETY. But you cause the other passengers DISCOMFORT and DANGER. Suppose you are one of the other passengers? Then be cautious—wait till the way is clear, so that you can get off without a CONTORTION. Make it INCONVENIENT for the persons who insist upon riding on the steps.

Stealing Rides

The campaign that this company is making for the prevention of accidents can be assisted in no greater measure than by the warnings that parents and teachers give to the children against "Stealing rides."

There are many accidents which would not happen if you would warn the children—if you could prevent them from courting DANGER by jumping on our cars. They do it for fun—OR DEATH.

The conductor is the man who knows. You will not find HIS children "Stealing Rides."

The Quebec Railway Light & Power Co.

In the Public Eye

A budget of comment presented in the interest of public welfare, independent of party politics and with malice toward no one.

ROSS RIFLE AGAIN

Startling indeed in view of the attitude adopted by the official and unofficial apologists of the Ross rifle is the news contained in the London letter to the Toronto Telegram. Briefly, the correspondence is to the effect that following complaints from all branches of the service, Gen. Alderson, in command of the Canadians, formally protested to the Canadian Government against arming the men with the Ross rifle, which has proved, according to the soldiers, a failure and a pathetic failure at Ypres and was later to be followed by a similar failure at St. Eloi.

General Alderson's protest was received and answered in a style that unfortunately for the good name of the Dominion is becoming to be regarded as characteristic of the administration of the militia department. He was told to mind his own business and the Canadian soldiers were told to take what the militia department considered good for them and were warned that any further objections to the use of the Ross rifle would not be tolerated. The printed circular containing this warning was apparently an artfully contrived defence of the rifle and an obvious attempt was made therein to blame the faults of the arm on the quality of the ammunition used by the troops.

The main point and the point that will appeal to most people who have little or no knowledge of what constitutes a good military rifle or makes a bad one, is that the men who are using the weapon should be the best judges of its fitness for the work they have to do. When a man's life depends upon the quality of the weapon which is his sole individual defence, he is apt to be curious about it, he is likely to watch its effect and eager to learn all about its dependability, or otherwise, in a crisis. In the case of the Ross rifle there seems to be little doubt that it was unsuitable in the opinion of the vast majority of the men armed with it. That in itself should have been sufficient to cause an investigation of the most careful and painstaking kind. Instead, we are compelled to hear that the protests of the men expressed through their officers and divisional commanders, were received with disdain, and that eventually the Canadians were collectively reprimanded for their attitude and warned that no further nonsense would be tolerated. This to men who were willing and ready to face death for the Empire, and who, it seems to us, should have been given every consideration and whose opinions should have been respectfully listened to and met, if possible. Putting aside all consideration of the technical faults or merits of the rifle, it would seem that it would have been a wise policy to have made a more tactful reply and to have demonstrated to the troops that they were not being sacrificed for political reasons or for any other reason. If the morale of the troops depended on a change of rifle, it should certainly have been effected, and at once. This aspect of the matter would seem to be the common sense view of the dispute.—Ottawa Citizen (Independent Conservative.)

The Dealer and Contractor

A continuation of the report on the Second Annual Convention of the Electrical Contractors &:Dealers' Association of Ontario—A helpful talk on various kinds of advertising by Mr. J. C. Kirkwood.

The subject of advertising is a very comprehensive work. It has a wide scope and it is hard to give a definition of the word. I understand I am speaking mainly to men engaged in the business of selling service and supplies—not supply men, but men selling service—installation of electric equipment—and to men who have equipment to sell. It is supposed I am to say something to you that will be helpful in that work, the work of selling your service and selling your equipment. Now, the gospel of advertising has been preached so thoroughly by its preachers that very often a man begins to think that advertising is a very magical thing, and if he advertises, buying space in newspapers, that that is going to do all the work. That is wrong. I know a great many men think they can buy success—sell their goods with a cheque, buy space and pay for it, occupy space with good copy, and that that will sell the goods. It will not. I will illustrate by calling your attention for a moment to sunlight. Now, sunlight is very necessary to a farmer who depends on sunlight to grow his produce for him, but sunlight will not sell much off his farm; and he has to cultivate the farm, and to sweat over it, or he will not have much to sell, and sunlight will not sell it for him.

Now, advertising is like sunlight. It has a great influence and reaches a great mass of people, but the influence of advertising will be effective only when you do work on top of it. Our minds these times are occupied with war. We read a very great deal about battles—Verdun conflict right at the front. Was it ever borne in on you that the winning of battles means the use of large forces, long range shooting doing destructive work—the mining, the trench work, and then the close personal infantry work of bayonet and rifle shooting. The battles to-day, generally speaking, are being won by the preparatory work of the artillery followed up with the close bayonet work. Advertising is much like artillery—work of preparation. It makes close-to-hand work effective. But if you simply put advertising in the papers, and do not on top and behind it do close personal work, you are not going to get all that it is possible to get out of advertising. It so often happens that men in business rely on advertising alone, and think they do not have to work at all with it to get results, but advertising without that plus work will not get results, and then they throw stones at advertising because they have not been a success. They might just as well throw stones at the sun for not selling the farmer's produce. It would not be a bit more foolish to do so, than to rely on the publicity of advertising without the plus work to get you the results of advertising. It is advertising plus the other forces that brings success.

Then there is the man who sells newspaper space—or printing—or posters—or street car or other advertising; each urges the value of his own medium and knocks the other medium. That is not right. It takes judgment to find out which is the best value to you, and not any one will do the work by itself, it takes a combination of forces to do the work you want done. I am sometimes asked the question—which brings home the greatest results, newspaper advertising or direct advertising—the personal work of a travelling salesman, or letters sent out, or booklets. They want to know just which is the best. I simply ask the question—which blade of a pair of scissors does the cutting? The answer is, it takes two to do the work. Of course, it is right that each should emphasize what they are selling, but not to knock another; and you ought not. Success is achieved by a combination of forces. Keep playing for success in selling. Advertising does its work, and it is not alone done by the newspaper, but one thing it does is to get the eyes of the people focussed on what you have to sell, and it gives a quick delivery of your message, and approximately quick results.

Advertising a New Idea

It is not long since that modern advertising had its birth. It began when steam came in. The coming of railways brought new markets—men must get quick action, slower ways are no longer sufficient. It meant getting the attention and favor of people more quickly, and there is no quicker way of attracting attention than by publicity, but that alone would not do. Now, take men situated in communities of small populations—how can you sell your service and equipment to people in your neighborhood? You are busily occupied every day with actual service, looking after your men, putting your product into houses, giving attention to the delivery of service and goods you have paid for; but you ought to remember your business cannot grow unless you are trying to prepare other people to be customers of yours—people you are not serving this week, but there is no reason why you should not serve them next week—doing preparatory work all the time. You have things in front of you that should have places in the homes of the people you serve. You will go away appalled by the number of times the word "No" is written opposite questions asked as to whether they have your electrical equipment in those homes. Now, what can you do to get them to answer "Yes"? Every "Yes" would mean money in your pocket. What can you do to change that situation that exists to-day, where the "No" answers far outnumber the "Yes" answers? Now, that leads to this. Unfortunately, you alone cannot do very much. I mean to say you ought to do some co-operative work.

That work is being done for you by a number of people in different ways. Take the "Evening Post" advertisement, "Do it electrically." That is doing work for you, preparing people to buy your goods, but you know that unless you go on top of this particular work and have people ask for it, you are not likely to get many orders. Success is not in handling a good product, but by getting directly in touch and

NAME DATE

HOUSE WIRING RECORD

AMT.	ITEMS	WIRING	SERVICE	SWITCHES	SUMMARY
750	FEET 14 WIRE	750			JOB NO. 38
	" "				CLASS OF WORK
50	" 12 "		1.00		OLD HOUSE
	" CABLE				
200	" LOOM	4.00			ATTIC OPEN
20	" CONDUIT		1.30		STYLE OF SERVICE
	" "				CELLAR CONDUIT No.12
1	CONDULET & COVER		50		NO OF OUTLETS
	" "				CEILING 10
1	SERVICE BOX		2.55		BRACKET 5
	CUTOUT BOX & CUTOUT				SWITCH 5
120	KNOBS	1.20			PLUG
140	TUBES 3"	50			TOTAL OUTLETS 20
10	TUBES	20			
	LOCKNUTS & BUSHINGS		5		COST PER OUTLET
	FEDERAL BUSHINGS		16		MATERIAL .80 cts.
	FUSE PLUGS		16		LABOR 60
	GROUND CLAMPS		18		TOTAL $1.40
	CLIPS, NAILS, SCREWS	10	5		
	ASBESTOS & BOARD	15	20		NO. OF HOURS PER OUTLET 2
	SOLDER & TAPE	45	5		
	GAS PAINT PASTE	15	10		MATERIAL USED PER OUTLET
1	SNAP SWITCHES			20	FT. OF 14 WIRE 37½
4	FLUSH SWITCHES COMP.			2.00	" " LOOM 10
	" PLUG "				NO. OF KNOBS 6
	INSPECTION	1.50			" " TUBES 7½
	INCIDENTALS	25			
	TIME WIRING 40 HRS.	12.00	-		
	" SERVICE 5 HRS.		1.50	-	
	" SWITCHES 2 HRS.			60	TOTAL CONTRACT COMPLETE
	TOTAL COST	28.00	7.80	2.80	$38.60 TOTAL COST
	PRICE RECEIVED	40.00	11.00	4.35	55.35 PRICE RECEIVED
	GROSS PROFIT	12.00	3.20	-1.55	16.75 GROSS PROFIT
	LESS 25% OVERHEAD (ON SALES)	10.00	2.75	1.08	13.83 LESS OVERHEAD
	NET PROFIT	2.00	.45	47	2.92 NET PROFIT
	NET PERCENTAGE ON SALES	5%	4%	11%	5% NET PERCENTAGE.

This is the data sheet shown by C. D. Henderson, of Brantford, in connection with his paper "Some Cost Figures on House Wiring," read before the recent Toronto Convention of Ontario Electrical Contractors and Dealers and reproduced in the last issue of the Electrical News.

asking people to buy it. Take another advertisement, "When the hot days come"—advertising electric fans. Another advertisement to make people ready when hot weather comes, to make their rooms cool by the introduction of electric fans. These are the people residing in your community—people who live on St. George Street—Rosedale—Indian Road. In successful selling you have to break into that unnamed crowd. You must take those people, that unnamed mass, and break it up so that you know its names and addresses, the people who need your goods—John Smith, 36 High Street—James Jones, 10 Park Boulevard, etc.—that is, you must be sending those names and addresses something into their homes. Then you know something has gone into that home to break up the apathy and make them a customer of yours. To be content with having names and addresses, and not serving them, is not going to increase your business. You must know the people in your community and have something going into their homes—booklets, blotters, circulars, etc., getting your business carried away from your address by some agency, your message carried away from you straight into the homes you want to sell.

Everybody Knows Us (?)

You say, "Everybody knows us—they know our shop." How many people would be married if the men said, "All the girls know we are single"? If you do not send men out to solicit business and call on the man with a name who has a bank account and wants to buy, you are not going to sell your goods. You must go to the people with names and addresses, identities, and take your business away from its present location right to them, and when you do that you are going to sell goods. No amount of reliance on the fact that people ought to know all about you is going to give you the maximum of sales. It is possible for you to sell more than you are doing—probably to the street with all the "No" answers—and you are not as rich as you would like to be until you get "Yes" answers. I think you ought to join together, gentlemen. I understand there are over three hundred of you in the Province of Ontario. You all have a common message, a work of education, the gospel of selling goods, the message that will preach more than thirty in Brantford or more than twenty in Guelph to have electric toasters or electric heaters, etc., and this will all be accomplished by co-operative means.

In the United States at the present time the makers of coal stoves are getting together to put the men out who are marketing electric ranges, because the men who make electric ranges have been the more active.. Gas men are preaching to cook with gas, and the makers of stoves burning coal have awakened to the fact, and to-day they are joining together to preach the gospel of "Cook with coal." Florida, California, the Southern States joining together, pooling their money to sell Cuba, Florida, California and the Southern States—all this great publicity and advertising to make them establish stoves. Makers of southern pine have joined together to build a "porch of cypress"—a "house of pine"—they have the same message to volley forth, so they join forces, wrap themselves together, pool their money and produce effects they could never do alone. Railways want to defeat legislation, join together and pool their money, carry on an aggressive advertising campaign to get at the minds of the people to defeat legislation for them. They were not successful, but they found that the money spent has come back to them in many ways. Raisin growers joined together to get the public to eat raisins in bread —you are familiar with that? Men are joining together today to get a common message home by pooling their money.

Co-operative Advertising

Gentlemen, we who are here, and those who are represented here, I suggest you get together and do something in a co-operative way to make the people you serve more desirous of things electrical that you have to sell, and the service that goes with their installation. Do something electrically along with your own name in your own community. One suggestion is the Toronto Gas News; the Toronto Electric Light issues something of the same nature—inducing people to use more gas—more electricity. I suggest that perhaps you people could get together and distribute something in your own communities, monthly or otherwise, to get the idea planted in the minds of the women and men who occupy the homes to put more electrical equipment in their homes. Suppose you have a book, "Do it electrically"; chapters on "Cooking with electricity," "Heating with electricity," Cleaning with electricity," "Making Coffee with electricity," "Adding to health with electricity." Get the message into the home so that the people will come to the idea that electricity comes in to do the work better, cheaper, and healthier than in any other way. You could all put in something to get a book of that sort published, possibly the supply people would come to the rescue, too. Get your name put on the book and distribute it in your community. Advertise in the newspapers, not taking big space to advertise your own business, but to get the idea planted to "Do it Electrically," and advertise, "Send for that book." Get people to send for it and break them out of the unnamed crowd, and the people of your community who send for the book will get it with your name on the back.

That is what is necessary to make your advertising successful. They go into electrical shops and buy something and take it away. The question who you are was not asked. You should get card indexes and do trench work. Know those who have bought from you, say you will be glad to have them come and see something new you have to offer. They are appreciative of the fact that you remember them. We are all human in that respect. You address a letter to me and say that I called at your shop June 10th last and bought so-and-so, you get me and my wife to come in, make me feel I have red blood and that you have red blood, and I think to myself, I will go into that shop the next time I want anything.

Make it Personal

Some years ago an agent came to Canada, to London city, with a vacuum cleaner, that he could put on the market to sell at $35.00. He persuaded one of the largest stores to take the agency. Called thirteen of the floor staff and told them it was for sale at $35.00. Thirteen men said it could not be done at $35.00. This man swore quietly, and told them he would show them. In a very few months he had made $700 altogether on sales, and he got a $5 bonus from the firm, which put $100 in his own pocket. Thirteen good, smart men had said it could not be done. They looked at the big, unnamed mass and said, it cannot be done. This man looked, and then said to himself, there is this rich banker, that rich widow, sell them a percolator, sell them this, sell them that, make a cleaner so desirable to them that they will have to have it. Twenty of them bought. He made it so personal that they thought they could not do without it.

A man advertised small farm buildings of concrete. He told the farmer how he could have the best farm buildings in the land, sent them booklets with attractive pictures and photographs of concrete farm buildings. Hundreds and hundreds of barrels of cement were sold as a result of that advertisement. Hold my interest with something I should have. Make me hungry for it till I simply have to have it. Something can be prepared, "Do it electrically," and put into the homes. Get it there. Have letter paper with the heading of your Association on it.

Take a case in Iroquois. He writes to the Association to send copies of the book to a certain address. The copies would have Mr. Brown's (your name) on the back. Some central organization will include all that. At Christmas time, for instance, or a little before, suggest an electric sale. At a time like this when it should be warm and isn't, send a definite suggestion to people whose names and addresses you have, and tell them a little electric heater would make them nice and comfortable this dreary wet weather. Drop your line, and fish, and some sucker will bite. But you will not catch a fish without a hook. Then some hot day send a suggestion that a fan would make it nice and cool. Don't wait for them to come, send out for them. Spiel it out. Get names of people going to be be married. Find out their friends, send suggestions to these to choose electric goods —a percolator—suggest the fragrant smell of coffee for breakfast—a duster, to keep a house the way a bride would like it—a cooker—a toaster. Send suggestions to those who are to attend the wedding. It puts dollars into your pocket and pays for postage stamps. It is these definite suggestions into the home that will help you sell your goods. Perhaps I have said enough to put into your minds some practical things you could do to sell your goods and service in your communities and neighborhood. If I have done that, I have done what I came to do.

Co-operation in the Electrical Business

MR. R. T. JEFFREY

In asking me to speak to you for a few minutes this afternoon on the subject of co-operation, I do not think your chairman could have chosen a subject in which the various members and employees of our Commission are more interested. The word co-operation has been the watchword of our Commission, and we would like to see it carried still further, and have more co-operation with the electric wiremen and contractors. The more customers the central stations are able to obtain for their system, the more successful is that system going to be. The more customers the central station can obtain, the more business the wiremen and contractors are going to get.

Now, how can the central station and the electric wiremen and contractors co-operate, and obtain additional customers for the central station and additional business for the contractors? There are the two extremes the contractor could go to, either one of which will prevent the central station from getting business. In the first place, he can charge too much for his work.

I know of one municipality on our system—I will not mention the name—it has a population of about 4,500 people. We have approximately 53 domestic customers in that municipality, and we should have 253. Now I think I can say truthfully that the reason we have not got those other 200 is because the wiremen and contractors in that municipality are charging too much for their work. I say that without any qualification whatever.

Then, I know of another municipality on our system where the customers are prevented from getting their houses wired because there are not any wiremen or contractors in that municipality, and the reason for that is that their only wiremen are of the carpet-bagger variety who go in and do work at such a low figure that a reputable contractor cannot afford to start in that municipality and do business. Now, there is a happy medium between an excessive rate for wiring and a rate that is altogether too low, along which the wiremen should attempt to steer his path.

How are we going to remedy this? How are we going to get the wiremen to charge a fair price, not to charge too high, and not to go in and work at a price at which it is impossible to make a living? Some weeks ago the Brantford manager of our Commission called me up by 'phone, and stated he would like me to go over to Brantford and meet the Brantford Electrical Club. Just how that club was organized, started, and its object, I am going to leave for Mr. Lyons to explain—he is going to take the platform after me. I went over to Brantford as a central station representative, and they explained to me their whole scheme —a scheme that had for its object co-operation between the wiremen of Brantford and the central station; that is, co-operation on the one hand between the wiremen and contractors in Brantford, and co-operation on the other hand, between those wiremen and contractors as a club, and the Brantford Hydro-Electric Commission, and also the Western Counties Electric Company. Now, co-operation between wiremen and contractors is not for our Commission or the municipalities connected with our system alone, it would be for every central station in our province—the Cataract Company, the London Electric Company, and all the others.

I came back from the meeting at Brantford and explained it to our Chief Engineer, who was very favorably impressed with it. The members of the Brantford Club had got together and formed an organization, and had got out a list of prices at which they considered wiring could be done and still give a fair profit. They handed us these prices, and we looked them over, though not very carefully yet, and we believe it is possible to form clubs or centres in various districts all over this province, and have standard rates for wiring the ordinary standard work. Of course there is the special work, for which a special rate would have to be considered, but it is possible to fix it very accurately; that is, the actual cost of doing electric wiring, or various types of it; and our Commission are agreed to get together with electric wiremen and settle on fixed rates at which this wiring can be done. That rate would cover actual cost plus all overhead charges, plus profit, in order that a man who does a fair day's work can get a fair day's pay.

Now, how is that going to help us out? The success of our various concerns depends upon the amount of work we get out, and the number of customers. A great many houses are not wired up at all. They come to a wiring man and ask what he will wire the house for. One says $60, another says $40. Well, they say, someone is getting a graft out of this, I guess I won't have it wired at all. This is holding hundreds of customers out. We would like to get them all, and we would like to co-operate with the wiremen so as to get that trade.

A Basis to Work On

After it is possible to fix a rate that is agreeable to you and agreeable to the central station as a fair rate for wiring, our solicitors will then be able to go out into these various municipalities and say to a man—you can have your house wired for so much an outlet. If you want to have it wired at these figures, here is the rate at which a dozen companies will do the work for you—and hand him a card with the names of those contractors, who all stand on equal footing, and the customer would then know he was getting his work done at a fair rate. It would save the contractor soliciting business; it would bring more business to him, and more consumers to the central station.

The Commission, and I believe every central station in this province, will be quite agreeable to co-operate, if the contractors are agreeable to accept a fair price for a fair day's work. It is not the intention to form a combine or anything like that, but if these clubs are formed in centres, the various members of the clubs will have their names handed to the central station, and the central station will hand out their cards to the consumers. Anyone who does not belong to the club would not have his business advertised in this way, and would not have the advantage of having his business handed to him. It is not the object of the Brantford club to cut prices at all, the idea is to raise the standard for work, and to raise the standard on which the work is done. Now that is perhaps a new scheme to many of you. It will be explained further by Mr. Lyons, of Brantford, and Mr. Henderson, both of whom belong to the Brantford Club. Our Commission are very anxious to co-operate with the electrical wiremen and contractors in getting more customers.

MR. F. M. DUSENBURY

I was very much impressed this morning by the talks of Mr. Kirkwood and the other gentlemen who spoke on the subject of advertising. The point was made by Mr. Kirkwood, regarding contractors getting hold of their customers in the different localities in a personal manner. Now, the contractors are the legitimate dealers in electrical material. I have believed that, and I think that most of the manufacturers have believed that right along, that electrical goods should be sold through electrical people. Now, the biggest competitor that the contractor has had in his sale of goods has been the central station, and I will say that it coincides very well with Mr. Kirkwood's idea, for the central station has for many years past been taking the names of the customers and sending out advertising, some daily, some only once a month, and in that way when it comes to carry something advertised the public will buy it from the central station, which will get the bulk of the business. They have done a great deal of advertising work, and it seems to me the electrical dealers trail a good way behind, but there are a great many towns in the province where the central station and the contractor are co-operating together. This has been done by organization between the central station and the contractor. The central station in these cases has refrained from selling the goods, and the contractor has been able to take hold and sell goods at a profit to himself. That is one thing about co-operation, I believe we should agree in every point in the province. I believe that when the contractors and the dealers take hold and push the lines and make sales and follow them up, the way it is done in the central station, that the central station would be very glad to be relieved of the onus of carrying material and current consumption devices themselves. That has been the general tendency across the line, and I believe the time is coming when we will have it here. One of the principal things talked about to-day has been the maintenance of resale prices. Gentlemen, that is a very important thing, not only to the contractors, but the jobbers and the manufacturers themselves. It is pretty nearly the vitals of the electric business to-day, and from a manufacturer's point of view, I would say that possibly one of the reasons they are not carried out the way they should be is because the manufacturers themselves have no organization. Individually they should have an organization, and the organization of the manufacturers should get together with the contractors and settle disputes that might come up in reference to terms of sale, etc. You would not want to regulate the prices of any manufacturer at all, but shipment, terms, etc., which enter very vitally into the business itself, and I think that as soon as both get together on grounds like that the problem will be solved to a great extent.

MR. A. H. WINTER JOYNER

It seems to me that in co-operation there are at least three relations to consider: the relation, or co-operation between the contractor and the customer, the co-operation between the contractors themselves, and the co-operation between the contractor and the manufacturer. The proper co-operation between these three makes the successful man of business—co-operation is undoubtedly one of the most important elements of a successful business. It is no use in these days attempting to run a business individually and without any reference to your neighbor at all. Union is strength. Perhaps we have so far run to individualism too much, and in the West we are beginning to realize that co-operation is a very necessary element, because, after all, it is not a principal in itself, but a mode of action. It is your method of securing something, that something you call a living, or whatever you are after—generally expressed by dollars and cents. I do not know whether this is really all we are living for, but it is very often expressed in that way. The reason we want success is because success spells dollars and cents. There is one thing to consider about co-operation. You may co-operate with other people for merely selfish ends of your own, or you may desire to co-operate for the general welfare of the community or of the trade—the electrical business. I submit that the only satisfactory way to approach the subject is to enter into the spirit of co-operation in a whole-souled, impersonal way, so that it not only may benefit you and those associated with you, but that when your weight, however relatively smaller or greater than the others, is thrown in with them it will accomplish results never hitherto dreamed of individually. In other words, we are out to give service, and according to the service we give, will be the results we obtain.

Practical Talk on Tungsten Lamps

Mr. H. D. Burnett

The dealers and contractors, standing between the producer and the consumer, occupy a position where they should be able to inform the public of the various points on which they are a little hazy, and you are all aware that the public in general has a very vague idea of the incandescent lamp. The terms used are all more or less confusing, and if I can give the dealers and contractors a few striking points that will enable them to interest the public, and if they will transmit some of these points, I shall think that all my time has been well spent.

Those of you who have been in the electrical business for the last ten years will know what undreamed of improvements have taken place, especially in the incandescent lamp. Up to ten years ago the old carbon lamp had the entire field all to itself. There were practically no lamps made until 1880-1. During 1881, I believe there were 25,000 lamps made. About 1895 what they called the "Gem" lamp appeared; then, at almost the same time, the Tamplin lamp, then in about a year the Tungsten; and to-day the carbon has become almost obsolete. I do not need to dwell on the carbon lamp, as you are all familiar with it. I will devote most of my time to considering the tungsten lamp in its various forms. Now, carbon filament, as you know, is very brittle. In order to impress you with the decided difference between the carbon and the tungsten, I am going to distribute a few samples of filament which is the size used in the 100 watt tungsten lamp. I want you to take it and bend it and try to break it. You will see that the tungsten is a decided improvement on the carbon, in that you can tie it up and twist it into knots, but you can-

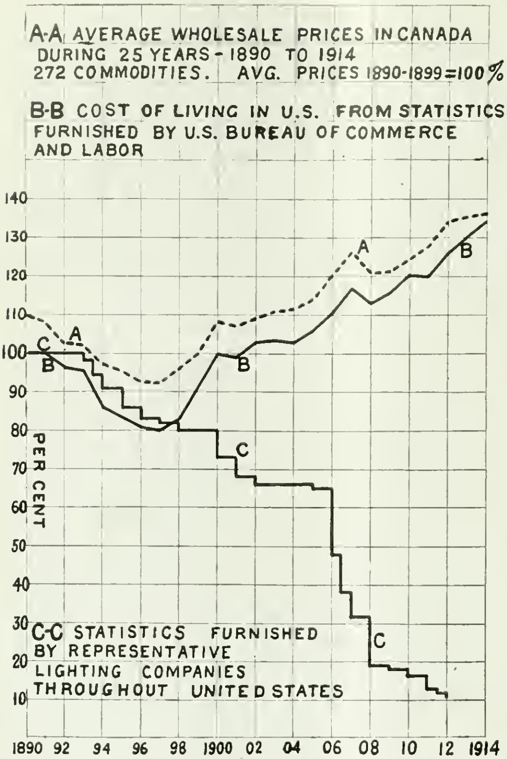


Fig. 1—Cost of Electricity Rapidly Decreasing

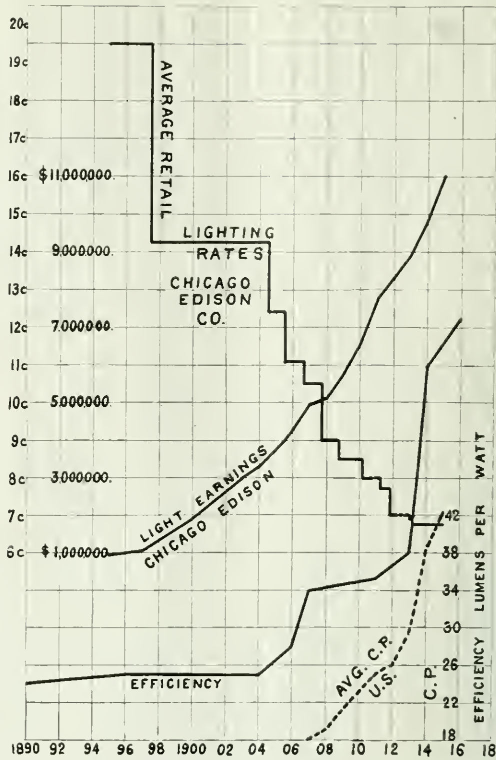


Fig. 2—Figures on Chicago Edison Co's Lines

not break it. That is a decided improvement on the tungsten of a few years ago. The chief fault of the original tungsten was its brittleness.

No person to-day who is paying for his lighting by meter can afford to use the carbon filament—even if he gets them for nothing. Take a simple little argument. The standard carbon lamp was 16 c.p., 56 watt. The 25 watt tungsten lamp gives about 24 c.p.; therefore, by substituting the 25 watt tungsten for the 56 watt carbon you are getting 50 per cent. more light with less than half the watts. If you take for nothing from some well-disposed concern a 56-watt 16 c.p. carbon lamp and burn it 1,000 hours, you are using up 56 × 1000, or 56,000 kw. hours.. If energy costs 1 cent per kw., that is 56 cents. Now, suppose instead of that, another man comes along and offers to sell you a 25-watt lamp, a tungsten, for 26 cents. The 25-watt tungsten consumes 25,000 watts, which costs you 25 cents. Now, you are paying 25 cents for your energy, which, plus the cost of your lamp, 26 cents, makes 51 cents, as against the 56 cents for the one you got for nothing, and getting 50 per cent. more light. At higher rates for current the saving is, of course, correspondingly greater.

[Mr. Burnett then proceeded to illustrate by two large maps he had placed before the audience. These are reproduced herewith. One of them shows the relatively low cost of lighting by tungsten, and how lighting, instead of going up, as everything else in the cost of living has, during the past ten years, steadily decreased. He took as an example the Chicago Edison Co., Fig. 2, showing actual figures and scales to illustrate, at the same time handing around samples of the different tungstens and wires used in the various-sized lamps.]

Electric Demonstration in Fort William

The Utilities Committee of the City Council of Fort William recently arranged a demonstration of electrically operated devices for use in homes, stores, and offices, and the demonstration was widely advertised. This display was held solely for the purpose of acquainting the user of electric current with the many purposes to which electricity could be economically applied. The display was held during the complete week of June 19 to 24, and the reports which reach us of the attendance during the early days of the week indicate that the efforts of the Utilities Commission are being highly appreciated by the citizens at large.

The finest display is being made by Mahon Bros., with whom is associated the F. S. Jones Company. This firm is also responsible for bringing to the city representatives of the Northern Electric Co., the Interstate Novelty Co., and the Renfrew Electric Mfg. Co. The F. S. Jones exhibit includes a number of Hughes electric ranges. Another attractive display is being shown by A. C. Waltz, of Port Arthur.

Fort William offers one of the cheapest rates on the continent for electric cooking, and a very large percentage of the citizens are appreciating that fact and "cooking by wire."

Received Government Order

The Siemens Company of Canada, Limited, Montreal, have received an order from the Government Telegraphs branch of the Department of Public Works, Ottawa, covering 17¼ knots of deep sea type submarine cable.

The Montreal Public Service Corporation has reduced its net rate for domestic electric lighting to 5c. per kw. hour.

What is New in Electrical Equipment

Lachine's New Fire Alarm System

The corporation of Lachine has just completed the installation of a new storage battery central office equipment for use in connection with their fire alarm service. The new office although not as large as some, is one of the best that has ever been installed in Canada.

When the question of changing the source of supply for their fire alarm system first came up, Mr. Gadbois, city electrician, under whose supervision the office was designed and installed, gave the matter a great deal of study and investigated other storage battery systems which were in use in other cities in Canada. The result has been that Lachine now has an equipment second to none.

The new office contains the following apparatus: 1 2-circuit storage battery switchboard; 1 motor-generator set; 1 specially insulated storage battery rack; 80 cells of storage battery, 6 ampere hour capacity. The battery and rack are installed in a special room which was built for the purpose and the switchboard and motor generator set are installed in an adjoining room, these rooms being in the basement of the new city hall which has just been completed. The switchboard is a combination board having facilities for both charging and discharging on the same set of panels and is so designed that should it ever be necessary to add additional circuits to the present fire alarm system, this could be done by simply adding another panel to the present set of two. In other words the switchboard is built on the unit principle, the main charging panel being designed to take care of as many as four unit panels of two circuits each.

The storage battery rack is designed to give the greatest insulation possible, both between jars and between jars and shelf, the well known principle of using glass rails and two-piece porcelain insulators, being employed. The storage battery jars used are of special design, in that they are arranged with special grooved bottoms so that they can be set and held securely on the glass rails and that they have lugs cast on their sides for the purpose of holding the jars apart and preventing any acid, which might possibly creep over, getting between the jars and short circuiting them.

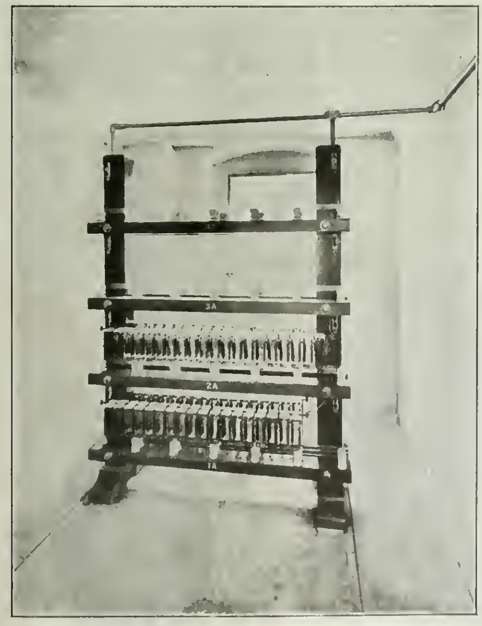
Mr. Gadbois has also employed a specially designed porcelain cover which will effectually prevent the acid boiling over the jar when charging.

The entire equipment was manufactured by the Northern Electric Company, Limited, Montreal, and the finish and design of the apparatus is in accordance with their usual standard.

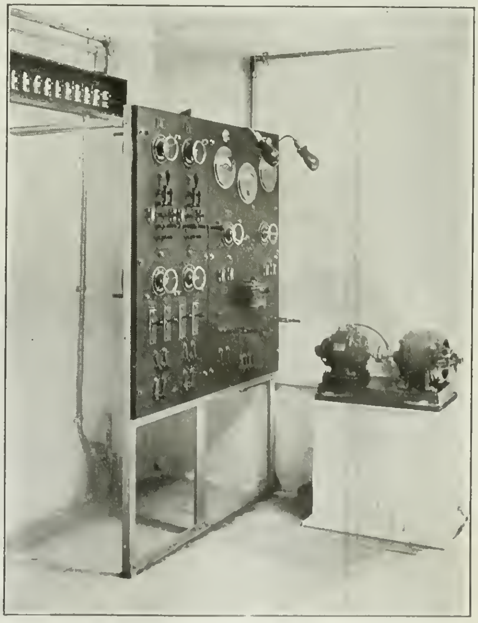
New Features in Transformers

The Canadian General Electric Company, Limited, have just completed some very interesting three-phase, 2,000 kva., oil-cooled transformers for the Montreal Harbor Commission. As will be noted from the accompanying cut, these transformers embody a comparatively new feature of coil construction as far as Canadian manufacture is concerned. Both primary and secondary are wound in flat, so-called "disc coils" which are interleaved primary and secondary. With this construction, the short-circuit forces are vertical instead of radial, which in itself, offers no particular advantage except that the construction permits of effective bracing. The oil ducts are horizontal instead of vertical, and the coil spacing strips are arranged radially, so that the flow of oil is not restricted, yet the spacing is in all cases at right angles to the turns, and in the case of strip conductor, is effective against the maximum strength of the conductor.

It has been found that the comparatively short horizontal

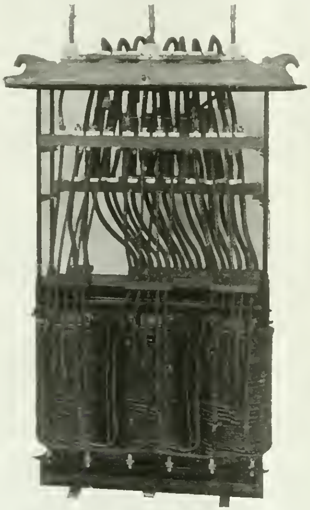


60" Double Storage Battery Rack Showing Special Glass and Porcelain Insulation.



Two Circuit Storage Battery Switchboard and Motor Generator Set.

ducts in connection with core type construction lend themselves to a rapid circulation of oil, which is an important consideration in oil-cooled transformers. The Harbor Commission transformers are assembled in tubular type tanks. While this type of tank is quite widely known by virtue of its extended use by several of the manufacturing companies in the United States, it is not generally appreciated in Canada that this type of tank, properly built, is absolutely oil tight and that no trouble may be expected from leaks. The tank proper is boiler plate with all seams welded, and the external tubes are expanded into place and welded on the inside. These considerations have an important bearing on the present tendency toward the use of larger oil self-cooled transformers.



Showing inside of Transformer.

The Peerless Freezer

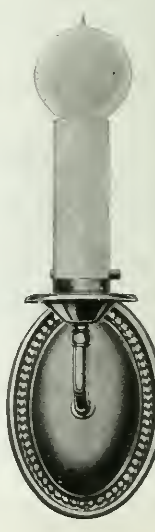
The illustration herewith shows a "Peerless" ice cream freezer manufactured by the Peerless Freezer Company. This company's freezers are equipped with the best standard make of motors, tested and fully guaranteed. The motors are mounted high above the base of the freezer, thus eliminating the danger of motors burning out or being injured by the careless handling of salt and ice. A 25 quart freezer uses a one-half horsepower motor; 40 quart, a 1½ horsepower.

Electric Blue Printing

The first Cooper Hewitt lamps used in electric blue printing were placed in front of a flat frame with reflectors behind the lamps, which only allowed prints as large as the frame to be made at one time. This limited the size of the tracing that would be accommodated, and made it necessary to reload the machine for each exposure. Lamps with flat frames are frequently satisfactory where the requirements are small, but where blue prints are large, the continuous machines are better. The Revolute Machine Company of 417 East 93rd Street, New York City, based the design of its Everett-McAdam type of blue print machine upon a revolving glass cylinder, the light being within the cylinder and the rays striking practically perpendicular to the surface of the blue print paper, which is wrapped around the cylinder. By this scheme, 75 per cent. of all the light is direct, 25 per cent. reflected, and none entirely lost. This makes the machine highly efficient and rapid and allows the production of a print of any length whatever. Special high power lamps, made for this particular service by the Cooper Hewitt Electric Company, of Hoboken, N.J., allow the machine to print at a high speed on comparatively small current consumption. This speed efficiency is due partly to the design of the machine, having the lights within the cylinder, and partly to the quality of the light from the mercury lamps, which is very well adapted to blue print work. The mercury lamps are automatic and start by the turn of a switch, and require no attention whatever during their life, which is guaranteed to be 1,200 hours. The machine is electrically driven, being equipped with a variable speed gear which allows it to be run at a speed necessary to suit the requirements of different kinds of paper and different tracings or negatives to be printed.

The Erie House corner, Blenheim, Ont., owned by Mr. W. R. Fellows, and a portion of which was occupied and conducted by him as an electrical supply and repair shop, was destroyed by fire June 8. Fire originated in the rooms of one of the tenants on the second floor. The property was valued at $3,000, and insurance amounted to $1,200. Most of the electrical stock was saved, though somewhat damaged. The business will be continued in another stand. During Mr. Fellows' term as mayor last year hydro-electric power was installed in the town.

Wall candle bracket, C-H manufacture. Sold in Canada by Benjamin Electric Co.



Current News and Notes

Agincourt, Ont.

It is stated that throughout the immediate vicinity of this village 140 farmers have signed up for use of electricity in one form or another, if the Hydro lines can be brought into the district.

Chatham, Ont.

Application has been made to the Dominion Government by the Electrical Distribution Company, of Windsor, to lay cables across the river to furnish a supply of hydro power to Detroit. If this request is granted it will mean that a considerable increase in power will be conveyed over the lines which now bring the current to Chatham and Windsor.

Fredericton, N.B.

The City Council have been supplied with a report by the Stone and Webster Corporation as to the proposition which it would be best for the council to accept regarding their street lighting; that is, whether to purchase power at a fixed rate from the Fredericton Electric Company or to continue the operation of the municipal plant, which is now out of date.

Kingston, Ont.

The ratepayers of Kingston, Ont., have ratified an agreement for a supply of electrical power from J. M. Campbell, at Kingston Mills. From 300 to 600 h.p. is being secured at three-quarters of a cent per kw. h.

Montreal, P. Q.

"Our Magazine" is the title of a house organ just issued by the Montreal Light, Heat and Power Company. The magazine contains much information relating to the inner working of the company, and is issued as part of the new publicity campaign inaugurated by the company.

The Electric Reduction Company, Buckingham, P.Q., have let a contract to the Foundation Co., Ltd., Montreal, for the erection of a large phosphate plant. The engineer is Mr. J. B. McRae, of Ottawa.

The consumption of electrical energy by ammunition and industrial plants in the Montreal district, is rapidly increasing. One of the latest contracts closed by the Montreal Light, Heat and Power Company is with the Dominion Textile Company, which has shut down its 3,000 h.p. plant at Merchants' Mill, Ambroise Street, Montreal, and replaced it by current purchased from the Montreal Light, Heat and Power Company.

The Controllers of Montreal will recommend to the Council that the Montreal Public Service Corporation be permitted to construct underground conduits for their high tension system. The Montreal Light, Heat and Power Company have already such a system in operation, and permission will be given to any other company, provided the conduits are built at the expense of the company and the plans approved by the Electrical Service Commission. These conduits are quite separate from those of the Commission, which are for purely distribution purposes, the former being in connection with the companies' generating systems and for tying up the various plants. They will be owned, operated and controlled by the companies.

The City Attorney has ruled that it will be necessary for the charter to be amended, to guard against the city being compelled to expropriate the conduits of the power companies in the event of the Electrical Service Commission extending their system to the districts in which the power companies' conduits are laid or may be so in the future. The latter companies can lay the conduits in the same districts as those of the Commission, but they will be entirely operated by the companies.

The city of Montreal has just put into operation the second portion of its new lighting system, described in an article in the Electrical News of March 15. This covers the down town district, including Craig, St. James, and Notre Dame Streets, and Fortification Lane, between Victoria Square and St. Lawrence Boulevard. There are 91 ornamental lamp standards, 12 of which are on Victoria Square. The light is furnished by inverted magnetite 6.6 ampere arc lamps, the poles being spaced at an average distance of 125 feet on alternate sides of the streets.

The Shawinigan Water and Power Company are erecting at Shawinigan Falls 50 workmen's residences, at a cost of $2,500 each. Terra cotta is largely employed in the construction.

Morrisburg, Ont.

The New York and Ontario Power Company, a corporation organized under the laws of New York State, have made application to the Dominion Government for permission to suspend an electric transmission line across the St. Lawrence River for the conveyance of electric current to a point on the Ontario shore near Morrisburg, Ont.

Nanton, Alta.

The town of Nanton has purchased, through the Northwestern Engineering and Supply Company, Limited, Calgary, a 75 h.p. Canada gas engine to operate on natural gas, and in conjunction with their present steam plant.

Orillia, Ont.

The Water, Light and Power Commission have awarded the contract for electrical machinery for the new power plant at Swift Rapids on the Severn River, to the Canadian General Electric Co. It has not been definitely decided whether two units of 3,000 h.p. each will be installed, or three units of 1,800 h.p. each. It is stated that the contracts for the hydraulic machinery have not yet been awarded.

Prince George, B.C.

Tenders will be received until July 8 for power plant equipment at Prince George, B.C. DuCane, Dutcher and Company, of Vancouver, are consulting engineers.

Quebec, Que.

Tenders are being called for a lighting system to cost $11,000, for the new grand stand and main avenue of the Quebec Exhibition Grounds.

Renfrew, Ont.

The Hydro-electric Power Commission of Ontario have investigated the power possibilities at the first and fourth chutes of the Bonnechere River with a view to supplying Renfrew, Ont. It has been found that at the first chute 1,500 h.p. can be developed, and at the second, 2,000. The cost of development and delivery in the first case would be $200,000, and in the other, $300,000. Both power sites are located within a few miles of Renfrew.

Ross Township, Ont.

The Zion Line Telephone Association, Limited, Ross Township, have been granted a charter.

Saskatoon, Sask.

The new addition to the power house is being rapidly pushed ahead, and it is anticipated that by fall the building will be completed. The switchboard to be installed is one of the largest in the Dominion and cost approximately $20,000. A new 700-kw. street railway unit is also to be installed.

Electrical News
Generation, Transmission and Application of Electricity

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Orders for advertising should reach the office of publication not later than the 5th and 20th of the month. Changes in advertisements will be made whenever desired, without cost to the advertiser.

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A Canadian Electrical Week

From time to time the Electrical News has drawn the attention of Canadian electrical men to the big advertising campaigns being put on by the Society for Electrical Development. Last year they had an "Electrical Week" campaign that was well advertised beforehand and resulted in a very big impetus being given to the wiring of homes, the sale of appliances and consequent added use of electric current. This year a repetition of this campaign is planned, to be known as "America's Electrical Week," which bids fair to eclipse the success of a year ago.

The question naturally arises—why cannot Canada get into this campaign and profit by it? Why not a "Canada's Electrical Week?" Naturally we would be included under the name which United States electrical men have been pleased to give to their organization, but so far as we can learn, this was not the intention. This habit of usurping a name that only belongs to them in common with other nations is becoming a recognized habit, however—the characteristic of their hyphenated associations—and Canada would do well to profit at least by the experience of the larger organization. Apparently these campaigns have resulted in large business and that is chiefly what interests us. If the idea is right in the United States, why would it not be right in Canada?

A valuable suggestion along this line has just reached us from a member of a western Canada electrical association. He says, "Why not a 'Canada's Electrical Christmas?'" We have a number of organizations that might take it in hand—electrical contractors, manufacturers, jobbers, central stations, are all interested. All it needs is a central executive with the necessary energy to get behind and push. No one doubts that it would go. Here is the suggestion as it comes to us.

"Last year the Society for Electrical Development organized 'Electrical Prosperity Week,' a week set aside during the year for the Electrical Industry; this week proved of great benefit to all; indeed, so great was the success thereof that this Society is again organizing "America's Electrical Week,' and it bids fair to outrival the week last year, and be a gigantic success.

"Within a few miles of us great preparations are being made for this week; are we in Canada going to allow this great business-getting proposition to pass without notice?

"It is true that at the present time Canada is engaged in a more important matter, but there are many that think those at home are 'doing their bit' keeping things going, especially when many depend upon them.

"During the past year associations of electrical contractors and dealers have been formed in almost every city in Canada. From coast to coast there is a feeling, 'Get together.' Is it not a fact that these associations are encouraged by the central stations and the great manufacturing concerns? If this is the case it should not be hard to combine together for 'Canada's Electrical Christmas,' a central executive being appointed to take the matter up."

Montreal Council Taking Wise Course

The question of the enlargement of the Montreal aqueduct and the hydro-electric development has undergone another change, and there is now every chance that the scheme will be investigated. The Council of the Canadian Society of Civil Engineers and other bodies requested an independent investigation, but the City Council refused this. Subsequently a special committee of the council appointed in May, 1915, reported that they had carefully considered the request of the Canadian Society of Civil Engineers, and were of opinion that the members should be allowed an opportunity of studying the plans, provided that the city be not called upon to bear any cost or to pay any fees, the committee being of opinion that "the Society is actuated in the matter solely by public spirit and have no pecuniary interest in view."

Members of the Society had previously offered to do this work free, and it is understood that they will willingly make the investigation on the conditions suggested by the committee and endorsed by the council. They have repeatedly stated that they have no personal interest in the matter except as a body of engineers and taxpayers; that the scheme, on the surface, appears to be costly, as compared with hydro-electric developments of public utility corporations; that the project as a whole has not been reported on by disinterested engineers; and that the Society's Council, while not criticising the project, believed that further study was necessary before proceeding with any additional expenditure. An investigation will show how far the claims of the city engineers that the plan is economically sound, and the contentions of other engineers that it is extravagant and not likely to give the estimated power, are justified.

In connection with the enlargement of the aqueduct, the Cook Construction Company has sent to the City Council a bill for $908,000, of which $452,000 is for claims. The three principal items of the latter amount are $123,000 for loss of reasonable profits owing to various delays and hindrances; $133,000 for re-classification, and $157,000 for overbreak excavation. The city is informed that the figures are not final, as the claims increase concurrently with the progress of the work. In addition to the claims, the company is asking for the payment of $455,000 made up of various accounts for work done under the contract. It is stated that the work was held up, owing to the company not having access to the land, the plant thereby being tied up. It is proposed to arbitrate the differences between the company and the city, it being stated by Controller Cote that the city has a counter claim.

C. E. A. Officers for 1916-17

The following officers and managing committee for the ensuing year were unanimously elected by the Canadian Electrical Association at their recent annual convention:—

President, D. H. McDougall, Toronto Electric Light Company; first vice-president, H. G. Matthews, Quebec Railway, Light, Heat & Power Company; second vice-president, E. A. Dunlop, M.P.P., Pembroke Electric Light Company; third vice-president, A. Monro Grier, Canadian Niagara Power Company; honorary secretary, T. S. Young, 347 Adelaide Street West, Toronto; secretary-treasurer, Alan Sullivan, 910 Excelsior Life Building, Toronto; managing committee: W. G. Angus, Dominion Power & Transmission Company, Hamilton; P. T. Davies, Montreal Light, Heat & Power Company; M. C. Gilman, Toronto Electric Light Company; J. S. Gould, Citizens' Electric Company; H. M. Hopper, The St. John Railway Company; G. Ratcliffe Hulme, Canada Electric Company; George Kidd, British Columbia Electric Railway Company; E. L. Milliken, Cape Breton Electric Company; J. S. Norris, Montreal Light, Heat & Power Company; L. W. Pratt, Dominion Power & Transmission Company; the president National Electric Light Association; R. B. Woodyatt, Southern Canada Power Company.

Winnipeg Electrical Men Elect New Officers

The annual meeting of the electrical section of the Canadian Society of Civil Engineers, Winnipeg branch, was held at the Royal Alexandra Hotel on Wednesday, May 31, at 8.15 p.m. There were 67 members present. After the election of officers for 1916-1917 a musical program was provided, which was enjoyed by everybody. The election of officers for 1916-1917 season resulted as follows:—President, W. G. Chace, acclamation; vice-president, E. V. Caton, acclamation; secretary, W. H. Reynolds; executive committee, J. M. Leamy, F. H. Farmer, F. A. Cambridge. Research committee: J. H. F. Wilson, R. Howard, T. L. Phillips, B. S. Stewart, H. E. Brockwell. Library committee: J. W. Dorsey, R. A. Sara, A. Lamont, R. J. Swain, A. S. Appleton, H. McConkey. Membership committee: J. H. Schumacker, E. H. Smith, J. A. Douglas, R. V. Slavin, J. G. Glassco, M. V. Sauer, R. W. Moffatt.

Great Lakes Power Company

Samuel Insull, of Chicago, president of the Middle West Utilities Company, a very strong holding corporation of public utilities located in various parts of the States, has been appointed president of the Great Lakes Power Company, a company formed to take over the Algoma Steel Corporation, Sault Ste. Marie, Ont. The following officers have also been elected: vice-presidents, John A. McPhail, of the "Soo," and Martin J. Insull, Chicago; secretary, P. L. James, Chicago; treasurer, Robert W. Waite, Chicago. The expenditure of upwards of $2,000,000 is contemplated in the development of some 18,000 h.p. and the contract, which has been let to James O. Heyworth, of Chicago, calls for the completion of the entire plant by December 31, 1917. A preliminary start has already been made.

Canadian National Exhibition

Unusual and special features at the Canadian National Exhibition will not be lacking on account of the strenuous times. Indeed, the conditions under which we are living seem to provide unusual opportunity for instruction and entertainment. The full programme is not yet complete, but we are advised that the following will be featured: Brilliant Assemblage of Troops, representing all sections of British Domains; the Process of Shell Manufacture, showing the operation of the various machines used in turning out projectiles; Exemplification of Germany's Method of Undersea Warfare; Bombing and Hand Grenade Throwing; Air Flights and Bomb Dropping, and many other equally interesting features.

The Romance of Wireless*

A popular fallacy is that there is no sentiment in business. To a certain extent that may be true, but it is at best a debatable point. Sentiment and romance are closely related, and no one will deny that the stories of modern business methods are romantic as well as dramatic. The same may be said of many inventions which have been commercialized. Take, for instance, our great modern public utilities—principally those of transportation and communication. The story of the development of any of these makes thrilling reading. In fact, in recent years, "the romance of 'big business'" has become a by-word. Steam, the telegraph, the telephone, and lastly the science which is the subject of this article—Wireless Telegraphy. We all remember reading of the Scotchman, James Watt, who sat in his kitchen watching the queer antics of the tea-kettle cover, when the spout through which the steam was permitted to escape became partially blocked. From this simple phenomenon came the romance of steam, which revolutionized industrial and transportation problems. Next in order came the telegraph. Imagine Morse's painstaking and persistent efforts, ridiculed at first, but afterwards crowned with success—the telephone, the product of the gifted inventor Bell, and lastly wireless telegraphy, which has reached out and claimed all the world as its field.

In Canada we complacently accept the fact that we possess the longest chain of intercommunicating wireless stations in the world, extending from Port Arthur at the head of Lake Superior down through the Great Lakes, along the River and Gulf of St. Lawrence, to far off Labrador. Along the Atlantic coast of New Brunswick, Nova Scotia and Newfoundland, stations are located, and, prior to the war, one of the busiest stations in the entire group was located at Sable Island, "the graveyard of the Atlantic," about 200 miles out from Halifax.

Volumes might be written of the Romance of Wireless as applied to Canada. It is related that, when one of the earlier French explorers ascended the Gulf of St. Lawrence on his first voyage, the rugged age-old cliffs near Gaspe arrested his attention. He turned to a companion and, pointing to the cliffs, remarked that these were in reality the gateway to a new world. "What sights they must have witnessed, and what scenes they will witness when this and many other generations will have passed away."

Legend has it that a large cross was erected at the top of the highest point as a signal for incoming voyagers. This probably was the very first signal ever employed for marine purposes in Canada. How true the explorer's words were has been demonstrated by the march of events since then. The small and slow sailing vessels have given way to huge, speedy, luxuriously fitted liners, and the cross on the cliffs

* From paper by J. H. Lauer, before Montreal Electrical Club.

of Gaspe has been superseded by a wireless station a few miles further up the river. At Quebec a wireless station is located on the historic citadel, and on that part of the Island of Montreal named after its founder, Maisonneuve, is located another wireless station. Further on up the river, and so on through the Great Lakes, the canoes and smoke signals of the Indians have given way to palatial steamers and wireless telegraph stations. To-day the ether throbs with whispers from thousands of wireless stations on ship and shore. Ships in all the seven seas are fitted with wireless, and the Arctic and Antarctic are no longer the isolated places they once were. While it is true that war is a great destroyer, it also stimulates inventiveness, and the present war is "par excellence" a war of science. Aeroplanes, submarines, motor cars, battleships, cruisers, hospital ships, and in fact craft of all descriptions are fitted with wireless. The whole world has become a vast whispering gallery.

It should be remembered, however, that wireless telegraphy is, first of all, a saver of life, and in modern warfare is only an adjunct to death-dealing devices. Wireless has never yet failed in an emergency, and thousands of lives have been saved through its medium. This is as its inventor would have it. There is ample evidence that the same spirit pervades the thousands of wireless operators scattered all over the earth. Although the service is comparatively young, it already has its traditions, and in reading of instances where wireless has brought succour to those in distress, it is invariably remarked of the wireless operator that he ably maintained the traditions of the service.

The Status of Electric Cooking Ranges

Extracts from a Report Covering Their Design, Manufacture, Advantages and Sale

Report on Electric Ranges

At the recent Chicago convention of the National Electric Light Association, the Electric Range Committee brought in a report covering the design, manufacture and advantages of electric ranges and suggested a number of interesting features in connection with the sale of them. The following extracts dealing with the more important phases of this industry are taken from the report:—

But few housewives have any conception of the advantages of cooking with electricity; the large majority of central station men are skeptical as to its feasibility from the consumer's point of view, as well as that of the company.

Yet the very considerable load that has been obtained by central stations actively developing electric cooking, on the European Continent, in many tropical countries, in Canada, and in many places in the United States; the fact that electric range business of many manufacturers has increased thirty fold during the past five years and the more than doubling, this year, of the number of concerns making electric ranges, causes all central station men to devote a great deal of thought to this question.

Advertising

Your committee advances the following conditions as a basis of facts on which to discuss the advertising requirements of the electric range situation; and in setting forth the following premises, it is your committee's conviction that in the field of advertising lies one of the most promising opportunities for effective work on electric range cooking. Contemplation of improvements in the advertising of electric range cooking seems to your committee to be predicated on the following present conditions:—

1. That no established, fixed, or positive demand exists at present on the part of the public for electric ranges.

2. That the actual marketing of electric ranges (the placing of ranges in homes) is being accomplished as the sole result of strenuous and insistent sales efforts by central stations.

3. That so devoid of manufacturers' advertisements on electric ranges and electric range cooking have papers, magazines, and other advertising media been, that not one woman in a thousand can name, off-hand, a reputable make of electric range.

4. That to date electric range cooking is still shrouded in mystery of operation, uncertainty as to results and costs; despite the vigorous efforts made by central stations lately to draw aside the curtains and let in the light and truth on electric range cooking.

5. That the great majority of new homes and apartment houses are still being built without wiring installed for electric ranges.

6. That not only is the burden of marketing electric ranges being borne by central stations, but that central stations are, in addition, bearing the burden of introducing, guaranteeing and familiarizing the public with the various makes of electric ranges—an obligation that clearly should have been met in the past, and should be met in the future by the manufacturers of the ranges.

7. That it is now true that the experimental stage in the construction of electric ranges is largely past; that central stations have established rates permitting economical electric cooking, and there is a sufficient variety of types and styles of electric ranges on the market to meet requirements; that electric water heating devices are being developed to a point where they promise to be efficient and economical.

Your committee believes that the advertising should give emphasis to the following points:—

1. That the elementary experimental stage of electric range cooking has long since passed.

2. That the age of electric cooking has not only arrived, but that it now occupies an impregnable stronghold in the homes of thousands of women.

3. That there are fixed standards in the manufacturing of electric ranges, to which all reputable manufacturers adhere—and this forms the housewife's protection, in (1) adopting electric range cooking, and (2) in selecting the make of range that most appeals to her.

4. Then drive home the general advantages of electric range cooking—cleanliness, economy, safety, added personal comfort, and all the other points that make for superiority in electric cooking over all other forms.

And on this foundation of manufacturers' publicity and advertising, may then be reared a superstructure of proper and adequate and effective co-operation in the supplementary advertising that will have to be done by both manufacturers and the central stations.

Then, too, will the central station be able to take its proper place in the scheme of marketing electric ranges and exercise its natural function of helping the housewife to select the size and type of electric range best suited to her individual needs; of helping and aiding her in the operation of the electric range; and in keeping the range on its lines year after year, while each such range by its own success and word of mouth advertising, will sell other ranges.

Your committee believes that special literature should be available for the use of central stations in their efforts to interest domestic science and home economics departments of public schools, colleges, and similar institutions in electric cooking.

Your committee suggests further that special literature be prepared for architects and builders so that they may have data upon which to recommend electric cooking to their clients and provide for range and water heating wiring in all new and remodelled residences and apartment buildings.

Your committee believes it would be a good thing to have an electric cook-book prepared for distribution by central stations; this book to contain information on the principles of electric cooking, on economical methods of using the electric range, and on methods of preparing and cooking articles of food on the electric range.

Your committee believes that the following will be of additional benefit in the advertising campaign:—

The use of a national slogan, such as "Cook by Wire," in all advertisements and literature dealing with electric cooking.

Billboard posters featuring "Cook by Wire" slogan, lithographs of electric range in use, with educational reading matter.

Readers and articles on electric cooking to be circularized among newspapers and periodicals.

Pamphlets on electric cooking, embodying the ideas used in newspaper and periodical advertising. Such pamphlets should contain educational reading matter, attractive cuts, and useful information about electric cooking, and should be distributed by central stations among their consumers.

Form letters and postals with human interest for "Direct to Consumer" advertising by central stations.

Cuts, literature and display copy for use in local newspaper advertising. In case the central station handles more than one make of range, it is desirable that this material should be neutral in character in so far as competitive range features are concerned.

Manufacturers' pamphlets or catalogues to be distributed by central stations, containing educational reading matter, illustrations, descriptions and prices.

Manufacturers' booklets containing effective testimonials and illustrations.

Electric range cooking demonstrations in connection with local newspaper advertising.

Experience of Central Stations

Compilation of data in answer to questions addressed to forty-six operating companies shows the following facts:

Types of ranges sold up to the present time have been the products of five manufacturers, all but one of whom have been making various electric appliances for some years past. There were 4,659 ranges reported sold, the majority of those apparently giving good satisfaction both as to operation and number of burners and sizes of ovens. The principal mechanical complaints were burning out of elements, slowness of operation and fragile construction. There seems to be a variance of opinion regarding the relative merits of the open coil and enclosed burners, the former apparently being the more popular. The type of electric range most desired seems to follow the lines of the popular gas ranges. There should be four 3-heat burners on the top (one 1,500 watt; two 1,000 watt; and one 750 watt). The side and upper ovens are by far the most popular. Ovens should be at least 12 by 15 by 18 in. and should contain a broiling element and a baking element. A warming oven above or below the baking and broiling oven is a desirable adjunct. The doors on side ovens should open down.

Installation—After an electric range is sold it is important that the installation should be of a proper character and at a reasonable cost. It is apparent that the variation in cost of installation—that is, from the meter in, depends largely upon local requirements. In some localities the standard of construction required is much lighter than in others—hence the variations in the cost of installation. About two-thirds of the companies do the necessary wiring from the meter to the range and install the range itself. The remaining one-third do no wiring, but deliver the set up ranges when sold by them. Apparently the companies putting out the greatest number of ranges are doing all wiring in connection with installations. Costs of installing electric ranges in consumers' kitchens vary from $4 to $30; the average being approximately $12.50. All companies make installations of electric ranges at cost, excepting eight, who charge a profit of 10 per cent.

Merchandising—There are many ways and methods of selling electric ranges to consumers, and these indicate a considerable variation of opinion as to what are the best means to be adopted. The answers to the questions seem to demonstrate that in order to create an interest in electric cooking and promote the use of electric ranges, the central stations had better handle the business, at least in the early stages, and make installations to consumers at cost, or as near to cost as it is possible to reach. Most companies sell electric ranges to their customers, one-half at cost and the other half at a small profit. Apparently very few dealers have become interested in the sale of electric ranges up to the present time. The majority of companies reporting state that dealers are not handling electric ranges and consequently there is little chance to co-operate. As the more progressive central stations find it necessary to make first installations of ranges at cost or with such small profit that, for a while at least, dealers will not be able to see much that is attractive in electric range installations.

The principal difficulties in selling electric ranges, indicated by companies reporting, are the following; their importance being in the order given:—

(a) First cost (including installation);
(b) Anticipated high operating cost;
(c) Lack of economical water heating facilities;
(d) Slow operation;
(e) Skepticism and lack of confidence;
(f) Disposition of old equipment;
(g) Satisfaction with present means of cooking;
(h) Necessity for heating kitchen during winter months.

A large number of electric range installations are reported to be made under deferred payment plans, the limit of payment varying from three to twelve months. The majority of companies endeavor to hold the limit of payments down to a six-month period, but fully one-half of the companies reporting seem willing to make sales on deferred payments extending beyond six months.

About one-third of the companies reporting, state that they sell electric ranges on deferred payments at the same prices as for cash. The remaining two-thirds report that they make additions to the cost price varying from 5 to 15 per cent., the average being 10 per cent. advance when purchases are made on the deferred payment plan.

Excepting in three instances, all companies reporting state that they maintain display rooms in their offices.

With two or three exceptions all companies reporting state that they select the best of each manufacturer's products to suit local conditions. The exceptions state that they order from one manufacturer only, so as to obtain quantity prices.

The average consumer apparently is not willing to pay more than $30 to $40 for an electric range, but he can be educated to raise the price if the reasons given are satisfactory. The majority of companies report that the average consumer will pay a price varying from $40 to $50 to get the type of range desired. The average of a few of the companies reporting seems to be in the neighborhood of $50.

The majority of companies reporting believe that, under present conditions, the lowest priced range which would at the same time be durable and efficient, should be from $30 to $35 and contain at least three burners with a side or upper oven. A number of companies fear the results of putting ranges upon the market which may be low priced at the expense of durability and efficiency, believing that ranges of this character will do more to hurt the electric cooking business than to help it.

General Merchandising Information

With the idea of obtaining all the information possible bearing upon this subject as a result of the experience of the companies reporting, some leading questions were asked, and the replies received are mostly practical and entirely interesting.

The following quotations give the ideas of some of the companies on dealing with manufacturers in order to obtain an ideal electric range at the lowest possible price:—

"The manufacturer should be willing to stand behind his product with a proper guarantee, and willing to defer some of the profits from the business until a future date, and not hope to make all on the first few ranges sold, but bring the price down as low as possible and let the central station have an opportunity to put out more ranges."

"Standardize requirements of the central stations so as to limit the types of ranges made by different manufacturers and thus reduce their overhead expenses. Also show manufacturers that increased output depends primarily upon lower priced ranges."

"Develop hot water attachment and durable elements."

"It seems as if a canvass of number contemplated to be used would allow greater number to be made and this would allow cut in price, or manufacturing company could sign tentative contract to sell at certain reduced price if specified number were ordered by entire trade."

"Power companies to combine in order to secure quantity prices."

"Standardization of types should reduce production costs. Some method of collective bargaining between representatives of the manufacturers and central stations to establish standard designs for a pre-determined period might work to the mutual advantage of all concerned."

"Standardize and cut out novelty idea."

"A maximum production to lower unit cost."

"Through increased output; central stations could club together and order a certain number in advance."

"Dispense with nickel and frills unless especially ordered."

"Standardize so as to cut down manufacturers' cost."

"Study the gas range closely and capitalize its experience."

"Let the electric manufacturers make the element and the stove manufacturers the stove."

"Ship complete line of repair parts to the distributor."

"Manufacturers should be more particular in details and mechanical construction."

"Do not load the development costs on first shipments."

"Better insulation in oven on cheaper ranges."

"Standardize on design and equipment. Reduce number of types of ranges and talk quantity to the manufacturers."

Special Methods

The following quotations give the ideas of some of the representative companies as to methods of special value:—

"Install one in each community on trial and use it as a demonstration."

"Personal solicitation and demonstration."

"Expert instructions and frequent visits for tests."

"Get an efficient range properly installed in a consumer's residence. That consumer, satisfied, will use the range and talk about it, which will be the best advertisement for same."

"Deferred payment plan. General use of electric ranges among company employes. Testimonials of satisfied users of the ranges. Demonstrations on large scale, as well as follow-up work of all new installations by demonstrators. Domestic science equipment in the schools. Continuous publicity work as to the advantages of electric cooking."

"Thirty days' free trial."

"Cooking schools and demonstrations. Salesmen to follow up prospects closely."

"Install range on trial; a good conscientious salesman will make it stick."

"Judicious advertising and personal letters."

"Sell range installed on small monthly payments, making allowance for old equipment."

"Personal solicitation by well informed, enthusiastic salesmen has done most for us. No one plan, however, can be relied upon altogether. Any well directed method of educating the public will prove a good merchandising method."

"Personal solicitation. Don't wait for the customer to go to the demonstrations. Let the salesman make an appointment and bring the customer to the demonstration and close the sale. After the installation is made, don't wait for the customer to send in a complaint. Call upon the customer regularly to inquire and give information and call the customer up on the telephone between personal visits. The satisfied customer immediately becomes a salesman without pay."

Rotary snap switches controlling the service to various heaters should have a distinctive feature either in color or position of indicator, or both, when current is off. The distinctive feature at the present time on most of these switches is the reading of the word "off," but in a dim light or when the eye sight is not of the best, reading is not always easy. A distinctive color for the lettering of the word "off" or the uniform or distinctive position for the indicator will quickly convey the idea to the operator whether or not the circuit is disconnected, even if only a hasty glance is given. Complaints regarding the size of bills are generally caused not by the use of energy but by its abuse or waste.

Advantages of Electric Cooking

When a consumer is approached by a salesman with the idea of creating an interest in electric cooking and the installation of an electric range, one of the first questions asked is, "How does it compare in cost," with the fuel which the customer may then be using for cooking purposes. The question of comparative cost is one which should be carefully handled and we do not propose to deal with it here. However, there are so many advantages in connection with the use of electricity for cooking purposes over any and all other kinds of fuel that the question of comparative cost is not of such great importance as it would seem at first glance. Lighting by means of gas has always been considered much cheaper than by means of electricity, but to-day almost everyone demands electric lighting if it can be obtained, regardless of the expense as compared with other illuminants. The reason of this condition is that electric lighting has advantages all its own. We feel that electric cooking also has advantages all its own, which tend to minimize comparisons regarding relative cost of operation. For the benefit of salesmen and other central station employes the following list of advantages of cooking by electricity has been compiled. It is not claimed that the list is a complete one.

1. Safe.—The elimination of matches and the fact that there is no flame, which means absolute protection from the hazard of fire. No danger of explosions.

2. Clean—No blackened walls, dirt, soot, or smoke. Also electric ranges are easy to clean and easy to keep clean because no dirt is caused by fuel.

3. Sanitary—No poisonous gases to escape and contaminate the atmosphere and the food which is kept in the kitchen or pantry. If a plant or flower is kept in a room where gas is used, it will soon wither. The air which is not good for plant life is not good for human beings.

4. Regulation—The electric stove has perfect regulation.

(Continued on page 27)

Experience and Recent Developments in Central Station Protective Features (Concluded)

By N. L. Pollard and J. T. Lawson

Multi-Recorder

The multi-recorder is a device for recording the time to the fraction of a second of the sequence of action of oil switches, circuit breakers, potential indicating devices and aluminum cell arresters. A record of this kind is invaluable to the station man in analyzing troubles or ordinary switching changes.

In order to have complete information on the performance of station apparatus under all conditions, it is highly desirable to have records of the closing and opening of circuit breakers, operation of lightning arresters, appearance and duration of high voltage in the lines and the occurrence of grounds and short-circuits. At the time of writing this paper the installation of the multi-recorder is not complete, therefore we are unable to give any actual operating experience with this instrument.

Insulation Resistance Recorder

The insulation resistance recorder is an instrument which gives a daily graphic record of the insulation resistance of the system. The results obtained so far from the use of this instrument have been rather disappointing, due to the fact that there are so many old insulators of different insulation characteristics. When the insulators are all changed so that they will have the same characteristics throughout the system, we can, by establishing a point on the chart which might be called "dangerous," but which is well above the breakdown point, give the operator an opportunity to report when the insulation of the system reaches this value. By isolating the transmission circuits one at a time, the line in question can be removed from the system and later by high potential testing or other methods, the bad insulators can be located and removed from the line.

In using this instrument on lines where the insulators have been standardized, very good results have been obtained. Its use has also shown the need of increasing the insulating qualities of porcelain, which is something that we did not know before.

Air Washer

The capacity of a generator is directly dependent upon its temperature. In order to keep its temperature as low as possible, it must be supplied with a sufficient amount of clean, cool, humidified air. The specific heat of air being low, it is necessary that it be humidified in order to increase its heat carrying qualities sufficiently. It is also necessary that the air be free from impurities in order to prevent a partial or complete closing of the machine ventilating ducts.

A well designed air washer will satisfy all the requirements mentioned above.

Air washers are used in connection with our largest turbo-generators and our experience leads us to believe that their use is almost a necessity; particularly where the conditions are such that the air contains a great many impurities. If an air washer is not used, it is necessary to remove the rotor of a machine periodically and clean the ventilating ducts or in time they will become so clogged with refuse that over heating will result and a burn-out occur.

Where large air blast transformers are used and the air conditions are not satisfactory, it would, in our opinion, be advisable to install an air washer.

Resistance Bulbs and Thermo-Couples

For several years it was our practice to install resistance bulbs in the windings of the largest turbo-generators and synchronous motor-generator sets, in order to know at all times the temperature of these machines. The results obtained by their use so far have not met with expectations.

The resistance bulbs furnished to-day are somewhat more substantial than the earlier type, but are still too frail to stand much hard usage. In the windings of our more recent motor-generator sets thermo-couples have been installed which, we believe, will give better service than resistance bulbs, as they are less liable to mechanical injury.

The temperature indicator has been found very useful in determining when a machine needs a thorough cleaning. Thus, a possible burn-out is prevented which otherwise could not be foretold.

It is our opinion that wherever possible thermo-couples should be installed at the hottest points in the windings of all large generators or motors.

Dampers on Air-Blast Transformers

In most of our stations where air-blast transformers are installed a common air chamber is utilized for all the transformers and we have found this method of air supply more economical than to use a separate and independent blower for each transformer. Each transformer is equipped with a top and bottom air damper so that in case of fire in the transformer, the dampers may be closed, thus shutting off the air supply and smothering the fire.

We strongly recommend top and bottom dampers on all air-blast transformers, especially where a common air chamber is used. If the transformers are not equipped with both top and bottom dampers and a fire starts in one of the transformers, it is necessary to cut off the entire air supply for a considerable time, depending upon how long it takes to put out the fire. This might compel the station man to disconnect the other transformers from the service; thus resulting in complete interruption.

Coherer Alarm Device

This device is used to register predetermined voltage rises on the transmission line itself, across reactance coils or on aluminum cell lightning arresters. In order to get a permanent record of its action, it can be connected to a relay which will make a record on a multi-recorder. This device has been found very convenient to register the discharges of our aluminum cell lightning arresters.

Previous to the installation of this device, it had been the custom to install with each aluminum cell arrester a discharge recorder which has a continuously moving paper punctured by the discharges. We finally came to the conclusion that while these recorders gave us much desired information, the continual replacement of paper record rolls was expensive and troublesome.

Potential Indicating Devices

Electrostatic potential indicating devices are used to indicate potential on feeder circuits. The instrument is connected to the middle point of two strain insulators in series, which are connected between each live wire and the ground. The displacement current through the insulators is sufficient to operate the instrument.

Another method of obtaining the voltage indications is to install potential transformers whose secondaries are connected to indicating lamps or voltmeters. However, this means is rather expensive and the required space for potential transformers is not always available.

It would therefore seem that the potential indicating device now on the market might fill a long-felt want.

Electric Railways

Montreal & Southern Counties Railway Extension, St. Cesaire to Granby, Que.—A Fine Stretch of Interurban Line

Another rung in the ladder of development undertaken by the Montreal & Southern Counties Railway has just been added by the placing in operation of the new 16½-mile extension from St. Cesaire to Granby. The new line marks a milestone in high speed electric railway development in Canada.

The Montreal & Southern Counties Railway is a suburban and interurban railway, connecting the south shore of the St. Lawrence River with Montreal via the Victoria Jubilee Bridge. From a limited service inaugurated in 1909 between Montreal and St. Lambert, a distance of 3½ miles, extension after extension have been added, until at the present time a large majority of the municipalities of the South Shore have been linked together in this chain of development and brought in such close communication with Montreal through frequent service as to make commuting a pleasure. The interurban arm of this development stretches in an easterly direction for a distance of 47.5 miles through the Counties of Chambly, Rouville and Shefford, the present terminus being Granby.

Construction work on the new extension was commenced in October, 1913, when a contract was let to Ross & McComb, contractors, to construct the concrete piers to carry the steel bridge across the Yamaska River at St. Cesaire. This bridge, which is of a deck girder type, is 240 feet long, supported on four concrete piers, 80 ft. centre to centre. The steel work for this bridge was supplied and erected by the Hamilton Bridge Company, of Hamilton, Ont.

In the spring of 1914 a contract was let to Grant, Campbell & Company, for the building of the grade, and laying of the steel. Work was commenced on May 25, 1914, and sufficient force was employed to complete the work and place the road in operation by October 15 of the same year. On August 5th, however, all construction work was suspended, due to England's declaration of war, and was not resumed again until May 19, 1915, from which date the work was carried on uninterruptedly until its completion, December 12th, 1915. As fast as the track was laid and ballasted, the overhead construction force followed setting poles and bonding the rails.

The work of electrification was carried on by the railway company's force under the direction of G. J. Meyer, chief engineer and general superintendent. The type of construction used on this section was similar to that employed on the previously electrified extensions.

Bonding

The bonding consisted of 4/0 concealed type triplex bonds with ⅞-in. terminals 10 in. centre to centre for compressing into web of rail.

Overhead Construction

The overhead construction is of the standard catenary type with 7/16 in. Siemens Martin grade stranded galvanized steel messenger cable, from which, at intervals of 15 feet is supported a 4/0 B&S gauge, American Standard, grooved hard drawn trolley wire. The hangers are of the floating type, specially designed to absorb the shocks, and consist of three bolt, malleable, iron Detroit ear, to which is riveted a ¾-in. wide by ⅛-in. thick strap iron hanger.

Pole Line

Within the town of Granby the construction is cross spans with 28 ft. steel poles set in concrete. The poles are

Steel towers over Yamaska River

Stringing overhead.

Trimming poles.

1.—Granby sub station. 2.—40 ft. trestle.

3.—Unballasted track through rock cut. 4.—Bonding.

built up of heavy tubing 5 in., 6 in., 7 in. in diameter. The remainder of the line is constructed with 40 ft. cedar poles with 7-inch top. On tangent the poles are set 150 feet apart, while on curves the spacing is either 75 ft., 90 ft., or 105 ft., according to the degree of curve.

On tangent track poles are set with a minimum clearance of 6 ft. from gauge. On curves this clearance is increased by 6 inches.

Bracket type construction was used wherever possible, and consisted of a 10 ft. T-iron bracket on which is mounted a malleable iron pin and porcelain insulator which carries the messenger wire. The messenger wire is allowed to ride free in the recess in the insulator; this permits of free adjustment of line between anchors which are located every half mile.

Throughout the yards and on a number of the curves cross-span construction is used.

Supplementing the trolley, the entire distance, is a 816,000 c.m. aluminium feeder. Taps are run from this feeder to the trolley every ¼ mile. The feeder is carried on glass insulators with oak pins, which in turn are carried on 3½ x 4½ x 4 ft. B. C. fir cross-arms with 1¼ in. x ¼ in. x 3 ft. galvanized iron braces. On all curves double cross-arms are used, and the wooden pins are replaced by malleable iron ones.

The feeder taps consist of 2/0 stranded weather proof wire terminating in a feeder ear attached to the trolley, and a 4 bolt aluminium clamp attached to the feeder. A Garton-Daniels lightning arrester is installed at each feeder tap.

Telephone System

The telephone dispatching system already in use was extended from St. Cesaire to Granby. The line wires are No. 10 B&S gauge hard drawn copper wire carried on side blocks. This line is transposed every third pole in order to counteract the effect of induction. The instruments are Northern Electric selector type.

Transmission Line

On the top of the same poles which support the trolley feeder and telephone, is carried the 25,000 volt transmission line. The type of construction adopted for the transmission line consists of 3¾ in. x 5 in. x 5 ft. B. C. fir cross-arms spaced 4 ft. centre to centre and secured to the poles with ⅝ x 14 in. galvanized machine bolts. To the arm is also bolted a 2½ ft. x 2½ in. x ¼ in. angle cross-arm brace.

The insulators, which are for 35,000 volt service, are supported on steel pins with porcelain bases; these insulators are placed 4 ft. centre to centre.

On the upper arm is carried one phase and the ground wire, while on the lower arm are the remaining two phases.

No. 4 B&S gauge wire is used for transmission and No. 8 B.W.G. galvanized iron wire is used as ground wire. This latter wire is grounded every ¼ mile.

Sub-station

A sub-station 40 ft. x 50 ft. x 23 ft. high, was constructed just outside the city limits of Granby. On top of the main building is a pent house 10 ft. x 10 ft. x 12 ft. high with concrete entrance hoods to admit the high tension line. The building, which is an all-concrete steel and brick structure, was built by Nicholson Constructions Limited.

The electrical equipment of this sub-station is as follows:—

One 2300 volt, 63 cycle, 756 r.p.m. self-starting synchronous motor on a common shaft and bed plate, with one 400 kw., 600 volt, d.c. interpole railway generator, and one 6 kw. direct connected exciter.

Three 185 kv.a. single phase, o.i.s.c., 25000/2300 volt transformers.

One 25,000 volt, 3-phase, grounded neutral, electrolytic lightning arrester.

One 200 amp., 25,000 volt, 3-p.s.t., automatic oil switch, mounted in separate cells.

Two 25,000 volt, 20-5 amp. oil insulated self-cooled current transformers.

Nine 300 amp., 25,000 volt disconnecting switches.

Three 200 amp., 25,000 volt, choke coils.

On the a.c. switchboard is mounted the remote control for 25,000 volt oil switch; also the auto starting switch for synchronous motor, combination rheostat, I.T.E. relays, volt meter, ammeter, field ammeter, power factor meter and field discharge switch.

D.C. Board

The d.c. board consists of two feeder panels and one generator panel. On each feeder panel is mounted 1-1000 amp., 600 volt, s.p.s.t., overhead circuit breaker; 1-1000 amp., 600 volt, s.p.s.t., quick break knife switch; one choke coil and one ammeter. On one of the feeder panels is also mounted one 800 amp., 600 volt, watt-hour meter.

The Generator Panel

The generator panel is equipped with: 1-1000 amp., s.p. circuit breaker with inverse current relay; 2-1000 amp. s.p.s.t. quick break switches; 1-200 amp. d.p.d.t. 600 volt quick break lightning switch; 1-100 amp. 600 volt s.p. field switch with discharge clips and resistance; 1-4 point receptacle; 1 rheostat; 1 voltmeter; 1 ammeter.

From where the a.c. line enters the building No. 1, B&S gauge, hard drawn bare copper wire is used for all busses and connections on the 25,000 volt side and No. 3/0 B&S gauge r.c. wire on the 2300 volt side.

All leads from switchboard to motor and from switchboard to generator are run underground in clay conduits. The leads themselves are lead covered, each insulated according to its respective service.

Passenger Stations

At Abbotsford the company erected a station 17 ft. x 46 ft. The building is divided into a passenger compartment, freight and express compartment and office.

At Granby the company purchased a three-storey brick block 45 ft. x 60 ft., utilizing the main floor and basement for passenger waiting room, express and baggage.

The new extension was placed in operation April 30th, 1916.

The officers of the Montreal & Southern Counties Railway Company are:—E. J. Chamberlain, president; Frank Scott, vice-president and treasurer; J. E. Dalrymple, vice-president; J. A. Yates, secretary, and W. B. Powell, general manager.

The last issue of the Electrical News contained an article on "The Electric Lighting of Pullman Cars." Through an oversight this was not credited to Mr. J. A. Shaw, electrical engineer C. P. R., Windsor Station, Montreal.

The Status of Electric Ranges

(Continued from page 23)

A quarter turn of the switch starts the fire at maximum heat, another quarter turn of the switch gives medium heat, another quarter turn gives low heat. It can be controlled in such a way that there is an even temperature at all times for the many different kinds of food to be cooked.

5. Certainty—The absence of uncertainty as to results to be obtained. A poor cook will cook food better on an electric range and a good cook will do her best with electricity.

6. Economy—Economy in food value otherwise wasted by shrinkage and additional nutriment retained in all food cooked; there being no flame, there is no extraction of juices that should remain in the food, these juices being as a rule the best portion and most vital parts of the food.

7. Cool.—Concentration of heat where it is needed; no unnecessary heat in kitchen. The electric stove is especially desirable in warm summer months, there being no radiation of heat in the room.

8. Bright—Bright utensils no dirty, smoky pots or pans to be constantly cleaned.

9. Perfect—The perfection of baking is done by means of the electric oven, all guess work as to temperature being eliminated. The perfection of broiling is the electric broiler, no fumes or gases to contaminate the food which is cooking so close to the heat and no smoke from spattering grease catching fire from a flame.

10. Saving—Saving in shrinkage in food means saving of money. Time is saved in cleaning up the range and cleaning the utensils. Health is saved due to better nutrition of electrically cooked foods and the living and working in a better atmosphere.

11. Controlled—Cooking becomes an exact science. No uncertainty and no failure, the cooking being controlled by regulators and not by guess.

12. Appetizing—Meals are more savory, more digestible and altogether better.

13. Efficient—Efficient and quick in operation. Heat is instantly available and readily regulated.

14. Conserved heat—Oven retains baking temperature long after current is turned off.

15. Dainty—Kitchen clothes no longer a necessity because kitchen duties become light and the work clean.

16. Progressive—Adds dignity to housework and keeps in step with the march of progress.

The Dublin Insurrection—As it affected the Tramway System—From Tramway and Railway World.

The Dealer and Contractor

Mr. H. F. Strickland, Chief Electrical Inspector of the Ontario Hydro Commission, talks to Electrical Contractors at their recent annual convention in Toronto

It was very good of the contractors to ask me to come, and also I appreciate the excellent exhibit. I have learned several things about wiring since I came here. I thought I had seen pretty nearly all the different kinds of wiring, but it seems there is always something to learn. Of course, this is only temporary and not permanent wiring, so I must not be too hard, and there is not much fear of danger with so many electrical experts around. Many unskilled persons cannot see why they cannot do their own wiring the way it is done here. We cannot allow farmers and people who know nothing about it to do wiring, who would not even know what to do in case of a fuse.

I thought this afternoon I would like to tell you how we are getting along with our new legislation. This is the fourth year we have got our rules made out. The average person thinks all you have to do is to take half a day off some afternoon, get together your organization, draw up and make a law—and that is all. I can assure you, gentlemen, it is not as easy as all that. It takes about a year to get things moving, then there is the time spent in getting information, to see if there is anything else to be introduced. And it may happen that then the first Act is not complete. This is not only the experience of electrical, but every other kind of legislation. I think you will bear me out in this. At the present time the Commission have got the regulations of the bill down to pretty nearly where we want them. We have been all through this book during the last two or three months, correcting grammatical errors in some places, revising others that appear to conflict. We have also introduced some new ideas. An Act has been passed during the last legislation, giving the Commission power to make these rules law. It may seem very funny to say so, but these things have not been law. We did not find that out until we had been running some time, but the minute the Cabinet issues an order-in-council these rules will become the law of the province. We will be able to start right in then and provide some heavy penalties—the large ones chiefly for letting currents be turned on before they have permits to do so. We have had a great deal of trouble over this. I think the great success we have had is owing in a large measure to the contractors, who decided that it would not be any good to go against existing legislation—that it would only give the contractors who are not doing right an opportunity to take advantage of it. At the present time this thing is so nearly law that it is practically an accomplished fact, and it is only a matter of a few days. Across the line the National Electrical Code changes every two years. That is rather long. For instance, after the last book came out the nitrogen lamp appeared on the market and upset the whole business, and that code had to stand nearly two years before it could be changed. We here can change our rules at any time. Anything new developing can be taken up merely by having a meeting of the Cabinet, when we can change the rules and keep them abreast of the times. I would like to say that the best way to take this subject up is to ask if anything occurs to any person about these Rules that they would like to discuss. I am just as anxious to hear what you have to say as you would be to hear what we have to say—just an exchange of ideas. The contractors have threshed out their end, but the supply dealers would no doubt like to hear what they are, and to have it more in the nature of a discussion than anything else. I think not very long ago the Benjamin people asked me some question about switches—

Mr. Groome: I think they had up with you the matter of 500 and 600 volt switches.

Mr. Strickland: As to the question of 500 volt switches, across the line they have drawn a distinction between 500 and 550 volts which just upsets all our calculations on this side. Most of our power over here is 550, and when you come across 500 volts in the National Code you have to jump up to 600. We find that by comparing switches made on the continent, they get along much better with a more economical switch than we have here, and we figure out that 550 volts is the same here as in Europe, and do not see why any greater margin is needed here than there. A 500 volt switch with barriers in it is very much more satisfactory, mechanically, and otherwise better in every way than the great big 600 volt switches, and our regulations will permit of the use of any of these 500 volt switches with 500 volt services, as long as brake distance is all right for 500 volts. That is to say, the brake distance at the points of the switch must be made for the 500 volt. But the distance between

Interior Wiring Methods

In this issue we print the first instalment of a comprehensive article by Terrell Croft, on the subject "Interior Wiring Methods." Mr. Croft is a practical man and at the same time a master of the theory underlying the science of this subject and we are hopeful that his treatment of the problems of interior wiring in all its aspects will prove of great benefit not only to beginner contractors, but almost equally to those of riper experience. Mr. Croft will cover this subject of interior wiring in a series of three articles, to be published consecutively in the Electrical News of dates July 15, August 1, and August 15.. This article is placed before Canadian electrical contractors with the hope that they will find many ideas in it that will help them in their daily work. We shall consider it a favor if you will let us know what you think of it.

the blades is all right, on account of the barriers. That makes the whole proposition much simpler and much less expensive, and as good in every respect. With a 600 volt switch you have to have a huge box with a similar cover.

Mr. Groome: As approved by the American National Labor Law—Does that make it better?

Mr. Strickland: All this reference to the underwriters has to come out of our books altogether, but the understanding is that where ordinary fittings are approved by the underwriters' laboratories there is no question of that; but there is, in the case of service boxes, because they do not have a service box over there; they would label a box merely as a box, that is all. That part of it is quite an undertaking. We have to get the Rules and Regulations settled first of all. Since meeting contractors last time a lot of things have been developed. There have been two or three different styles of appliances. The question has been raised whether our regulations would demand the use of these appliances. I do not think they would. All the Commission would say was that they may be used. A law would not be passed that they must be used. But they may use the splice in place of joints. There is another change in floor receptacles. One will appear in the next edition of the book. At present our rules require a water-tight box in all cases with floor receptacle, but the ordinary iron switch box would be acceptable. That would somewhat reduce the cost of installation, although I cannot see how reducing the cost of installation is of any advantage to a contractor, but they seem very anxious to cut it down for some reason. Page 56 of Rules, Figure 21—shows service equipment with some open cut outs. The question is very often asked why that cut is shown. The reason is this—if they would refer to the reading matter they would see—where they are out of the way, or overhead, the matter of being exposed is all right, but that is the only case where they would be permitted—when they are entirely out of reach.

There is another item that will appear in the new Rules, that is to abolish half-inch service pipes. The introduction of electric ranges has become quite a factor, and a great deal of trouble is likely to arise when they come to hitch up in small houses with half-inch service, taking out the old and putting in the new. The difference in the original cost is a very small matter. Introducing a three-quarter inch service as a minimum will be a large gain. It is very much easier to pull out a couple of small service wires and insert two new ones than it is to pull the whole pipe out. At a meeting of the electrical people, held a few months ago, it was decided to make that change. I suppose it will meet with the approval of the supply people. There is also a recommendation at the present time to introduce one-wire service. This is entirely new; I do not think it has been brought up before you gentlemen before. The idea is to cut down the cost of capital expenditure by this distribution of service throughout the country, feeding a house with one wire and using ground and water pipes for return. I would like to hear the views of those present on the question.

Mr. Deguerre: Wouldn't that cause some danger?

Mr. Strickland: It would if you were using D. C. It would have to be limited entirely to the use of A. C. current. We are meeting with opposition from the water companies to using their ordinary pipes for ground wires. A St. Catharines concern did not want a ground wire in the water pipes. He said he knew enough to know it would cause electrolitis. He does not know enough, however. It will not on the A. C. current.

I would like to hear if anybody has anything to ask about this I have my own private convictions which I could not exactly put into words . This matter was brought up last year, and was referred to the National Fire Protection Association in the United States, who were very much opposed to it. As to there being water in the pipes, I do not know that that would make any difference. And if you are going to depend on water or gas pipes, you would have to make sure that all the connections were properly made, so as to be sure of a continuous connection. A water pipe might be cut off without any notice to an electrical man. I am going to get all the information I can as to this.

We are sorry not to be able to announce this evening that the order-in-council has passed. It had been my wish to read out the new Act and to have copies of the order-in-council, with full particulars as to the exact nature of the new legislation. However, I do not think there is any doubt about it. As I understand it, it is the intention of the Commission to publish the matter throughout the province and give everybody a chance to understand what the law is going to be. During the last year we have been handicapped in taking action, although information of rather drastic violations of the Rules has reached us—chiefly among the curbstone wiremen and people of that sort, in the outlying districts. I think I can say it is only a question of a short time before we get this thing into good shape, and nobody will be better pleased than I will to have the thing right, and I have every reason to believe that the best members of the electrical wiring fraternity will stand behind us in that. The old saying that "union is strength" is a very good motto. While the inspectors are generally regarded as the natural enemies of the wiremen, I hope they will not feel it that way, because the inspectors and the wiring fraternity are people who should work together. The inspector's lot is not a nice one at best. The engineer has his building. He can lay out his plans, watch it grow, then sit back and look at it and say, "There is my job done." The inspector is just the opposite. Finding fault all the time—that is his business. He is supposed to keep on the right side of everybody and get after the other fellow, but when it comes down to any particular work it is a different thing, so when we get our new Act there is a chance for us all to get together and get off to a good start.

I would like to hear if there are any other points. There is one point that has not been threshed out, the regulation that requires both sides to be fused where there are only two wires—to prevent the possibility of wrong connections. If you have a three-wire service, you know one must be a neutral; where you have two, it is sometimes difficult to be sure which is outside and which is neutral.

A Broader Outlook

Because this department is headed "Electical Dealer and Contractor," do not get the idea that the other pages of this magazine are not of interest to you. An electrical contractor told us the other day that he reads the more general articles that precede this department because he likes to know what people outside of his particular groove are doing. He said it gave him a broader outlook. Isn't that the right idea?

Radial Construction May Proceed

Mr. T. J. Hannigan, secretary of the Hydro-electric Railway Association and of the Ontario Power Union, has been in conference with Premier Hearst and members of the Cabinet. There was some little misunderstanding as to whether municipalities could proceed with radial construction on account of the war. The Premier explained that the war would not interfere with preliminary work on the lines, such as surveying and securing options on right-of-way.

Standard Interior Wiring Methods

The first of a series of three comprehensive articles outlining the latest approved practices as required by the Code and as developed by the best workmen

By Terrell Croft

Conductors smaller that No. 14 B. & S. gauge should not be used in electric light or power wiring, except for wiring fixtures and for flexible cords, because wires smaller than this do not have sufficient mechanical strength to insure them against breakage. Stresses are frequently imposed on the conductors of a wiring system after the system has been installed and concealed by the walls and partitions of a building. Such stresses may be due to the warping or shrinking of timbers, to the settlement of buildings or to excessive vibration. If a wire upon which voltage is impressed is broken due to these strains, it might start a fire. Such a fire might, before discovery, gain considerable headway within a partition or wall.

Wires for fixture work may be as small as No. 18 because such conductors are always protected within the metallic tubing of fixtures or within fittings, so that if they do break, damage would not be likely to result. Furthermore, the wires within fixtures are not ordinarily drawn taut and therefore

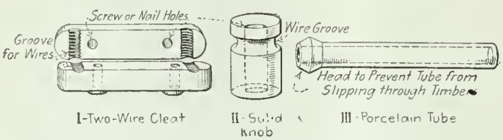


Fig. 1—Typical forms of porcelain for electrical insulation.

are not liable to be subjected to tensile stresses. See Code rule 55 for specifications for approved fixture wire.

Flexible cords must always, if installed in accordance with the Code, be exposed and should not have extreme tensile stresses imposed on them. Furthermore, it is desirable, from the standpoint of appearance, that they be of small diameter. For these reasons, experience has shown that No. 18 gauge flexible cord is, on the whole, safe and satisfactory. See Code rule 54 for specifications for approved flexible cords.

Insulators for interior electric wiring are ordinarily of porcelain. Fig. 1 shows typical insulators of this material. Practically all of the porcelain fittings on the market are now made to conform with the Code specifications and therefore will provide proper insulation if used for the services for which they were designed. The specifications and dimensions for porcelain tubes and bushings are given in Code rule

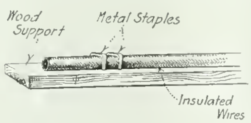


Fig. 2—An extremely unsafe method of supporting conductors.

61; specifications for cleats in 62; specifications and dimensions for knobs in 64.

Wires for light and power wiring should never be supported directly against the surface upon which they are carried. For example, the method of attaching a conductor directly to the supporting surface with staples, as shown in Fig. 2, has been shown by experience to be very unsafe and unsatisfactory. In the earlier days of electric lighting this method was used and doubtless many fires resulted therefrom.

The method of tying a conductor on a solid knob is shown in Fig. 3. In making such a tie, the tie-wire is bent into a U-shape form, then placed in the groove of the knob and its ends served around the conductor to be tied, as shown in the illustration. Such a tie should have at least 3, and preferably 4, "end turns."

Tie-wires should have the same insulation as the wires

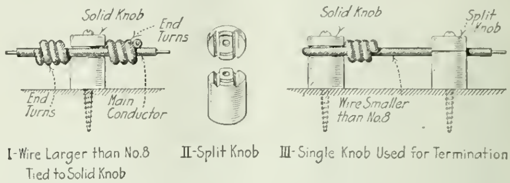


Fig.—3—Split and solid knobs and terminations.

they support to the knob for the following reasons: If a bare wire, or a wire with thin insulation, is used for a tie it is liable when being served on the main conductor to cut into the insulation on the conductor and damage it. If a bare wire is drawn up too tightly around the main conductor it may shear the conductor asunder. Furthermore, if the tie-wire is not insulated, or is thinly insulated, it may be twisted into contact with the metal of the main conductor and thereby provide a possible leakage path. A heavily-insulated tie-wire is, obviously, not as liable to cut into the insulation of the wire which it confines as would be a bare or lightly-insulated wire, because of the greater outside diameter of the heavily insulated conductor.

Split knobs should be used for intermediate supports for conductors smaller than No. 8, because if solid knobs were

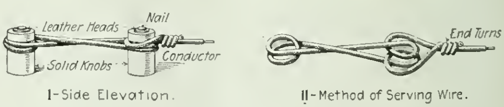


Fig. 4—Two solid knobs used for dead end for sustaining heavy-strain run.

used, tie-wires would be required. Experience has shown that the tie-wire method of attachment is unsatisfactory for small conductors, because there is a possibility of a small main conductor being sheared off or strained when a tie-wire is served about it. Small diameter tie-wires would be used for supporting small-diameter conductors to knobs. Such tie-wires would be readily untwisted by the application of a small force and then might permit the main wire to drop down on the supporting surface or pull away from the knob. Solid knobs, Fig. 1, II, were formerly used for all work, but now, as will be shown, split knobs are, in general, preferable for supporting wires smaller than No. 8.

The method of terminating a conductor on a solid knob at the end of a run is shown in Fig. 3, III. Where the strain assumed by the conductor is severe, it is frequently desirable to use two knobs at the termination of a run, as shown in Fig. 4.

The meaning of the word "terminated" may be explained as follows: conductors are ordinarily considered as terminated at a point where the run ends, as shown in Figs. 3, III, and 4. Where the run extends past knobs to an outlet, as in Fig. 6, it is considered that the run then terminates at the outlet, rather than at the knobs. In other words, split knobs may be used for wires smaller than No. 8 for conditions similar to that illustrated in Fig. 6. It is not necessary to use solid knobs, as shown in Fig. 5, at the point where a run extends to an outlet, although the construction shown in Fig. 5 is substantial and is ordinarily accepted. Briefly, then, a "termination" is the location beyond which the conductor run does not extend.

Strain insulators may be used at the terminations of runs, as shown in Figs. 7 and 8. Solid knobs should, in exposed running, be used at run terminations only where the conductors are relatively small, for example, smaller than No. 6. Where the conductors are larger than this, particu-

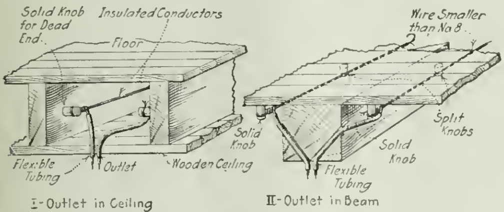


Fig. 5—Flexible tubing used for bushing at outlets.

larly if they are exposed, strain insulators provide the best method of termination. In the installation of Fig. 7 a porcelain insulator held to an eye-bolt set in the joist is used. This method is ordinarily applied only for medium-sized conductors, possibly those between No. 6 and No. 0, B. & S. gauge. Where larger conductors are to be terminated, a composition strain insulator of the type used in overhead line construction can be utilized in combination with a cable clamp, as shown in Fig. 8, to provide a very substantial and sightly installation.

Split knobs or cleats are used for supporting conductors smaller than No. 8, B. & S. gauge, because, as indicated

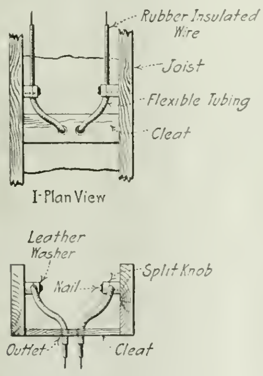


Fig. 6—Conductors terminating at an outlet.

above, the method of supporting them on solid knobs, which necessitates the use of tie-wire, has not been satisfactory. With a split knob, Fig. 3, II. and III., the wire is clamped between the base and the cap of the knob and will be held securely, providing the wire is not too large. Several satisfactory types of split knobs are obtainable. That shown in Fig. 3 is typical.

Tie-wires and knobs do not provide a satisfactory support for large conductors, in spite of the fact that the Code permits their application for this service. The weight of a

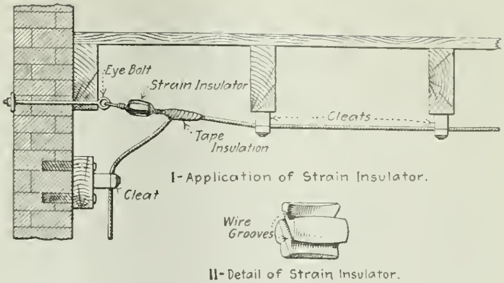


Fig. 7—Showing method of terminating a heavy-wire run on a porcelain strain insulator.

large conductor, or the longitudinal strains that it imposes in many cases, loosens the tie-wire and permits the conductor to sag down on the knob or to pull away from it. Fig. 9 indicates the most satisfactory methods of insulating such heavy conductors from their supporting surface. The wire

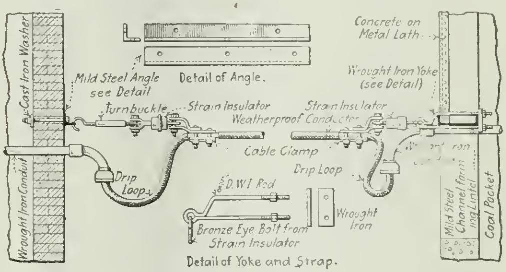


Fig. 8—Showing application of strain insulators, cable clamps and turnbuckles for heavy-run terminations.

may be held between two solid knobs, as indicated at the left of the illustration, or in a single-wire cleat of suitable proportions, as shown at the right. Fig. 7 also shows a heavy conductor supported in cleats.

Either screws or nails may be used for fastening knobs or cleats. At one time it was considered best practice to fasten all knobs and cleats with screws, but it was then found that a great many knobs and cleats were broken, due to the screws being set up too tightly. Frequently the break-

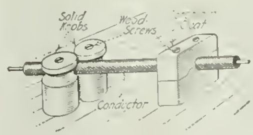


Fig. 9—Method of supporting very heavy conductors.

ages would occur some time after the screws had been driven, due possibly to expansion or contraction caused by heat, or to the swelling or warping of the wood. Such breakages have occurred within walls and partitions after the completion of the plastering. The wire originally confined by the knob was then permitted to sag uninsulated against the wood and plaster and thereby constituted a fire risk. If nails are used for supporting the knobs or cleats, with a leather washer between the nail head and the porcelain, as shown in Fig. 10, the breakage of porcelain is, so experience has shown, much decreased.

(Continued in August 1 issue)

Ad. Suggestions for Contractors

A series of twenty-two for use in local newspapers—We reproduce the first four

A new development in constructive work by an association is being brought out by the Society for Electrical Development. A series of twenty newspaper advertisements has been prepared and mailed to jobber and contractor members for use in their local newspapers in assisting them in building good will by pointing out the benefits of dealing with recognized contractors. The advertisements, with complete directions for the printer, have been mailed so that the members will not be troubled with the detail of writing and laying out copy. Each advertisement emphasizes the fact that price alone should not govern the letting of contracts for electrical work. The service is free to Society members.

This work on the part of an association opens a field untouched so far. It will be noticed that instead of recommending that this kind of advertising be done, the advertisements are actually prepared and placed in the hands of the men to be benefitted. The advertisements were arranged by an expert and will prove of material assistance to contractors using them. Contractors are constantly using newspaper space, but the advantage of using space for building good will is an opportunity frequently overlooked. It is to meet this opportunity that this series of advertisements was prepared.

Time was when the electrical contractor carried his office and kit with him from place to place. Now there are contractors in each locality doing business on a reasonable basis and at prices based on known costs of construction. These men carry stocks of goods, know the requirements of various jobs, do their work carefully, according to specification and the requirements of the insurance companies. Their prices are based on known conditions and the figures named permit of a reasonable profit that will permit carrying on business and development on a sound basis.

The Society for Electrical Development has prepared,

Cheapness in electrical work seldom means satisfaction

There are so many ways electrical work may be "skimped" by unreliable workmen that not only your satisfaction but your pocketbook demands that your wiring be done by a thoroughly reliable firm.

While the insurance inspection protects you as much as possible, don't forget that a lot of wiring—under floors and inside of walls—may never be seen by the inspector.

And perhaps it has not occurred to you that the standard set by the Underwriters for electrical work is the **lowest** grade which they will pass.

Our policy has not been to see how close we can come to this minimum standard and "get by." We aim rather to give you **better work** than is absolutely required. That's why we have become established, reliable and successful electrical contractors.

(Names and addresses of contractors)

Ad. suggestion No. 2.

Truth in Advertising

to tell of

Honesty in Electrical Construction

It is our purpose in the series of advertisements which will follow to tell the people of (your city) why it will be distinctly to their advantage to patronize an established and thoroughly reliable contractor whenever in need of electrical work of any kind.

The electrical industry has suffered more or less in the past from the irresponsible, partly trained electrician who often springs up over night—to disappear as suddenly as he comes. During his brief existence he may not only cause the established contractor temporary loss, but what is far more serious, by his incompetence often causes the uninformed customer irreparable damage.

We have no quarrel with the new contractor in the field, provided he is competent and knows his trade thoroughly. But we do feel that the public is entitled to know the truth about a certain class of so-called electricians and be forearmed by being forewarned.

(Names and addresses of contractors)

Ad. suggestion No. 1.

Wire as you build—for the future

Like the nails and screws, the electrical work should go into your building to last as long as the structure itself.

If the electric wiring is installed by a reliable, competent contractor of standing, it **will** serve you well. But if it is cheap in price and quality, you are only inviting trouble.

Perhaps you may never know all is not right until the day of trouble comes. **Then** it will be a mighty expensive job to find the trouble and have it repaired or have the whole defective system replaced.

And the "electrician" who installed your work —what of him? Probably out of business—couldn't make a go of it—didn't know that quality, not price, was the foundation of success.

And even if you do find him, what redress have you? He is financially irresponsible.

Protect your future as well as your present by having the electrical work of your building installed by a reliable, established and competent contractor.

(Names and addresses of contractors)

Ad. suggestion No. 3.

This building tried to save money

This is a true story. The sub-contract for the electrical work in this building was let to the "lowest bidder." The wiring was installed, supposedly according to specifications. The job looked all right—what could be seen of it, but of course, most of it was out of sight.

A few years passed. Slowly but surely the lighting bills grew. The meter was correct—but a test proved that the wiring was not. A few circuits were removed from the conduits and then came the revelation. It was the worst case of deliberately shoddy work on record. Where was the contractor? Oh, he failed and went out of business a few years before the discovery.

Then a **reliable** contractor, one who had figured on the original job and lost because "too high," was called in and the owners paid the price of rewiring. They had been paying the penalty of poor work for years.

Which kind of work will **you** have?

(Names and Addresses of Contractors)

Ad. suggestion No. 4.

also as a help to these contractors, a slip, No. 5, to be attached to bids or tentative specifications, telling why the lowest bidder may not be the best one to have the contract. Both of these sales helps should be found of material assistance to the sound, reliable contractor.

We reproduce herewith the first four of this series, that our readers may judge of their merits. One ad. each week

In considering this estimate please bear in mind that it is submitted by a responsible contractor who has built up his business on sound principles.

There are so many ways electrical work may be "skimped" by unreliable workmen that not only your satisfaction, but your pocketbook **demands** that your wiring be done by a thoroughly reliable firm.

Our aim is not to see how little we can put into a job and have it just pass muster, but rather how good a job we can give you for the money you spend. We are in business to stay and the work we do for you now is going to advertise us in years to come.

After all, as in most any other business deal, it pays to know that the "other party" in an electrical contract is really competent, reliable and responsible.

No. 5—Slip to attach to bids.

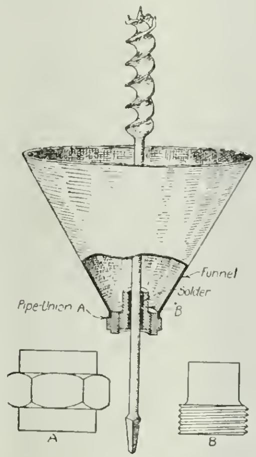
is suggested, though they may, of course, be used oftener, if desired. These ads are written primarily for electrical contractors' associations or groups of contractors operating in the same area. There would be little difficulty, however, in adapting the copy to individual use.

Complete instructions are given with the original copy as to type and arrangement. Cheltenham Bold is recommended for headings and Bookman for body.

Improved Dirt Catcher

Many devices for catching chips and dirt in boring holes in a ceiling have been developed, but I have found none as convenient as the one shown in the accompanying sketch. This device is made from a quarter-inch pipe union and a tin funnel is cut off and the burr of the union A is fitted and soldered in its place. The piece B is slipped over the end of the bit and held in place while a little solder or lead is run in between the bit as shown below.

If this soldering is neatly done, the piece B can be made to uniformly surround the bit and the device will not wobble. The threads in B may have to be reamed out so that it will pass over the end of some of the larger bits. When the bit is not used for ceiling work, the piece B is not in the way. When boring holes in ceilings the funnel is screwed in place by means of part A. When the bit becomes worn out part B is removed by heating with a blow torch and melting the solder. It can then be placed on another bit in the same way



and is ready for instant use. This simple device can be made at a cost of no more than 15 cents. I have used it for some time and have found it superior to anything similar. Bits can be changed with this arrangement in five minutes.

Robert W. Mallder, in Elec. Review.

The Montreal Wednesday Electrical Luncheons will be discontinued until the second week in September. At the luncheon on July 5 Mr. Frank T. Groome, sales manager of the Benjamin Electric Company, described the organization of the luncheons in Toronto, and spoke enthusiastically of the support given the gatherings in that city.

The Royal Securities Company, Montreal, have purchased the controlling interest in the Camaguey Company from Halifax interests and the head office has been transferred to Montreal. The Camaguey Company controls an electric light plant and electric railway system on the Island of Cuba. Head office was formerly in Halifax.

The Quebec Public Utilities Commission has given the Pierrefonds Electric Company permission to extend their wires to St. Genevieve, subject to the poles being placed as agreed between the company and the council. The rate for lighting is not to exceed ten cents per kw. hour.

North Toronto Railway Station Illumination

An Attractive Combination of Direct and Indirect—Solid Bronze Fixtures—General Waiting Room Specially Attractive

Fig. 1—One of the units in the waiting room.

THE accompanying illustrations show different views of the new North Toronto railway station, recently opened for traffic. Fig. 2 is a general view taken from Yonge Street on the south side and shows, on the left, the subway under which the tracks of the Toronto Railway Company will be constructed. The overhead lines of the C. P. R. and C. N. R., the canopies over these lines, the main tower of the station, which is practically complete, and on the right of the figure, the office building and waiting rooms. The new station is a single storey stone (Tyndall) structure. The tower is 140 feet high and will be surmounted by a 30 ft. terra cotta spire. The station building is 114 ft by 75 ft.

The central or high section of the station, as seen on the right hand of Fig. 2, is the main waiting room. This measures 70 ft. x 51 ft. and has a centre entrance from the driveway on the south and two entrances out of the main hall on the north. On the west side of this room are the ticket and telegraph offices, and on the east, women's waiting room, smoking room, lavatories, etc. The south and west sides of the station have metal canopies over the sidewalks. Along the west or Yonge Street side of the station is a 28-foot driveway, which gives easy access either to the baggage room or the waiting room and ticket office.

Back of the baggage room and running parallel with Yonge Street, is a midway, 20 feet wide and 14 feet high, this height practically representing the difference in level between the station floor and the track platform. The six overhead tracks pass over the midway and baggage room section of the station building.

Fig. 3 shows the interior of the waiting room. This room, together with the main concourse and the tower entrance, is walled with marble over the entire height. The midway is lined with glazed brick, as are also the staircases leading up to the platform.

This room is illuminated by four large bronze standard lighting units, combining the direct with the indirect system of illumination. One of these units is shown enlarged in Fig. 1. In the waiting room there are four of these units, the standard being 7½ ft. high and of solid cast bronze. These are surmounted, as shown, by a 24-in. diameter bronze bowl fitted with a reflector and lamps for indirect lighting. The indirect illumination is supplemented on each standard by 15 lamps placed, as shown, immediately below the indirect bowl. These lamps are frosted and provide a very

Fig. 2—General view of new station from Yonge St. south.

powerful illumination at every point of the room. In other parts of the building bronze fixtures of simpler design are used. In the main hall these are wall type with round frosted globe. The midway is lighted from the ceiling, the lamps being enclosed in ceiling bowls. The driveway outside, the baggage room, and the tracks and platforms above, are lighted by open lamps surmounted by metal reflectors, which are so spaced as to diffuse a very even illumination. The lighting fixtures throughout were designed and manufactured by McDonald and Willson, Limited, Toronto.

To reach the train platforms, passengers must pass through the midway and up one or other of the three staircases. The platforms are 20 ft. 3 ins. wide by 600 ft. long and are covered by butterfly roofs for a distance of 360 feet, which later will be extended to the full length of the platform. The roof is wood on a steel frame supported by steel

Fig. 3—A handsome interior—The general waiting room.

posts in the middle of the platform. The roof has a spread of 25 feet, and extends well over cars standing on the platform tracks.

The baggage room is 137 ft. x 62 ft., and occupies all the area beneath the tracks between the midway and the Yonge Street driveway. Baggage is received from the driveway through five doorways, as shown, and raised on trucks to the platform level by elevators. Passenger communication with the baggage room is through the main concourse.

The construction work was carried through by P. Lyall & Sons, general contractors. Darling & Pearson were the architects. Mr. Blair Ripley, now Lt.-Col. No. 1 Overseas Construction Battalion, had charge of the engineering work for the C. P. R.

What is New in Electrical Equipment

Some Details of Tank Type Oil-Break Circuit-Breaker Construction

The main changes that have recently been made in tank type oil circuit breakers have been introduced to make the breakers more accessible for inspection and repair. No radical departure in the design of the current carrying or operating parts has been necessary. The forms of breaker shown in this article represent two of the Canadian General Electric Company's high voltage, large capacity tank type circuit breakers for both indoor and outdoor use. Indoor and outdoor breakers are practically similar. The only difference consists in the addition to the indoor breaker of a few parts to enable it to be serviceable both from a mechanical and an electrical standpoint under all weather conditions. The K21 and K26 oil break circuit breakers are used indoors on voltages from 35,000 to 150,000, and the K22 and KO26 are used on outdoor work from 22,000 up to 150,000 volts. The K22, Fig. 1, is exactly like the K21 except that the K22 has outdoor bushings and the mechanism is protected from the weather by an iron housing. The KO26 is like the K26, Fig. 2, except weatherproof covers and bushings are used for outdoor installations.

A noteworthy advance in the breakers consists of mounting them on framework and in the handling of the tanks by a tank-lifting device recently designed. The lifter consists of a detachable frame equipped with shaft, handle, worm gear and windings and unwinding drums. The advantage of this equipment is that it allows a tank to be removed or placed in position without difficulty. The device is readily detached and can be moved by one man from one switch to another, thus making it a very simple operation to lower or raise an oil tank, and also making it easy to align, inspect contacts and oil and deplace contacts if necessary.

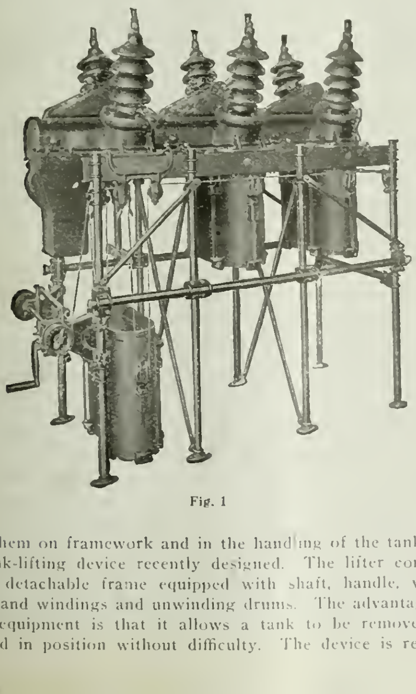


Fig. 1

These top connected circuit breakers are self-contained for use on systems of potentials up to and including 200,000 volts. One tank with two breaks in series is used in each phase. The breakers are made for either automatic or non-automatic operation. The breakers are closed by hand, solenoid or air, and the automatic breakers are tripped under overload by series trip coils (mechanical trip indoor only) or current transformers. In using these circuit breakers for hand operation, they can be installed behind the switchboard panel with the operating handle in front and connected to the breakers by connection rods and bell cranks. All the breakers can be mounted on a framework except 110,000 volts and above. All the breakers can also be operated by a removable wooden lever connected directly to the mechanism. When solenoid or air-operated the breakers may be located where desired and controlled from the switchboard or other convenient place by a pull control switch or air valve. The operating mechanisms and bushings are secured to the cast iron cover of the heavy sheet steel tank. Each bushing extends through the switch cover into the oil, and is so clamped to the cover that the throwing of oil is impossible. The bushings are easily removable and interchangeable. The oil tanks are constructed of sheet steel, and, being acetylene welded, are of more than ample strength for the service required.

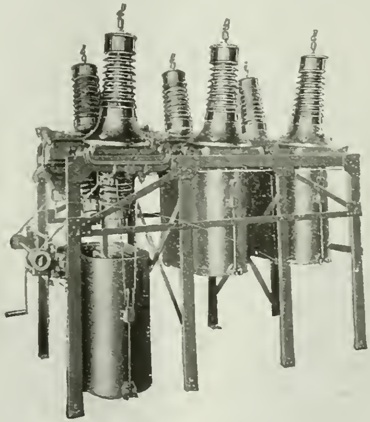
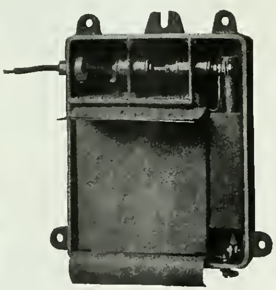


Fig. 2

Hydro current was turned on in Harriston, Ont., a few days ago.

Condenser Type, Direct Current Lightning Arresters

The arresters illustrated, designated as type K-3 and recently placed on the market by the Westinghouse Electric & Manufacturing Company, are for use on voltages from 100 to 1,500, direct current. They are especially adaptable for the protection of direct current railway and power motors, direct current generators, and rotary converters. When properly connected they are also of value in preventing flashovers on the commutators of rotary converters. They are furnished for car, pole, or wall mounting. Type K-3 arresters are made in two forms, one consisting of a condenser with a spark gap in series with it and a high resistance in shunt with it, for car and station service, the other consisting of the condenser alone, without series gap or shunt resistance, for line mounting. The condenser is of the flat plate form, of high electrostatic capacity and amply tested for breakdown voltage. For car mounting, the condenser is of 1 microfarad capacity, equivalent to the capacity of 100 miles of average line. For line mounting the capacity is .3 microfarad, equivalent to the capacity of 30 miles of average line. In the line mounting form, without gap or resistance, the condenser is connected direct to the line and ground terminals. In the forms that include gap and resistance, the line terminal is connected through an adjustable spark gap in a separate chamber. This gap is in series with the condenser, the ground lead being connected to the case, and a resistance is connected in shunt across the condenser serving to keep it discharged to zero value. This resistance is so high that even with the spark gap closed only a negligible amount of direct current can flow. The spark gap provides a means of noting the discharge of the arrester by placing a test paper in the gap. It can be easily adjusted and set so close as to just prevent line voltage



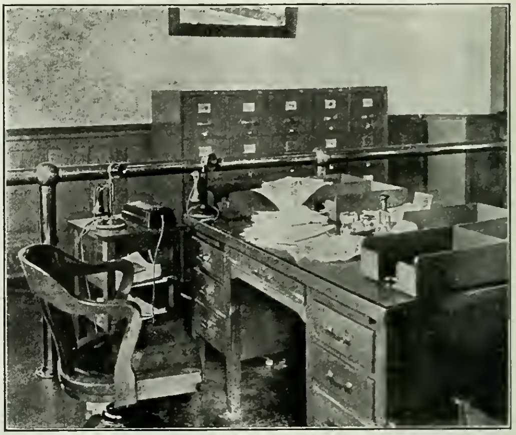
from bridging it. Both forms of these condenser type arresters are mounted in a rectangular cast iron box with waterproof cover. The spark gap chamber is accessible by removing a small separate cover. They are easily mounted underneath or on roof of car, and in any position on car, pole or wall.

Interphones in Wrigley Factory

To produce the greatest efficiency in office and factory management the inter-communicating telephone system is daily coming into more general use. An inter-communicating telephone system does not take the place of a private branch exchange, but it supplements it. By its use executives can get into instant communication with one another, or with their subordinates. Conferences may be arranged without having to leave the office, and the time which these telephones save shows that the system pays for itself within a year from date of installation.

One of the finest examples of an inter-communicating telephone system was recently installed in the big factory of Wm. Wrigley, Jr., Company, Toronto. This installation consists of 11 No. 6016-G 16 button desk type interphones. Four of these instruments are located in the general and private offices and the balance throughout the factory.

From each station one can select and ring any other station without disturbing the rest of the stations in the



Inter communicating Telephone System in Wrigley Factory.

system. As many separate conversations can be carried on simultaneously as there are pairs of interphones in the system. This class of service is known as "Selective Ringing and Selective Talking" or "Non-interfering service."

The cabling of the system consists of lead covered interphone cable installed in conduit. At each telephone the conduit terminates in a T. & B. floor box. In this floor box green cotton braided inter-phone cable is spliced to the lead sheath cable and brought to the key box of the inter-phone. This is not only a substantial method of bringing the cable out of the conduit, but is also most pleasing in appearance. Current to operate this system is supplied from five Northern telephone batteries for ringing and three for talking, installed in a substantial oak cabinet.

The illustration shows one of these inter-phone sets installed on a broad table beside one of the executives' desks. Additional instruments may be installed on this system at any time as required. All of the telephone equipment was supplied by the Northern Electric Company, Limited, and installed by Keith's Limited, of Toronto.

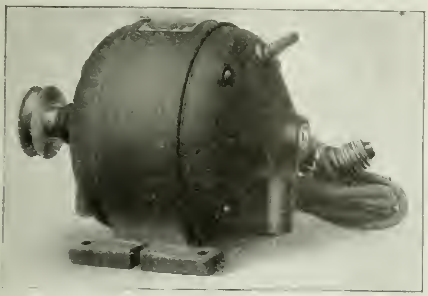
Canadian Beauties

The Renfrew Electric Manufacturing Company are distributing to their customers a series of 12 monthly calendars, to represent different types of "Canadian Girls." With each one of these calendars the company will endeavor to bring to the notice of the public a group of "Canadian Beauty" appliances or some new article which they may be adding to the "Canadian Beauty" line. The company are also distributing reproductions of a couple of advertisements regarding "Canadian Beauty" appliances, one of which will be used by the company in all the large daily newspapers throughout the Dominion on July 22. The smaller advertisement is for the use of local dealers who may wish to advertise in their own papers and for their own customers. This latter advertisement is supplied free by the Renfrew Company to any dealer who will accept and use it. It illustrates four "Canadian Beauty" appliances—an upright toaster, an iron, a toaster grill and a two-plate stove—and draws the attention of the reader to the value of these appliances during the hot summer days. This latter advertisement measures 5 in. x 4 in. and may be had on application to the company.

Westinghouse Splash Proof Motors

A line of small alternating current motors that are splash proof, called the type C A H, has recently been placed on the market by the Westinghouse Electric & Manufacturing Company. These motors are particularly adapted for use on washing machines, dish washers, water pumps, and the like, and are designed with a view to satisfactorily meeting the most exacting requirements. As will be seen from the illustrations, the frames of these motors are so constructed that it is next to impossible for water to get into the motor. They shed water like a duck's back.

Forced ventilation along the same lines successfully used in turbo-generator design is obtained by a small blower and ample ducts, fully protected from liquids and small objects. This means cool operation under all conditions. There are no exposed electrical contacts, connections being made through cable or binding posts fully insulated against



accidental shock. There are no rotating electrical contacts, or brushes, thus decreasing renewals and amount of attention required. Starting is effected by means of a switch that is frictionless except at instant of opening or closing, making wear negligible. The operation of the switch is snappy and the break quick. Lubrication is furnished by oil cups of unusually generous capacity.

Changing Transformer Oil

A reader of the Electrical News asks us to insert the following question. We shall be glad to forward any answers to the enquirer:

What is the method usually adopted to decide when oil used for the cooling of transformers should be replaced by new?

Appointed Arbitrators

Mr. James M. Robertson and Mr. M. A. Sammett, of Montreal, have been appointed arbitrators in a dispute between the City of Sherbrooke and the Canadian Brake Shoe Company, as to the amount due to the former for current supplied by the city under a contract. Mr. Robertson is acting for the company, and Mr. Sammet for the city.

To Generate at Black River

The Pembroke Electric Light Company, Limited, are interested in the Renfrew, Ont., power supply which is insufficient to meet the demand. The Pembroke company propose to generate the current at their plant on Black River. This will entail the expenditure of some $40,000 on this plant but the Renfrew council would construct the transmission line, which is about 35 miles in length.

Personal

Mr. Stanley L. Eisenhofer, assistant engineer on the Hydro-electric System, Hamilton, Ont., has received an appointment with the Hydro-electric Power Commission of Ontario and has taken up his new duties in the new Hydro building on University Avenue, Toronto.

Mr. Fred. A. Robertson, Science, Toronto, '08, has resigned from the engineering sales staff of the Canada Cement Company, Limited, to accept a position with the Ontario Hydro-electric Power Commission.

Mr. R. F. Hayward, general manager Western Canada Power Company, was re-elected chairman, and Mr. H. N. Keifer, sales engineer Northern Electric Company, was re-elected secretary of the Vancouver Section of the American Institute of Electrical Engineers at the June 1st meeting.

Mr. W. K. Jeffrey, formerly general manager of the Ottawa Car Manufacturing Company, Limited, has been appointed sales manager of the Lyman Tube and Supply Company, Limited, 323 St. James Street, Montreal. The company recently purchased the railway and supply department of John Millen & Son, Limited, and are agents for a number of leading United States, English and French firms.

Trade Publications

Wiring Specialties—catalogue of wiring specialties manufactured by the Arrow Electric Company, Hartford, Conn., illustrating and describing this company's very complete line.

Bond Testers—Bulletin No. 200, issued by the Roller-Smith Company, describing their portable direct reading bond testers for testing the conductivity of rail bonds; illustrated.

Electric Railways, Mine Haulage, Power Transmission—bulletin published by the Ohio Brass Company, Mansfield, Ohio, an interesting publication dealing with the above subjects.

Soot Cleaners—Catalogue issued by the Vulcan Soot Cleaner Company, Du Bois, Pa., describing and illustrating Vulcan Soot Cleaners as applied to boilers, super-heaters, economizers, garbage destructor boilers, waste heat boilers and similar apparatus.

Lightning Arresters—Bulletin 1-A issued by the Westinghouse Electric & Manufacturing Company. A discussion of lightning and its effects is given, followed by a description of the application of lightning arresters for the protection of various kinds of apparatus.

C. G. E. Publications—Exide, Type ZA Motorcycle Storage Battery; Flexible Steel Armored Conductors; G. E. Flow Meters, for measuring steam, water, air and gas; Ivanhoe Metal Reflectors and Fittings for Multiple Mazda Lamps; Small Centrifugal Blowers; Electric Glue Pots.

Something In It for You—attractive booklet issued by the Westinghouse Electric & Manufacturing Company to assist its agents and dealers in marketing the Westinghouse electric range. This booklet describes in a brief, concise manner the advantages of this type of range, and includes a number of illustrations. In addition it outlines several methods of selling and gives suggestions covering newspaper advertising, window trims, demonstration, etc.

Self-Contained Continuous Current Dynamos and Motors—Pamphlet No. 21-C, published by the Bruce Peebles Company, Limited, Edinburgh, Scotland, completely illustrating and describing the sixteen frame sizes which are manufactured by this company in any of the usual types, i.e., protected type; semi-enclosed type; totally enclosed type; mining type and pipe ventilated type. In addition very complete lists of output ratings are given for the usual standard voltages.

Current News and Notes

Bowersville, Ont.

The Bowersville Telephone Company, Limited, Bowersville, Ont., have obtained a charter.

Brampton, Ont.

A resolution was carried by the town council authorizing the Hydro-electric Power Commission to obtain tenders on three 150 kv.a. and on three 300 kv.a. transformers to be installed in the sub-station.

Chelsea, Que.

There is a possibility of Chelsea, Que, being supplied with electric light from a privately owned power house at Farm Point, which has supplied the current as far as Kirk's Ferry for some time.

Collingwood, Ont.

The Collingwood Hardware Company have been awarded the contract for the installation of a Lister-Bruston lighting plant in the Capstan Inn, Wasaga Beach.

Courtright, Ont.

The village council will make request to the Ontario Hydro Commission for an estimate of the cost of the necessary equipment to serve the needs of Courtright with light and power.

Edmonds, B.C.

Permission has been granted the Western Canada Power Company to erect transmission poles and wires on the Cariboo Road.

Fredericton, N.B.

The city council shelved a proposition to purchase current from the Fredericton Gas & Light Company, at 3½ cents per kw.h. and will continue to light the city streets with current supplied from the city's plant on Carleton Street.

Halifax, N.S.

At the annual meeting of the Demerara Electric Company, head office Halifax, N. S., the fuel problem formed a vital subject for consideration. Some form of cheaper fuel, such as wood or oil, will likely be employed. This company operates in British Guiana.

Markham, Ont.

A mass meeting will be held in Markham to discuss the advisability of linking up with the Hydro system. Local opinion seems to be favorably inclined.

Moose Jaw, Sask.

Fourteen workmen on the Moose Jaw electrical system walked out on June 20 following the refusal of the city to grant an increase in wages.

Nelson, B.C.

The West Kootenay Power & Light Company are busy installing another 8,000 h.p. unit in their No. 2 plant, thus bringing the total horse power of the company up to 32,000. Increased demand for power in the development of mines and smelters in Kootenay and Boundary has made this installation necessary.

Port Alberni, B.C.

Mr. Arthur W. Odlum, city electrician, has resigned his position.

Prince Albert, Sask.

The contract for the construction of the government long distance telephone line from Prince Albert to Shellbrook, Sask., has been awarded to the North Saskatchewan Telephone Construction and Development Company of Prince Albert, and work is being commenced on the line at once. The contract calls for the completion and operation of the service within two months. It is anticipated that almost immediately projects for rural lines to connect with the new long distance line will be started in the country through which it passes.

Rainy River, Ont.

The Rainy River Electric Light and Power Company have secured a ten-year contract to supply the C. N. R. with water. The necessary equipment is to be purchased. They have also secured a five-year lease of the river front land and as soon as the water subsides they will start the construction of a sawmill.

Saskatoon, Sask.

The Government of Saskatchewan is undertaking an investigation into the possibilities of development in the rivers in the northern portion of the province with a view to supplying hydro-electric service to the villages, towns and cities in that district.

Stratford, Ont.

Stratford council have approved $30,000 debenture appropriation for hydro-electric extensions.

St. Catharines, Ont.

At the regular monthly meeting of the Hydro-electric Commission held on July 5, Manager Yates reported a net gain of 55 services, making a total of 2,357.

Scarboro Township

The Scarboro township council are negotiating with the Hydro-electric Commission with a view to securing an electric service from the city limits along the Kingston Road and up through the township.

Vancouver, B.C.

The B. C. Telephone Company will build a new exchange at Nelson. The present system is the old style, the subscriber having to ring central, but in the new exchange the central energy system will be installed.

The British Columbia Electric Railway Company's returns for May show that it is the fourth in a period of 25 months to record an increase in both the gross and net earnings. The total gross earnings were $542,363, in increase of 40 per cent. over the preceding month.

Windsor, N.S.

Work has been started on the Bay of Fundy tide power project at Cape Split, N. B., by the Cape Split Development Company, Limited. A demonstration of this invention took place a short time ago on Gaspereau River, in the presence of a number of engineers. The motor worked perfectly, gradually developing more power as the water rose to a higher level, reaching its maximum of over two horsepower when the water buried the top of the machine. The same model, which is about 12 feet long and 2½ feet high, would develop 54 horsepower at Cape Split in a current of nine miles an hour.

Winnipeg, Man.

The annual statement of the Winnipeg hydro-electric plant for the fiscal year 1915-16 ended April 30, shows total earnings of $995,511, and surplus of $79,729 after meeting all operating expenses and fixed charges for the year.

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Generation, Transmission and Application of Electricity

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ADVERTISEMENTS

Orders for advertising should reach the office of publication not later than the 5th and 20th of the month. Changes in advertisements will be made whenever desired, without cost to the advertiser.

SUBSCRIBERS

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Electrical Industries Making Good

"Electrical Industries," London, describes in its current issue a recent meeting of the British Electrical and Allied Manufacturers' Association and points to the co-operation work of this association in getting together the electrical and allied interests, not only in the Mother Country, but also in the various overseas possessions, for developing and consolidating trade relations now and after the war. The article points to the activity of the British electrical factories to-day as refutation of the charge that these industries had become decadent and declares that in so thinking Germany has made one of her biggest mistakes. The following extract is to the point and, to all appearances, correct:

"In the electrical industry, for example, an impression has got abroad that British manufacturers have allowed the Germans to get to windward. The Germans have fertilized that impression, and sown the seed of it broadcast, in the subtle fashion of which they—like the Devil—are masters. British electrical manufacturers are alleged to be backward in knowledge and in organization; British electrical engineers are alleged to be weak in science and out-of date in the technique of design and production. Even in Great Britain some people were poisoned with the idea that the British electrical trade was deprived of its milch cow when the war cut off German supplies. A prominent London journal committed itself to the statement that 'in the main' Great Britain depended upon Germany for electrical apparatus.

"'In the main' this was nonsense. There were certainly a number of directions in which the state-aided, subsidized, gas-producing German had cut into British electrical trade lines. Porcelain for insulators was one of them; bulbs for electric lamps were also largely imported; and there was a miscellaneous crowd of cheap and mucky accessories in which the Germans were supreme. But the manner in which the British electrical industry has been able to 'carry on' during the war—supplying everything needed for the Army and Navy and all the plant required for the multitude of new munition shops—proves that the dependence upon Germany was a myth."

Competing With Gas Cooking

The uses of electric cooking ranges in Montreal and Westmount are very few, and until recently there was no aggressive campaign to increase the number. One reason for the scarcity of users was the high cost of current, as compared with that of gas, and although electricity has many advantages as against gas, the greater cost naturally offset these. The corporation of Westmount, through its light and power department, has decided to do some educational work in the matter of electric cooking, heating, etc., and as an inducement to householders to use current has reduced the price of 2½c per kw.h. to 1½c. The corporation has a store where various ranges, electric irons, etc., are on view. All customers are at liberty to purchase any make of range, but if the article is purchased through the city, the latter will install it free of charge, and will also do a certain amount of wiring. The meter charge is 15c per month. The following circular has been addressed by the corporation to local householders:

"The City of Westmount Light & Power Department have now fixed 1½ cents per kw.h., registered by meter, as the new reduced rate for electric current for cooking and heating and for motor driven or other appliances for household use, except lighting.

"At this price the electric range is no longer a luxury but a convenience within the reach of every householder. Gas, with its dangerous fumes and odor, can be banished from the house. The washing machine, vacuum cleaner, sewing machine motor, hot water heater and other labor-saving and hot weather devices become a real economy.

"It is ten years since the Light & Power Department of the City of Westmount was inaugurated. The City's credit was then pledged to make the venture succeed. If there should be a deficit the ratepayers must pay the loss through their taxes. As a matter of fact the venture has been a pronounced success. Thanks to the city's system poles and wires have been removed from many streets, and powerful and handsome arc lamps installed. Expenses have been met, depreciation amply provided for, and the old rate of 15c per kw.h. paid by the consumer ten years ago, has been reduced to the present rate of 5c for lighting and 1½c for other household uses.

"With the generous patronage from our citizens and an increase of customers, both these rates will be still further reduced."

Grounded Return Systems

Some little time ago the Committee on Electric Wiring Systems of the Electrical Industry in the United States appointed a sub-committee to investigate grounded return wiring systems. The committee desires the co-operation of the entire electrical industry in that work and to this end requests that information and any data on wiring systems having a bare grounded conductor be sent to the secretary, William S. Boyd, at 175 West Jackson Boulevard, Chicago.

The committee would especially appreciate the following information:—

(1) Safety, cost and reliability data based upon practical experience with concentric wiring, or any other type of wiring having one or more bare or partially covered conductors which are permanently connected to earth.

(2) Theoretical or tested installation details or protective features which will safeguard concentric wiring or other wiring systems having bare grounded conductors.

(3) Reliable methods of preventing meter setters or linemen from reversing the polarities of a two-wire system

(4) A suitable definition of "ground" or "earth" as these words relate to electric wiring.

(5) Practical experience with ground or earth connections:
 (a) Whether they have been found reliable, or unreliable;
 (b) The proportion found to be unreliable, if any;

(6) Adequate methods of establishing and maintaining a reliable ground or earth connection for safety purposes.

(7) A simple method of test which will insure the detection of unreliable ground or earth connections.

(8) Economies which may be practised with safety in connection with any of the existing wiring methods.

(9) Estimates or actual figures as to the cost of any protective features reported upon in response to the foregoing requests; and

(10) Any data or experience calculated to assist the committee in reaching an accurate conclusion relative to the practicability of bare grounded return wiring systems.

Illuminating Engineering Lecture Course

In the fall of 1910, the Illuminating Engineering Society, in co-operation with the Johns Hopkins University, held a notable lecture course on subjects relating to the production of light, characteristics of illuminants and the theory of illumination, which went far toward placing before the public the general principles of the art. This course was participated in by illuminating engineers, lighting company representatives, physicists, ophthalmologists, manufacturers of lighting appliances, etc., and has always been considered one of the most important undertakings in the history of the Illuminating Society. In the six years which have since elapsed, there have been many changes in methods, improvements in apparatus and developments in theory which seem to call, at the present time, for another effort toward education in illumination.

For the second time in its history, the Illuminating Engineering Society has decided to hold a series of lectures. This event is to be held at the University of Pennsylvania, Philadelphia, Pa., from September 21-28, inclusive, immediately following the Annual Convention of the Illuminating Engineering Society, to be held in that city The Lecture Course will include the principles of illumination and various aspects of lighting practice. Whereas the 1910 course, at Baltimore, emphasized the science of illumination, the new course will emphasize the art of illumination. This course will include about twenty lectures by men selected, on account of their qualifications, to deal authoritatively with the several phases of the subject. Associated with the lectures will be an exhibition, at the University of Pennsylvania, of the latest developments in illuminating appliances, including lamps, accessories, photometers, etc., together with novel applications of light. The exhibition is expected to be of great educational value.

The following list of lecture subjects has been decided upon:—

Subjects	Lecturers
(A)—General—	
(1) Illumination Units and Calculations ...	A. S. McAllister
(2) Modern Photometry ...	Clayton H. Sharp
(3) The Principles of Interior Illumination (Two Lectures) ...	Committee J. R. Cravath, Chairman
(4) The Principles of Exterior Illumination ...	Louis Bell
(5) Color in Lighting ...	M. Luckiesh
(6) Architectural and Decorative Aspects of Lighting ...	Guy Lowell
(7) Recent Developments in Electric Lighting Appliances ...	G. H. Stickney
(8) Recent Developments in Gas Lighting Appliances ...	R. F. Pierce
(9) Modern Lighting Accessories ...	W. F. Little
(B) Special Lectures on Interior Illumination—	
(10) The Lighting of Factories, Mills and Workshops ...	C. E. Clewell
(11) The Lighting of Offices, Stores and Shop-windows ...	Norman Macbeth
(12) The Lighting of Schools, Auditoriums and Libraries ...	F. A. Vaughn
(13) The Lighting of Churches ...	G. Perrot
(14) The Lighting of the Home ...	W. H. Jordon
(15) Railway Car Lighting ...	G. E. Hulse
(C) Special Lectures on Exterior Illumination—	
(16) Street Lighting (Two Lectures) ...	(a) P. S. Millar (b) C. F. Lacombe
(17) The Lighting of Yards, Docks and Other Outside Works ...	J. L. Minick
(18) Headlights, Searchlights and Projectors	E. J. Edwards
(19) Sign Lighting ...	L. G. Shepard
(20) Building Exterior, Exposition and Pageant Lighting ...	W. D'A. Ryan

Cost of Lecture Course

The price of tickets for the Lecture Course, which includes admission to all lectures and functions connected therewith, has been fixed at $25.00.

This tuition fee includes a reprint of all of the lectures, which will form a valuable addition to the library and reference data of any one interested in the science and art of illuminating engineering.

Electrically Propelled Fire Apparatus*

In no transportation problem is the inadequacy of the horse more forcibly emphasized than in the fire department service, where the faithful, spectacular, but uneconomic horse is rapidly being replaced by the efficient and dependable mechanically operated equipment. There is considerable sentiment associated with the plunging, well-groomed fire horse, but the fast moving motor apparatus not only excites the admiration of the public, but accomplishes speedily the purpose for which fire equipment is primarily designed. Because of the great demand for horses since the outbreak of the European war, and the present needs in this country, just now increased by the Mexican situation, the American market for the higher breed of horses suitable for a fire department has been fairly exhausted. The scarcity has, of course, caused a tremendous advance in the cost of the best grade of horses, and as this condition is likely to become more acute before it is improved, the question of a substitute naturally arises.

It is interesting to note that a number of municipalities have converted their old horse-drawn equipment into the

* By A. Jackson Marshall, Secretary Electric Vehicle Section, National Electric Light Association.

best type of motorized fire apparatus—the electric. It was found that with very little expense the simple electrical mechanism could be substituted for the fire horse, which, through years of faithful service has endeared himself to the public. The service rendered by electrically propelled fire apparatus proves itself of a very much higher order than that previously used. It not only eliminates the unsanitary features associated with the horse in the station house, and likewise on the street, but reduces the fire hazard, which is also rather enhanced with the use of the gasoline car. It is important to realize that the remarkable simplicity of the electric fire apparatus enables the drivers of the old horse-drawn vehicle to become rapidly familiar with this new equipment. It is therefore unnecessary to employ the services of an expert mechanician, as is usually the case with other motor types. In the event that the regular driver is not available, any member can drive the electric apparatus, which is speedily, safely and easily negotiated, even through congested traffic. It is also of considerable importance that the electric gets under way from the station quicker than either horse or gasoline car, and when compelled to remain for a long period at a fire there is no suffering from exposure, nor freezing of the radiator. When the electric apparatus is returned to the station it merely requires the ordinary washing, and charging—minus the careful attention that has to be bestowed upon the horse, or the numerous parts of the gasoline car, in order that it may be quickly available for the next fire. The high average speed maintained by the electric is attributable not only to its high running speed, but to its ability to stop and to accelerate faster than other types of motor vehicles, thereby eliminating bursts of excessive speed in an effort to compensate the loss of time in starting and stopping. The more even and constant speed is of advantage in protection of pedestrians and other vehicles, and because the electric is always under the absolute control of the operator less injury is apt to happen to the apparatus itself.

Shawinigan Water & Power Extensions

In connection with the contract recently made between the Sherbrooke Railway and Power Company and the Shawinigan Water and Power Company for the supply by the latter of 2,000 h.p., an extension of the power house of the Sherbrooke Company is being made, for the purpose of taking in frequency changers and transformer equipment. The power will be transmitted over the Shawinigan transmission line between Victoriaville and Windsor Mills, and from the latter point a new transmission line is being built to Sherbrooke. The power will be transformed to 2300 volt, 60 cycles. The consulting engineers are J. M. Robertson, Limited, Montreal.

Industrial Uses of Hydro-Electric Power

By J. B. Challies*

At the present time the great steel mills of this continent are absolutely dependent upon the electric furnace for the production of alloys. The automobile manufacturer is dependent upon another electric furnace production, aluminium, for car bodies. The manufacturer of steel products needs these materials for making tools, and countless factories require abrasives which cannot now be imported, and which are now being produced, in the United States at any rate, only by electric processes. Without acetylene gas and graphite, and other electric products, many existing industries would be absolutely crippled.

So far as the products of electro-chemistry are concerned, it is found that the surgeon and the doctor look to electric plants for chloroform and disinfectants; the cotton and the paper manufacturers need the bleaches produced by electricity; the user of soap patronizes the electro-chemical establishment, as does every user of matches. Gold and silver mining of the west requires electric products to assure a profit, and it is only lately that the United States, cut off from its supply of German dyes, has found itself dependent upon electric products to supply the deficiency, in part at any rate.

These are but a few of the industries dependent upon cheap electric power. The further development in either Canada or the United States, or the inauguration of such processes in Canada, is very largely, if not altogether, dependent upon cheap available, dependable power. The source of such power is admittedly, for a very large portion of our country, water-power. The development of water-power in making available a supply of cheap hydro-electric energy in various parts of the Dominion, would probably result in the reduction of the cost to the consumers of countless articles of every-day use, which, to the man on the street, are in no way associated with hydro-electric development.

To be more specific, the manufacture of steel is one of the greatest of the United States industries, and is fast becoming a very important one for Canada. To-day, electrically produced ferro-silicon is used as an alloy by most steel manufacturers, with the result that the Bessemer process is fast becoming obsolete. The essential element in the manufacture of armour plate and armour-piercing projectiles, is introduced into steel by the alloy, ferro-chromium, strictly an electric furnace product.

Ferro-chrome, another product of the electric furnace, has made possible the manufacture of high-speed tools, which in turn have tripled the capacity of our machine shops and enhanced the efficiency of our mechanics. It has cut to one-third the capital invested in tools to accomplish a given volume of work.

In the absence of chromium, tungsten, vanadium and molybdenum, all alloys made by electrical processes, the builders of American battleships and other weapons of national defence, and a large portion of our Canadian steel and metal-working industries and other industries, would be in the condition of twenty years ago. The electrical industry itself is largely dependent upon silicon steel, a product that does not age and does not wear.

The development of aeroplanes also calls for aluminium, and only with the abundant production of cheap electric energy from water-power will the price of aluminium kitchen utensils come within the reach of every housewife.

At the outbreak of the war, we were cut off from the supply of Greek and Turkish emery. To-day the metal-working industries of this country are dependent almost entirely upon electric furnace abrasives, carborundum and alundum. The manufacturer of agricultural machinery, locomotives, firearms, milling machinery, automobiles, and countless other metal products must have these abrasives, and they can now be made only where waterpower is developed cheaply.

The electric furnace also turns out calcium carbide, the only source of acetylene, which is being so extensively used in Canada. The oxy-acetylene flame has become of intense value in the welding of metals and the cutting of steel. This

* Superintendent Dominion Water Power Branch, in Trade and Commerce Weekly Bulletin.

same calcium carbide is the important factor in the fixation of atmospheric nitrogen, and is the source of supply upon which we may have to rely for nitric acid and nitrates employed in making munitions of war and fertilizers.

All the artificial graphite used in the world to-day is produced at Niagara Falls, by cheap waterpower. Its uses are manifold. Practically the whole supply of abrasives on this continent is from Niagara.

Considering the products of electro-chemistry alone, chlorine stands out as of first importance. The sterilization of water supplies of countless cities has been made possible by the use of bleaching powder or hypochlorite, and in communities where this is used extensively, typhoid has been largely eliminated. The armies of Europe use chlorine to avert typhoid, and other chlorine products, including chloroform, are used surgically, both as anesthetics and antiseptics. This same chlorine, or bleach, makes possible the manufacture of white cotton goods and white writing paper. Other products of chlorine, produced electrically, enter into the manufacture of soaps. Even into fire extinguishers goes this product of cheap electricity.

To meet the shortage in coal-tar dyes, by the combination of chlorine with coal-tar benzol and tuluol, there is now beginning to be produced quantities of those necessary intermediates formerly made and exported from Germany.

Metallic sodium, also a product of electricity, is the basis for sodium peroxide, which is used in generating oxygen for hospitals, for laboratories, and for submarines and mine-rescue apparatus. It also enters into the manufacture of hydrogen peroxide. Without sodium cyanide, many gold and silver mines could not possibly operate at a profit.

These are but a few of the products of every-day use which will largely depend upon water-power. Many of these, a few years ago, had no known value. What other products remain to be developed with the growth of electricity, no one can predict.

There can be no question regarding the fundamental and essential relation of water-power to the economic and industrial situation in Canada.

Wireless Telegraphy and the War

By J. H. Lauer

Leading journals the world over have from time to time thrown open their columns for popular competitions as to what comprised the "Seven wonders of the world." It is at least a remarkable coincidence that in the two most recent of such contests, the result has been identical in placing "wireless" at the top of the list. Whether given as the deliberate opinion of trained minds in academic discussions, or as that of the popular vote of the "Man on the street," wireless telegraphy has been universally conceded to be not only one, but the foremost one of the wonders of the 20th century.

Its development, following on the realization of its value and utility as a means of communication across great distances by sea or land, has been phenomenally rapid. It was only in 1902 that Mr. Marconi, the Wizard of Wireless, succeeded in transmitting signals across the Atlantic. In 1904 the transmission of news to liners in mid-ocean had already become a practical fact.

In a brief review such as I propose to give of the important services rendered by wireless to the operations of the present war, I do not assume to place before you any information which you have not already been able to gather from general statements which have appeared in the press. For reasons of strategy which must be obvious to everyone, the press accounts are necessarily vague in order that no news of value to the enemy may reach him. We read accounts of movements of troops "Somewhere in France" to attack certain enemy trenches indefinitely described. But these accounts are for the most part impersonal. The human interest and the means adopted are generally absent. My present purpose is to supply some of these personal touches taken from the records of the Marconi Company.

Imperial Wireless Chain

Before going into these records, I desire to emphasize one important aspect of Wireless Telegraphy which deserves greater attention than it has yet received by the public. In 1913 after the conclusion of the great International Wireless Convention of 1912, in London, the Marconi Company submitted a proposition to the British Government for the construction of an all-British world-wide chain of Imperial wireless stations. The stations were not built, and are not yet built. In the light of subsequent events it is not unreasonable to assume that German activities, dominating a world-wide subsidized press campaign, had some hand in the opposition to the British Imperial chain, as the competing systems were principally of foreign origin. Certain it is that Germany at once seized on the importance of building high power stations throughout its colonial possessions communicating with powerful stations in Germany. Money was spent lavishly, but proved a good investment, as at the outbreak of war, on August 1st, 1914, wireless messages were immediately sent to all German merchant vessels throughout the world to proceed at once to the nearest neutral port. Thus an expenditure of some ten million dollars saved shipping to the value of at least one hundred million.

In the early beginning of wireless, only 16 years ago, the London "Times" in 1899 remarked approvingly on the employment of Mr. Marconi's system in the naval manoeuvres of that summer. It had been demonstrated that signals could be transmitted and received up to 30 miles from ship to ship. If a means of signalling over distances of about thirty miles was welcomed by the "Times" sixteen years ago in a leader of a column and a quarter in length, how great must be the indebtedness of the navy to the new system when a squadron based on Malta can receive signals direct from the Admiralty by this new system, and when the ordinary installation of a large ship of the fleet can send messages over a distance of 2,000 miles!

When the new means of communication was in its infancy, installations were made only in battleships and large cruisers; the system was afterwards extended to small cruisers; later to destroyers, and finally to submarines. The German underwater craft, which have played such a dramatic role in the present war, are provided with installations which enable them to communicate three or four times as far as could a battleship in the naval manoeuvres of 1899. This contrast supplies evidence of the remarkable development which has taken place in the adaptation of wireless telegraphy to the uses of the navy in the last sixteen years. Practically every ship in the British navy to-day can dispatch and receive wireless signals, and consequently the intelligence work of the navy has undergone a radical revolution. An admiral need never be out of touch with his vessels, and he need practically never be out of touch with the Admiralty.

From the very outset the Government took over all the wireless stations of the empire. Even before the declaration of war the order for the first fleet, which had left Portland after the great review at Spithead at 5 o'clock on the morning of July 30th, 1914, was recalled by wireless and ordered not to disperse for manoeuvre leave as had been previously arranged.

The Importance of Prompt Communication in War

The object of hostilities is to defeat the enemy, and in order to effect this purpose it is desirable to know what the enemy is doing in this or that theatre, and to possess means of communication which will enable superior power to be concentrated and exerted against him at the right time and in the right place. It is also essential that the power shall be of the right kind. Sometimes it may be necessary to employ battleships; on other occasions battle cruisers—that is, ships with the speed of cruisers and the gun-power of battleships—may be more suitable, while in other circumstances it may be necessary to use scout cruisers, destroyers or submarines. The more complete and exact the information obtained as to the movements of an enemy, the better will be the arrangements for defeating him, providing the higher command is exercised with competency and sureness of purpose. It may, indeed be said that in war almost everything depends upon rapid and accurate intelligence.

The important use to which wireless is put on British battleships of to-day has been pointed out. Each ship has its wireless installation adjusted so that it can send and receive signals and messages to other squadrons at sea or in harbor and to stations ashore. It is customary for one ship of a fleet to be always in direct touch by wireless with the Admiralty, the risk of interference from an enemy's craft being reduced to such an extent that it is hardly worth while taking into consideration.

Slow Methods of the Past

Let us turn back just 100 years, and consider the position Nelson was placed in for obtaining information. The old system of intelligence may be illustrated by recalling the story of the errand of the brig "Curieux." Nelson, acting on his unequalled intuition, had chased Villeneuve across the Atlantic, and in June 12th reached Antigua, only to learn that the enemy had apparently started for Europe. The British admiral decided to send the "Curieux" to England with information of the enemy's movements and details of what he himself intended to do. Sailing at her swiftest, she did not reach Plymouth until July 7th. Commander Bettesworth posted at once to London, only to find that the First Lord of the Admiralty, Lord Barham, had gone to bed and that no one dared arouse him.

One can imagine how the admirals at sea and the members of the Board of Admiralty chafed under the delay which was imposed upon them, owing to the slow means of communication which then existed. The "Curieux," from the time when Nelson decided on his course of action, until Plymouth was reached, was at sea twenty-four days. Then followed Captain Bettesworth's post to and from London, and further delay occurred before the vessel was able to complete the chain of intelligence by communicating with Cornwallis. In the past hundred years steam has replaced sail-power, and movement by sea has thereby been rendered more rapid. On the other hand, except where cable communication exists, the navy of to-day would still have to rely upon the same slow methods of communication as existed a century ago, were it not for the invention of wireless telegraphy. The relation between the speed of the enemy and the speed of the intelligence ship of the opposing party is now much what it was in Nelson's day. Under the altered conditions, however, a wireless signal "incode" can accomplish in a few seconds all that the Curieux was able to do in many days.

Lack of efficient intelligence was under other conditions the bane of the lives of our admirals, as their letters reveal. When Nelson was blockading Cadiz he had to maintain a chain of small vessels, which stretched from the enemy's port to the main British fleet, fifty miles away, and the news that the enemy had sailed did not reach him for two and a half hours. To-day, a single scout cruiser, under steam, could cover that distance in an hour and a half, and no chain of repeating vessels would be necessary; and the enemy, instead of taking 24 hours to manoeuver out of port, could complete the operation in one or two hours. Steam in the first place rendered possible a reduction in the number of links in the chain where great distances had to be covered, but it was not until Signor Marconi invented wireless telegraphy that it became unnecessary to have any chain in any circumstances.

The Famous "Treasure Ship"

Considerable interest was aroused during the earlier part of the war in what all the newspapers denominated the "Treasure Ship." Few people can, even now, understand how it was that the "Kronprinzessin Cecile," with her two millions in gold and six hundred thousand pounds in silver managed to escape the cruisers seeking for her. The full story has since appeared, and, as wireless was responsible for the success of her elusive feat, you may be interested in the narration of how it was done. At the time of the declaration of war, she was 107 miles West of Plymouth, en route for Bremen, via Plymouth and Cherbourg. With German thoroughness every eventuality had, for years, been provided for. In common with all other commanders of German liners, Captain Polack was in possession of sealed orders which had remained unopened on board his ship for about two years. At ten o'clock on the night of August 1st he received the following message by wireless:—"Eberhard has suffered an attack of catarrh of the bladder. (Signed) Siegfried." He immediately went to his cabin and opened his sealed orders. The translation read "War has been declared between Germany, France and Russia. Turn back." Lights were dimmed, portholes covered, and the "Cecile" hurried at full speed back to the United States. More explicit wireless telegrams reached him during the next twenty-four hours, and the result was that, thanks to wireless aid, the enemy's treasure ship eluded British cruisers, and put into Bar Harbour on August 4th. These sealed orders from the German Admiralty had been distributed amongst the captains of merchantmen as far back as the spring of 1908.

Note the hypocrisy of the German plea that they were attacked by jealous powers, and were fighting a purely defensive campaign.

The Emden

It was one of the ironies of fate which decreed that wireless telegraphy—so frequently an aid to the German cruiser "Emden" in her depredation of the Allies—should prove to be her Nemesis; for it was while men of the German craft were destroying radio apparatus on an island on the Indian Ocean that she was attacked by a ship of the Allies which had been summoned by Marconigrams before the station was demolished. Driven ashore and burned, the destruction of the "Emden" marked the end of a vessel which had been veritably a terror of the seas to the enemies of Germany.

The way the "Emden" located its victims was very ingenious. Her usual course was to send out wireless signals enquiring if there was any news of the whereabouts of the "Emden." On one occasion she enquired for the results of a Rugby match at Singapore. On getting replies to her wireless calls, she naturally got the position of any vessels within her immediate radius. She thus netted about twenty victims among the British merchantmen in the Indian Ocean. One of these was the "Lovat," carrying a cargo of soap. The crew of the "Emden" was indeed in need of soap, for their faces were black with coal dust which had gathered upon them in shoveling many tons of coal from a captured ship. The "Lovat's" crew, on reaching Calcutta, their lives having been spared, went to the firm to which the soap had been consigned and told how it had been seized by the Germans. The consignees, however, had been fully informed of the incident, for Captain von Muller had sent them a wireless message thanking them for the soap and apologizing for its seizure. He explained that the circumstances made it absolutely necessary to confiscate the shipment.

After a more successful career in the destruction of commerce than even the "Alabama," of historical fame, achieved, she (the "Emden") put into Cocos-Keeling Island and landed a party with the intention of isolating this small community. The wireless operator had time to send out a message for help. The signal was picked up by the senior officer in charge of the cruisers which were convoying transports from the Antipodes to Europe. The information was so full and accurate and was received so rapidly that no doubt existed either as to the identity of the enemy's ship or the possibility of catching her. The senior officer selected for the duty of destroying the "Emden" the "Sydney," of the Royal Australian Navy, a vessel more powerfully armed and swifter than the "Emden." Within a few minutes of the signal of distress being dispatched from Cocos-Keeling Island, this man-of-war, cruising many miles away, had changed her course and was bearing down upon the "Emden" for the purpose of destroying her; and destroy her she did. Wireless telegraphy, it is claimed, was thus responsible for the destruction of this famous commerce raider; but for Signor Marconi's invention there is no saying when her career would have come to an end.

The "Dresden"

This raider had a more intimate connection with Canada than the others. It was she who cut the Pacific Board Cable between Vancouver and Fanning Island. Indeed the people in Victoria and Vancouver were for a time firmly convinced that the "Dresden" would pay them a visit, and took precautionary steps accordingly in the purchase of submarines for the West Coast.

Her final fate was tragic. She later joined the main German Squadron which made a sad end to gallant Admiral Craddock's detachment off Chile on November 1st, and later escaped from the Falkland Islands battle around Cape Horn to find her fate in Juan Fernandez, the spot in the "Robinson Cruso Island," where, guided by wireless, the three British cruisers—Kent, Glasgow, and Orama—discovered and destroyed the German "commerce destroyer." The island was discovered in 1563 by the Spaniard whose name it bears, and was, for five years, the solitary abode of Alexander Selkirk, a Scotch bucaneer, whose story is supposed to have suggested Daniel Defoe's famous novel referred to above. So ended the career of these mischievous wasps of "commerce raiders." This brings us to the larger field of the few big naval encounters of the war, for the German grand fleet still skulks behind the great fortifications of the Kiel Canal.

Wireless in the Field

Wireless is now recognized as an absolutely indispensable part of military equipment, and a station of one type or another has been adapted to practically every branch of the service. The primary need has been portable apparatus capable of the most rapid assembling and this has been met by various types of apparatus carried by automobiles and carts designed by the Marconi Company, which can be set up and put in commission in four minutes to a quarter of an hour after arrival at the side. These sets have an effective range of from 40 to 800 miles.

The most novel use to which wireless has been put in warfare is certainly in connection with the "third" or serial arm, for the aviator when in flight is enabled to transmit to his base almost instantaneously reports and information on the enemy's position and batteries, etc., checking and directing the range and accuracy of our own guns on the long battle lines from the English Channel to Switzerland, the Italian Alps and from the Baltic to the Persian Gulf.

The following extract from a letter from the front gives a telling description of the way in which the wireless telegraph and aeroplane assist our gunners:—

"I'm sitting in a little hole with the wireless operator, and his telephonist. The wireless man bends over his instrument. He then starts to scribble on his message pad.

"I lean over and read the words 'Just leaving. Shall be with you in four minutes.' The telephonist transmits the message to the gun, and almost immediately a white speck appears on the sky, and the drone of a powerful engine is heard. The operators adjust their instruments for the last time, and fit their ear-pieces more firmly on their heads.

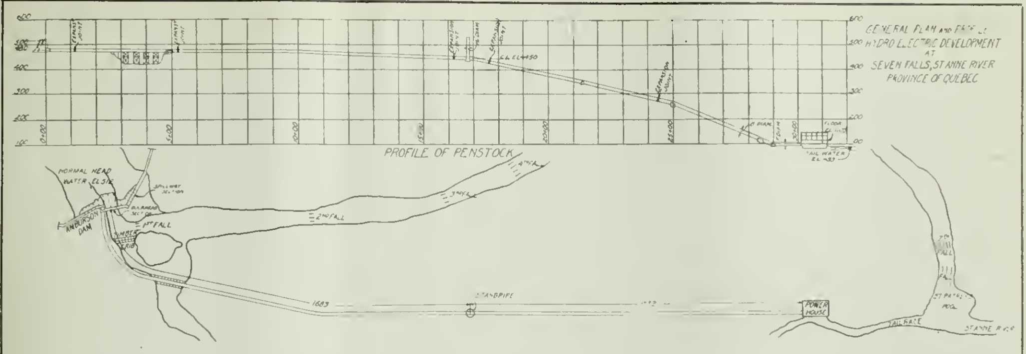
"'Prepare for action,' writes the wireless man. The message is duly transmitted, and I stuff cotton wool in my ears as the aeroplane soars over our trenches, then higher and higher over the German lines. 'He will get it in a minute,' mutters the telephonist: and sure enough, as he speaks, a huge white ball of smoke appears to the left of our machine.

"The flying man makes a graceful detour with his machine, and then takes up his original course once more. The wireless man stiffens again, stoops and writes; this time a jumble of figures and numbers, or so it appears to me, and as they are transmitted the huge barrel of the gun to our rear moves slowly, and at length comes to rest. The gun team stand clear, the lanyard is pulled, and the gun runs back 'midst a huge cloud of dirty smoke. It is immediately followed by a deafening roar, whilst the projectile is heard screaming away over the enemy's lines.

"While the gun is being resighted for a second shot we in the 'dugout' anxiously await the wireless message from the skies, telling us the effect of the shot. 'Fifty yards short,' says the operator. 'Fifty yards short,' repeats the telephonist. With great care the gun-sighting is corrected, and again a shell is sent hurling towards the target. The anxious wait follows; our wireless man taps impatiently with his pencil; I light a cigarette to while away the seconds. 'Good!' the operator exclaims, 'Direct hit'; fire six more shots. Thus he writes down the message from our aircraft."

Many novel and remarkable developments in wireless telegraphy were brought about by the exigencies of the great war of 1914-15. Not only had gaps to be filled owing to cut cables (particularly in the case of Germany), but warships standing in all the seven seas, aeroplanes, and Zeppelins, and even submarines had to be communicated with. And in addition to this, the extent of the modern line of battle is so great that wireless telegraphy is found to be an ideal and indispensable means of communication.

Messages are passed between all parts of the war area by various means of communication—by wireless, by ordinary telegraphic and telephonic lines, by messengers on motorcycles, or mounted dispatch-riders. All means are employed; but, under the intense concentration of artillery fire which characterizes the present-day battle, the only one which can be looked upon as absolutely reliable is wireless. Over and over again it has been found in certain sections almost impossible for orderlies or dispatch-riders to cross fire-swept zones, whilst telegraphic and telephonic wires are smashed by high explosives almost as soon as they are laid. Only the invisible ether waves remain unaffected, and it is for this reason that more and more on the field of battle, as well as at sea, the reliance of the higher command is leaning towards wireless.



General plan and profile, hydro-electric development at Seven Falls for Laurentian Power Co.

Hydro-electric Power Development at Seven Falls, Ste. Anne River, Montmorency County, Quebec

The Laurentian Power Company, Limited, Quebec, controlling the Seven Falls development on the Ste. Anne River, have placed in operation a four unit hydro-electric plant and transmission system to Montmorency Falls, Que., of particular interest owing to the natural head available and the provision made for regulating the natural flow of the river.

According to the most recent regional maps of this watershed as made by the Provincial Government, the drainage area of the Ste. Anne River is 432 square miles, 400 miles of which are tributary to Seven Falls. This river has its source in the Laurentian Mountains, within the boundaries of the Laurentian National Park and flowing in a southerly direction and empties into the St. Lawrence River about 27 miles below the city of Quebec. The mountainous character of the watershed, which for the most part is well wooded and not under cultivation, thus reducing the absorption and evaporation; the northern latitude in which the head waters are situated, and the fact that a large part of the drainage basin is under preservation by the Provincial Government, are characteristics favorable to hydro-electric development and regulation of the natural flow.

The geological formation at Seven Falls is exclusively a typical Laurentian gneiss, composed of quartz, feldspar, mica and horneblendes with traces of iron pyrites. The slope or grade of the main river is high, the bed having mostly boulder stone and rock. The water is remarkably clear, free from sand or detritus at normal stage, indicating the presence of naturally filtered underground sources. Along the main river very few level reaches exist, which might be utilized for storage reservoirs, but several lakes of considerable area are available for impounding the run-off and regulating the seasonal variation in flow.

Records of precipitation taken at Quebec for the past forty years give a mean of 41.25 inches, a maximum of 52.39 inches and a minimum of 32.12 inches. Owing to the mountainous character of the Ste. Anne watershed and its higher altitude in the path of the easterly winds from the Gulf of St. Lawrence, more favorable conditions should exist for a higher precipitation, and this has been verified by records so far taken at Seven Falls.

Reconnaisance surveys of the watershed to date have established the location of storage reservoirs, whose capacities aggregate about seven billion cubic feet of storage available, which may be obtained at a reasonable cost.

Discharge records taken at Seven Falls since 1909 indicate a mean annual flow of 2.10 second feet per square mile of drainage area for this period, the maximum reaching as high as 35 second feet per square mile and the minimum 0.475 second feet per square mile.

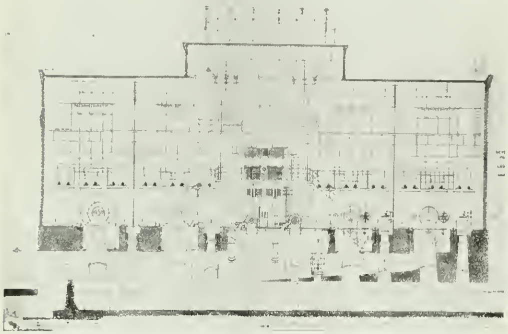
It is estimated that with the storage available, this stream may be regulated to give continousuly a discharge at Seven Falls of 450 second feet, which under the working head will produce 15,000 shaft horse power on a 100 per cent. load factor basis and 20,000 shaft horse power on a 75 per cent.


Down stream side Ambursen dam, showing penstock, bulkhead, log sluice and spillway.

load factor basis, the generating station having been designed accordingly.

Diversion and Regulating Dam

About nine miles from its outlet into the St. Lawrence, the Ste. Anne River has changed its course, forming an island between the old and the new channel, extending down stream about 3,500 feet, where the channels reunite. On the island thus formed is located the water conduit and generating station of the development. The new channel passing over a series of precipices through a gorge whose banks



Longitudinal section of generating station.

increase in height to the foot of the last falls, has formed seven distinct falls, the total difference in elevation between the water at the head of the upper falls and the foot of the lower falls being 364 feet at normal stage. This natural head has been increased at 425 feet by the erection above the upper falls of a reinforced concrete dam of the Ambursen type. The river at this point takes a sharp bend to the south before passing over the first falls, the channel being about 50 feet in width and the banks about 50 feet in height, the latter almost vertical and composed of Laurentian granite of irregular contour, offering a most suitable foundation for a dam. The main channel is spanned by the bulkhead section with buttresses spaced on 18-foot centres, raising the natural elevation of the river 61 feet and discharging it on higher rock to the south over a spillway section 150 feet in length, 85 feet of which is solid section where the height does not exceed 12 feet, the remaining 65 feet being standard Ambursen curtain section, with buttresses spaced to suit the irregular contour of the rock. The most economical layout was secured by an irregular plan, there being five angles along the centre line of the dam. The length along crest line from shore to shore is 561 feet, 395 feet of which is bulkhead section with a crest elevation 8 feet above the spillway. The buttresses of maximum section, located in the main channel, have a difference in elevation between the rock foundation and the crest of 75 feet. Four 36-inch Coffin sluice gates, located in the main channel 27 feet below the intake are provided for scouring out sand and for lowering the headrace for inspection of rack. and intake. Between the bulkhead and the spillway sections a log sluice has been provided with a clear opening of 20 feet, the crest being two feet below the spillway crest and having a full apron discharge with provision for closing by stop logs.

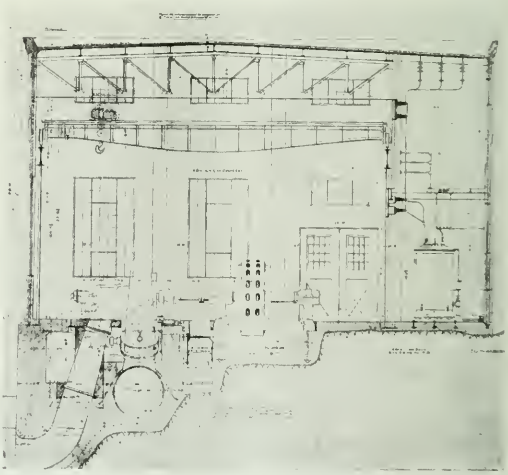
The dam impounds about thirty million cubic feet of regulating storage above the working elevation of the intake which may be increased to fifty million cubic feet by the erection of regulating sluices on the main spillway controlled by stop logs or gates.

The intake to the water conduit is located between two buttresses spaced on 18-foot centres, heavily reinforced and protected in front from floating debris and ice by a reinforced concrete apron, back of which are located the rack bars, 3 in. x 5/16 in. x 28 ft. 6 in. in length, spaced on 1¾-in centers. The floor of the intake chamber is 36 ft. 6 ins. below the crest of the spillway. The rack bars are set at an angle of 60 degrees and are completely submerged. They are supported on heavy I-beams set between the buttresses and rest on a deck slab extending above the water line, back of which is the raking platform with an ice chute for sluicing purposes during cleaning of the rack bars.

The head gates consist of two 4 ft. x 8 ft. Coffin standard cast iron sluice gates, bronze mounted throughout, having spigot ends and rising stems operated by ball bearing, variable power stands with provision for hand operation or motor control from the generating station switchboard. The intake is formed in the concrete and heavily reinforced, reducing from a rectangular section to a conical section terminating in a steel plate thimble riveted to the main penstock.

Water Conduit

Between the intake and the generating station, a distance of 3,098 feet measured along the conduit, the water is conducted by 1,677 feet of flow pipe terminating in a standpipe 16 feet in diameter and 79 feet in height and 1,421 feet of pressure penstock. Both the flow pipe and the pressure penstock have a minimum inside diameter of 8 feet, the courses being telescopic. When it reaches a point 100 feet from the station the pressure penstock is reduced in diameter to 7 feet, and on reaching the station it is continued by a steel plate distributor set in the concrete foundations of the station and supplying the spiral casings of the four main turbine units by steel plate nozzles. All plate used in the conduit is open hearth boiler flange quality. Those used in the flow pipe are 114 inches in width, ⅜ in. in thickness, two plates per course, double riveted longitudinal and girth seams, caulked on the outside only.



Transverse section of generating station.

From the intake the grade for the first 1,050 feet is 0.66 per cent., the remainder is set to a grade of 4.93 per cent. On leaving the intake the flow pipe turns an angle of 65 degrees on a radius of 200 feet and then crosses a gorge on structural steel trestle bents spaced 18 ft. 3¼ in. centres, varying in height from 15 to 40 feet, the distance between abutments being 200 feet. The pipe is supported at the centre of every alternate course by structural steel saddles set on concrete piers with an intervening steel plate to allow of movement of the saddle. Three expansion joints of the bellows type are used between the intake and standpipe.

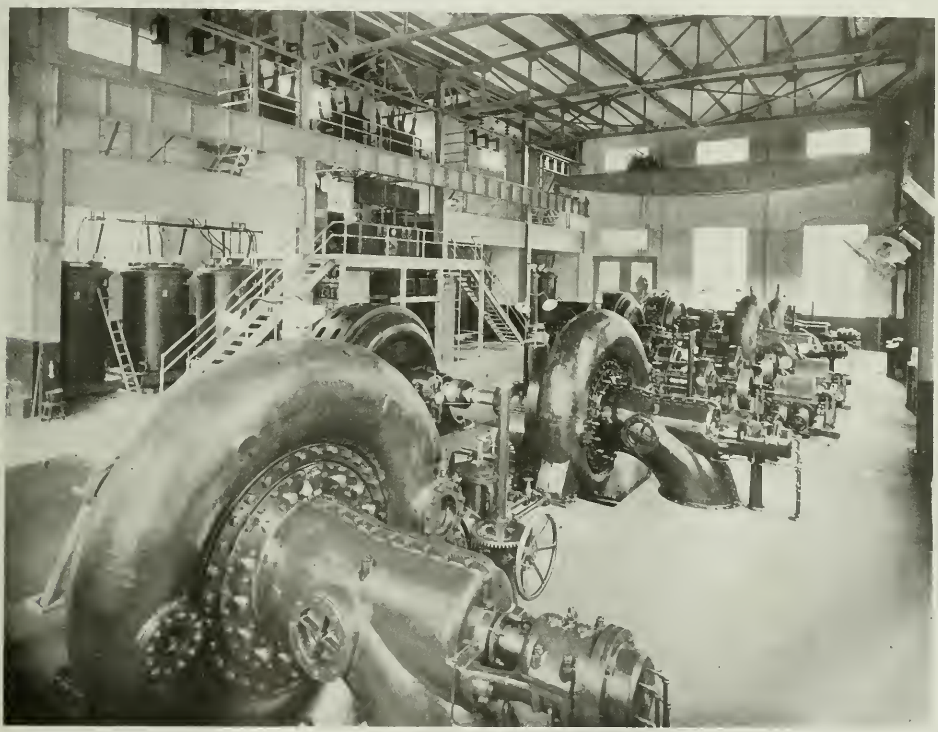
The pressure penstock varies in thickness from 3/8 in. to 13/16 in. Plate ½ in. in thickness and above is edge planed, rivet holes sub-punched and reamed, with triple riveted butt strap longitudinal seams and double riveted girth seams. The grade for the first 450 feet from the standpipe is 20.4 per cent., where it increases to 25 per cent. for a distance of 353 feet and continues at a grade of 41.7 per cent. for 436 feet, terminating in the reducing section from 8 ft. to 7 ft., and is continued horizontally through a curve of 74 ft. radius to the station. The foundation for this penstock being mostly sand and cemented gravel, particular care has been taken to carry down the concrete supporting piers to good foundation and to provide cut-off drains for carrying off the surface water. At all changes in grade heavy anchor piers have been placed, embedded in which are heavy anchor angles riveted to the penstock.

All plate before leaving the shops of the contractors was coated with linseed oil and after erection given three coats outside and two coats inside of special Detroit graphite penstock paint.

The completed conduit and standpipe are enclosed in a wooden housing covered with tar paper and sheet metal for protection from frost.

The station has a normal full load rating of 18,720 kv.a. generated by four units of 4,680 kv.a. each, with an overload rating of 25 per cent. for two hours. Three complete units are at present installed; the turbine for the fourth unit is in place, the generator and its bank of transformers to be installed later.

Each unit consists of a horizontal, 6,000 b.h.p. Allis-Chalmers (Milwaukee), single discharge, single Francis runner, set in a cast steel spiral casing, operating under a normal effective head of 410 feet at a speed of 630 r.p.m., connected by solid flanged coupling to a 4,680 kv.a., 6600 volt, 63 cycle, 3 phase, revolving field Canadian General Electric generator which is provided with a solid cast steel rotor, water cooled bearings and provision for ventilation by solid cast steel rings with fan blades in one piece securely bolted to the cast steel spider of the rotor. The total weight of the complete generator is 140,000 lbs., the weight of the revolving field and shaft being 60,000 lbs., giving a flywheel effect of 200,000 feet pounds without recourse to any auxiliary flywheel.



Interior generating station, Seven Falls, Quebec—Laurentian Power Company.

These machines have been given a runaway speed test of 1200 r.p.m. for one hour at the factory before shipment, and are guaranteed to withstand short circuit current for one minute at any load.

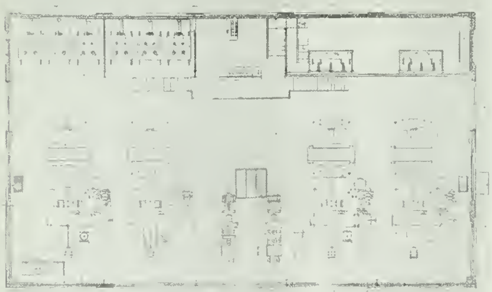
The generator voltage is raised to 50,000 volts by banks of three single phase, 1566 kv.a., oil insulated, water-cooled Canadian Westinghouse transformers delta connected on high and low tension sides.

Duplicate exciter sets, each of sufficient capacity for the excitation of the four main units, are installed, consisting of Canadian General Electric, 130 kw., 125 volt, 900 r.p.m. interpole generators, water wheel driven by Canadian Allis-Chalmers impulse wheels with provision for motor drive by 200 h.p. C. G. E. induction motors supplied from the 550 volt local service circuits. The exciters are arranged for operation with Tirrill regulators. No governors are used in connection with the impulse wheels, but provision is made for motor control of the needle nozzles from the switchboard, if required.

The above equipment, in conjunction with the duplicate, 24 mile, 50,000 volt transmission lines, is controlled by benchboard and auxiliary switchboard centrally located on a gallery above the main floor from which the operator has a clear view of all units. All high and low tension switches and control equipment was installed by the Canadian General Electric Company.

The Allis-Chalmers, Francis turbine runners are cast solid, of special runner bronze, having a mean diameter of 40 inches, the width of the inlet between the guide vanes being 5¾ ins., particular care being taken to insure uniform thickness and spacing of the vanes, the inlet and discharge edges being finished to template and all water passages given a smooth finish. The runners are ream-bolted to a steel flange forged solid with the open hearth steel shaft, carefully balanced and are designed to withstand the runaway speed due to full gate and no load on the generator. The axial thrust of the runner due to the single discharge is balanced hydraulically by opposing annular spaces provided on opposite sides of the runner and so arranged that any movement of the rotor axially causes the throttling of the flow through clearance spaces at one end and corresponding relief of the pressure at the opposite end, so that the rotor is returned automatically to its original position, a small thrust bearing being provided at the end of the shaft to limit the axial play during stopping and starting.

The spiral casings in which the runners are set, are cast in one piece of special cast steel, in the form of a true evolutionary spiral, with decreasing area in proportion to the discharge through the guide case. The sides of the casing are not bolted together as is the usual practice, but at the inner circumference tension members are provided cast integral with the speed ring, curved in section so as to conform to the flow lines and produce a minimum disturbance, absorbing the strains imposed by the internal water pressure.



Floor plan of generating station.

These casings have successfully withstood a hydrostatic pressure of 400 pounds per square inch, before leaving the shops of the manufacturers.

The bottom inlets to the turbines are controlled from the main floor by hand operated, 48-in. butterfly or wicket valves, designed to allow of closing under penstock pressure, having cast steel bodies and wickets with the shafts mounted in bronze bushed bearings.

Each turbine is provided with the latest type of Allis-Chalmers, oil operated governor especially adapted to heavy duty service under fluctuating loads and severe penstock conditions. The pressure is maintained by a belt-driven rotary pump, mounted in the cast iron housing of the governor, taking its suction from a separate receiving tank located under the floor near the governor and delivering the oil under air pressure to a separate steel plate pressure tank; the entire oil system being "open," so that neither vacuum or pressure can be formed in the receiving, tank circulating oil being in continuous contact with the air.

Control of penstock pressure, which is normally 172 lbs.

Switching tower. Right angle tower. Standard tower.

per square inch in the distributor, is maintained by Allis-Chalmers, governor operated, automatic, pressure regulators or relief valves. Each turbine has a by-pass outlet located close to the inlet of the casing which is connected to the main body of a 15-in. relief valve with separate discharge piping to the tailbay, capable of discharging 75 per cent. of the water required for full load operation of the turbine, and is guaranteed to control the rise in penstock pressure within 15 per cent. with full load thrown off the generator. These regulators may be operated through positive and substantial connections synchronously with the gates or the rate of discharge may be adjusted to suit the pipe line and operating conditions.

Auxiliary to the four relief valves connected to each of the turbine casings, a fifth regulator is connected to the penstock distributor of the same size and general construction, except that it is operated directly by pressure from the penstock and may be adjusted to discharge at a pre-determined pressure. It is estimated that in the event of all four units being in operation and the full load be dropped from all simultaneously, the pressure rise in the penstock will not exceed 30 per cent. with all pressures regulators adjusted and in operation.

The station building, 114 ft. x 66 ft. in plan, consists of rubble concrete substructure supporting structural steel columns which divide the station into five bays and support the roof trusses and runway for a thirty-ton crane, the walls acting simply as curtain walls reinforced for temperature strains only. The substructure, founded on rock over 90 per cent. of the area, the remainder being on hard pan, cemented gravel and small boulder stone, has imbedded in it the seven-foot diameter steel plate distributor supplying the main turbines through steel plate nozzles set at an angle of sixty degrees with the distributor and connected in the 48-in. butterfly valves controlling the bottom inlets to the main turbine casings set vertically above the distributor. Particular care has been taken in the design of these intake nozzles to reduce the loss in head from change in direction

Penstock crossing gorge on steel trestle.

of flow, sharp bends or obstructions to the path of the water to the scroll casings.

The upper sections of draft tubes and discharge piping from relief valves are made of steel plate, the lower sections being moulded in the concrete foundations, flaring as they approach their exits to the tailbay adjacent to the station, which is lined with a concrete measuring weir located near the down stream end of the building.

Inspection and ventilating tunnels are provided in the station foundations for examination of piping below the floor line and ventilation of main generators with air drawn from the exterior of the building.

Of the five bays dividing the station, four contain the main units with their corresponding bank of raising transformers, above which a gallery extends for the operating of the 50,000 volt disconnecting transformer switches, the roof of which supports the 50,000 bus-bars extending the full length of the station, supported on suspension insulators. The centre bay contains the exciter sets, floor space for dismantling a unit, back of which is located the 6600 volt bus bar structure and circuit breakers, the local service transformers and the main generator field rheostats. Above the main floor in this bay is the operating gallery containing the benchboard, exciter and local service switchboard, and the 6600 volt bus-bar tie switch, and on another gallery above the operating gallery is located the 50,000 volt line and bus tie circuit breakers, and on the roof directly above is housed the electrolitic lightning arresters directly in line with the transmission lines.

The station may be operated with two units on one transmission line as two separate stations, complete flexibility and interchange being provided in the switching equipment. During the past few months the plant has been operating in parallel with the existing plants of the Quebec Railway, Light, Heat & Power Company with entire satisfaction.

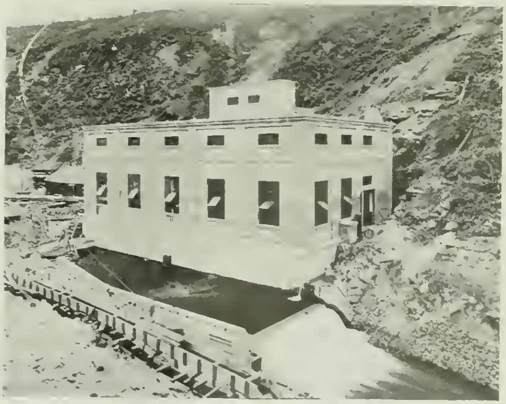
Transmission System

The two 50,000 volt lines from Seven Falls to Montmorency Falls, a distance of 21 miles, each have a capacity of 10,000 kw. The first five miles from the generating station is over a private right-of-way, 66 feet in width, the remaining 19 miles being along the right-of-way of the Quebec Railway, Light, Heat & Power Company, over which the Laurentian Company have been granted rights.

The three wires of each circuit are composed of No. 1/0, seven strand, hard drawn copper cable, the centre strand being soft drawn. The cables are arranged in a vertical plane on each side of the tower, supported on 66,000 volt pin type insulators. Above each circuit is a 3/8-in. galvanized stranded ground wire, supported on channel cross arms, similar to those used for the line conductors. The vertical spacing between all wires is 4 ft. 6 ins., and the horizontal spacing between circuits is 8 ft.

The type of standard tower or latticed steel pole used was designed and fabricated by the Canadian Bridge Company and consists of a straight shaft, 40 feet in height from the upper cross arm to the concrete footing, composed of four angles 3 in. x 3 in. x 3/16 in., 16 ft. long, set symmetrically on the corners of a square whose sides are 3 feet, spliced to 2¼ in. x 2¼ in. x ⅛ in. angles 26 feet in length. These angle legs are not tapered but the same distance apart for their full length and are latticed symmetrically on all sides by 1¼ in. x 1¼ in. x ⅛ in. angles secured by half inch bolts formed of 3 in. channels, carrying the two ground wires and the six main conductors. The footing in earth consists of 3 in. x 3 in. x 3/16 in. angles, 6 ft. 7 ins. long, securely braced together and bolted to the tower legs.

All material used throughout is open hearth steel, hot galvanized, except the footing, embedded in concrete. Standard towers are increased in length where required by the addition of extension sections of the required length, members being strengthened where required and footings spread at the base. The spacing on tangents for standard towers is 250 feet. Strain towers with footings spread 7 ft. 8 ins. along the line, are used every two miles. Each circuit is transposed three times in the total distance of 21 miles, the



Generating station, discharge side.

transposition being made on standard 40-foot towers, with special cross arms and extra heavy shafts. Two river crossings are encountered, requiring extra heavy 66-foot towers with spread footings, supporting copper clad steel cable in the place of line cable. The lines are sectionalized into three sections by special 50-foot switch towers, equipped with disconnecting switches manually operated from a platform 10 feet below the lowest conductors. At the junction of the private right-of-way with the Q. R. L. & P. Co. right-of-way a right angle in the line is turned on a special heavy 40-foot tower with spread footings, no anchor guys or lateral bracing being used.

All structural steel footings in earth are encased in concrete, the footing being set in place on completion of excavation and removable forms used to provide a six-inch wall of concrete surrounding the four legs, leaving an annular square space 2 ft. 6 ins. in the centre, which is back filled and tamped to within 6 inches of the top, the whole being capped with about six inches of concrete sloping to the outside edges. All connections between tower legs and footings and where the steel emerges from the concrete are given a coat of thick paint for protection from corrosion.

Personnel

The Ambursen Hydraulic Construction Company of Canada were contractors for the main dam and headworks, having Mr. A. G. Gardner as Superintendent of Construction. The Walsh Plate & Structural Works were contractors for the penstock, fabricating the material at their Drummondville, Que., shops. Mr. E. A. Wallberg, C. E., Toronto, was contractor for the generating station and transmission line, having Mr. J. R. Nichols as Superintendent of Construction. Mr. James Ruddick is Engineer and Manager for the Laurentian Power Company, with Mr. E. R. Shirley in charge of the operation of the station as Superintendent.

We are indebted to Mr. A. R. Henry, M. E., consulting engineer, Montreal, for the above description of this development, under whose supervision the surveys, plans and specifications were carried out. During construction Mr. Henry has been represented by Mr. C. H. Hollingsworth, C. E., and Mr. J. R. Montague, B.Sc., as resident engineers at the site.

Power Development in Saskatchewan

By E. Hanson, A. A. I. E. E., M. I. Mun. E.*

The City Council of Saskatoon passed a resolution some time ago urging the Provincial Government to take steps to investigate the Churchill River, with a view to the development of electrical energy for distribution throughout the province of Saskatchewan. This resolution brings up again the question of water power development and distribution throughout the province on a basis similar to that on which it is carried out by the Hydro-Electric Power Commission of the Province of Ontario. Even if it is found possible to obtain power from the Churchill River, such an investigation, to be of any permanent service to the province as a whole, must include data as to the stream flow, storage possibilities, etc., covering a period of, at least, ten years. In the meantime this country is passing through a period in its history when help of any description is urgently required, and will permanently affect the prosperity of the province.

The situation in Saskatchewan, as I see it, is this: The trend of colonization is westward; our railways are situated in the southern half of the province; the distance from our markets, both for buying and selling, is very great; no other means of transportation being possible but by rail, freight rates are naturally high; in many cases prohibitive. Labor, owing to the relatively high cost of living, is also expensive; therefore, to encourage the development of our province and the establishment of industries, there remain only two solutions to the problem of decreasing the cost. Of these two navigation and cheap power,—I shall deal only with cheap power.

There does not seem to be a clear understanding in the minds of many people as to the limitations of water power, and the difference between, say, this province, and the province of Ontario, which is a typical example.

In Ontario, the manufacturing centres are situated at, or very close to, the centres of power development, thus making possible, the distribution of power on a large scale for industrial and municipal purposes; whereas, the nearest possible source of water power development in Saskatchewan, is situated on the Churchill River, 161 miles north of Prince Albert, which is the nearest city. These 161 miles pass through virgin territory, having almost entirely no settlers. This, apart from any other consideration, would mean expensive development, owing to the distance of transmission away from the nearest railroad point. The distance from the source of power to the various centres from which power would be distributed, is so great that for economical purposes a very high transmission voltage would be necessary. This introduces insulation trouble and other troubles peculiar to extra high tension voltage.

* Before the Utilities Engineering Society, Saskatoon.

The object of water power development on a large scale in any province is to foster industries. Now, the chief industrial centres of Saskatchewan are Regina, Saskatoon, Moose Jaw, North Battleford, Prince Albert and Yorkton. The distances between these points are as follows:—

Moose Jaw is 42 miles west of Regina.

Regina is 160 miles south of Saskatoon.

Yorkton is 103 miles northeast of Regina.

Prince Albert is 87 miles north of Saskatoon.

Battleford is 80 miles west of Saskatoon.

Prince Albert is 161 miles from the nearest point on the Churchill River.

A total of 633 miles of transmission line.

These distances are taken "as the crow flies," therefore the estimates which follow are only approximate.

The estimated average cost for the aforementioned extra high tension, say 150,000 volts, and of sufficient capacity, would be about $10,000 per mile. This, I think, is a very fair estimate, as it must be remembered that 161 miles are entirely out of touch with any railway facilities, so that haulage and labor on that end would be extremely high. The mileage, at $10,000 per mile, would make a total expenditure of $6,330,000, which, at 10 per cent. for interest and sinking fund, would leave $633,000 as an annual charge against revenue, to be borne directly by the above mentioned cities in proportion to their average maximum demand, which would be as under:

Saskatoon	2,500 kw.
Regina	2,500 kw.
Moose Jaw	1,250 kw.
Yorkton	150 kw.
North Battleford	450 kw.

Saskatchewan's Cost

The Department of Mines at Ottawa has issued a map showing the coal fields of Saskatchewan. The investigation from which this map has been developed shows that we have vast fields of lignite in this province, and, with very few exceptions, these have never been developed to any extent. One of these lignite fields extends from the international boundary, passing Moose Jaw within fourteen miles, and within thirty miles of Regina. Another field of Belly River coal formation extends from the international boundary in Alberta, going north from Lethbridge and Medicine Hat, crossing our provincial boundary and extending north to within thirty-five miles of Battleford. The eastern edge of this field is within fifty miles of Saskatoon. I might mention in passing that this field is the same as that from which we get the coal which we have been burning with very satisfactory results in our power house for the last two years. It is supplied from Lethbridge.

It is estimated that there are billions of tons of this lignite lying untouched and undeveloped.

Mr. S. M. Darling, in his report on the carbonizing and briquetting of lignite, covering an investigation carried out by him for the Government of Saskatchewan during 1914, on the Souris River coal field in the vicinity of Estevan, states that power can be produced for $8.00 per horse power year (at the switchboard). I have gone into this report thoroughly, and have no doubt but that such is the case, and find that, besides making possible the generation and distribution of cheap power, it solves the problem of cheap heating for out of town dwellers, as it could be sold for about $2.25 per ton in any part of the province.

Mr. Darling also points out that in the development of this power, the straw which is produced in this province from our agricultural activities, and which is at present wasted by being burned, would, with cheap power available, form the basis of a paper industry. In addition all this, there are the by-products from the tar and ammonia compounds. The very fact of the numerous industries which the development of this lignite in Saskatchewan would make possible, seems to me an unanswerable argument in favor of the development of these fields as quickly as possible.

I will endeavor to show that the development of these lignite fields, with the necessary transmission lines, making a network throughout the province, covering the greatest part of its settled portion, will be very much cheaper in the initial cost; also very much cheaper in the cost per kilowatt, at least for a great many years to come, until such time as the province has been developed to the stage where development of water power from the north can be tied in with the ten existing transmission lines. Meantime, while developing our resources, producing power at least equal in price to Niagara power, and fostering the industries which are already in the province, the development of these fields will, in each and every one of its various steps, tend towards the grand programme of the development of this province.

This development also, owing to the fact that its transmission lines will run mostly north and south, will have a tendency to settle the country along the lines which are for the ultimate good of the province, in a way that will cheapen freight rates and shorten hauls, viz., from the south, northward.

In dealing with a power development scheme, when the towns to be supplied have already their own power house, the greatest drawback is the enormous capital charges, which, in every case, have to be met, and, of course, added to the cost of power, in order to determine the cost to the consumer. The following figures are based on 1915 reports of the various cities mentioned, and, as is the case in Saskatoon, the output for 1916 will, we hope, be larger than for 1915, thereby reducing these charges. For estimating purposes, however, we can only take reports for the period immediately preceding the estimate.

The capital charges, on this basis, would be as follows:

	Capital Charged per kw.h.
Saskatoon	1.31c.
Regina	1.60c.
Moose Jaw	1.93c.
North Battleford	1.99c.
Yorkton	4.34c.

Assuming that we are charged on the basis of maximum demand per month, I have arrived at what I consider the average maximum demand for a year, which will give us the cost for power per annum, bought in bulk. These figures are arrived at by assuming a maximum price of $8.00 per horse power per annum at the switchboard, and the total cost works out, taking the 1915 output, as follows:—

	Total Cost	Cost per Kw.h.
Saskatoon	$26,800	.3523c.
Regina	26,800	.3640c.
Moose Jaw	13,400	.4200c.
North Battleford	4,824	.6030c.
Yorkton	1,608	.4541c.

The total capital expenditure on the transmission line, at $10,000 per mile per annum would be, approximately, $6,300,000, and, as I have allowed $8.00 per horse power year, we do not require to take into consideration any capital charges on power development, as this, of course, is included in the current rate. Assuming 10 per cent. overhead charges on line, which would include capital charges and maintenance of line, this would equal 3.26c. per kw.h. on the metered output of the above mentioned cities, and would give us total charges as follows:—

	Saskatoon	Regina	Moose Jaw	N. Battleford	Yorkton
Capital	1.31c	1.6c	1.93c	1.99c	4.34c
Max. demand	.3523c	.364c	.42c	.603c	.4541c
Line charges	3.26c	3.26c	3.26c	3.26c	3.26c
Line losses	0352c	.0364c	.042c	.0603c	.0454c
Distribution	.15c	.15c	.2c	.4c	.6c
Total cost	5.1075c	5.4004c	5.852c	6.3133c	8.6995c

Against the above, the cost, if produced by the development of the lignite fields, would be as follows:—

	Saskatoon	Regina	Moose Jaw	N. Battleford	Yorkton
Capital	1.31c	1.6c	1.93c	1.99c	4.34c
Max. demand	.3523c	.364c	42c	603c	.4541c
Line charges	1.627c	1 627c	1.627c	1.627c	1.627c
Line losses	.0352c	.0364c	.042c	.0603c	.0454c
Distribution	.15c	.15c	.2c	4c	.6c
	3.4745c	3.7774c	4.219c	4.6803c	7.0065c

In this case I have assumed the cost of the transmission line to be $8,000 per mile, owing to the fact of the very much shorter distance, and the proximity to railway facilities, as well as the fact that a lower transmission voltage would be economically possible, thereby reducing the cost.

The total cost per kw.h. metered at these various places last year was as follows:—

Saskatoon	Regina	Moose Jaw	N. Battleford	Yorkton
3.51c	3.31c	4 72c		9.11c

Now, even with these results, the proposition does not, on the face of it, seem to be a very profitable one for the cities. If you will look at the map, however, you will see that the transmission line will run through settled country, and that a lower voltage would be possible, thereby enabling us to supply, cheaply, every municipality along the line of transmission. The railway companies, too, glad of an opportunity to cheapen the cost, especially in handling their peak load, which is during the grain rush, by electrifying their systems, would create a demand which would still further reduce the cost per kw.h. I would advocate that in all districts adjoining the main transmission line, every municipality be approached, and an agreement made with them, whereby they would take a certain block of power to be distributed among the farmers.

Now the question of the farmer taking power is no small one, and, while in this country we are not accustomed to associating the farmer with the consumption of electricty yet, that this is a fact is shown wherever the transmission line runs through a farming district, as, for instance, in Ontario, Colorado, Ohio, and numerous other sections of the United States; but these few will suffice as examples. At a meeting of the engineers of Seattle recently, Mr. C H. Williams surprised most of his hearers when he told them that the electric companies of Colorado were doing a large business with the farmers.

In Miami Valley, Ohio, motors have been used successfully for threshing, plowing, and treating the soil in other ways. Some of the uses to which the farmer can put electricity are as follows:—cutting and grinding feed, sawing wood, pumping water for the house and barn, as well as for irrigation purposes; churning and separating cream, pressing hay, milking cows, clipping horses, as well as for a hundred and one household purposes such as it is used for in the city.

In furnishing light, which, in conjunction with the new system of flood lighting, electricity can help to save the farmer's crop, as, in my short experience, I have heard of many cases of the difficulty in getting the grain cut and threshed before the autumn frosts set in. Assuming the farmer to have a power service, there is little trouble or work involved in connecting up one, two, or any number of flood lighting projectors which would enable him to work far into the night, and thus save time against the coming of the frost.

Regarding the lighting of the home, there is no one but who will concede that the evening in the home would be brighter, and probably devoted to higher thinking; this, in turn, would reflect on the children, making for brighter, happier and better educated rural populatio,n which is one of the crying necessities of this province. With the many conveniences which electricity affords, farm life would be made much more attractive, and would hold out more inducements to settlers than it does at present.

I think that, in view of the many uses and labor-saving devices to which electricity can be applied, a small estimate of the amount of power which each farmer would require, would be about 10 h.p. This coming off the line at, say, every second municipality, a distance of about 15 or 20 miles, would materially lighten the overhead cost on the transmission system, and assuming that this load, even lightened the capital charges to the extent of fifty per cent., would give figures as follows:—

Saskatoon	Regina	Moose Jaw	N. Battleford	Yorkton
2.6610c	2.9639c	3.4055c	3.8668c	6.253c

Besides this reduction, and the greater assurance of continuity of service made possible by the shorter transmission line, the cities which have steam plants at present in operation would be in a position to develop a system of steam heating from the central station, which would again materially lessen the capital charges per kw.h., without affecting the stand-by value. The aforementioned possible railway traction load ,also, would be quite a factor in reducing the cost per unit.

In conclusion, I can only say that, in the light of the number of advantages which the development of these lignite fields would make possible, and the number of industries which would be brought into the province, as well as the unlimited possibilities which the advent of electricity to the rural districts would open up, I consider that no further argument is required in favor of the development of our lignite fields, and conclusively points out the duty of every engineer to forward this movement to the best of his ability.

The Great Lakes Power Company, Sault Ste. Marie, Ont., have closed a contract with the Canadian Westinghouse Company for the extension of their power house as follows: Twenty 650 kv.a., 25 cycle vertical generators, 136 r.p.m., with Kingsbury thrust bearings; four 650 kv.a., 60 cycle vertical generators, one 38 r.p.m., with Kingsbury bearings, and one 660 h.p. motor generator exciter set complete with bench-board, switching equipment, circuit-breakers, etc. All this equipment will be built in Hamilton.

Personals

Mr. P. R. Farrow, superintendent of the Kaministiquia Power Company, Kakabeka Falls, has been elected to membership in the American Electrochemical Society.

Mr. M. M. Inglis, manager public utilities, including telephones, light and street railway, at Port Arthur, Ont., has resigned. Mr. W. P. Cooke has been appointed acting manager.

Mr. Gilbert Preece, of the firm of Wales and Preece, electrical contractors, Toronto, who is at present on active service at the front, has been wounded. He holds the rank of bombardier in the British army.

Mr. L. S. Montgomery, district manager in charge of the Buffalo office of the National Metal Molding Company, Pittsburgh, and Apollo in the Eleventh Jovian Congress, is on the Mexican border with Troop I, First Cavalry, N.Y.N.G.

Mr. H. M. Ashman, formerly of the electrical distribution department of the Montreal Light, Heat and Power Company, has been appointed electrical superintendent of the St. Lawrence Brick Company's plant, Laprairie, P. Q.

Mr. W. C. Williams has recently been appointed as manager of the Cincinnati branch office of the Robbins and Myers Company, Springfield, Ohio. Mr. G. H. Liebel, the former manager of this office, resigned to devote his time to the Liebel Manufacturing Company of Cincinnati, of which he is now president and general manager.

Lieut. Alex. Wilson, of the 244th Battalion, C.E.F., has been presented with an automatic Colt revolver, suitably inscribed, by the electrical distribution department of the Montreal Light, Heat and Power Company, of which he was head, prior to joining the colors. The presentation was made by Mr. Kenyon, assistant engineer of the department.

Mr. MacAllister Moore, well-known throughout Canada as representative of the Simplex Electric Heating Company, has resigned that position and joined the sales force of the National Electric Utilities Corporation, New York, manufacturers of electric cooking and heating appliances. Mr. Moore expects to cover the Canadian territory on occasion and look up his old friends.

Mr. D. A. Valleau, for many years superintendent of the Oshawa Electric Railway System, has resigned. Before leaving he was the recipient of many sincere expressions of appreciation and regret by the men who had worked with him. Among other pleasing incidents was a presentation and address by the mechanical staff of the company, and another by the office and yard staff.

Mr. J. J. Callaghan succeeds Mr. Valleau as superintendent of the Oshawa Electric Railway Company. Mr. Callaghan was formerly with the Montreal Tramways as chief inspector, and later was superintendent of the Montreal and Southern Counties Railway system. For a time also he was operating superintendent of the London and Port Stanley Railway system after its electrification by the Hydro-electric Power Commission of Ontario.

New Books

Principles of Electrical Design—by Alfred Still, Professor of Electrical Design, Perdue University, F.A.I.E.E., M.I.E.E., etc. The McGraw-Hill Book Company, Inc., New York, publishers. Price, $3.00 net. This book is intended mainly for the use of students following courses in electrical engineering, special emphasis being laid on fundamentals and principles of general application. Contains 360 pages, size 6 in. x 9 in.; well illustrated; bound in publisher's standard dark green cloth.

The Dealer and Contractor

Oil-Type Fuse Cut-Outs in a Western City

One of the problems which has been the cause of much study by electrical distribution engineers is the providing of an effective means for handling short circuits and overloads through fuses.

The most important duty that a fuse is called upon to perform is to open the circuit quickly in case of short circuits, extreme overloads, etc., for if an arc is formed and the circuit is opened slowly the cumulative effect of the disturbance, to the lines and apparatus, is very great and sometimes disastrous.

Realizing the effect that efficient protective apparatus would have in the way of reducing interruptions to service and consequent loss to the consumer, the Electric Light Department of the city of Calgary in 1913 made a very careful investigation into the merits of a number of the fuses then on the market, with the view of obtaining a fuse and cut-out that the city could standardize for use on its electrical distribution system where heavy or important loads were to be controlled and protected.

Their investigation showed that of the fuses tested, the D & W oil type most completely filled their requirements, and further, its cost was such as to permit of its use on comparatively small installations. This fuse was subjected to a number of tests under normally exacting conditions, which

Fig. 1 - Fuse cut-outs protecting pole type transformers.

tests were carried out close to the generator station and on a load of low power factor. Its operation proved entirely satisfactory. The illustration, Fig. 1, shows an installation of the pole type cut-out protecting a bank of three 50 kv.a transformers, and Fig. 2 shows the subway type fuse protecting four 75 kv.a. transformers for light and power in one of the underground manholes.

The pole type cut-outs are made in capacities of 50, 100 and 200 amperes at 2,500 volts. They consist of an oil container and fuse carrier or plug; the oil container is provided with a plug outlet at the bottom to permit of the drawing off and changing of the oil when necessary, which under normal conditions should be every two or three years. The fuse carrier is so designed that when in position the

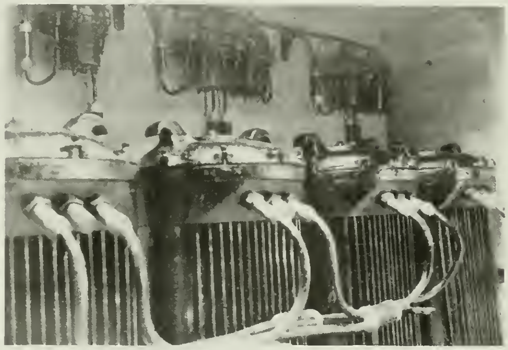


Fig. 2 - Subway type fuse protectors.

fuse proper is under a heavy body of oil. On the blowing of the fuse, the terminals are so arranged that they are forcibly thrown apart and the oil interposed between them, very effectually preventing the formation of an arc. The design also renders re-fusing safe for the operator. The fuse can be inserted when the line is short circuited without danger, as the whole device is effectually locked against blowing out of the fuse carrier or oil. This is effected by automatic locking of the cover before contact is made with the fuse terminals. Care must be taken to use an oil with characteristics suited to local climatic conditions.

The subway type is identical in the essential principles with the pole type, only such modification being made in the design as to adapt it to the different class of service, the principal differences being the substitution of a lead gasket for the compressible gasket employed in the pole type; also, different provisions are made for venting the cut-out and protecting it against the possibility of water entering through the vent openings, and the providing of lead-covered cable terminals to insure a moisture-proof joint and to facilitate its connection with the underground cable system. The method of fastening the fuse carrier to the oil container is somewhat different, in that it is equipped with a "V" shaped ring on which the lead gasket rests. A swivelling yoke is connected to the top of the oil container and is equipped at its centre with a powerful compression screw and lock nut, which provides a very efficient and effective means of making a water and oil tight joint at the point where the cut-out and fuse carrier connect.

Standard Interior Wiring Methods

The second of a series of three comprehensive articles outlining the latest approved practices as required by the Code and as developed by the best workmen

By Terrell Croft

Either screws or nails may be used for fastening knobs or cleats. At one time it was considered best practice to fasten all knobs and cleats with screws, but it was then found that a great many knobs and cleats were broken, due to the screws being set up too tightly. Frequently the breakages would occur some time after the screws had been driven, due possibly to expansion or contraction caused by heat, or to the swelling or warping of the wood. Such breakages have occurred within walls and partitions after the completion of the plastering. The wire originally confined by the knob was then permitted to sag uninsulated against the wood and plaster and thereby constituted a fire risk. If nails are used for supporting the knobs or cleats, with a leather

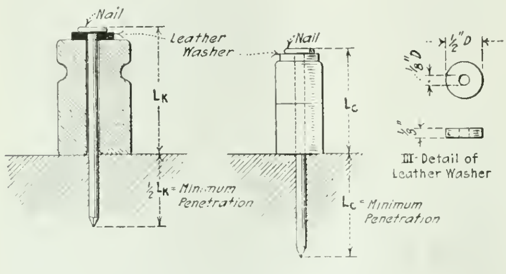


Fig. 10—Showing application of nails for securing cleats.

washer between the nail head and the porcelain, as shown in Fig. 10, the breakage of porcelain is, so experience has shown, much decreased.

Furthermore, the tendency of the average wireman is, if screws are used, to drive them in with a hammer so that they then provide little more holding power than do nails. There are, however, certain conditions which necessitate the use of screws for supporting knobs or cleats. For example, if a knob or cleat is to be fastened to a relatively thin piece of wood, a nail will not hold it securely, nor will a nail, under these conditions, have a hold in the wood equal to half the

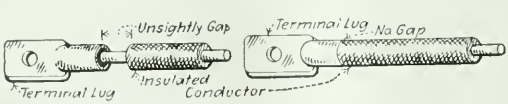


Fig. 11 Incorrect and correct methods of soldering lugs on conductors.

length of the knob, or equal to the thickness of the cleat, as it should have to satisfy the Code requirements. Fig. 10, I., indicates the minimum permissible penetration for a nail holding a solid knob. In II. the minimum permissible penetration for a nail supporting a cleat is shown.

Leather washers are used to prevent injury to knobs or cleats. The washers lie, after the nails are driven, between the nail head and the porcelain. At Fig. 10, III., are indicated the approximate dimensions of leather washers, or as they are sometimes called, leatherheads, ordinarily used in interior-wiring construction. The outside diameter and the diameter of the hole are always approximately those shown in the illustration, but the thicknesses of the washers vary over a wide range because they are punched from scrap leather. Where the leather is thin, two or more washers may be packed together on one nail to form a suitable cushion. The thickness of such a leather cushion under a nail head should never be less than 1/8 inch.

The splicing of wires for inside work is effected in accordance with practically the same methods as are used for

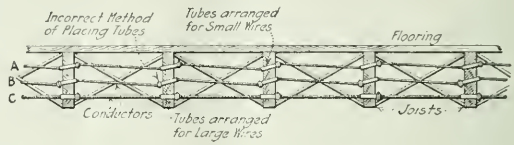


Fig. 12—Methods of placing tubes in Joists.

splicing outside conductors and as specified in National Code rule 12c.

The ends of stranded wire should be soldered into a solid bundle before being fastened under binding screws or clamps. When the unsoldered end of a stranded conductor is placed in a terminal clamp and the screw is turned down, the small component conductors spread out and render difficult the provision of an attachment that is mechanically secure and that has good electrical conductivity. On the other hand, if the strands are all soldered into a compact bundle, the clamp will grip it fairly and firmly. Practically the same difficulty occurs if an endeavor is made to fasten the unsoldered end of stranded wire under a binding screw. The binding screw, when it is set down, will force the unsoldered ends apart and may "bite" into some of the small component conductors. Furthermore, it frequently occurs that where all of the strands of a conductor are not soldered together prior to being placed under a clamp or set screw that one or two of the strands may be forced to carry all the current and may thereby become dangerously overheated

Wires larger than No. 8 should always be soldered into lugs at terminal connections, because this is the only method which provides a substantial connection. It is difficult to bend wires larger than No. 8 around binding screws, and in bending them the binding screws may be strained. In setting a binding screw down on a heavy conductor that is bent around it, its threads, or the threads of the metal into which it turns, are often sheared. These difficulties are not likely to occur when terminal connections are made with lugs soldered on the ends of the wires. In soldering a lug on a wire, the installation at the wire-end should be trimmed back for a distance not greater than the depth of the hole in the lug. It will then, when soldered into the lug, appear as shown in Fig. 11, II. If the insulation is trimmed back

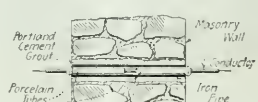


Fig. 13—Masonry wall bushed with iron pipe, porcelain tubes providing insulation.

too far there will be an unsightly gap, exposing a section of the conductor between the insulation on the conductor and the end of the terminal lug, as shown at I.

Wires passing through floors, timbers, or partitions, should be insulated therefrom with porcelain tubes, as shown in Figs. 12, 13, 15 and 16. Any substance other than an insulating material, such as porcelain or glass, through which a conductor passes, must be considered as a possible conductor. For example, wood, when moist or wet, becomes a fairly good conductor, as do masonry and most other building materials. It is for these reasons that holes should be bushed with a non-conductor. Porcelain bushings are used because—all things considered—this is the most adaptable insulating material. If thorough insulation is not provided there is always a possibility of current "leaking" from a conductor through damp woodwork or masonry to another conductor of opposite polarity, which may or may not be grounded. Such current leakages have been known to cause fires and to "eat" the conductor in two, due to electrolytic action. A conductor thus broken and upon which voltage is impressed may, obviously, originate a fire.

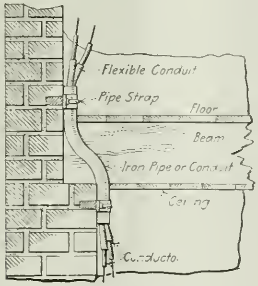


Fig. 14—Conductors passing through floor protected by iron pipe.

Insulating tubes should always extend from a distance of ½ to ¾ inch on both sides beyond the member that they bush. Furthermore, they should not extend much farther than ¾ inch because of the liability to breakage where the extension is too great.

The methods of bushing conductor holes in joists with porcelain tubes are shown in Fig. 12. Where the conductor is of small diameter it is usually considered preferable to bore holes for the tubes on a slant, as shown on runs A and B in Fig. 12. Where this is done, the tubes should be inserted with the enlarged end at the upper outlet of the hole so that the enlargement will prevent the tube from slipping through the hole. The tubes should not be inserted, as shown in run B, with the enlarged ends at the lower openings of the holes because then their tendency is to fall out. When the tubes are inserted in run A and the conductor through them is drawn taut, the bushings are held very firmly in position.

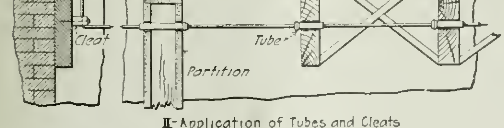


Fig. 15—Illustrating the use of porcelain tubes and cleats for insulation.

However, it is the usual practice with wiremen in working in buildings under construction to bore the holes through joists at right angles to the faces of the joists, as shown in Fig. 12, C, because where this is done it is somewhat easier to insert the tubes and to thread the wire through them. Holes can also, where modern joist-boring machines are used, be bored more readily at right angles to the faces of the joists than on a slant. In boring holes in joists in finished buildings which are being wired, the holes are ordinarily bored on a slant because then the wireman works from the floor above the space between the joists and it is then easier to bore holes on a slant than perpendicular to the face of the joist. Where the conductor is of large diameter the tube holes and tubes should be in line with each other and perpendicular to the joist faces, because if they are not it is difficult to thread the conductor through them. Furthermore, after it is threaded through, if the tubes are not in line and a strain is imposed on the conductor, some of them will be broken. Fig. 15 shows how a porcelain floor tube, especially designed for the purpose, is applied. Where conductors pass through the floor, as shown, boxing should be installed around them.

Bushings must be continuous through the entire length of a hole. This requirement is specified where one continuous porcelain tube extends through a hole, as through the partition in Fig. 15, or through the joist in Fig. 12. Where it is not feasible to bush the hole with one continuous length of porcelain, the hole may be first bushed with a "waterproof" (a piece of iron pipe) tube and this tube rebushed with porcelain, as shown in Figs. 13 and 16, II. Where it is impossible to use a straight length of pipe, rebushed with porcelain, it is permissible to bend the pipe as shown in Fig. 14, and insulate the conductors which pass through it with flexible conduit, provided the location is dry. Where a wall is so thick that two tubes of the lengths available are not sufficient to bush the pipe through it, as shown in Fig. 13, then a third piece of flexible tubing can be inserted in the space between the two tubes.

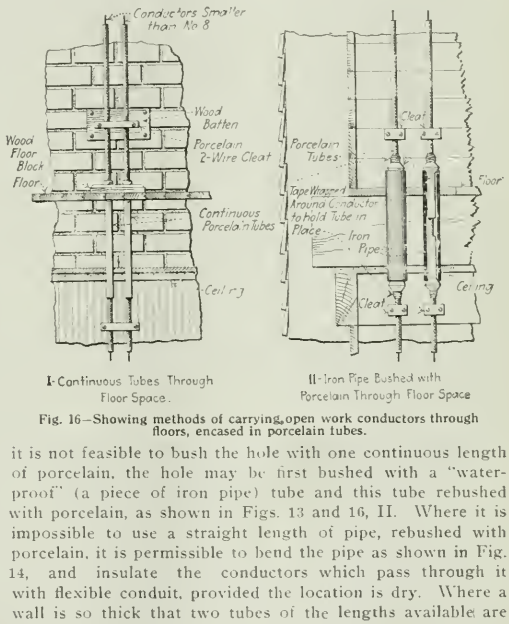


Fig. 16—Showing methods of carrying open work conductors through floors, encased in porcelain tubes.

(To be continued.)

Owing to the increasing demand for power, due largely to the activity in the munition factories, the city of Sherbrooke has decided to improve the city plant. The present rock-filled crib dam on the Magog River will be replaced by a concrete structure, 225 feet long, 49 ft. high, 8 ft. wide at the top and 34 ft. at the base. There is to be a sluice gate and six stop-log openings. Three twin central discharge turbines of 1,400 h.p. each will replace the present turbines, together with three new generators each of 1,000 kv.a. rating, with the necessary additions to the switchboard equipment. Mr. T. Tremblay is the city engineer, with Mr. M. A. Sammett, of Montreal, as consulting engineer.

Adv. Suggestions for Elec. Contractors

Four more of a series worked out by the Society for Electrical Development. Each individual contractor may think it wise to change the wording slightly to suit his own case. Educating the public to distinguish good work from bad

Why *you* are the loser when electrical prices are too low

Forgetting or disregarding "overhead" expense is one of the reasons for price cutting by inexperienced electrical contractors. Every contractor worthy of the name and of your patronage must have expenses such as rent, light, wear and tear on tools and equipment and many other incidental expenses.

A certain proportion of this expense must be charged to every piece of work which a contractor undertakes—that is, if the contractor is to make a fair profit and continue in business.

If this "overhead" is not considered one of two things must happen. Either the contractor must "take it out of the job," skimp on the material or workmanship, or lose money and eventually fail. Needless to say, the first expedient will be attempted—to **your** loss.

Ordinary business judgment will tell you to patronize a contractor who has had enough experience to know how to estimate a job correctly.

(Names and Addresses of Contractors)

Quality in electrical material can not be too high

There are few places where quality counts for so much as in electrical work. The failure of a tiny spring in a wall switch may throw your entire lighting system out of order. But the better manufacturers realize the importance of quality and as a result their electrical material is built to last and **does** last.

The better class of electrical contractors, realizing that their reputations hand on the material which they use find it pays to buy only the best.

But of course there are cheaper grades to be had because there are short-sighted contractors to buy this cheaper material. It goes into the "cheap" jobs, too.

And sometimes it's pretty hard to tell the difference at **first**. But time is a great seeker-out of poor material and poor workmanship.

After all, there is little argument, is there? If you want **good** electrical work and **good** material you will go to a reliable, established contractor.

(Names and Addresses of Contractors)

Price-cutting must often mean poor workmanship

A good workman is worthy of his hire. An electrician is generally paid what he earns. Some earn $1.50 a day, some $6.00. Their work shows plainly why there is a difference in their pay.

Then, too, a $6.00 man may do $1.50 work if hurried too much.

If an inexperienced contractor figures his labor cost too low—as is often the case—he has one of two alternatives: He may employ cheap workmen or he may attempt to rush good workmen. In either case the work must suffer. **You** are the loser.

Again we say, employ an established and reliable electrical contractor, one who understands from long experience how to estimate costs of labor and material. He will save you money in the end.

(Names and Addresses of Contractors)

"Sorry, sir, but we can't go ahead until the electrician is through"

How annoying it is to have the completion of your electrical work unnecessarily delayed! Other contractors are held back—plans are all disarranged.

The annoyance is doubled if there is no real reason for the wait. Very often an inexperienced and financially irresponsible contractor will start a job without having sufficient capital or credit to carry it through. **You** suffer the delay and perhaps even a financial loss. As a last resort you may be only too glad to advance sufficient cash to finish the job.

A reliable electrical contractor, one who has sufficient working capital and credit, will save you not only time and annoyance, but money too, in the end.

(Names and Addresses of Contractors)

Electrical Work—St. Denis Theatre, St. Denis St., Montreal, P.Q.

The St. Denis Theatre, one of the largest and most magnificent theatres in Montreal, is especially fine and unique for its complete and up-to-date electrical equipment. It has certain electrical features in lighting and the control of same, that no other theatre in Canada had before this theatre was built. These features will be described in more detail hereafter.

There are four distinct and separate services for this theatre, namely—two 110/220-volt a.c. services, one for general lighting and the other for emergency lighting; a 550-volt, 3-phase a.c. service for power and a 220-volt d.c. service for the arc lamps on the stage and for the arc lamps in the moving picture machines.

One of the 110/220-volt services feeds the box office panel, which is divided into two sections; one section for general lighting and the other for emergency lighting. The general lighting comprises the lights in the lobby, manager's office, corridors, mezzanine floor, step lights on the balcony floor, etc. The emergency section is fed by both 110/220-volt services. This is accomplished by a double throw switch on the panel. The emergency lights are those lights which must be kept lit during a performance, namely—some of the lights in the lobby, all exit lights, corridor lights and the lights in those places to which the public have access.

The above mentioned step lights are very small incandescent lamps under each step leading down to the front of the balcony and behind a glass door, set in each stair riser. They are all kept lit during a performance and thus, a person can see his way about without tripping, although the entire theatre is in darkness; the step lights being so arranged that practically no light is reflected upwards.

The 550-volt, 3-phase a.c. service feeds all the motors in the theatre, among which is the 10-h.p. motor of the motor generator set, located in the space above the moving picture booth. The generator delivers d.c. current to the picture booth panel at a potential of 70 volts. On the panel are two double throw switches, at one end of which enters the current from the 250-volt d.c service; at the other end the 70-volt d.c. current from the above mentioned generator. One of these switches throws either of these currents on the stage switchboard and from there to receptacles in the floor of the stage. These receptacles are for portable arc lamps. The other switch throws either current on to double throw switches in the same panel and thence to the arc lamps of the picture machines. On this same panel is a single throw switch, fed by one of the 110/220-volt a.c. services and connected to one side of the double throw moving picture arc lamp switches.

As explained above, there are three different services to this panel and the chance of all three services failing at the same time is very remote and unlikely.

The main feature of the ceiling under the balcony is a large oval shaped dome with a cover around the edge. The auditorium ceiling is the same, except that the design includes a circular shaped dome; in the coves of these domes are reflectors filled with small incandescent lamps. Besides these reflectors and numerous bracket lamps around the side walls, there are large chandeliers on the ceiling under the balcony and on the auditorium ceiling. There is also a reflector in a cove around the proscenium arch over the stage.

The circuits from these lights run to a fuse only panel on the stage, called the magazine panel. To the magazine panel, foot light, border light and proscenium arc light circuits are also brought. The panel is arranged in sections of two to four fuse circuits to each one.

Each fuse section is controlled by a switch on the stage switchboard and all these switches are controlled by one main switch which shunts the automatic switch located near the switchboard. The automatic switch is controlled by three remote control switches, one in the moving picture booth, one in the box office and the last on the main switchboard itself. By this arrangement, all the lights in the main part of the theatre can be lit or put out instantly from either of these three places.

There are four borders; these and the foot lights are composed of red, white and blue lamps, each of which is controlled by a switch on the switchboard, and all the switches of one color of light is controlled by one main switch. In conjunction with these are a bank of dimmers for increasing or decreasing the intensity of the lights.

The theatre has five large stores, each of which has a separate service switch and meter on the main service and meter board in the basement.

An intercommunicating telephone system enables a person in any part of the theatre to talk to another in some remote part. There is also an annunciator in the box office, controlled by a number of push buttons in the theatre, which enables the ushers to let the box office man know just what seats are empty during the performance, so as he can sell these seats if the theatre is used as one of the "Continuous Performance" types.

The design and construction of the theatre was worked out by Barrorr, Blackader & Webster, Architects in Montreal, and Albert E. Westover, Philadelphia, Pa., consulting architect.

This unusual electrical equipment for a theatre of this type was executed by the L. K Comstock & Company, contracting engineers, of Montreal, and stands as a splendid example of their thorough and high grade workmanship.

Read the second instalment of Terrell Croft's paper on "Standard Interior Wiring Methods," which appears in this issue. Then let us know what you think of it. Mr. Croft will be pleased to answer any questions.

Lightning Protection on Same Pole with 4000 Volt Transformers

The subject of lightning protection for transformers on 4000 volt distributing circuits was discussed by Mr D W Roper in an interesting paper at the recent convention of the N.E.L.A. At the time of starting the investigations which form the basis of this paper, the distributing system of the company with which he is connected, included about 9,500 transformers and supplied service to about 100,000 customers. The maximum load on this system of distribution at that time was about 28,500 kilowatts. Since that time this system has been growing very rapidly, so that at the present time there are over 16,000 transformers supplying service to more than 240,000 customers, and the maximum load during the past winter was about 74,000 kilowatts.

A preliminary investigation of all interruptions on the 60 cycle distribution system had indicated that the transformer troubles were responsible for more interruptions than any other single apparatus, and further, that lightning was primarily responsible for about 70 per cent of all transformer troubles. As the object of the investigation was to improve the service by finding and removing the causes of trouble, it was apparent that the subject of lightning protection was of prime importance.

The practice of the company in matters regarding lightning protection at the time of beginning this investigation, was briefly as follows:

(a) Transformers were purchased and installed with primary terminal boards above the oil.

(b) Lightning arresters were installed on the line poles, i.e., poles supporting wires only, and placed so that there was one arrester for about 2,000 feet of primary line.

Their first step in the investigation of the causes of lightning troubles consisted in making a careful examination of all transformers whose fuses blow in several lightning storms. In about 80 per cent. of these they were able to find marks on the transformer case or on the primary terminal board where the arc had jumped across between primary terminals or from primary terminals to the cover, or around the primary bushings. They selected an area which included several hundred transformers, removed all transformers within this area in which the primary terminal boards were above oil and substituted transformers which had their primary terminal boards removed or submerged below the oil. The results of this investigation indicated a considerable improvement in the service, so that they there-

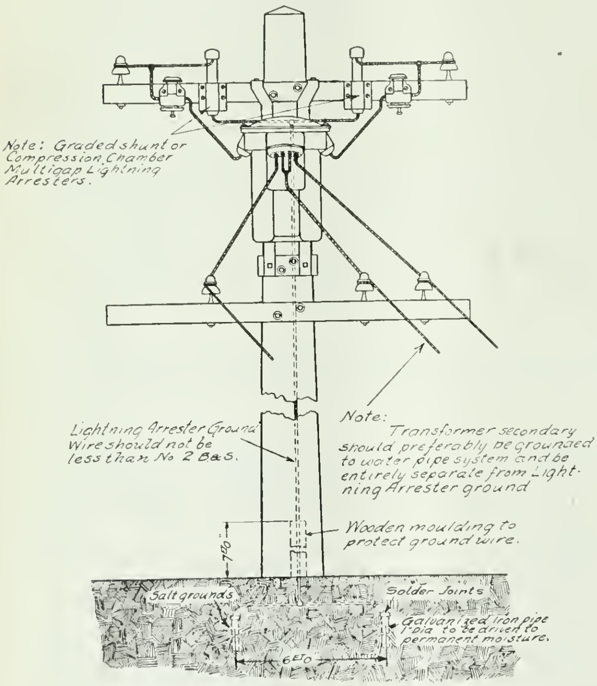


Illustration of an arrangement of Transformer, Lightning Arresters and Primary Cutouts on the same pole

after specified that all new transformers should have their primary terminal boards either removed or submerged. In addition they arranged that all transformers which were for any reason returned to the storeroom from the line, should have their primary terminal boards removed before being again sent out to be reinstalled.

About the time the theory was advanced that in order to be most effective lightning arresters for the protection of transformers should be installed on the same pole with the transformer. Several additional areas were then selected for the purpose of giving this theory a trial, and in those areas a lightning arrester was installed on the same pole with each transformer: For convenience these areas were called "100 per cent. protection areas." Careful records were kept of the results in these areas and in the rest of the city, and as these indicated a considerable advantage in placing the arrester on the same pole with the transformer, all lightning arresters were moved from line poles to transformer poles.

Again, careful records were kept of all of the transformer burn-outs and primary fuses blown by lightning, the results of which are shown in Table 1. This table indicates that, other conditions being the same, the installation of lightning arresters on the transformer poles instead of on the line poles, reduces the number of transformer troubles due to lightning by about 75 per cent.

Table 1—Summary of Results for 1915

	Transformers protected by lightning arrester on same pole	Transformers not protected
Number of transformers	9,307	6,298
Transformers burned out, number..	25	98
Transformers burned out, per cent..	0.27	1.56
Primary fuses blown only, number.	111	271
Primary fuses blown only, per cent.	1.19	4.30

Type S. J. B. Disconnecting Box

A new disconnecting box which is specially adapted for use on series ornamental street lighting systems has recently been developed by the Northern Electric Company, Limited. It has been designed for use on series circuits, operating at potentials of 7,000 volts or less. The function of the box is to provide a means of disconnecting the lamps from circuits supplied with current by two conductor cable, and its greatest field of application will be found on ornamental street lighting circuits where the boxes will be installed in the pedestals of the standards. It consists essentially of a rectangular box of moulded insulating material, which is divided into a rear and front section by a barrier of the same material. The box and separating wall are moulded in one place, the wall supporting a number of metal details used for disconnecting the lamp from the circuit.

The conductors from the lead covered cable enter the box at the bottom and the rubber or cambric insulated leads to the lamp leave the box at the top. Tinned brass

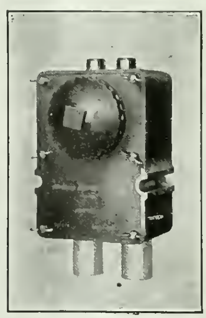


Fig. 1.

sleeves are screwed into the base of the rear section and connection is made between the lead sheath of the cable and the sleeve by a wiped joint. The conductors are sweated into the lugs marked detail "A" as shown in the rear view of the box with the cover removed, Fig. 2. A flat plate of moulded insulating material, which forms the back cover of the box, is attached to the main section by suit-

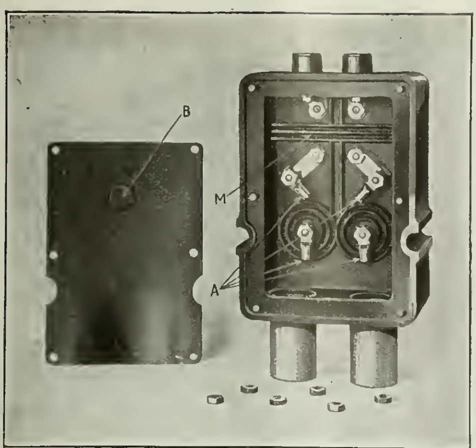


Fig. 2.

able studs and nuts. A rubber gasket is provided to hermetically seal the rear chamber. The chamber is filled with compound at the point marked detail "B," Fig. 2, where a suitable plug is screwed into the back cover.

The metallic parts which form the disconnecting feature are shown in the front view, Fig. 3, by details "C" and "D." Detail "C" consists of phosphor bronze clips, so arranged that when the lamp is not in circuit the clips make contact at the point marked "E," thus providing continuity of circuit for one conductor of the cable. The second conductor of the cable is connected to the studs marked "G," the circuit being closed by the link "F." Details "D" consist of split knife switch receptacles. The two lower receptacles are connected to the studs "H" by the brass straps to suitable studs and lugs, to which are attached the leads which connect from the box to the lamp terminals.

In operation, a lamp is placed in circuit by inserting in the space provided a plug knife-plug switch. This plug switch is shown in Fig. 3 as detail "K." It is provided at

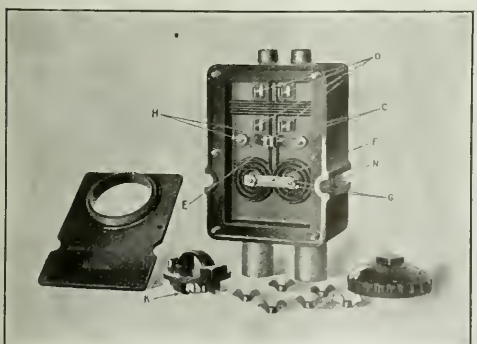


Fig. 3.

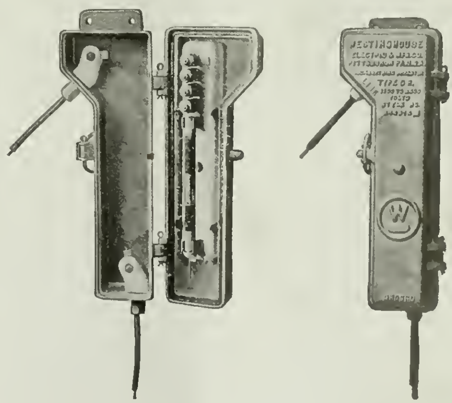
the bottom with an extension which opens the phosphor bronze clips at the point "E," when it is placed in position, thus throwing the lamp in the circuit.

The front cover is formed by a flat plate of moulded insulating material provided with a threaded projecting section for holding a suitable cap. It is held in position by studs and wing nuts and a rubber gasket provides a tight seal. When the plug switch is in place the front is entirely closed by screwing the cap into position, as shown in Fig. 1. Special attention has been given in designing the box for the provision of a large creeping surface between all metal parts connected to different sides of the circuit. This has been accomplished by the corrugations shown in the cuts, such as at "M," Fig. 2. The boxes have an ample factor of safety and are tested at 20,000 volts before shipment from the factory.

An important feature of the design of the box is the arrangement which allows both conductors of the circuit to be disconnected at each lamp post. This provides an easy means of testing the circuit in case of trouble, which is impossible with other types of cut-outs where only one conductor is accessible. If the lighting system goes out of operation on account of trouble in the circuit, due to crosses or breaks in the conductor, the circuit can be opened up at any lamp post by unscrewing the nuts on the studs marked "H" and removing the phosphor bronze clips. The second conductor can be opened up at any lamp post by removing the link marked "F." If it is desired to test the circuit for continuity, it can be closed at any post by using the link "F" to connect between studs "G" and "H." This arrangement provides a miniature testing switchboard at each lamp post, which allows the circuit to be tested in sections until the trouble is located. Another special feature of the design of the box is the provision of the grooves at the side, detail "N," Fig. 3, which allows it to be supported from the rear of the pedestal to suitable studs. The box presents a neat rigid appearance and will fill the demand for a first class article for the class of work for which it has been designed. Type S.J.B. boxes have been used on the entire new ornamental system of the city of Montreal.

Single Pole Lightning Arrester for Distributing Transformer Protection

For use on alternating current circuits of any frequency, from 1,000 to 2,500 volts, and of unlimited capacity, the Westinghouse Electric & Mfg. Company, East Pittsburgh, Pa., has recently placed on the market the type CR lightning



arrester, illustrated herewith. This type of arrester is for pole mounting and is similar in many respects to the type C arrester made by the same company, with the addition of series resistance. It consists of four knurled, non-arcing, metal cylinders mounted on a porcelain base, with a series resistor which is held by fuse clips, the whole being mounted in a cast iron box. The arrester unit is mounted on the inside front cover of the box, so that it is automatically disconnected from the circuit when the box is opened. This safety first feature eliminates all danger of accidental shock to lineman when making inspections and repairs. This method of mounting the arrester unit is especially desirable in an arrester of this kind, which will ordinarily be used in considerable numbers on a line and receive routine inspection. Like the type C, the type CR arrester is designed particularly for the protection of distributing transformers and is unlimited in application.

Mr. C. W. Knighton, general manager of the Canadian Hart Accumulator Company, Limited, of St. Johns, P. Q., has opened an office at 701 Merchants Bank Building, Winnipeg. He hopes to considerably develop the company's western business as manufacturers of electric storage batteries.

It is estimated that there will be 60,000 electric light globes used in the lighting scheme of the Canadian National Exhibition this year.

Obituary

Mr. R. W. Turp, district superintendent of the Hydro-electric System for Beaverton and Brechin, Ont., is dead.

Private James J. Campbell, who represented the Swedish General Electric Company in Montreal at the outbreak of hostilities, is reported as having died a prisoner of war. He was awarded a first class medal by the Czar of Russia for bravery on the field of honour. This Russian Medal of St. George has just been received by his father, who resides in Ottawa. Mr. Campbell joined the first contingent and was paymaster sergeant of the 13th Battalion, Fifth Royal Highlanders, Montreal, but on going to the front reverted to the ranks in order to get into the firing line.

Lieut. H. Dalziel Browne, the general purchasing agent of the Northern Electric Company, has been killed in action. Lieut. Browne, who obtained leave of absence to go to the front, was the machine gun officer of a Montreal battalion. He was 34 years of age.

Current News and Notes

Arnprior, Ont.

The order for the turbine for the Galetta Electric Power and Milling Company, Arnprior, Ont., in connection with the extension to the plant, has been let to the Boving Hydraulic and Engineering Company, Limited, Lindsay, Ontario. The generator—400 kw., 2500 volts, 60 cycle, 3-phase—and additional switchboard equipment will be supplied by the Canadian Westinghouse Company. Mr. R. S. Kelsch, Montreal, is the consulting engineer.

Drumheller, Alta.

The town council of Drumheller, Alta., have under consideration the lighting of the town with electricity and are willing to consider giving a franchise for that purpose. Correspondence is invited from parties interested.

Edmonton, Alta.

The property owners of Edmonton, Alta., have under consideration a plan to sell the street railway to a private company. For some time past outside interests have been working to get control of the public utilities of that city and have been successful on two occasions—the Alliance Company having secured the gas supply franchise and the Edmonton Power Company the franchise for electric current.

Iroquois, Ont.

The village council of Iroquois, Ont., have accepted the tender of the Swedish General Electric Company, Limited, to install a 125 kw. generator, with exciter and switchboard.

Fort William, Ont.

The Public Utilities Commission of Fort William at a recent meeting decided to get wholesale prices on electric heating and cooking apparatus, with a view to the city handling these articles for sale.

Lachine, Que.

Eugene I. Miller, electrician, has registered.

Millbrook, Ont.

The Millbrook Rural Telephone Company, Limited, have obtained a charter.

Montreal, Que.

Mount Royal Electric Supplies Company, Montreal, Que., have registered.

Kaministiquia Light and Power Company have declared a quarterly dividend of 1¾ per cent., payable August 15. This means an increase from 6 per cent. to 7 per cent. per annum.

The Laurentide Power Company is making an issue of $3,500,000 bonds. It is officially stated that, based upon the 1916 contracts, the earnings will be at the rate of $500,000, with operating and fixed charges at the rate of $415,000. The utilization of the remainder of the power will mean an increase to earnings of $750,000, a total of $1,250,000, with a small increase in charges. The installation covered by the bonds will give 125,000 h.p., provision also having been made for three additional units of a capacity of 20,000 h.p. each.

M. J. Stack and Company, contractors, Montreal, have been awarded the contract for the construction of underground conduits, from plans prepared by the Montreal Electrical Commission. The conduits will be constructed on St. Lawrence Boulevard from Sherbrooke to Craig Streets, the amount of the contract being $57,334. The plans provide for single and double manholes.

At a special meeting of the shareholders of the Western Canada Power Company held in Montreal on July 15, the reconstruction plan, outlined in our July 1 issue, was ratified. Mr. C. H. Cahan, K. C., explained in detail the necessity for the reorganization, and spoke in an optimistic way of prospects in British Columbia. The general business outlook in Vancouver is, he said, distinctly better than at the beginning of the year. Bank returns are showing a very satisfactory increase over the corresponding period of the previous year, and while every trade and industry is being carried on as economically as possible, all are busy. There is a scarcity of labor. Mr. Cahan also alluded to the activity in shipping and shipbuilding, the fishing industry, steel rolling, lumbering, and mining.

A number of changes have just been made in the C. P. R. telegraph department. Mr. A. C. Fraser, superintendent of the eastern division, Montreal, is transferred to the Atlantic division, St. John, N.B., in succession to Mr. W. M. Goodsoe, who has been assigned to other duties. Mr. W. D. Neill, superintendent of traffic, Montreal, becomes superintendent of the eastern division, and Mr. William Thompson, chief operator, Montreal, succeeds Mr. W. D. Neill.

The Montreal Light, Heat and Power Company have issued a new house organ under the title of "Our Magazine."

Telegraph statistics of the Dominion of Canada for the year ended June 20, 1915, show a pole mileage of 46,896. There were 132,343 miles of galvanized wire, 27,812 miles of overhead copper wire, 747 miles of underground, and 649 submarine.

The Montreal Board of Control will seek legislative power for controlling the erection of poles by the lighting and power companies. It is proposed that the companies should give a month's notice to the city of their intention to erect poles and that the city should have authority to indicate the locations where the poles shall be placed.

Cie d'Eclairge et d'Energie Electrique, Napierville, Ltee., have secured a charter.

Nelson, B.C.

A long-distance telephone line between Nelson, Kaslo and New Denver, is now under construction and will be ready for operation, it is anticipated, within a few weeks.

Ottawa, Ont.

The Ottawa Electric Railway Company have averted a strike by agreeing to pay its men an increase of three cents per hour over that formerly paid, and also to have a nine-hour day instead of ten. The increase is said to represent about $75,000 per annum.

The Government will appoint a commission to look into the possibilities of generating 2,000,000 h.p. of electric energy below Niagara Falls, without disturbing the Horseshoe and American falls. The promoters are T. Kennard Thomson and Peter A. Porter, incorporated under the style of the Thomson-Porter Cataract Company. The scheme proposes a dam in the rapids below the falls to raise the water one hundred feet. Half the power developed would go to New York State and the other half to Ontario, and the company would agree to sell the Canadian half of the dam to Canada at the initial cost, plus a percentage, and to make an agreement as to the charge made for power. The scheme was outlined in a recent issue of the Electrical News.

Quebec, Que.

The Public Service Corporation, operating in the city of Quebec, recently opened a new office and store at 146 St. John Street, Quebec, under the name of "The Electric Shop." The display rooms are well equipped with the various manufactures of labor saving devices, including a complete line of ranges; motors (including sewing machine motors); the common household appliances, such as irons, percolators, toasters, etc.; water heaters for installation in the ordinary tank; dish washers, and so on. The Electric Shop will sell at retail, and also demonstrate the use of the various equipment carried in stock. Mr. John Bourgeois, Jr., is in charge of the office as manager.

Goulet & Belanger, electrical contractors, Quebec, Que., have been awarded the contract for the Quebec Exhibition lighting system; cost to be $11,000.

Richibucto, N.S.

The village councils of Richibucto and Rexton, N.S., are considering a proposition to dam the Kouchibouguac River and erect an electric plant. Estimates of cost are now being prepared.

Senlac, Sask.

The Senlac Rural Telephone Company, Senlac, Sask., have awarded the contract for a telephone system; total cost $25,000.

Stratford, Ont.

The public utilities commission have adopted the recommendation of the hydro commission to replace the old boiler house with a new building, adjoining the local electric plant. This addition will cost $11,000 and will be fireproof, of steel and concrete construction. Three new 750 kv.a. transformers will be installed to replace the present two banks of three 150 kw. units each.

St. Hyacinthe, P.Q.

The Southern Canada Power Company is rebuilding the sub-station, of brick and concrete, at St. Hyacinthe, P. Q. Three transformers, of 500 kw. each, supplied by the Canadian General Electric Company, are being installed, while the Monarch Electric Company, St. Lambert, P. Q., is supplying the switchboard equipment for the full capacity.

Sault Ste. Marie, Ont.

The Algoma Steel Corporation, of Sault Ste. Marie, Ont., have awarded a contract to the Turbine Equipment Company to supply one 15 million gallon De Laval single stage, double suction, centrifugal pump, direct-connected to one 550 h.p. Canadian Westinghouse motor; also one 3 million gallon unit direct-connected to a 125 h.p. motor, and two 1 million gallon units to be direct-connected to 40 h.p. motors. These are required for the new furnace which is being installed.

Toronto, Ont.

The Hydro-electric Power Commission have made arrangements with the Canadian Niagara Power Co. to secure electric energy up to 50,000 h.p. at a cost of $12 per h.p. This is to relieve the former shortage which at times caused serious interruption to the service.

Condensed Department

Publisher's Notice

Advertisements under "Situation Wanted" or "Situation Vacant" are charged at two cents a word per insertion, minimum charge 50 cents.

Advertisements for tenders, equipment, wanted or for sale, etc., or miscellaneous, are charged at $2.10 per inch.

All advertisements must be in the publisher's hands by the 10th or 23rd of the month to insure insertion in the subsequent issue.

Copper-Clad Wire For Sale

20,000 lbs. 30 per cent. Copper-Clad wire or cable purchased before the war for sale, away below the market price. Can be drawn to size to suit purchaser.
15-15 P. O. Box 1900, Montreal, Que.

75 H. P. Motor For Sale

One Westinghouse Type 'C" 75 h.p., 2200 volt, 3-phase, 60 cycle, 690 r.p.m. Motor for sale at $1,650.00 f.o.b. cars Calgary. This Motor is complete with oil starter, switchboard and base, and as good as new.

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1	35	3	25	550	750	C. E. M.
1	15	3	25	550	1400	J. & M.
1	7½	3	25	550	700	Lancash.
1	7½	3	25	550	750	Packard.
1	7½	3	25	550	1420	Westg.
1	7½	3	60	550	1700	Lancash.
1	5	3	60	200	850	Westg.
1	5	3	25	550	1500	Langdon.
2	5	3	25	550	1400	Lancash.
1	3	3	25	650	1400	Swedish.
1	2	3	25	550	1400	Westg.
1	2	2	125	104	1875	C. G. E.
1	2	1	25	110	1460	Century.
1	1	3	25	550	1400	Westg.
1	1	1	25	110	1450	Excelsior.
2	¼	1	25	110	1450	Excelsior.
2	¼	1	25	110	1450	Fisher

5—500 c.p. incandescent lamps with sockets and globes.

Write Us for Prices

H. W. PETRIE, Limited
Front St. West - Toronto, Ont.

FOR SALE

Three 500 K.V.A., 23,000/440 volt, 60 cycle, Type C Packard Electric Transformers, complete with oil, and primary taps, Form B-1. Transformers have never been used.

Box 425, Electrical News, Toronto, Ont.
15-15

Notice to Electrical Contractors, Builders and Others

Notice is hereby given that no electric wiring or apparatus shall be installed in any building, premises, or erection, in the Province of Ontario, without a written permit from the authorized Electrical Inspector of the district in which the work is to be executed; nor shall any such electrical work be covered from view by lath, plaster or other material, until duly inspected.

It is also contrary to the provisions of the Power Commission Act to alter or add to any electrical work without due notice to and permit from the inspector.

It is also contrary to the provisions of said Act to supply electric current from any source to any installation of wiring, motors, or other electrical apparatus until a written certificate has been issued authorizing such supply.

Violation of the foregoing or any of the Rules and Regulations of this Commission pertaining to electrical inspection is punishable under the Ontario Summary Convictions Act.

Copies of the Rules and Regulations may be obtained at 15c each upon application to the nearest Electrical Inspector.

HYDRO-ELECTRIC POWER COMMISSION OF ONTARIO
15-15

WANTED

45 or 60 K.V.A., 60 cycle, 3-phase, 2500 volt, Y-connected generator, one with second-hand machine in good repair. Write Box 426, care Electrical News, stating lowest cash price. 15-16

WANTED

A good live salesman for retail electric store. Excellent chance for promotion for the right party. State reference and salary expected. Apply to Mahon Bros. Electric Co., Fort William, Ont. 15-16

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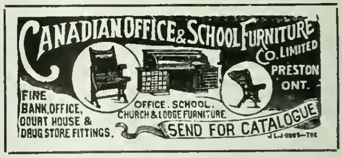

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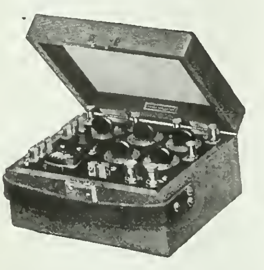

Useful in the Shop and Laboratory for the Measurement of Resistance.
Adapted for Fault Locations in Telegraph and Telephone Lines and Cables.

The Type S Bridge is a thoroughly practical instrument for shop and field use. Being complete in every detail it is ready at all times for immediate use. It is easily portable, its weight being but 8 pounds. The precision of adjustment of its coils (Rheostat 1/10 per cent., Ratio 1/20 per cent.) insures accurate measurements. The galvanometer, the weakest element of such an instrument, is unusually rugged. It is a separate element and may be removed for examination or repair by taking out two screws. The battery is of the ordinary "flash light" type, and renewals may be procured practically everywhere. The price is $60.25 net, f.o.b. Philadelphia, boxed for shipment.

Bulletin No. 530 describes this instrument.

THE LEEDS & NORTHRUP CO.

Electrical Measuring Instruments

4912 Stenton Ave. PHILADELPHIA, PA.

Electrical News
Generation Transmission and Application of Electricity

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The Cost of Generating Electricity

A good article appears elsewhere in this issue on the cost of generating power, in which, among others, the interesting statement is made that development by water power is often a doubtful investment. Among engineers, central station managers and others intimately connected with the construction and operation of electric plants, this point of view occasions little comment, but to the layman, who, in general, has been taught that a water fall capable of transformation into electricity is a certain forerunner of "dirt" cheap light, heat and power, such statements come in the nature of unwelcome surprises. There is no doubt that the value of hydro-electric plants has been over-estimated. At the same time there has been a tendency to commiserate the poor, unfortunate company or community that is forced to worry along with a mere steam-driven plant. The fact is, however, that whatever handicaps steam may have labored under in the recent past, it is now often "even-up" in the race, and in certain cases well in advance. Given a supply of fuel at a fair price and under average operating conditions, it has been demonstrated that electric current can be generated at a lower rate per kw.h. by steam than from water power plants in the immediate vicinity. Events of the past few weeks at different points in Canada have served to emphasize these facts. For example, we have a case where the carrying charges on the capital expenditures have overtaxed the earning capacity of a hydro-electric plant to the extent of necessitating a reorganization of the capitalization of the company. At more than one other point we have examples of superior continuity of service by steam plants, which, under conditions of keen competition, have serious results for the hydro plant. The first case clearly shows the prime necessity for a high load factor before a hydro-electric plant can be economical. The cost of the preliminary work before the first unit of a hydro plant can be put in operation is a very large percentage of the total expenditures necessary for the complete development. With a steam plant this is not true to anything like the same extent, and as a result the capital charges in the earlier stages of the development do not bear so heavily on the company.

For the present, at least, a steam plant, as a result of greatly increased efficiencies, lower initial cost, and greater flexibility (especially in construction) is a good enough proposition to be carefully considered by any company or municipality before making their choice in favor of water power.

Electric Super-Dreadnaughts

The system of propulsion being installed on the "Tennessee," a U. S. super-dreadnaught of the largest and finest class, differs from any now in use by battleships. Instead of the propellers being mechanically connected to the driving engines or turbines, there are two steam turbines developing over 33,000 horsepower driving electric generators which furnish current to four 6,700 horsepower motors, each motor driving a propeller. Electric drive for this battleship has been adopted after a careful investigation by the Navy Department, to whom it presented numerous features of structural, operating, and military advantages, among which are that the steam turbines developing the electric energy may be located in any desired portion of the ship, that the propelling machinery may be better protected from injury, that full power may be available for reversing, and that greater rapidity in manoeuvering is made possible compared with existing mechanical systems of control.

The contract for the electrical equipment has been awarded to the Westinghouse Company. In addition to the main generating equipment and propelling motors, the contract includes the auxiliaries for the main turbine generator sets and smaller auxiliary turbine generators supplying light and power throughout the ship. There will also be several hundred electric motors for doing nearly all the work on board from raising the anchor to steering. Electricity will also be used for cooking, ice making, refrigeration, and numerous other sundry purposes. In all 37,500 horsepower of electricity will be needed, the amount required for a city of about 100,000 inhabitants.

Society Doing Good Service

As an indication of the increased interest evinced by central stations in the work of the Society for Electrical Development, it is announced that recently one hundred and forty-one central stations have become members. The increased membership is representative of all parts of the country. This society is rendering valuable sales-service to the lighting companies, especially as regards electric range campaigns and special advertising services. It is announced that the society now has on file complete records of rates in 3,250 communities which quote a 5 cent rate or under for heating and cooking. Of this number about 70 per cent. are 4c rates and under and 30 per cent. are 3c rates and under. This information service has been particularly valuable to central stations planning electric range and heating campaigns. Central stations everywhere are becoming more active supporters of the society in every way. Hundreds of prominent executives have accepted appointments as chairmen of "America's Electrical Week" local committees, and it is apparent that the big 1916 campaign will have the support of the central station industry as a whole.

The Cost of Generating Electric Power

Generally under-estimated because capital charges overlooked—Water power often a questionable investment—Interesting discussion before A.E.R.A.

By H. G. Scott*

The subject of power generation is a very broad one, which must be studied from both the financial and economical viewpoint. In any power generation problem the cost of power is made up of two main items—fixed charges and operating charges—which in many steam plants are very nearly equal. Fixed charges are made up of interest on capital, amortization of capital, functional depreciation, taxes, and a portion of administration expenses or running expenses chargeable to the cost of power. Operation and maintenance costs include all costs of operating the plant and maintaining it at normal efficiency.

Unfortunately the element of fixed charges is often neglected or ignored in computing and comparing power costs. When you operate a trolley car you do not simply include the platform labor and the maintenance of the roadbed, track, etc., but you have to go back and see what the money costs you. You have to buy money just as you buy cable or anything else. You cannot get money for nothing; no one will lend money without expecting interest on it.

What Capital Will Cost.

The first item to be determined in fixed charges is what the money will cost you, considering interest and providing for the return of the money to the one you borrowed it from. The latter is called an amortization charge, and is usually included with interest, resulting in a total cost for the money of about 6 per cent. Taxes form a larger percentage of the total cost of power than is often realized, amounting to something like 3.5 per cent. on the total investment, varying from 2 to 5 per cent. By the time you have included all the items in fixed charges you will find that it

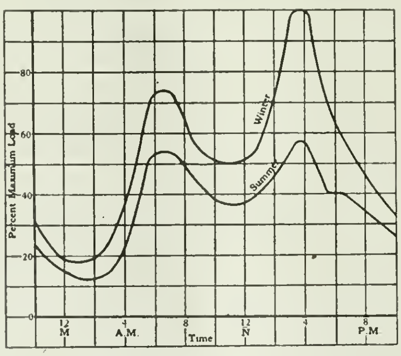


Fig. 1—Typical daily railway load curve.

will cost you not less than 10 and probably 12 per cent. or more for the money you have invested.

In hydraulic plants the condition is quite different, for the operating charges are so small as to be negligible, while the fixed charges are usually high.

The curves given in this article will serve to illustrate many points regarding the cost of power. Thus a typical daily load curve of a large railway is shown in Fig. 1, the lower curve being typical of summer conditions and the upper curve for winter, when the extra power required for electric heating and the heavier schedule result in a greater power demand. In this particular case the heating amounts to 20 per cent. of the load schedule.

Showing average cost of power, steam, and hydraulic plant.

Assuming a given daily cost of power, as in Fig. 1, a comparison is given in Fig. 2 of the cost of power derived in varying proportions from a steam and from an hydraulic plant. It may be seen that, under the typical conditions assumed, there is a certain combination of steam and hydraulic service that will result in the lowest power costs. For railway work it is almost invariably found that such a

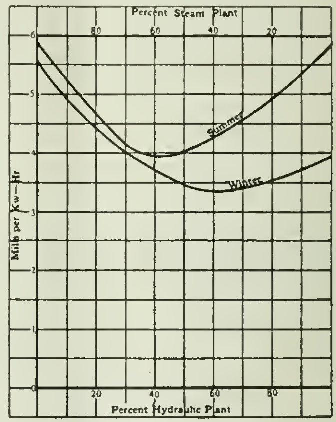


Fig. 2—Typical summer and winter curves.

combination results in lower costs than power from either a straight steam or hydraulic plant.

In Figs. 3 and 4 summer and winter load conditions have been analyzed to show the hourly cost of power for each hour of the day, for a number of combinations of steam and hydraulic power supply. It will be seen that the curve of cost of power goes up as the load goes down; that is to say, if we analyzed the cost of power for twenty-four hours we would find that it reaches a maximum during the small hours of the night. The difference between the cost at 3 a.m. and 9 a.m. is very marked. The first, or A curve, is all hydro-electric power, and shows how the cost goes up enormously at certain hours in the night, which indicates that you cannot afford to run an hydraulic plant on light loads. The B curve shows the cost with 75 per cent. hydro-electric power, and 25 per cent. power from a steam plant, the curve C being 50-50, and D represents all steam power.

Fixed Charges and Cost of Light Loads.

The variations in the cost of power with load factor, of one plant costing $60 per kilowatt and one costing $80 per kilowatt, are shown in Fig. 5, the lower curves plotted below the zero line being the operating and maintenance costs. The first curves above the zero line show how important fixed charges or investment costs become at light loads. As the load factor increases the fixed charges become less and there is also a decrease in operation and maintenance cost. At any load factor the total cost of power can be obtained by adding the two ordinates, as represented by the upper curves

* Superintendent of Motive Power, Interborough Rapid Transit Company.

above zero line. This shows how important it is in any plant to build up the load factor.

Referring to the upper $80 per kw. curve, it will be seen that at 50 per cent. load factor the total cost of power is about one-half of what it is at 20 per cent. load factor.

Typical load curves for the $60 and $80 per kw. plants are given in Fig. 6, operating at 45 and 25 per cent. load factor respectively, the idea being to illustrate what would happen when the smaller load is added to the large one.

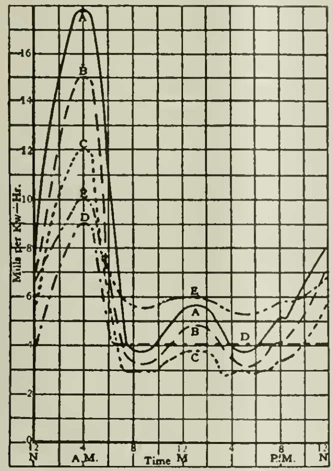


Fig. 3—Cost of power during day—summer load.

A—100 percent hydraulic— 0 percent steam.
B— 75 percent hydraulic— 25 per cent steam.
C— 50 percent hydraulic— 50 percent steam.
D— 25 percent hydraulic— 75 percent steam.
E— 0 percent hydraulic—100 percent steam.

Suppose you had a small direct-current station and shut it down and took the load on to another plant which already had a fairly large load. That introduces another factor, sometimes called the diversity factor, but I do not think that describes it very well. "Time differential" is a little better description. It is simply this, if you can find a load to add on to your other load, whose peak load or high point does not come at the same time as your other load, then you can carry the second load with advantage without adding much to the capacity of your plant; in other words, the fixed charges will not be increased by adding the load in the valleys as long as you do not add it to the higher peak. The difference between the broken line and combined curve at the peak represents the time differential, and 5,000 kilowatts in total capacity of the plant would be saved by having this small load added; in other words, if you have a 5,000 kilowatt plant in one place and a 50,000 kilowatt plant in another place, and could take the small load and add it to the large load, without making the peak 55,000 kilowatts, it would pay you to shut down the small plant.

Typical First Costs.

The average installation of hydro-electric plants at the present time in first cost will amount to not less than $150 per kilowatt of capacity. You can put up a first-class steam plant to-day, depending on the size, varying from about $55 to $75 per kilowatt capacity. That is considerably less than half of the hydro-electric plant. If you have to build a big dam to give you large storage of water, then the hydro-electric plant may run from $200 to $250 per kilowatt of capacity. The other difficulty with the hydro-electric plant is that there are usually certain dry seasons, one or two months in the summer, or maybe in the early fall, when your hydro-electric power will be cut down largely, so that now it is becoming pretty well recognized that as an investment the hydro-electric proposition must be considered very carefully. The reason for this is the uncertainty of water supply, unless you go to enormous expense for dams and storage. These questions exist even in such water supplies as furnished by the Niagara River.

The writer came in contact with a case some months ago in a consulting capacity, where a large company not very far from Niagara Falls was confronted by two conditions. First of all, they were not allowed to get any more power from the Falls. The Governments of the United States and Canada had established a certain maximum number of cubic feet per second which they will allow to be diverted from the Falls. They have now reached that point. The business of this company kept on growing at a very rapid rate, and the question was—What is the best thing to do? After making a thorough investigation of the shape of the load curve and an analysis of the whole situation, and taking into consideration what power is costing them now, it developed that they could afford to put in a large steam plant of their own and make power at least as cheaply as they could buy it at Niagara Falls. That, of course, is conditioned on the load factor; that is to say, if the load was going to last more than twelve hours a day the hydro-electric power would be the cheaper. If the load lasted less than twelve hours a day the steam power would be the cheaper. The result of the investigation is that this company is now building a plant which will cost $4,000,000, so as to make the greater part of their own power.

If such a condition exists at Niagara Falls, where they have ideal conditions, you can imagine what would exist at the average water power plant, which runs dry half the time. There has never been known to be a lack of supply of water at Niagara Falls.

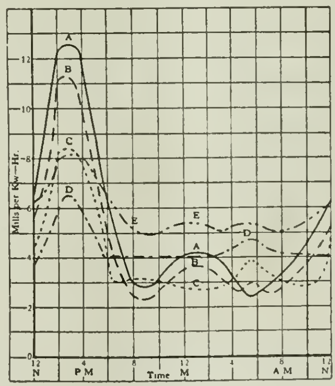


Fig. 4—Cost of power during day—winter load.

A—100 percent hydraulic— 0 percent steam.
B— 75 percent hydraulic— 25 percent steam.
C—50 percent hydraulic— 50 percent steam.
D— 25 percent hydraulic— 75 percent steam.
E— 0 percent hydraulic—100 percent steam.

When we talk of cheap hydro-electric power, there is a string attached to it. It is cheap, of course, when you consider the cost of running the water power, when you get it going, because there is little labor, practically no material to be supplied, as the water runs into turbines and makes the power. That is very simple, but, as pointed out before, you cannot get the money for nothing; you have got to pay for the money. Instead of paying for coal or other supplies that you do pay for in a steam power plant, you have to pay in this case for the money, pay interest, and provide an amortization fund, in connection with the money that you borrowed with which to build the plant.

So we find that for practically all cases where the load is that of a lighting company or a railway company, which means that the load factor is not more than 50 per cent., and in some cases goes down to 30 per cent., water power is a very questionable investment, and it would have to be looked into very carefully to find out whether the total cost of that power would not be greater than you could make it from a steam power plant.

Size of Plant and Cost of Power.

The size of plant has quite an appreciable effect on cost of power. Below certain sizes of steam generating units, in the case of the modern turbine, the efficiency goes down very rapidly, below about 1,000 kilowatts. In such cases it would be better to buy a reciprocating engine, direct connected to your generator, than to put in turbines. As the size goes up, however, the turbine shows considerable improvement over what the reciprocating engine can do, and when we get to units of 30,000 kilowatts or more there is a very marked improvement. The unit purchased not long ago by the company with which the writer is connected is going to give 70,000 kilowatts, on 10.5 pounds of steam per kilowatt hour. Further, there must be a certain number of men around to take care of the station, engineers, firemen, oilers, etc. A man can take care of a large unit almost as easily as he can take care of a small unit, so that the cost of help does not go up in proportion to the size of the plant. That is another thing which makes a large plant cheaper; but with a very large plant the cost of these items

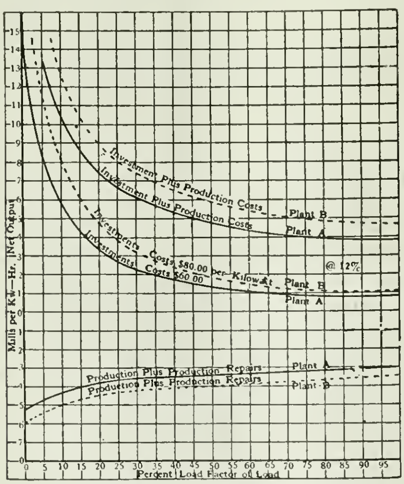


Fig. 5—Variations in cost of power with load factor.

is almost negligible, and the cost of coal and water are very important things, especially the cost of coal.

For illustration, when we started developing power for the electrification of the Manhattan Elevated Railway System in New York, about fifteen years ago, it took almost three pounds of coal per kilowatt hour, and to-day we are making power for 1.5 pounds of coal per kilowatt hour, with modern turbines. The difficult situation which has arisen has been a financial one. When the old units were put in they were the finest units ever built. They cost a very large amount of money, but owing to the progress of development of the steam turbine, which offered such large improvement in economy, it seemed advisable to take out the engines and replace them with the turbines. Those units cost approximately a quarter of a million dollars, and when we took them out and scrapped them they were worth about $10,000. How are you going to write off the difference? These are some of the problems in financing which do not appeal to the average person, because they do not run up against them; but it is a real problem, a perfectly honest one, because money was paid for the units fifteen years ago, they were perfectly good to operate, had high economy for their time, but to get better economy they were taken out and sold for scrap and replaced with turbines. That touches the question of what we might call the effect of obsolescence upon the economy of production.

Advantage of Diversified Loads.

The general question as to whether the railway company should manufacture its own power or buy it is a very interesting one. If we look at the thing from its broadest

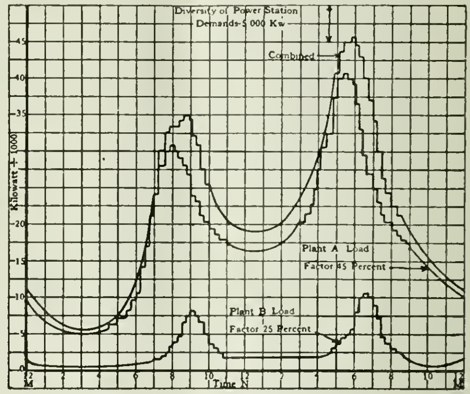


Fig. 6—Combined load curve for large and small station.
Plant A—$60 per kw., 45 percent load factor.
Plant B—$80 per kw., 25 percent load factor.

aspect, there is no reason why a railroad company cannot build just as economical plants as any power company can. The only difference is the one pointed out in Fig. 6, where, if you can combine several different kinds of loads with your own railway load, then you get what you might call a time differential; in other words, you fill up the hollow in the load curve without adding anything to the investment. Suppose there was 50,000 kilowatts capacity, which the railroad required only at certain times. If you could sell power to some consumer who would come in and fill up the valley in the railway load, such a valley as is shown in Fig. 6, then you could sell your power for a very low rate, as you have not added anything to the fixed charges. It would, at the same time, cut down your own cost, as you would certainly expect to make a profit on what you sold.

The flatter your curve—that is, the more you can fill up the valleys—the cheaper you can manufacture the power. That is the main object in the general power company going out and getting loads from all sources, various kinds of loads, and especially night loads. If you can build up a load factor as good as the power company can, then there is no reason why the railroad company should not make the power and sell some of it to someone else. If the power company can build up a better load curve than you can, then they can make power cheaper than you can make it.

Hebert & Girouard (Gaspard Hebert and Honore Girouard), Montreal, Quebec, civil engineers and contractors, have registered.

Electrics Used in Refuse Collection

Experiences of an English Superintendent Favorable—Opinion Upheld by a Number of Municipal Officers

By J. Terry*

Having given much thought and consideration to the various papers relating to motor traction given at our conferences during recent years, I had decided that motor vehicles were not suitable to the peculiar conditions which prevailed in Nottingham.

Many of you will no doubt remember that our conference last year synchronized with an exhibition organized by the Road Board at the Horticultural Hall, where vehicles of various descriptions were displayed, and it was there I saw the first electric vehicle, with which I was very much impressed. From the information then received, and from my previous knowledge, I summed up the advantages and disadvantages of the various vehicles as follows:—

Petrol-Driven Vehicles

Advantages:

- Moderate capital cost.
- High speed.

Disadvantages:

- High running costs.
- Proved inability to withstand constant starting and stopping.
- High maintenance costs.
- Heavy tire expenditure.
- Dear fuel. Fluctuating price of same.
- Many working parts.
- Motor running while vehicle stands.
- Noisy on low speeds.
- Skilled drivers needed, and special maintenance staff.

Steam-Driven Vehicles

Advantages:

- Moderate capital cost.
- Satisfactory speed.
- Cheaper fuel.
- Satisfactory starting and stopping.

Disadvantages:

- Constant wastage of power when standing.
- Skilled labor to manage, and then two men required.
- Costly maintenance.
- Heavy tire expenditure.
- Frequent loss of earning power during overhaul.
- Fear of boiler troubles.
- Noise—steam exhaust offensive.

Electric

Advantages:

- Ample speed.
- Ability to withstand starts and stops.
- Very rapid acceleration.
- Few moving parts, therefore low maintenance.
- Cheaper tires (initial cost).
- Less wear on tires owing to easy turning movement.
- Cheap fuel at fixed prices.
- Ease of control, therefore horse-men prove successful drivers.

By employing the electric there would be no noise, odor, smoke, gears to change, no clutch, no carburettor to adjust, no ignition troubles, or no boilers to overheat; therefore I could not fail to lean towards this vehicle, which had to be used on the heaviest possible work, with a staff whose engineering experience was, to say the least, modest.

Heavy Initial Cost

While I favored the electric vehicle, I did not approve its high cost, and did my utmost to obtain a reduction. I found that the manufacturers, although keenly competitive, were unable to reduce their charges, the reason for this being that the output of electric vehicles is very small compared with other types of vehicles. The works costs must therefore remain high until the demand grows. Added to this, the high cost of freight and insurance brings about a total which appears very heavy compared with the purchase price of petrol and steam vehicles available on their merit at their present prices. I found that users had experienced little or no maintenance, and that the claim that an "electric" was good for a life of even so much as fifteen years, without undue maintenance, was likely to prove true. This materially simplified the proposed initiation, with the result that I advised my committee to make an immediate experiment, which suggestion was promptly acted upon.

I then decided that I needed vehicles of 3-ton capacity, but I have since seen that a mixed fleet of 2 and 3 tonners working in pairs of equal capacity will be ideal for the convenience of our town. The body must be of sufficient capacity to carry the load under average conditions, but no concern need be felt when the weight per cubic yard exceeds normal, as no vehicle of good design should be strained under the occasional maximum conditions.

High speed would be no advantage, for when working in pairs the maximum speed required is governed by the speed of filling. It would obviously be a fallacy to accelerate speed if the empty vehicle has to wait while the second vehicle is nearing the completion of loading, and alternatively the capacity of body is governed by the distance the loads have to be taken. A speed of from 9 to 12 miles per hour is ample.

It was essential that, whichever power was selected, the vehicle must be capable of starting and stopping upon all levels and conditions of road without causing undue maintenance. The simplicity of the mechanism convinced me that the "electric" would excel in this respect.

Batteries

The next and more difficult point to decide was the selection of battery. When I first mentioned electrics to my chairman he opposed the idea, on the ground that his experience of them was not satisfactory. I replied that I was not surprised, as undoubtedly he had been using lead batteries, and as this may have been the experience of others I trust you will excuse me if I appear to dwell somewhat on this point.

I do not pretend to be an electrical engineer, but I have friends whose advice is worth seeking. Upon hearing my requirements they sagely shook their heads and gave ma many hints on the upkeep of lead batteries, which were of a more or less bewildering nature. I then chanced to meet with a pamphlet describing the upkeep of a traction lead battery. The following is a part of the article in brief outline: "All positive plates slowly disintegrate during their working life, though, as will be shown later, the rate of disintegration is largely controllable by the user, depending upon the care exercised in avoiding free and violent gassing in the course of charging the battery. But, slowly or quickly, the process of shedding the active material goes on, and unless

* Cleansing Superintendent, Nottingham, at Annual Conference of the Institute of Cleansing Superinrendents, held at Cardiff, England.

ample space is provided for the reception of material so thrown down, it will soon accumulate to a level where it touches the plate, when it 'short circuits,' or, in other words, makes a circuit inside the cell. Unless the cells be immediately cleaned out—and this involves time as well as a certain amount of skill and expense—the plates will soon be ruined."

I need hardly state that such precaution seemed difficult when the nature of our work was considered, and it was a considerable relief to find upon examination that the "Nickel Iron Accumulator" battery was free of weaknesses such as have been described. I agree that the imperfections of the lead battery may be more aggressive when explained in cold print than when handled by skilled electricians. I had to remember that skill in handling does not end the care necessary for successful maintenance. Much harm can be done to the battery by careless discharge, and temporary short circuit, if not absolutely disastrous with some types of lead battery, at least causes inconvenience, and may entail its removal from service. This would necessitate spare sets and special appliances for the easy removal of approximately three-quarters of a ton of cells by the means of lifts, jacks, trucks and similar contrivances.

Obviously in this class of service it is essential to have the battery dust-proof and mechanically strong. This you will agree is even more necessary than very high efficiency, for current is cheap, whereas battery maintenance is expensive. In the nickel iron battery I believe we have a battery which is almost indestructible within a reasonable service. Certainly the manufacturers believe in its longevity, for they have formulated a special guarantee which states that on the completion of 60,000 miles service the battery will still show its original rated capacity, failing which, they will at their discretion bring the cells within the specification, or replace same free of charge. This guarantee is subject to certain conditions as to maintenance, which are simple to follow and offer no loophole whereby the terms of the guarantee can be avoided.

As the mileage per day on refuse collection is from 15 to 22 miles, the average can be taken at 20 miles per day, which represents at 300 days per annum a ten years' guarantee. The manufacturers stipulate that the maximum period of the duration of the guarantee is eight years. It is comforting to know that, notwithstanding this shortening of the actual period of guarantee, "service" is the destroying factor—not "idleness." Since there are many instances where Edison batteries have much exceeded 100,000 miles service in heavy-draught vehicles, it seems probable that the capital write-off at 10 per cent. per annum is much too conservative. At this rate of reduction of value the vehicles successfully carry out the work at a price hitherto unheard of with horse traction; therefore it is wise to retain the figures and benefit at a later date should my calculations prove too pessimistic.

The cost of the best type of lead battery is about half that of the nickel iron. Certain makes carry no guarantee whatever, but for a fixed sum per mile a battery maintenance can be arranged. Other makes are guaranteed for a minimum of 20,000 miles. In the event of this mileage not being completed, then a new battery is equipped at a reduced cost proportionate to the lost mileage. That is to say, if 15,000 miles only is completed, then the replacement will cost 75 per cent. of a new one, subject to the fluctuations of the metal market.

Cost of Current

The guarantee of the iron battery has been already stated, and from a business point of view I can, without any highly technical knowledge of electricity, appreciate the fact that on guarantees the nickel iron battery is undoubtedly much superior and more conclusive. Then comes the question of efficiency. The cost of current at 1d. per unit (which is the almost universal charge for traction current, but, unfortunately, not so in Nottingham, will average approximately 2s. per day. What is the difference of 10 per cent. in efficiency? This is the admitted advantage of the more efficient lead cell. I repeat, what is this small charge compared with the much higher maintenance costs? I doubt if the difference will cover the loss and inconvenience occasioned by the vehicle being out of commission while the lead batteries are being periodically overhauled and defective plates being replaced.

While on the point of cost of current it is well to remember that where destructors are available so can electricity usually be found, or the necessary plant be installed at a cost not affecting the proposition whatsoever.

The makers of the Edison battery give me the following description of the construction of the nickel iron battery: The Edison battery is composed of a number of steel plates contained in corrugated nickel steel containers. The positive plate contains alternate layers of nickel hydroxide and pure flake nickel, this material being supported in spirally made steel sheaths, the edges of which are overlapped, the whole being submitted to a very high pressure during filling, rendering the contents to a rock-like nature. These are further encased with a number of small steel rings. These pencils are supported in frames made of the same material. The negative plate consists of a number of perforated steel pockets containing iron oxide, similarly supported. The opposite poles are supported by pure rubber strip sheets and frames in a concentrated form, the heavy cost of which, I understand, is largely responsible for the high cost of the cells.

The electrolyte is non-acid, and is composed of a solution of lithia and potash. These ingredients are interesting, inasmuch as it is known that potash is a preservative to steel; all the metal parts being of steel, it is probably due to this fact that the long life of the plates may be confidently anticipated.

With regard to maintenance, so far no cost has been involved, but a small sum of money has been set aside to ward against possible expense at a later date. It is usual to add distilled water to each cell by means of an automatic device two or three times per week, depending upon the climatic conditions. The frequency of these operations is regulated by the amount of evaporation. The filling device indicates whether the cell requires more water, by means of a bell or buzzer, which is vibrated when filling is normal. This process occupies from six to ten minutes, and is carried out by unskilled labor. The exterior of the containers is submitted to a bath of nickel, and afterwards painted with an insulating paint known as Esbalite. It is important that cleanliness be observed, and that the cells be regularly repainted should the original coating of Esbalite have flaked off, which is sometimes observed. These precautions are taken with a view to preventing rust, and negligence in this direction may cause leakage to the containers which cannot be repaired, but must be replaced. The replacements of the cans will not destroy the value of the plates, and while the expense is little, such a debit need not be incurred provided ordinary precaution is taken. The Edison battery is totally enclosed, the filling aperture being provided with an ample cap in which is contained a ball valve which prevents foreign matter from encroaching. At the same time it breaks the globules of electrolyte. These are thrown up in an effervescent form during high rates of charge and discharge, and are thus returned to normal useful condition.

Working Costs

In the report presented to my committee in September last I submitted estimates from the makers of various vehicles and the results of special tests made at Barnes, Heston, and Isleworth, Dover and Sheffield, which figures I can supply if desired; but as we now possess figures covering fairly long periods under normal working conditions I think these are preferable.

During six months ending July 1, 1915, the cost of emptying dry ashbins by horse vehicle in Nottingham averaged 4s. 4d. per ton, but owing to the increased charges for horse-keep, wages, etc., the cost is now 5s.

Our No. 1 motor was delivered on October 15, 1915, commenced work on the 18th, and has been in use daily ever since. During the six months ending April 15th it carried 422 loads, weighing 1,288 tons, at a cost of £241 13s. 10d., which is equal to 3s. 9d. per ton, the average weight per load being 3.05 tons.

The costs are made up as follows:—

	£	s.	d.
Depreciation at 10 per cent.	52	13	0
Insurance	4	5	0
Oil, water, repairs, etc. (allowed)	11	9	8
Tires—1,819 miles at 1.1d.	8	6	9
Current—2,541 miles at 1¼d.	13	4	8
Wages	151	14	9
	£241	13	10

If we take the six months ending July, 1916, we get a period corresponding to the period covered by the figures given in my original report, and this is a more fair comparison than taking the first six months' work, which are all winter months. We find that during this time we removed 1,167 tons of refuse, at a cost of £253, or 4s 4d per ton, which is exactly the same as the cost by horses, as mentioned in my original report; but it must be remembered that the conditions then were the same as before the war. Under existing conditions, as I have already stated, the cost is 5s, thus showing 8d per ton in favor of the motor, which means that if all our dry-ash refuse were removed by motors a saving of over £1,000 per annum would be effected, and this in a town which I consider not best adapted to motor traction for this class of work. I have dealt only with the results obtained by our No. 1 motor, but the figures for the No. 2, which has been at work daily since March 13th, are identical.

Mr. Priestley, cleansing superintendent, Sheffield, whose experience of electric motors in the collection of house refuse is greater than that of any other superintendent, recently presented a report to his committee, from which I have pleasure in submitting the following figures:—

No. 1 Vehicle.—Day Work Costs for twenty-two weeks.
Refuse collected, 858 tons, 6 cwt. 1 qr.

	£	s.	d.
Wages	154	15	8
Vehicle costs	40	7	1
Electricity, 3,269 units	13	12	5
Tires, 2,168 miles	9	0	8
	£217	15	10

Cost per ton, 5s. 0.8d.

Cost of one month's work on same districts with horse labor:—

Refuse collected, 167 tons, 19 cwt., 2 qrs.

	£	s.	d.
Cost	59	1	9

Cost per ton, 7s. 0.4d.

No. 1 Vehicle.—Night Work Costs for twenty-one weeks.
Refuse removed, 1,142 tons, 19 cwt., 1 qr.

	£	s.	d.
Wages	72	3	8
Vehicle costs	38	10	5
Electricity, 2,927 units	12	3	11
Tires, 1,880 miles	7	16	8
	£130	14	8

Cost per ton, 2s. 3.4d.

Cost of three months' work on same districts with horse labor:—

Refuse removed, 473 tons, 11 cwt., 2 qrs.

	£	s.	d.
Cost	77	10	3

Cost per ton, 3s. 3.2d.

No. 2 Vehicle.—Day Work Costs for six weeks.
Refuse collected, 314 tons, 4 cwt., 3 qrs.

	£	s.	d.
Wages	47	10	5
Vehicle costs	10	19	3
Electricity—670 units	2	15	10
Tires—417 miles	1	14	9
	£63	0	3

Cost per ton, 4s. 0.1d.

Cost of one month's work on same district with horse labor:—

Refuse collected, 204 tons.

	£	s.	d.
Cost	38	16	0

Cost per ton, 3s. 9.6d.

No. 2 Vehicle.—Night Work Costs for six weeks.
Refuse removed, 406 tons, 13 cwts., 2 qrs.

	£	s.	d.
Wages	21	18	0
Vehicle costs	10	19	3
Electricity—758 units	3	3	2
Tires—459 miles	1	18	3
	£37	18	8

Cost per ton, 1s. 10.3d.

Cost of one month's work on same district with horse labor:—

Refuse removed, 440 tons, 8 cwts.

	£	s.	d.
Cost	55	10	2

Cost per ton, 2s. 6.2d.

Mr. Jackson, cleansing superintendent, Birmingham, who has been working an "Orwell" dust van since May 29th, reports that it is equal to 2.5 horses.

Even if the running costs and standing charges of motor vehicles are only equivalent to the present cost of horse collection, I most strongly contend that from a sanitary point of view the change is to be recommended. I feel personally that too much emphasis cannot be brought to bear on what appears of national importance, for the following among many other reasons which no doubt will occur to you:

(1) Cleanliness of street.

(2) Labor provided for building chassis in this country.

(3) Reducing the demand for fodder and cereals for horses.

(4) Correspondingly increasing the supply available for feeding cattle.

From a hygienic standpoint the value of No. 1 alone compels us as cleansing superintendents to be in the front rank in adopting this improved form of traction.

In conclusion, it is worthy of mention that my faith in the success of electrics is upheld by many other municipal officials who with myself have franked their good opinion by placing orders and repeat orders as follows: Edison Battery Vehicles.—Sheffield, 5; Chester, 4; Dover, 6; Barnes, 4; Glasgow, 2; Pontypridd, 2; Newcastle, Heston and Isleworth, South Shields and Smethwick, 1 each. Lead Batteries.—Birmingham, 2; Wolverhampton, 1. In many cases reports have been made, in each of which substantial savings have been made.

Recent Street Lighting Developments

Discussed by J. R. Craveth, before the I. E. S. and the W. S. E.— The Study of Silhouette Effects and Glare.

In order to consider recent street lighting problems and developments in their proper light we must necessarily constantly refer back to the older conceptions of the street lighting problem, many of which older conceptions still exist in the minds of the lay public, and to some extent among the members of the engineering fraternity who have not closely followed street lighting matters.

The most noticeable change, to the layman, has been the change in the illuminants available. The open carbon arc lamp of 25 years ago gave way to the enclosed carbon lamp of lower efficiency and lower maintenance cost and this in turn is giving way to the luminous or magnetite arc lamp and the gas filled tungsten incandescent lamp. The low efficiency series carbon filament street lamp used up to about 10 years ago found but limited application in spite of the decided advantages of small units for the lighting of most residence streets. The series tungsten lamp, first in its vacuum and later in its gas filled form, has within the last ten years worked radical changes in the possibilities of proper treatment of residence street lighting, and the multiple tungsten lamp is found on hundreds of miles of "white way" on business streets.

The competitive street illuminant, gas, has also been doing its share of progressive work the past 25 years; the first and most important change being the mantle burner in its upright form supplanting the flat flame open burner. Later the inverted mantle and improvements in burner construction as well as in methods of maintenance have kept gas from giving way entirely to electric street illuminants.

In the electrical field just at present the two kinds of lamps which hold the supremacy are the gas filled tungsten incandescent lamp and the luminous or magnetite arc lamp with the new high efficiency electrodes. The flame arc lamp with long burning electrodes as used in Chicago and some other cities has shown such a decrease in candle power due to fouling of the globes between trimmings as to put it out of competition with the two other lamps just mentioned. Its initial efficiency, however, is high.

Ideas as to the proper methods of rating lamps for street lighting have undergone radical changes along with our increase of knowledge as to the actual photometric performances of lamps and their accessories. The old erroneous rating of 2,000 candle power applied to the 9.6 ampere, 450-watt, open carbon arc lamp has been written into hundreds of street lighting contracts and in many cases has made trouble between municipalities and lighting companies. It is impossible to adopt any one rating that will properly value a lamp for street purposes as there are such varied conditions to be met on different kinds of streets. There is, however, substantial agreement among leaders in illuminating thought and practice that all lamps of whatever kind, whether for interior or exterior illumination should first be rated according to total lumens emitted; or upon what is the same thing differently expressed, viz., mean spherical candle power. This as a first step in uniform methods of rating is now being made and is a great improvement over the old method of rating by candle power in some particular direction, said direction sometimes being chosen to best suit the desires of the lamp salesman. On account of incandescent electric lamps having been rated so long upon a horizontal candle power basis, and such candle powers having been included in many street lighting contracts, it is still the practice of the lamp manufacturers to give the horizontal candle power rating for series street incandescent lamps; but since the horizontal candle power of a gas filled lamp with a coiled filament is an exceedingly variable, and difficult to determine, quantity, the practice is to give the rated horizontal candle power as one-tenth the total lumens of the bare lamp. Thus a lamp rated at 100 horizontal candle power is a lamp giving 1,000 lumens total light flux. This method of rating is approximately fair to all concerned, and in fact is about the only feasible way out of the difficult situation which arose when the introduction of coiled filament gas filled lamps rendered horizontal candle power measurements so erratic. Those engaged in writing street lighting contracts, however, should incorporate the foregoing stipulation as to how the horizontal candle power rating is obtained so as to avoid any possible future question on that point.

However, the rating of a lamp by total flux output in lumens of mean spherical candle power is now recognized as only the first step in ascribing the lamp a relative value for street illumination. It is important that the distribution of light flux be such that as large a percentage as possible is indicated where it is most needed. The particular places where the greatest flux of light is needed or rather the particular angles at which the greatest flux should be emitted depends on the height and spacing of lamps and the nature of the roadway or pavement. In general, it is a safe rule to follow to get as much of the flux delivered midway between lamps as possible. It is conceivable that this might be overdone; but not with present appliances or under any common present conditions of street lighting practice. Tests made by the street lighting committee of the National Electric Light Association and Association of Edison Illuminating Companies in 1914 and 1915 indicated that discernment of obstructions and obstacles along a street might be less with nearly uniform illumination coming from a few larger sources. Conditions where an object can receive considerable light from a number of sources are only found on business streets and boulevards where the available expenditure per foot of street is much lighter than in residence streets. Residence streets constitute the far greater mileage and the most important problems in street lighting, and call for the most intelligent planning to get the best results on account of the small appropriations available. On such streets, there is no present danger that the uniformity of illumination or the multiplicity of light sources illuminating any one point will be so great that quick or easy discernment is less than it would be with a smaller number of large sources. In such locations the main question is how far can the lighting units be sub-divided and be kept within reasonable expense limits.

The auxiliary appliance (consisting of globe, reflector, or what not), that delivers as much of the light flux as possible on the street midway between lamps (but not very much beyond that midway point), is likely to be by far the most economical for most conditions, and the use of proper equipment of this kind is important. As a second step, therefore, in our process of rating illuminants we must consider the lamp as equipped with whatever auxiliary appliance may deliver the flux of light in proper proportion along the street for the given conditions in question.

Along with the rating of lamps comes the question of depreciation of the lamp under actual service conditions below the performance of the same lamp in the laboratory when new. This necessitates consideration of the actual blackening or fouling of globes in service and the amount that depreciation in service may be prevented by proper cleaning and maintenance. This depreciation is much more serious than commonly supposed, and should be watched. This brings us to the question of contract relations between lighting companies and municipalities, to insure proper maintenance. The time honored form of contract is to stipulate a certain candle power of lamp to be operated according to a certain lighting schedule at a flat rate of so much per year. In some contracts this has been wisely modified to stipulate a certain type and kind of lamp with possibly some further stipulations as to operating conditions and maintenance. Maintenance stipulations in most contracts are decidedly weak.

It was at one time proposed, and in fact recommended, by the 1907 and 1908 committee of the National Electric Light Association on street lighting, that street illumination be sold on the basis of the illumination obtained on a vertical plane about midway between the lamps. This recommendation, however, did not find favor in practice, and it is perhaps fortunate that it never did as it confuses the question of lamps and systems of illumination in an undesirable way. In 1913 a committee of the same association recommended that the desirable form of contract should specify definitely the kind of lamps and their performance, leaving the question of the proper spacing, equipment, height, kind of lamps, etc., to be determined in advance of the contract. Under such a procedure the lighting company would contract to maintain and operate certain specified types of lamps up to a certain specified standard of service determined by candlepower tests. It might be specified that such tests be made on the streets or by removal of street lamps to the laboratory and operating them in the laboratory under as nearly as possible actual street conditions. Such contracts should not be entered into, however, without a full knowledge of the actual street performance of the lamps in question. Extensive experience in checking street performance against the performance of new lamps in the laboratory causes me to urge extreme caution in this respect, as the discrepancies between these two performances are great in most cases. However, in some cases the existence of street performance tests has had a very marked effiect in improving maintenance conditions. This improvement has sometimes been fully equal to that of a much heralded improvement in efficiencies of lamps as accomplished by the manufacturers. Lamp efficiency, therefore, is both a manufacturing and an operating matter, and every large contract should have some check on maintenance.

As to the broader economic aspects of street lighting contracts there have been some interesting recent developments. Public utility commission regulation in many states has helped to remedy conditions of over charge and under charge for street lighting service. Assuming that a public utility commission does its duty in a theoretically perfect manner, municipalities should pay continuously the actual cost of street lighting service, including the depreciation caused by obsolescence of street lighting art. Such ideal conditions, however, have rarely been found in practice as yet, and most critics are paying too much or too little for such service. In order to provide flexibility in a street lighting contract a few contracts have been drawn, under which the city pays on a kilowatt hour basis much like a private customer. If the city owns the lamps, it is then free to change the size and type of lamp as often as it may see fit without the necessity of renewing a street lighting contract or having a commission investigation. City ownership may even extend to circuits and poles with purchased energy. Equitable results should be obtained with either form of contract and the choice must depend largely on the relative flexibility of the two methods in any given case.

I have left the most important changes in our conceptions of what constitutes the real problem of street lighting until the last. How are lamps to be spaced, how high are they to be mounted, and how equipped as to globes and reflectors, to give the best discernment of objects along the street, with the best general appearance; or if the questions of easy discernment and pleasing appearance are not answered in the same way, what point of compromise shall be adopted? An early idea was that the effectiveness of a system of street lighting depended mainly on the total candle power of the lamp placed along a street without much regard for the height, distance apart, equipment, or size of each unit. Later, more scientific ideas were advanced, based on the illumination along the street. Ten or fifteen years ago, vertical illumination was the chief thing considered in street lighting. Later horizontal illumination on the street surface received more consideration. All of the following have been proposed as criterions for the value of a system of street illumination:

Minimum vertical illumination between lamps.
Average vertical illumination.
Minimum horizontal illumination.
Average horizontal illumination.

None of these is sufficient and all of these together would be incomplete for the reasons given later, but if one is selected as a practical working measure for residence streets at the present time, minimum vertical illumination between lamps would probably be as good a criterion as could be established, and minimum horizontal illumination for business streets, but these are far from taking into account all of the conditions which influence clearness of vision. In the year 1910 two memorable contributions to the literature and knowledge of a street lighting were made. One of these by Mr. Preston S. Millar, before the Illuminating Engineering Society, showed that a considerable portion of our seeing by street lighting at night is by virtue of the silhouette effect, whereby objects are seen as dark silhouettes against a light surface background. Illumination of the street surface rather than the vertical objects on it is necessary for this.

The other contribution was by Mr. A. J. Sweet in the Journal of the Franklin Institute, in which the blinding effects of glare were studied. The blinding effect of glare, that is, the effect of a row of lamps within the line of vision when looking along a street at night, renders ineffectual a certain percentage of the light expended upon the street for the purpose of illumination, because it decreases the ability of the eye to see. The existence of such an effect is easily demonstrated by anyone, but quantitative measurements of it were first published in 1910 as stated, and have since been studied in more detail by Mr. Sweet.

We see objects along a street at night just as we see all objects at any time, namely, by virtue of difference in brightness and color of their surfaces. A study of silhouette effect in connection with this fact leads to some interesting results. As stated, a considerable portion of our discernment at night is by virtue of this silhouette effect. Fortunately, the reflection from paved surfaces is greatest at very oblique angles, so that, as shown by Millar, the brightness of a street surface is much more nearly uniform than would be indicated by a measurement of horizontal illumination. All this helps to make a uniform background for a silhouette effect.

The avoidance of glare effect (which in common past practice may easily be such as to call for from 1.2 to 1.8

(Concluded on page 32)

Electric Railways

Educating Motormen and Conductors to Maintain Amicable Relations with the Travelling Public—the Successful Policy of a Great Railway

The Twin City Rapid Transit Company's system, operating in and around St. Paul and Minneapolis, are looked upon in Canada and the United States as one of the best, if not the best, maintained and managed systems on the continent. Not the least important evidence of this good management is the amicable relationship existing between the patrons of the company and the employees—the results of a plan for effective training of conductors and motormen in the best attitude to assume, under different conditions, towards the public. At intervals of about a month the general superintendent arranges to have as many men as can be spared from their work called together for a heart-to-heart talk by the general passenger agent. Every employee about whom any complaint has been received since the last talk is obliged to attend these meetings, as well as all the new men. These talks are begun by referring specifically to each of the complaints that have been received (without mentioning the names of the employees against whom the complaint is made), and as each complaint is mentioned the passenger agent offers suggestions as to how the trouble with the passenger might have been avoided and how the trainmen should have acted under the circumstances so as to avoid any dispute. After the specific cases have been dealt with, a general talk of twenty minutes follows on how to meet best some of the inevitable troubles that are continually cropping up with passengers. Over fifty of these addresses have been given during the recent past, with an average attendance of 200 men.

These conferences are in charge of the general passenger agent, Mr. A. W. Warnock. We print extracts below from a number of his talks, reproduced from a recent issue of the Electric Railway Journal:

Rules can be made to cover every situation, but, after all is said and done, you must use common sense in following them. And we expect you always to use common sense. By using common sense you can do much to make our service more attractive and avoid cause for complaint as to your conduct.

The company expects you to be careful and zealous to protect its property and interests, to take a just pride in the service in which you are engaged, and urges you to bear in mind that in any public service, whether street railway work or any other employment where you come into contact with the public, you are constantly called upon to exercise care, patience, forbearance, and self-control.

Courtesy to Passengers.

First, last, and all the time, always be civil and courteous, no matter what the provocation. Trying situations may arise when it is difficult to follow that rule, but strict adherence to the rule of politeness to every passenger under all circumstances will save complaints being made against you. You will also make friends for yourself and for the company by which you are employed. It is often difficult to be courteous to people who are not courteous to you. But you must learn to take such difficulties in good temper; it is a part of your job. You must treat passengers courteously, no matter how they may treat you.

Common courtesy is the duty of every man who meets the people in any capacity. In handling the public we must all take the public as it is and not as it should be. Those of us who come in contact with the public can do much toward educating it by our example. The good-will and friendship of the communities served by this company are greatly desired. The strongest recommendation for promotion which an employee in any department can have is the fact that by uniform courtesy and accommodation to patrons he has secured for himself and for the company the good-will and friendship of the public he serves each day. For this reason all employees of the Twin City lines are earnestly urged to extend to patrons of the road every courtesy, and to bear in mind the fact that our sole purpose is to furnish the public the highest class of service, and that the character of the service—its acceptability to the public—depends in a great measure upon the spirit in which it is rendered.

If every conductor and motorman will treat every passenger in the same way that he would like to have his mother, wife, daughter, or sister treated under similar circumstances by some other trainman, we are sure the resulting good service will cause all our passengers to feel kindly toward us.

Kindness is one of the manliest of qualities. Be kind and considerate, even though the weather is disagreeable and your passengers are irritable. Make it a habit to be kind. Kindness is the greatest friend-maker and friend-keeper in the world. People won't stop riding on your car because they do not like you, but they will judge our whole service by your conduct. It is up to the company to give the public satisfactory service, not only in cars and equipment, but in men, and that is the reason why we strongly emphasize the necessity of being kind and courteous as well as careful at all times.

And be courteous not merely most of the time to most of our patrons, but all of the time to all of our patrons.

Collecting Fares and Making Change.

Sometimes a dispute arises between a passenger and a conductor as to whether fare has been paid or not, the passenger contending that he has already paid it. A conductor may also make the mistake of asking for a second fare from a passenger, particularly if the passenger has changed his seat after paying his fare. In both of these cases the conductor should accept the passenger's word without any comment whatever, and not demand another fare. The same rule applies when a parent in charge of a child says that the child is under six years of age, and therefore should ride free. Conductors must not question such statements from parents. The parent certainly knows how old the child is. Even though the conductor has good reason to doubt the parent's word, he must not say so.

If a passenger pays fares for other passengers on a car and points out where the passengers are sitting or standing, the conductor must take pains to see that the second fares are not collected from such passengers. If he should make such a mistake and a demand is made for a refund, the conductor must not refuse the passenger in a rough or uncivil manner. The conductor should explain that when once he has rung up fares on his register he is not permitted to make refund of same under any circumstances, or fail to ring up the next fares collected. He should say: "I am sorry I made this mistake and that you are put to any trouble, but if you will please drop a postcard to the general passenger agent he will make the matter right with you.'

There is no definite rule as to how large a bill you are obliged to change. We want you to change any piece of money that you can. A good way to check yourself as to what you have received from a passenger is to name the denomination when you receive the coin or bill. If a passenger hands you a 50-cent piece, say to him, "Fifty cents," as you take the coin, or "Five dollars," as you take a five-dollar bill or gold piece. Such a check will not leave any room for doubt as to what the passenger gave you. It will save you from giving wrong change.

Be sure, absolutely sure, you give every passenger his proper change. Let there be no mistake about that. Every passenger must get what is coming to him. While you can accept Canadian coins for fare, nevertheless, if passengers object to receiving Canadian coins in change from you, give them United States coins.

Conductors must not show annoyance when passengers give them large pieces of money to change, nor should they take out their feelings on passengers by returning them a lot of bulky change. If a passenger asks for any particular kind of change, whether bills or large silver pieces, instead of small change, try to accommodate him, and give him what he wants. If you cannot give him what he desires or are obliged to hand him some small coins, say: "I am sorry I cannot give you anything better than this." Change must always be returned to a passenger in a civil manner. Never throw change on the lap of a woman, but hand it to her in the same decent way you would like to have change handed to you.

Conductors must never make comments as to money they receive from passengers, so long as it is good money. Do not tell passengers that they should provide themselves with smaller change before getting on your car, or threaten that you will not change any more money for them if they offer you large coins or bills in the future.

If, when you hand money to a passenger, any of it is dropped on the floor, pick it up and hand it to the passenger, even though the accident was the passenger's fault. Such a little service is a courtesy sure to make a friend. The more little courteous things we do for those with whom we come in contact the more friends we shall make for ourselves. If a passenger hands you a bad coin or a foreign coin of such a kind that you cannot accept, explain to him quietly and politely why you cannot accept his money. By handling such a situation in a gentlemanly manner you will avoid another cause for complaint.

Issuing Envelopes.

We believe this is the only company in the United States that issues envelopes to passengers when they find themselves on our cars either without any money or with bills or coins of such size that conductors are not able to make change. While this practice is abused considerably, nevertheless we are glad to continue it, not as an obligation on our part, but as an accommodation. Unless a bulletin is posted directing you not to issue an envelope to any particular passenger and he tells you that he has no money with him to pay his fare, you must issue him an envelope promptly, without talking to him discourteously or lecturing him for not having money with him.

Let there be no doubt whatever that you have offered a transfer to each passenger when he pays his fare. Sometimes a passenger will complain that a transfer was not offered to him. He may not know our general rule, which is the same as in all large cities, and designed particularly for the benefifit of passengers, that transfers are issued only when fare is paid. See that the passenger gets a chance to take a transfer by asking him distinctly if he wants one, and to what line he desires to transfer, so that you may punch same correctly. If care is taken in this regard many other complaints will be avoided.

Keep thoroughly informed as to all our transfer rules, know and understand how to punch your transfers properly, and be careful to do so. Also understand what transfers are good on your line, and how they should be punched. Be careful that you do not refuse a good transfer, and be absolutely sure when you do refuse a transfer, for any reason, that you are in the right and following your rules intelligently.

If a passenger gets on a car with a transfer that has been mispunched in any way by the issuing conductor, or if he gets on a car away from the proper transfer point, or if he presents a mutilated or torn transfer, it is necessary to collect a second fare from him. But be sure that you do so civilly. Explain to the passenger politely why the transfer is not good and why you are not able to accept it. If the passenger says that the transfer was given to him mispunched or torn, or that he was told to get on the car at the wrong place and that he took the first car—in other words, that he was not to blame—we are sure you will have no trouble with him if you will say to him: "I am sorry that our rules do not allow me to take your transfer (explaining the reason). Please pay me another fare and mail your transfer to the general passenger agent, and he will reimburse you for the transfer, as well as for the postage you spend in sending the transfer to him." Such a civil explanation is sure to satisfy the passenger in such cases.

If a passenger finds a misplaced transfer and asks for a return of his cash fare after you have rung it up, tell him that you are not allowed to refund a fare after you have rung it up, but that it is not necessary for him to be out of pocket by reason of his mistake. Tell him to mail the transfer to the general passenger agent, who will promptly refund, as already mentioned.

If a passenger takes a transfer when he pays his fare, and later on decides that he wants a transfer to another line, you should exchange it for him on his request, without any comment on your part, such as telling him in the future to make up his mind what he wants.

No Nuisances on Cars.

In order to give our patrons the best service, all nuisances on our cars must be stopped. This includes passengers who act in a disorderly manner, who use profane, vulgar, or obscene language, who mutilate the company's property, such as cutting car seats, who spit anywhere on the car, and who smoke in the car except on the platform, as well as those who are intoxicated to the extent that they are offensive or frighten other passengers. Handle all such cases with good judgment, without getting angry or losing your self-control.

If a passenger gets on your car thinking it is the car he wants and almost immediately afterward finds that he has made a mistake, let him get off at once on his explanation to you that he made a mistake. Do not insist on collecting his fare and issuing him a transfer, unless you know positively that such a transfer will be accepted on the car he wants. If you cannot issue him a transfer to his proper car, let him off without collecting any fare. Do not tell him to keep his eyes open next time, or make any uncivil remarks. We all make mistakes.

Keep your car seats and floor free from paper and other rubbish, and thus have your car neat and tidy at all times.

We want all conductors to comply readily with the reasonable little requests made by passengers that contribute to good service. As far as possible help on and off your cars women and children, the aged, the weak, and the helpless, and open and shut the doors for them, as well as shut the doors after all passengers who do not do so themselves. Shut the doors promptly when a passenger asks you to do so. Do not say: "Shut it yourself," or anything of that sort.

If you see a passenger trying to open or close a window and you can take the time to do so, step up and open or close it for him. The passenger probably does not know how to do it as quickly as you do. Do not tell him you haven't time. Take time. If a passenger asks you to open a ventilator do so, even though it is best to close it after the passenger gets off. Ventilating a car is a serious problem, which we are studying, and our cars are not all equipped with the same sort of ventilators.

If a passenger raises a front curtain when the lights are turned on, do not pull it down angrily and tell him to mind his own business, that you are running the car, or anything of that kind. He may have raised the curtain unthinkingly. Simply pull it down and say: "Please do not raise the curtain. The motorman cannot see to do his work properly with the curtain up while the lights are on in the car."' Such a suggestion is sure to be received in good spirit, and you will avoid unnecessary trouble. When it is necessary to ask passengers to move up in front on account of blockade in the rear part of the car, do not say, "Move up in front, there," in a surly tone. Put a smile in your voice and say, "Please move up in front." Here, again, courtesy will do the work best.

If a passenger gives the signal for a car to stop and for any reason the car does not stop, the conductor must give the overhead signal promptly to let the passenger off. If a passenger gives the overhead signal himself, the conductor must not resent the action in any way, as a passenger has a right to do so under the circumstances.

While we do not believe it is good policy to permit conductors to give information to passengers relative to articles claimed to have been lost on our cars, nevertheless that does not mean that conductors should mislead passengers by telling them that they have not found any articles when they have. Simply say: "I cannot give out any information as to lost articles. Please call at the general office and inquire at the lost article department."

Personal Appearance.

All trainmen are urged to present a neat personal appearance at all times. A man's appearance has much to do with his success or failure in any work involving contact with the public. A man of slovenly appearance is often taken for a man with a slovenly brain, and hence is overlooked when chances for promotion come up. Keep well washed, well shaved, well brushed. Get the clean, well-groomed habit.

Answer Questions Promptly.

Questions must be answered carefully and correctly and with a cheerfulness that does not offend or discourage the questioner. It should be remembered that questions which on their face appear to be foolish to those familiar with our business are not foolish to the person asking them, and should be answered promptly and kindly. You, with your experience and training, are thoroughly familiar with many things that strangers in the city, and even local people, do not know, and you should bear that fact in mind; and, in replying to questions, always give the information fully and plainly in as few words as possible and without any suggestion of superiority born of greater knowledge. It is true that the manner in which a statement is made or question answered by any person serving the public is frequently more aggravating and offensive than the words that are used. A kind and gracious manner is the mark of a self-respecting man—and a man who respects himself rarely fails to command the respect of others.

The efficient trainman, or man in any walk of life, does not discriminate between rich and poor, men, women or children—or between a well-dressed person and a poorly-dressed one. He treats everybody with equal consideration. Keep posted as to location of streets or public buildings and points of interest along your line and all other lines, so as to give the public accurate information. Every employee has many opportunities to increase the value of his services by a little personal effort that costs him nothing, and wins smiles of approval that are more desirable than frowns.

Finally—Never Get Angry.

Do not get angry under any circumstances. Remember, if you are in the wrong, you can't afford to get angry; if you are in the right, you don't need to get angry. When a man gets angry he discounts his ability heavily.

For his own personal good and the strengthening of his character every street railway employee should cultivate the art of smoothing things out—truly more satisfactory than to end the run of a day with some useless altercation with a patron rankling in his mind and filling his hours off duty with worry. A prominent street railway man has wisely said: "There is no place in which the golden rule can be so effectually employed or will pay such large dividends as on our modern street cars." And the application of the golden rule with Twin City trainmen simply means this:

Treat every passenger with whom you come in contact exactly as you would like to be treated if you were the passenger.

Every victory over discourtesy is well worth the effort, and makes the man bigger and stronger and a better employee. It brings him nearer promotion and raises him in the esteem of his family. It pays to be good-humored. It pays to control yourself.

We feel confident that our trainmen will all join in the effort to be watchful and considerable of our passengers' safety and comfort. Let us all check ourselves and resolve that as far as we are each concerned, no patron can ever complain justly against us for failure to do our work honestly, cheerfully, and properly."

With an increase in gross earnings of $84,533 during the year ended June 30th, the Montreal Tramways Company had a gain in net of $91,476. The rate of operating expenses fell from 56.9 in 1915 to 56.1 in 1916. The net income available for dividend is $784,304, an increase of $105,436.

The first electric railway in America, and the second in the world was operated at the Canadian National Exhibition, Toronto, Ont.

Recent Street Lighting Developments

(Continued from page 29.)

times the illumination that would be necessary if glare were not present), is partially accomplished by increasing lamp heights. Good practice now mounts lamps from 16 to 25 and even 30 feet in height, where formerly heights from 10 to 14 feet were employed.

As to how far it is feasible to reduce the blinding effect of glare materially by the use of refractors which reduce the flux of distant lamps entering the eye, without too much darkening of the street surface between lamps, is a point upon which conclusive demonstration may be looked for soon. That a partial solution of the difficulty is feasible there is no doubt.

I have been able here to touch but briefly on some of the more important points of this subject.

The Dealer and Contractor

The Jobber and His Relations with the Other Factors in the Electrical Trade—A Valuable Link.

By F. L. Fullerton*

Did it ever occur to you, gentlemen, what a wonderful opportunity you would have to improve your conditions if you could call together at a general meeting the people you are serving in this great and glorious State of Pennsylvania —the architects, builders, mill and factory owners, the house owner and home maker? Don't you believe with me that they would listen with keen minds and open hearts to your problems? And don't you believe by explaining to them the amount of brains, energy and capital you are required to employ in wiring their buildings and homes in a safe, artistic and efficient manner, they would appreciate and support in a substantial way the established and reliable electrical contractor rather than the "fly-by-night, carpet bag, bell hanging engineer," who follows the code of "just get by" and cares naught for what may happen to the job after he has been paid?

This is the opportunity that your committee have given me—the chance to tell the people we jobbers are serving in Pennsylvania our problems, and of the brains, energy and capital required to serve you efficiently. The fact that you have asked a jobber to address you indicates most conclusively that you realize how necessary we are to each other, and with this spirit of co-operation in mind I am given courage to talk plainly, feeling that the sting of any unvarnished truths I may utter will be received as they are intended and that you will think them over before allowing your anger to rise. I thank your committee for the honor they have bestowed upon me and wish that the mantel of Billie Sunday might fall on me so that I could more forcibly impress upon you the necessity of co-operation between the electrical contractor and jobber.

The Jobber

Is there an electrical contractor in this room who believes he could get along without the jobber? If there is I am going to give him a package to take home that will change his belief when he opens it up and thinks it over.

Do you know how many lines of different manufacturers' product you are using during the course of a year in your work? I have by consulting simply one buyer's directory discovered that there are more than 1,700 manufacturers of electrical house wiring devices such as a jobber carries in stock for you. This number does not include manufacturers of motors, generators, turbines nor apparatus of this character. These manufacturers make tens of thousands different items of various sizes and shapes; things that you must have before you can start or complete a job. When you get a job on which you have the preference because your price was forty per cent. lower than your nearest friend, can you wait until you have written out orders to some thirty different manufacturers and they have shipped the goods by freight from either north, east, south or west after spending a week in looking up your credit rating? If there is a time clause in your contract I will wager that your pants will wear thin squirming on the anxious seat, and while you are waiting you will try and figure the chance of your old uncle dying so you can get that $25,000 or $50,000 necessary to have these wiring supplies in your stock in order that you may start a job at once. But, as it is, with your favorite jobber located near you, you are relieved of this large investment and the burden of overstocking, or the carrying on your shelf of profitless or obsolete material. You are able to take advantage of every new device or character or grade of material that is placed upon the market, and yet it is from you who put the assembling of small orders upon the jobbers that the greatest outcry for better treatment comes. You have at your call our high class salesmen to advise you of the latest appliances, and you many times waste his valuable time cooling his heels at your office door while you make your arrangements for a fishing trip. You do not realize that each salesman moment wasted adds some more to the jobber's operating cost, and if we are to make a net profit at the end of the year it is necessary for us to add these wasted moments to the price of our goods.

Backs the Contractor

You procrastinate in placing your orders and then threaten us with the loss of your business if your shipment is delayed. Your orders are compiled in such a manner that our editor has to be a Sherlock Holmes to understand what you want, and if you receive the wrong goods and carelessly install them you threaten to sue us for damages. If you make a mistake in your specifications or order more material than your job or stock requires you feel perfectly justified in returning this excess to your jobber, perhaps six months later, and you expect full credit, refusing to consider a reasonable service charge. You don't seem to realize that the expense to a jobber for taking goods back into his stock and issuing necessary credit memorandum is greater than his expense on the original sale and shipment. You expect prompt and infallible service from us, but become very much peeved when sixty days later our collection department respectfully reminds you that we would like to have the money for our goods, and you tell us that it is an insult for us to ask for our pay before your customer has settled for the work on which our material was used. In other words, the jobber must not only act as your warehouse, stock room and shipper, but must also be your banker and banker of your customer. During the present period of continual increases in the costs of materials some contractors have taken advantage of their credit with jobbers to such an extent that they have even used our money to speculate with. Do you call this a square deal? What do you pay us for this capital, energy and scientific warehousing necessary for the distributing of your necessities? You may think you pay us the price we ask, but this is not true. You use the buyer's "prerogative," which allows you to deviate

* President Fullerton Electric Co., New York City, before Convention of Electrical Contractors' Association of Pennsylvania.

from the truth. Our salesman has already spent the entire morning on account of your "fishing" arrangements and takes your order subject to the house's approval. The house finds that the salesman has spent five dollars of his time and car fare and that the price you are willing to pay on the $100.00 order will show a 5 per cent. gross profit, which will allow us to break even on the salesman, so we make you a present of 12 per cent., which is our cost for handling the order (this does not include collection expense). When you receive the goods the $12.00 will be included with them. You may not see it, but it is there. Look for it the next time you play the Russell Sage act on the jobbers' salesmen.

Unfair Conditions

The instances I have cited are but a few of the unfair, unreasonable and unjust conditions that the contractor, our largest buying customer, imposes upon us, and in view of the fact that the jobber is an economic factor in the distribution of electrical appliances and supplies and is saving the contractors time, worry and investment, it is up to you to co-operate to the fullest extent. You should give us your unqualified support and not flirt with the manufacturers over the jobbers' shoulders unless you find that you can get along without the jobber's varied stock. The manufacturers to-day realize that the jobber is an economic factor in his business and that he cannot afford to distribute his goods to the general trade at a profit, for to cover carefully such a broad expanse of territory as our country represents would take an army of salesmen, and yet there are "weak-kneed" manufacturers who have wishbones instead of backbones, and who, because either through the inferior quality of their goods or inefficient methods of marketing them, are compelled to go direct to the contractor and dealer. You should tell this manufacturer to correct his policy so that the jobber will handle his line, and that when he does this you will buy his goods through your jobber. Instead of taking this stand, some of you yield to the temptation and become inflated with the idea that because a manufacturer has offered to sell you direct that you are a jobber, and you become the same menace to our business that the "fly-by-night, carpet bag, bell hanging, electrical engineer" is to yours.

Work With Central Station

An analysis of your excuse and my excuse for being in the electrical business shows us that we are both beholden to the central station for the enormous capital and brains they have directed to the development and utilization of electrical energy and it is up to us as good business men to aid them to the best of our ability in increasing the load on their lines. The demand for current consuming devices is increasing in every direction, and with the development of each new device the consumer is being brought to realize more fully the comforts and benefits that may be obtained by the use of electricity. We should foster and promote the use and sale of socket devices for the home, and by so doing we can increase the central station and our profits considerably, besides aiding mankind to take advantage of this wonderful energy that God has given us.

Hydro Rules and Regulations Being Enforced

The warning notice inserted in the daily papers and the Electrical News recently regarding the enforcing of the Hydro Inspection Rules and Regulations is being generally regarded, but there are still, apparently, a few who are inclined to treat the matter lightly. The result is that already two convictions have been made in the police court. Last week in the city of Hamilton one contractor was fined $5.00 for putting copper wire in fuse holders and another paid the same penalty for adding to an installation which had been passed, without noticie to the inspector.

The Hydro-Electric Power Commission of Ontario have issued instructions to H. F. Strickland, Chief Electrical Inspector, to prosecute offenders against the Act and we are advised that the names of some parties in the city of Toronto are now before the Commission, and it is likely that police court proceedings will follow immediately. The Commission state they are determined to enforce the regulations and to bring to time contractors and others who fail to take out permits. This notice may serve as a further warning to all those who are inclined to presume too much on the former leniency of the Inspection Department.

Saskatoon Cooking by Wire

The city of Saskatoon have recently reduced their rate from 4 cents to 2¼ cents per kw.h., with a view to encouraging the use of electricity in the home, and they announce that the public is becoming more interested in the electric range. With the idea of bringing the advantages of electric cooking to the attention of the citizens the electrical department of the city recently addressed the following letter to the homes of their customers. This letter does not exaggerate in any way the advantages of the electric range:

Saskatoon, Sask., August 1, 1916.

Dear Madam,—Here are a few good reasons why you should "Cook by Wire":

Electricity is **safe.**

Absolute protection from fire. The use of matches is done away with. There is no flame anywhere. No danger of explosion. No overheated flues.

Electricity is **clean.**

No blackened walls or ceiling. No dirt, soot, ashes or smoke. Electric ranges are easily cleaned and easy to keep clean. No dirty, smoky pots and pans to be constantly cleansed.

Electricity is **sanitary.**

No poisonous gases to escape and contaminate the atmosphere or the food which is in the kitchen or pantry.

Electricity is **healthy.**

The atmosphere in the kitchen is always pure and wholesome.

Electricity is **economical.**

There is no waste of food by shrinkage. Additional nutriment is retained in all food cooked. **Time is saved** in cleaning range and utensils. **Current is saved,** as the heat is retained long after the current is switched off automatically when the desired temperature is reached. **Money is saved,** as at 2¼c per unit electricity is cheaper than any other fuel; also, with the dirt eliminated, the expense of housecleaning is reduced to the minimum. Your fire insurance premium is less if electricity is used instead of fire.

Electricity makes a **cool kitchen.**

The heat is concentrated where it is needed. No excess heat in the kitchen. The electric range is especially desirable in the summer months.

Electricity is **under perfect control** at all times.

With three degrees of heat—low, medium, and high—there is an even temperature at all times for the many different kinds of food to be cooked. Several kinds can be cooked at once, each getting the correct degree of heat required. Cooking becomes an exact science. No uncertainty and no failure.

Electricity is **efficient** and **quick** in operation. Heat is **instantly available** and readily regulated.

Yours truly,

F. Hanson,

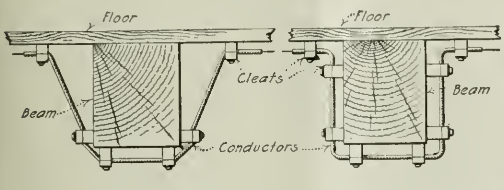
City Electrical Engineer.

Standard Interior Wiring Methods

The last of a series of three comprehensive articles outlining the latest approved practices as required by the Code and as developed by the best workmen

By Terrell Croft

In carrying wires on cleats around timbers, where it is desired to maintain the number of cleats used at a minimum, it is better to locate the cleats screwed to the ceiling about 3½ inches from the timber around which the wires are being

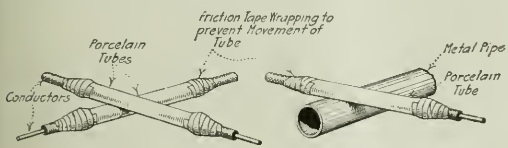


I-Wires Held away from Beam II- Wires Close to Beam

Fig. 17

carried, as shown in Fig. 17, I., rather than to set the cleats close to the timber. Where the cleats are too close, the vertical portions of the wire are likely to come in contact with the timber. Probably the best arrangement is to use an additional set of cleats, as shown in Fig. 17, II., in which case the wires lie reasonably close to the timbers and yet are prevented from contacting therewith.

The protection of conductors against accidental contact



I-Crossing of Two Wires II-Wire Crossing Pipe

Fig. 18

with pipes, metallic conducting material, or other conductors which lie near the route of the wire run may be effected as specified under Code rules 16e and f. The first sentence of Code rule 16e specifies how conductors in dry places lying near pipes or other conducting material should be protected against contact therewith. The remainder of 16e specifies how conductors in dry places lying near other conductors should be protected. Rule 16f indicates the protection that must be afforded conductors in wet places against contact both with other conductors and with metallic objects. The three conditions just noted are discussed in following paragraphs.

Methods of protecting conductors in dry places against contact with piping or other conducting material are illustrated in Figs. 18, II.; 19, II., III., and VI. Either flexible tubing or a porcelain tube may be used on conductors on wires for protection in such locations. Porcelain tubes are preferable, but flexible tubing is frequently used, particularly where the wireman fails to slip a porcelain tube on the

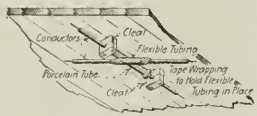


Fig. 20

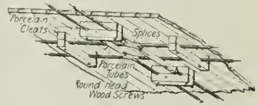


Fig. 21

conductor before it is pulled into position. In this event he he can split a length of flexible tubing longitudinally, snap it around the conductor and tape it in place. Split porcelain tubes can also be used for this service, but usually they are not available. Either flexible tubing or porcelain tubes on a conductor must be prevented from slipping, either by taping their ends to the conductor, as shown in Fig. 18, II., or by placing knobs (or cleats) at either end of the tube, as shown in Fig. 19, III. and IV. A water-pipe crossing is ordinarily considered a "wet place," regardless of where it is located in a building, because a water pipe is always liable to sweat and thereby saturate with moisture things that touch it. Gas and soil pipe crossings are ordinarily considered as dry places unless they occur in a basement or bathroom or in some location which obviously is a wet place.

Methods of protecting conductors in dry places from contact with other adjacent conductors which they cross are shown in Figs. 18, I., 20, 21, and 22. Note that if a 2-inch

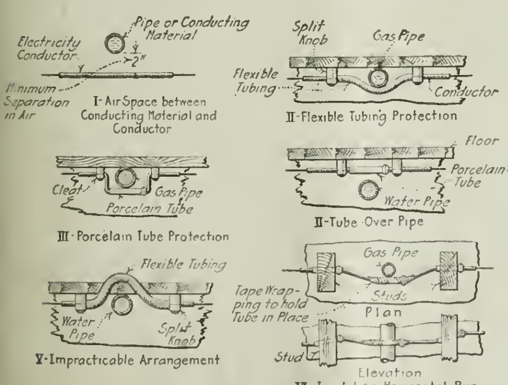


Fig. 19

Fig. 22

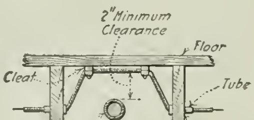


Fig. 23

air space can be provided between the crossing conductors protection of the nature indicated is not necessary. Ordinarily, where conductors of opposite polarity or of different systems cross, it is necessary to put a tube on only one of the crossing wires, as shown in Fig. 21. However, tubes are sometimes used as shown in Fig. 18, I. Flexible tubing is sometimes used for this service instead of porcelain tubes under conditions specified in the preceding paragraph and as shown in Fig. 20. However, the porcelain undoubtedly provides the most effective insulation. Where large conductors, say those exceeding No. 6, B. & S. gauge, cross one another in exposed work, a crossing made as shown in Fig. 22, by forming a bend in one of the conductors at the crossing point, is ordinarily acceptable, particularly if all of the conductors are substantially supported, as shown by cleats. In any case the flexible tubing or tubes protecting conductors at crossings must be securely held in proper position, as shown in Figs. 18, I., and 21, by either cleats or knobs or by a tape wrapping.

Where conductors cross metallic objects or other conductors in wet places a 2-inch air space should always be provided between the conductor and the object which it

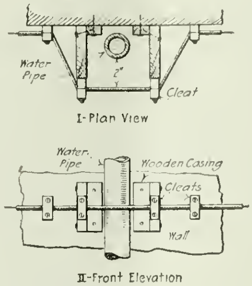


Fig. 24

crosses, as shown in Fig. 19, I. and V., and in Figs. 23 and 24. Frequently, where it is difficult or impossible to provide this 2-inch air space, inspectors will accept crossings made as shown in Fig. 19, III. and VI., where porcelain tubes are placed on a conductor for its protection.

Wires should be run over rather than under pipes subject to dampness, Figs. 18, II., and 19, IV. and V., so that there will be minimum likelihood of the moisture from the pipe permeating the insulation on the conductor. However, in practice, it often occurs that this rule cannot be followed rigidly. In such cases inspectors will frequently approve an installation, in accordance with the terms in the last paragraph of rule 16f, where the conductor runs under rather than over a damp pipe, particularly if porcelain tubing is used on the conductor for possible insulation in addition to

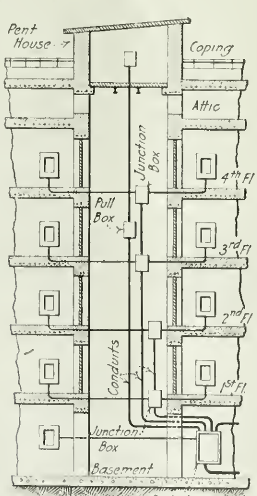


Fig. 25

the 2-inch air space required in damp places. Where a conductor is to be protected from a vertical lamp pipe, a "bridge" may be arranged around it, as shown in Fig. 24.

Electrical conductors in elevator shafts should not be supported on insulators or on molding, because experience has

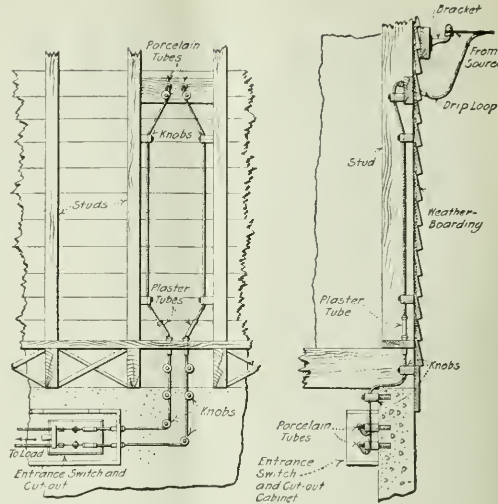


Fig. 26

shown that wires installed in accordance with these methods are frequently displaced and sometimes short circuited. Another objection to wooden molding is that it is likely to carry fires, if they are started, from the bottom of the shaft to the top because of its combustible nature and because of the strong drafts that frequently exist in elevator shafts. Conduit should be used, as shown in Fig. 25, where it is desirable—and it frequently is—to install conductor runs in elevator shafts.

The details of an entrance into a frame building in a knob and tube installation are shown in Fig. 26. The entrance switch is located in the basement and the conductors are carried thereto from the entrance outlet down in the outside wall space between studs. The arrangement shown

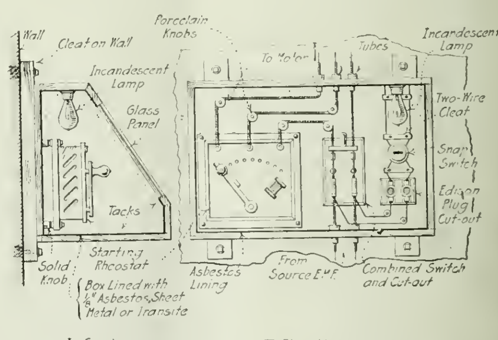


Fig. 27

is an excellent one and one that can be placed with a minimum expenditure of time.

The details for an enclosing case for a motor starting rheostat located in a dirty or moist place are shown in Fig. 27. A glass panel is provided in the door, enabling the operator to note the position of the starting rheostat handle and whether the switch is open or closed. The incandescent lamp is provided so that there will be light inside of the box for inspection and repairs. Note that the lamp is tapped in on the line side of the motor cut-out so that even if the fuses protecting the motor "blow," the interior of the box may be lighted. In a location that tends toward dampness the incandescent lamp may be permitted to burn continuously. It will then usually dissipate sufficient heat to keep the interior of the box dry. The front of the box is inclined so that the door will always tend to close itself in accordance with the requirements of the Code.

An enclosing case for motors located in dusty or linty

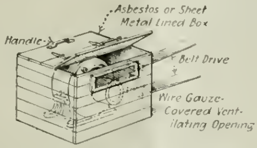


Fig. 28

places may be made as shown in Fig. 28. Such a case, as hereinbefore indicated, is not ordinarily necessary for alternating-current motors or for enclosed direct-current motors, but should be provided for open direct-current motors unless the motors are protected from the lint and dirt by some other means. Such a case can be made from ⅞ inch tongued and grooved timber and should be lined with asbestos, or preferably with sheet metal. In addition to having the covers so that they will open as shown in the figure, it is very convenient to arrange the sides on hinges so that they can be let down to provide for the maintenance and inspec-

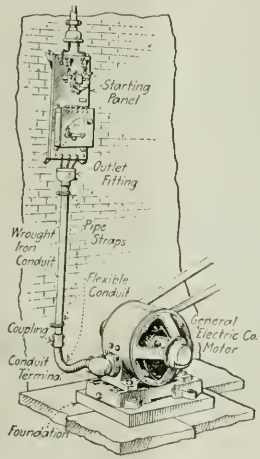


Fig. 29

tion of the motor. Gauze-covered ventilating openings must be provided, as shown, otherwise the motor is liable to overheat.

A conduit wiring motor installation wherein a starting panel is used is shown in Fig. 29. The installation illustrated is probably as compact and as neat a one as it is possible to make. Note that the motor is provided with a conduit-wiring terminal box and that a starting panel requiring a minimum of wiring for its installation is employed. Flexible conduit is used between the vertical conduit run and the motor, permitting the ready removal and replacement of the motor.

Boving Turbines for Sherbrooke

The Boving Hydraulic and Engineering Company, Ltd., Lindsay, Ont., have been awarded a contract for the twin turbines to be installed in connection with the new dam for the city of Sherbrooke, Que.

Onward Mfg. Co. Granted License

The United Electric Company of Canton, Ohio, have granted a license to the Onward Manufacturing Company, of Berlin, Ont., to manufacture and sell the Eureka electric vacuum cleaner in Canada. The Canadian patents on which the license is based are numbered 76595, July 8, 1902, and 79641, dated March 17, 1903. The Onward Company have been marketing the Eureka for the past five years, and, it is stated, there are now over five thousand of these cleaners in use in Canada. The granting of this license finally settles the rights of the Eureka on the Canadian market. The Onward Manufacturing Company have adopted the policy of establishing exclusive sales agencies, and an elaborate plan of campaign has been laid out that will be of great assistance to the dealer. It is intimated that dealers and users of all unlicensed vacuum cleaners will find themselves involved in legal prosecution for infringement, as it is the intention of the owners of patents to vigorously defend their rights.

German Gas Will Not Penetrate

Griffiths Brothers & Co., of London, Eng., manufacturers of "Ferrodor" paint, "Anti-Sulphuric", enamel, and other paints well known in Canada, have received an order from the British Government for five thousand gallons of new material which is used to prevent asphyxiating gases penetrating the stitches of the protective masks worn by British and Canadian troops. This new preparation was subjected to the severest tests before being finally adopted. Spielmann Agencies, Regd., Montreal, are the Canadian representatives for this company.

Allen Soldering Materials

The L. B. Allen Company, Inc., 4517-29 North Lincoln Street, Chicago, manufacture a very complete assortment of soldering equipment as required by electrical wiremen and contractors. The list includes: The Allen soldering paste, the Allen soldering stick, the Allen soldering salts, a liquid flux put up in portable form; the Allen commutator lubricant, a soldering flux for aluminium; also a very convenient form of flux for other metals, put up in handy containers, one of which is known as the Allen Fountain Brush, or the Solderman's Fountain Pen, with which you just brush the flux on; this soldering liquid is non-acid, odorless, non corrosive, and is easily cleaned off.

Adding 5000 kv. a. Turbine

Mr. R. S. Kelsch, consulting engineer, has just closed a contract with the Canadian General Electric Company for a steam turbine, for the Acadia Coal Company, of Stellarton, N.S. The turbine is five stage, 3000 r.p.m. Capacity of generator will be 5,000 kv.a.; speed, 3,150. The generator will deliver three-phase, fifty-cycle current. The Canadian General Electric Company will also furnish the Worthington condenser, pumps, and all auxiliaries. The odd voltage and frequency selected is due to the fact that this turbine will operate in multiple with the coal company's existing turbines furnished some years ago by Allgemeine Elektricitats Gesellschaft, Berlin, Germany.

The merger of the Montreal Light, Heat and Power Company and the Cedars Rapids Manufacturing and Power Company came into force on August 1. The companies are now operated by the Civic Investment and Industrial Company, and the notices, etc., sent out by the two merged concerns bear this intimation.

Electricity, as a street illuminant, was introduced to Canada at the Canadian National Exhibition, Toronto, Ont., in 1882.

Adv. Suggestions for Elec. Contractors

Nos. 9, 10, 11 and 12 of a series worked out by the Society for Electrical Development. Any contractor may think it wise to change the wording to suit his own case. Consecutive advertising to educate the public to distinguish good work from bad

"Let the buyer beware"

Where electrical work is done by contract—the work being "let" to a contractor for a fixed sum—changes in the original specifications may mean additional cost. Rightly used, this practice of charging for "extras" is perfectly fair to both parties. It allows you to add features to your electrical equipment which you may have overlooked at the start or improvements which at first you did not think you could afford.

But "extras" may also be the "life savers" of the irresponsible electrician. If this type of contractor finds—as is only too often the case—that he has figured his price too low—here is the golden opportunity to make up his loss **and then some!**

On the other hand, if a responsiible and competent contractor is doing your work you will pay a fair price and will know that "extras"—if **necessary**—will cost in proportion.

(Names and Addresses of Contractors.)

A competent contractor would have saved this man considerable money

An electrical contractor was called in to explain what was wrong with Mr. Blank's wiring. The insurance inspectors had told him he must have a large part of it removed.

It appeared that Mr. Blank, wishing some additional outlets for a toaster, table lamp, and flatiron, had asked the electrician of a friend's factory to do the work. The work was done—the first cost was very little, too—but the electrician either was ignorant of or "took a chance" on violating the rules of the insurance underwriters — rules established for **your protection.**

As a result, the first cost of the work was a total loss. The wiring had to be entirely removed and installed correctly and safely.

How much better it would have been to employ a recognized and competent electrical contractor in the first place! Work correctly done is worth its cost. Wiring incorrectly installed is worse than worthless—it is dangerous. Why take chances?

(Names and Addresses of Contractors.)

Perhaps there's an Ethiopian in the wood pile

When one estimate on a piece of electrical work is way below the others it should be a caution signal for you. That particular low figure will bear looking into pretty thoroughly.

You see we electrical contractors pay pretty much the same prices for our materials. Labor of like grade costs the same. And, as we don't know of any contractor who is in danger of becoming a "malefactor of great wealth," our profits can't be so big after all. So if there is a big difference in estimates on the same job it's a pretty good sign of one of two things. Either the bidder **knows** he will lose money on the original contract or he has made a mistake in his figures. And it's highly probable that "extras" will be called on to make up the loss in either case.

After all, as in most any other business deal, it pays to know that the "other party" in an electrical contract is really competent, reliable, and responsible.

(Names and Addresses of Contractors.)

Don't entrust your electrical work to a novice!

Many self-styled electrical contractors are really little more than amateurs. No doubt they **mean** well and do the best they know how, but can you afford to let them gain experience at **your** expense?

The making of a competent electrician requires study and years of experience.

And, more than this, before a man is justified in hanging out his shingle as an electrical contractor he should have the business experience and financial backing to carry him through to success.

And yet some fondly believe all that is required to "go into business" is a stock of business cards, letterheads, and—not forgetting the billheads.

There is a decidedly more substantial foundation under our shops—for **your** protection, too!

(Names and Addresses of Contractors.)

What is New in Electrical Equipment

Circulation Water Heaters

Electrical circulation water heaters afford an easy means for supplying heating water for household purposes. They are intended for use with the ordinary kitchen tank of 30 to 40 gallons capacity, and may be readily connected by a local plumber. The heater illustrated herewith is manufactured by the Canadian General Electric Company. The Type L-59 heaters are recommended for continuous service, while the

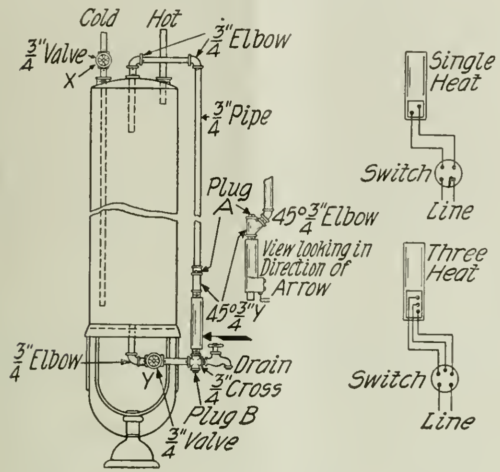


Fig. 1

Type L-60A heaters are designed especially for intermittent service. A 30-amp., three heat, indicating snap switch is furnished with the Type L-60A heaters. The construction comprises a ¾-in. iron pipe enclosed by a coil of sheathed wire which is embedded in cast aluminum. The Type L-59 casting is approximately 9 inches long and that of the Type L-60A 30 inches long. The latter type also has a heat-insulating cover of hair felt enclosed in a sheet metal casing. A terminal box with removable cover is located at the lower end of each heater. This design of heater provides a single rugged construction and one which may be easily cleaned. The cleaning is accomplished by removing the top and bottom plugs so that a cleaning brush may be passed through the heater without disturbing the main piping.

The heaters should be installed in a vertical position, as shown. The piping shown is arbitrary and may be changed to meet the requirements of present installations. The tank should always be heat-insulated as it has been found that the operating efficiency is increased approximately 40 per cent. when this is done. One inch of hair felt encased in a canvas covering is commonly used for this purpose. The pipes should be covered with standard 1-inch magnesia pipe covering.

When connected for three heats, the high heat is used for first heating and low heat to keep the contents of the tank hot. The cold water enters at the bottom of the heater, becomes heated, and rises to the top of the tank. This circulating action continues until the entire contents of the tank become hot.

The following curves, Figs. 2, 3 and 4, are taken from tests of these heaters connected to a 36-gal. tank. These curves show the amount of water available at temperatures of 104 and 149 degs. F. or above, after the heaters have been in operation for various periods of time and are based on the assumption that the water enters the tank at 59 degs. F.

Power Extension in Montreal

In connection with the twenty-seventh annual convention of the Canadian Association of Stationary Engineers, in Montreal, on July 25-28, a "power" exhibition was held in the Technical School. The great proportion of goods was in the nature of packings, belting, and hose, together with a small amount of machinery and purely electrical equipment. Among the exhibitors were the Economy Fuse and Manufacturing Company, showing a large variety of fuses and also the component parts of fuses—a very interesting booth. The Electrical Equipment Company, Ltd., Montreal, had on view a variety of appliances, including Canadian Eveready lamps, D. and W. fuses, Esterline and Keystone recording meters, Mazda lamps, etc. The Lyman Tube and Supply Company, Ltd., Montreal, had an extensive exhibit, which included Garton Daniels lighting arresters. The H. W. Johns-Manville Company showed many of their specialties, while the Goldie & McCulloch Company, Ltd., Galt, had arranged their booth with many photos of the engines and boilers installed in various parts of the country.

5000 H.P. Twin Runner Turbine

Mr. R. S. Kelsch, consulting engineer, Power Building, Montreal, is preparing specifications for one additional twin runner turbine of 5,000 h.p. capacity, together with penstock and all auxiliaries, including a new generator and accessories. The apparatus is to be installed in the Shipshaw plant of Price Brothers & Co., Ltd., Shipshaw, Que.

Oakwood ratepayers are discussing the advisability of securing hydro-electric power and light.

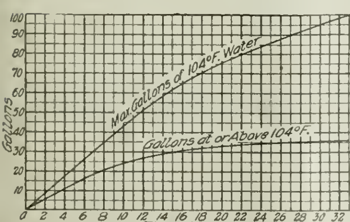


Fig. 2—600 watt unit.

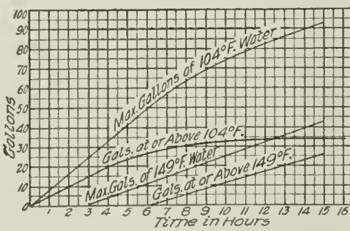


Fig. 3—1000 watt unit

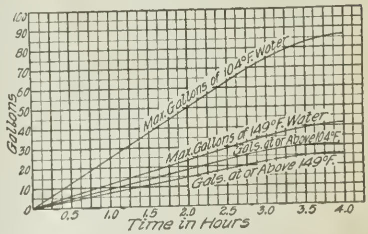


Fig. 4—3000 watt unit.

Current News and Notes

Arnprior, Ont.

The Galetta Electric Power and Milling Company are installing a second unit, the demand being now too heavy for one machine.

Assiniboia, Sask.

The town council of Assiniboia, Sask., are calling tenders, up to August 15, for the installation of an electric lighting plant. The equipment required will be one 150 h.p. internal combustion engine, generator, exciter, switchboard and other apparatus; also poles, wire and other line material. The consulting engineers are Murphy & Underwood, Saskatoon.

Chatham, N.B.

Fire on the morning of July 22 completely destroyed the lighting plant in the town of Chatham, N. B. The loss is estimated at $30,000, which is partially covered by insurance.

Chatham, Ont.

The Blenheim and South Kent Telephone Company have let a contract to the Northern Electric Company for the installation of storage batteries and necessary equipment for supplying same with hydro power.

Clinton, Ont.

The Bell Telephone Company, Clinton, Ont., are contemplating the installation of a new switchboard and placing the wires on Main Street underground. The work will be carried out by the company's own men.

Lyall, Man.

A by-law was submitted on August 2 to raise the sum of $8,000 for a light and power plant at Lyall, Man.

Raymond, Ont.

The Raymond Telephone Company, Limited, have been granted a charter.

Rockwood, Ont.

The Rockwood & Oustic Telephone Company, Limited, have been granted a charter.

Saskatoon, Sask.

Receipts for the Saskatoon Municipal Street Railway for the first seven months of this year are nearly $35,000 ahead of the corresponding period last year.

Sussex, N.B.

The New Brunswick Telephone Company recently acquired new premises and will commence the erection of a two-storey modern telephone exchange in the near future.

Thorold, Ont.

Work is now under way on the new $100,000 transformer house for the town of Thorold, Ont.

Toronto, Ont.

The Toronto Hydro-Electric System will build a large stores building at the corner of Caer Howell and Murray Streets, Toronto, to cost between $200,000 and $250,000. This is anticipated to effect a considerable saving owing to the concentration of all stores.

Truro, N. S.

The town council have finally decided to purchase the Chambers Electric Light plant for the sum of $57,000. Alterations are contemplated but not yet decided upon.

Waterford, Ont.

The ratepayers of Waterford, Ont., have passed a by-law authorizing the installation of a hydro-electric distributing system.

Trade Publications

Ohmmeters—Bulletin No. 300, issued by the Roller-Smith Company, New York, illustrating and describing their portable direct reading slide wire ohmmeters.

Plastic Conduit Wrappers—leaflet by B. S. Barnard and Company, describing and illustrating Hercules plastic joint conduit wrapper, an adhesive compound for rendering ducts water and dirtproof by bandaging the ends.

C. G. E. Publications—Bulletin No. 47135, describing and illustrating isolated and small plant alternating current switchboard panels; Bulletin No. 45603, describing and illustrating graded shunt resistance multigap lightning arresters for alternating current constant potential circuits.

Personal

Mr. Lawford Grant, sales manager of the Eugene F. Phillips Electrical Works Limited, Montreal, has been appointed assistant general manager and assistant treasurer, with a seat on the board of directors.

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Electric Water Heating

The natural accompaniment of the rapidly approaching general use of electricity for cooking is its use also for water heating purposes. Indeed, it would appear that the obstacles in the way are much less formidable than those that have been overcome in popularizing the use of electric ranges. For example, a very real difficulty in the cooking field has been the lukewarm attitude of the central stations, for the double reason that the installation generally involves considerable expenditure in heavier copper and often produces a more or less unbalanced load. Added to this is the fact that the cooking load has an unpleasant way of coming in right on top of the evening peak load of the average station. In spite of these conditions, however, the cooking business is developing wonderfully, and rates have been reduced so materially that electricity for cooking costs decidedly less—to say nothing of the many other advantages—in a great many Canadian towns and cities, than any other source of heat supply.

And now, not only is the public turning its attention to electric water heating, but the central stations also, having looked into the conditions surrounding the supply of electricity for this purpose, have decided that they can safely encourage it. This is because the water heating load, practically speaking, is a 24-hour load, and, indeed, under the most favorable circumstances, can be kept off the peak entirely. This has been accomplished in certain cases, and it seems to be the most satisfactory arrangement to date, by installing the electric water heater in connection with the electric range, using a double throw switch, so that both cannot be operated at the same time. This works little inconvenience, if any, to the consumer, as with a properly lagged tank the heat may be retained (except in very unusual cases) over the period the current is being used for cooking purposes. Any possible delay or inconvenience may be overcome by installing a slightly larger heating unit, which will leave the water at a higher temperature—sufficient to carry it over the cooking period.

It seems to be an established fact that a 500 or 600 watt unit, operating continuously on a 30-gallon or 40-gallon tank, properly lagged with a material that resists the escape of heat, will supply water enough for the average kitchen and bath requirements of a family of four or five. For the usual size wash this unit may be a little too slow, and a custom frequently followed is to install a larger unit to be used for a couple of hours each wash day. A method that has been adopted is to carry the three service wires, giving 110 and 220 volts, up to the tank element. For the low heat 110 volts is used, and for the high, 220, on the same element, which doubles the current and consequently quadruples the wattage. As this extra load is most likely to come in the morning fairly early, it runs little chance of interfering with the peak.

One Canadian city, where the rates for cooking are already very low and this end of the business is being vigorously developed, is now building up a good water-heating load on the basis of a flat rate of $2.00 a month (less 10 per cent.) for 500 watts operating continuously and not metered. For more rapid heating the 2,000 watt supply, as described above, is also installed. This latter is metered and charged for at the usual rate. It is found with this arrangement that, though the peak is slightly raised, the whole load curve is considerably flattened out. In actual practice it appears to be working out that the larger wattage is in demand for only about eight or ten hours per month, which at a 1c rate costs about 20c, and brings the total water heating charge to not more than $2.00 per month net.

An arrangement such as this is highly satisfactory to the customer, too. Most houses have the water tank attached to a coil in the furnace, but, of course, this operates only about six months in the year. The electric heater, therefore, takes on the summer load entirely when the demand is least, and remains to supplement the furnace during the winter, when the demand is greatest.

A most interesting paper covering experiments on combined heating and cooking loads is to be presented at the Pacific Coast convention of the American Institute of Electrical Engineers, extracts from which, taken from the last issue of the proceedings of that society, we reproduce elsewhere in this issue. So far as we know, these are the first really authentic figures on this most important phase of central station supply.

Ownership vs. Control of Public Utilities

As the best solution of the problem of the control of public utilities, the Dominion of Canada, at many points during the past ten years, has striven to put into effect the theory of public ownership and control. This has entailed the expenditure of a vast amount of public moneys, has discouraged, to the same extent, private enterprise, and has produced in a number of cases wasteful competition in a business which is a natural monopoly. In many instances, it is true, the rates have been reduced, but this may be due in a greater measure than we think to advances in the art, and, so, almost inevitable in any case. Certain it is that there has been no evidence adduced that government operation, municipal or otherwise, can be carried on more economically or more efficiently than private operation. It is equally certain that some of our municipalities are already chafing under the financial load they are obliged to carry, sometimes at a loss, and are looking to private capital again for relief.

After all, it may prove that in applying our remedy we have gone beyond the extreme of good, sound business sense.

In the United States, on the other hand, whether because the electors as a class are less impulsive or whether the private interests were more alert to foresee, and better organized to forestall, the disastrous effects of public ownership on their business interests, a middle course has been adopted—regulation of public service utilities by state commissions. As has been pointed out time and again in the Electrical News, private ownership, properly controlled in the interests of the people, is as near the ideal as we can hope to get for many generations. The Consumers' Gas Company, of Toronto, has often been mentioned in these pages, and still stands, as to its control, as an almost ideal public utility. The citizens of the United States are finding that this solution of their troubles is sound, for in practice it is giving entire and continuous satisfaction. It relieves the municipalities of big financial burdens which they are both unwilling and unfitted to carry, it guarantees them proper service, and it insures them against unfair rates.

In the United States, though it is less than ten years since the first state commission was created, this kind of regulation has been established by law in something over thirty states. A number of cities in states not having regulating commissions have also established municipal commissions and inspection bureaus. A number of state commissions have adopted rules and recommendations for electric service regulations. Now the Government at Washington has stepped in and is placing the organization of their Bureau of Standards at the service of the people, in an endeavor to standardize the rules and regulations which shall govern the operations of the commissions in the various states. The results of their labors to date have now been issued in a circular form (No. 56), under the heading, "Standards for Electric Service," in which a survey is given of the general field of state and municipal regulations in so far as electric service is concerned, and rules and regulations are suggested, which may be adopted as they stand or may be used as the basis upon which to build up a set of ordinances to suit peculiar conditions of any state or city. The Government also invites criticisms and suggestions on this circular from interested persons, such as commissioners, engineers, public utility operators and owners, committees of technical societies, municipalities, operating companies, and so on, and announces its readiness to assist to the fullest extent in the establishment of standards and the promotion of a good understanding between regulating bodies, operators, and customers.

Shortage of Power at Niagara Falls

As indicating the importance industries in the United States place upon Niagara power, some of the comments made before recent hearings of the Joint State Committee at Niagara Falls, N.Y., a few days ago, are especially interesting. One of the most important witnesses was Mr. FitzGerald, president of the American Electro-chemical Society, who urged immediate legislation so that the full amount of 20,000 cubic feet per second may be developed on the United States side. This means an additional 4,440 cubic feet per second, calculated roughly to develop 80,000 h.p. Mr. FitzGerald spoke strongly in favor of the establishment of a nitrogen fixation plant at Niagara Falls, N.Y., at the same time pointing out the absolute necessity of an independent supply of nitrates if the country should be involved in war. Dr. Acheson, of the Acheson Graphite Company, said that they had been forced to contract for 9,000 h.p. with a steam generating plant in Buffalo. Mr. Tone, of the Carborundum Company, complained that lack of power was forcing United States industries to establish branches in Canada and Europe. Mr. Jamieson, of the W. A. Rogers Company, Ltd., said that they wanted to double their capacity, but could not do so owing to shortage of power. Mr. Muran, of the Caster Electrolytic Alkali Company, now using 10,000 h.p., said that they would contract for another block of the same amount if it were available. Mr. H. G. Akers, hydraulic engineer of the Hydro-electric Power Commission of Ontario, also attended the session.

The condition on the United States side of the line may be a little more aggravated at the present time than it is in Canada, but it simply indicates the condition for which we should be prepared. There is no question that Canada will need every unit of her share of the electricity generated from Niagara Falls in the very near future.

Power of Winnipeg River

The Water Power Branch of the Department of the Interior, Ottawa, has just issued a report covering its investigations of the water power resources of the Winnipeg River, one of the large rivers of Canada.. These investigations were commenced about four years ago, under the advice of two consulting engineers eminent in water power practice, John R. Freeman, of Providence, R.I., and J. B McRae, of Ottawa, Canada, and have been continuously under way. J. T. Johnston, chief hydraulic engineer of the Water Power Branch, has had immediate direction of the investigations, and is the author of the report, which is interesting from both historical and engineering standpoints.

The engineering and economic aspects of the river for water power are, now, of great industrial interest, and a cursory examination of this report shows that there is no locality in Canada more fortunately situated in respect to water power than is that part of the province of Manitoba in the vicinity of the city of Winnipeg. One chapter in the report covers in detail the comprehensive system of hydro-electric and power development by which it is proposed that the power resources of the river will be developed to their maximum capacity. The report shows that there will eventually be as much, if not more, power available from the Winnipeg River than is now being developed at Niagara. The city of Winnipeg and the province of Manitoba have, therefore, an assurance and guarantee of future industrial, commercial and municipal growth.

The investigations of which this report is the result were carried on by the Department of the Interior, primarily for administrative purposes. The work has covered a period of several years, at a total cost of approximately $70,000. Expert and experienced engineering advice was obtained at the inception and throughout the investigations. Moreover, the government has spent over $104,000 in purchasing water power properties along the Winnipeg River from private parties.

The investigations show that at nine distinct power sites, by means of storage easily and cheaply accomplished at the Lake of the Woods, at Lac Seul and certain lakes in the province of Ontario, it is possible and economically feasible to develop over 418,000 continuous twenty-four-hour horsepower, all within 75 miles of the city of Winnipeg, and within feasible transmission distance of all commercial centres of the present settled portions of the province.

Of the nine possible power sites on the Winnipeg River, there are three now under development, representing a total power capacity of 200,000 twenty-four-hour horsepower. One site is completely developed by the Winnipeg Electric Railway Company on the Pinawa Channel, and produces about 28,000 h.p. Another site at Point du Bois Falls, developed by the city of Winnipeg produces at the present time about 25,000 continuous horsepower, but is capable of extensions to a maximum of 77,000 twenty-four-hour horsepower. Development at a third power site, at Great Falls, having a maximum possible development of 95,000 twenty-four-hour horsepower, was about to be commenced by the Winnipeg

River Power Company when war broke out and delayed the project.

There is, therefore, at the present time about 53,000 continuous horsepower produced and transmitted for use in and around the city of Winnipeg, which can, with the two present plants and the projected plant be increased to 200,000 twenty-four-hour horsepower. The six remaining power sites are under the control of the Dominion Government, and can furnish a further amount of twenty-four-hour power to a maximum of 218,000 h.p. In addition, there are several important power sites on the Winnipeg and English Rivers within the province of Ontario, which are within easy transmission distance of Winnipeg.

Proposed Inspection Tour in Connection with the Illuminating Lecture Course

The committee in charge of the inspection tour which it is expected will be an outstanding feature of the lecture course to be given under the auspices of the Illuminating Engineering Society and the University of Pennsylvania, in September, has issued the following information:

The general purpose is to assemble as many as may be interested in taking this trip and take them as a party to visit places of notable lighting interest. At each city there will be a local committee having charge of the entertainment of the visitors and seeing to it that they obtain as much as possible of value in the way of information and interest. The cities of Pittsburg and Washington will be visited in advance of the convention. During the lecture course there will be a week-end side trip to Atlantic City. Subsequent to the lecture course the party will visit New York, Boston, Schenectady, Buffalo, Niagara Falls, Cleveland, and Chicago. Arrangements will be made so that those desiring to do so may join the party at any point and leave it whenever desired, provided only that each delegate must register for that part of the trip which he proposes to take in order that arrangements for taking care of him may be completed. The following is the itinerary: Pittsburg, September 16; Washington, 17; Philadelphia, 18 to 23; Atlantic City, 24; Philadelphia, 25 to 28; New York, 29 to October 1; Boston and Lynn, 2; Schenectady, 3; Buffalo and Niagara Falls, 4; Cleveland, 5; Chicago, 6.

Canadian Electric Railway Annual Meeting

The annual meeting of the Canadian Electric Railway Association, which was held at the Royal Canadian Yacht Club, Toronto, the last week in July, elected the following officers for the ensuing year: President, E. P. Coleman, general manager Dominion Power and Transmission Company, Hamilton; vice-president, C. R. Wilson, assistant manager Toronto and York Radial Railway; executive committee: A. Eastman, vice-president and general manager Windsor, Essex and Lake Shore Rapid Railway, Kingsville, Ont.; H. G. Matthews, general manager Quebec Railway, Light, Heat and Power Company, Quebec; G. Gordon Gale, general manager Hull Electric Company, Hull, Que.; A. Gabourg, superintendent Montreal Tramways Company, Montreal; J. S. McKenzie, purchasing agent Winnipeg Electric Railway Company. This year's meeting was presided over by President James D. Fraser, director and secretary-treasurer of the Ottawa Electric Railway Company. Papers were presented by W. G. Murrin, general superintendent B. C. E. R. Company; W. G. Gordon, transportation engineer C. G. E. Company; S. B. Griffith, Dominion Power and Transmission Company; F. S. Livingstone, traffic manager Toronto and York Radial Company.

Railway men give the Canadian National Exhibition credit for being the greatest creator of traffic on the North American continent.

Steam Plant for Granby Consolidated

The Taylor Engineering Company, of Vancouver, consulting and contracting engineers, are at present building at Anyox, B.C., for the Granby Consolidated Mining, Smelting and Power Company, an auxiliary steam plant to supplement the Granby company's present water power plant, which has a normal capacity of approximately 7,000 h.p.

The new auxiliary plant will be housed in a reinforced concrete building, 98 ft. x 88 ft. x 37 ft., and the equipment for the plant will consist of five 550 h.p. water tube boilers arranged for fuel; a 3,000 kw. and 2,000 kw. Westinghouse turbo-generator; a 100 kw. Westinghouse exciter; a 3,500 ft. 100-pound pressure De Laval turbine-driven centrifugal compressor, driven at the one end by an 800 h.p. De Laval turbine through reduction gears and at the other end by an 800 h.p. Westinghouse motor, also through reduction gears. This unique arrangement has been adopted so that the compressor could be operated by motor in the summer time if it is decided not to operate the steam plant.

All electrical apparatus is being furnished by the Canadian Westinghouse Company.

The boilers are served by a Custodis radial brick chimney, 10 feet in diameter and 150 feet high.

The power house building is nearly completed, and most of the foundations are in place ready to receive machinery. Complete engineering details will be available later, when the plant is finished.

The entire plant has been designed by the Taylor Engineering Company, under the direction of Mr. F. M. Sylvester, managing director of the Granby Consolidated Mining, Smelting, and Power Company.

The approximate cost of the completed plant is $600,000, and it is expected that the largest proportion of the plant will be in service by the end of the year.

800 Posters Submitted

Some time ago the Society for Electrical Development instituted a poster campaign from which to choose the most suitable poster to use with the society's advertising of America's Electrical Week, in December. Over 800 artists submitted designs, the prize-winner being No. 717 and the prize $1,000. To add further publicity to this contest the various posters were exhibited in the galleries of a number of the larger cities in the United States, and the public were invited to come and vote their choice of the one they considered best. This vote also carries a prize. It is further argued that the interesting of so large a number of artists in this competition must have a considerable effect on the work of these men and women in the future, which is thus much more likely to be tinged with electrical suggestions. The society is issuing a booklet showing, in colors, the 125 best posters submitted. This booklet will be sent free to 25,000 men interested. It has been calculated that the chosen design will be reproduced at least 200,000,000 times during the autumn campaign.

Chatham, N. B. Has Temporary Plant

As a temporary installation until new units can be placed in the power plant, partially destroyed by fire, the lighting committee have procured from Moncton a second-hand generator of 120 kw. capacity on a rental basis. It is understood that the generating station will be kept on the old site, in consequence of the heavy cost of removing the boilers, making foundations and erecting a new building; a gas producer or Diesel oil engine is also being considered. An offer was received from the Yarmouth Light and Power Company of $15,000 for the plant and $5,000 for the franchise. The members of the council did not, however, favor the acceptance of the offer.

Some Features of Domestic Electric Cooking and Water Heating

By H. B. Peirce*

Since the use of electrical energy first developed, the possibility of successful heating or cooking by heat, generated electrically, has never been questioned; the problem has always been: Can it be done at a profit to the central station, with energy sold at a price low enough to put electricity in competition with other fuel?

To-day we find a sudden stampede for this ideal fuel, but we find the electrical engineer unprepared to solve the problems of heating and cooking electrically.

It will be the province of this paper to show what may be expected by a central station after there has been developed a load of ranges and water heaters, and along what lines engineering assistance is needed to solve certain knotty problems connected with this phase of the industry.

First, to consider the effect on the central station of a cooking and heating load. It would be natural to expect that a cooking load would have a load factor considerably lower than the lighting load in the same community. This we find is not the case, and it further appears that there is a greater increase in load factor in a cooking load by reason of an increase in number of consumers served than would be gained in a lighting load by such an increase of consumers.

These deductions are the result of a number of tests made on actual water heater and range installations in homes using electrical energy for cooking and water heating.

The tests consisted of installing recording ammeters on the various cooking installations and reading the charts taken therefrom to the nearest five-minute interval; these readings were then assembled and the total load for any day at any hour determined.

A number of assumptions were, of necessity, made in securing these composite loads.

First, it was assumed that the clocks of the various meters were synchronous. This is in error for two reasons: (a) The charts were not all taken on the same calendar day, but were taken at different seasons for different ranges and superimposed according to the day of the week on which the readings were taken; (b) the clocks were not absolutely accurate, either as to time of day or as to speed.

Second, the readings were taken on a five-minute interval; this meant that the reading for the interval had to be integrated by inspection, which was, of course, difficult to do with much accuracy, particularly in view of the fact that the swing of the needle on these instruments was considerable.

The first opportunity for error would appear to have more weight than it proved to exhibit in practice, since a set of charts for a week, taken at one time of the year, have a strong resemblance to similar charts taken during a week at another season. In other words, in the community observed, the habits of the public as it concerns the preparation of meals appears to be uniform at different seasons of the year. The opportunity to run into error by inaccuracy of the clocks is so slight as to be incommensurable with the accuracy of the results which at best are only approximate.

Curves shown in Figs. 1, 2, 3, 4, 5, 6, and 7 exhibit the daily load of 42 ranges of assorted manufacture and varying capacity from 2.5 to over 6 kw. As the coincident maximum demand of these ranges can be obtained from the curve, and as the total connected load is known, the demand factor can be computed. As the average kilowatt-hour consumption of each range is known, it is also possible to figure the combined load factor of the group. These values show that even with as small a group as 42 ranges, the demand factor is 4.5; with 25 ranges, it has been found never to be less than 3.5.

It might be expected that the demand factor would increase as the number of ranges increases. This is shown in Fig. 8, where a number of groups of ranges have been observed for demand factor and these demand factors plotted as ordinates with the number of ranges as abscissas.

The result is a shot-gun diagram, which interests us not

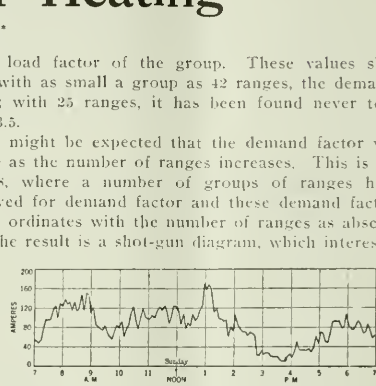

Fig. 1—Composite Range Load Curve
Number of ranges 42—Connected load 155.4 kw.—maximum demand 20.07 kw. voltage 116.

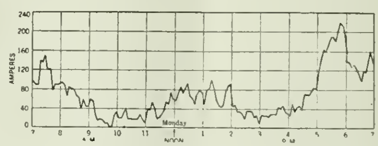

Fig. 2—Composite Range Load Curve
Number of ranges 42—connected load 115.4 kw.—maximum demand 27.75 kw.—voltage 116

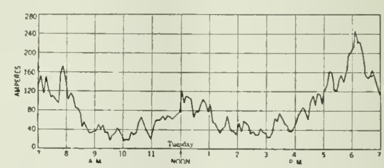

Fig. 3—Composite Range Load Curve
Number of ranges 42—connected load 115.4 kw.—maximum demand 28.65 kw.—voltage 116

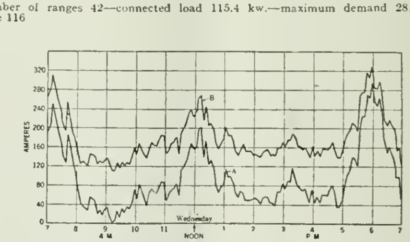

Fig. 4—Composite Range and Water Heater Load, Curve "B"
Number of ranges 42—number of water heaters 21—conne ted load ranges 155.4 kw.—connected load water heaters 12.18 kw.—maximum demand 37.47 kw.

so much in its upper limits as in its lower limits; that is, the worst condition which we are liable to experience in any given installation is that for which we must make provision.

The curve through the points on the lower limits appears to have logarithmic characteristics, and by plotting the points on logarithm paper (Fig. 9) we find that they approximate a straight line—that is, they follow roughly a logarithmic curve.

Such a curve would have infinity as its upper limit, and

* Before the A. I. E. E.

this we know is impossible, as the demand factor can never exceed the reciprocal of the average individual load factor.

It is possible that this last statement requires a word of explanation, as it is not self-evident.

Consider ten installations, each with a demand of 1 kw. and an individual load factor of 10 per cent. The greatest demand factor, 10, would be secured when each individual installation was turned on for a tenth of the period and then

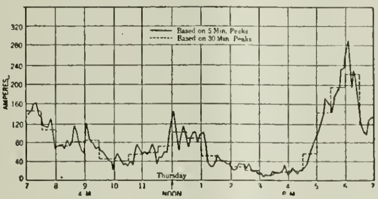

FIG. 5—COMPOSITE RANGE LOAD CURVE

Number of ranges 42—connected load 155.4 kw.—voltage 116—maximum demand (5 min.) 33.75 kw.— max. demand (30 min.) 25.63 kw.— demand factor 5 min. peak 4.6— demand factor 30 min. peak 6.1— demand factor 30 min. peak (Wed.) 5.5

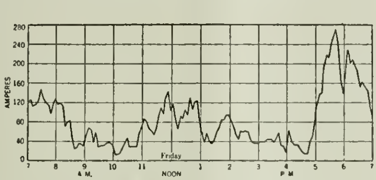

FIG. 6—COMPOSITE RANGE LOAD CURVE

Number of ranges 42—connected load 155.4 kw.—maximum demand 31.43 kw.— voltage 116.

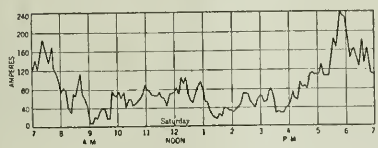

FIG. 7—COMPOSITE RANGE LOAD CURVE

Number of ranges 42—connected load 155.4 kw.—maximum demand 27.96 kw.— voltage 116.

turned off while a second was thrown on the line. The result would then be a demand never exceeding 1 kw. and a load factor of 100 per cent. for the entire group.

Let us apply this to the ranges tested. The connected load, which for convenience may be assumed as the individual maximum demand of each individual range, will average about 5 kw. on the present types of electric ranges. These same ranges will each average a consumption of about 100 kw.-hr. per month—that is, the individual installation will have a load factor of about 2.8 per cent. The reciprocal of 2.8 per cent., or 36, is then the maximum limit of the demand factor on ranges of this type. To reach this value it would be necessary for the combined load factor to be 100 per cent., which is, of course, impossible under present conditions, as there are hours during the day in which there are no cooking operations being conducted.

As an academic example this result might be secured from a central station supplying energy to consumers extending around the globe in a zone of perfectly uniform density. If the logarithmic curve is followed out to demand factor 36, it will be seen that this amounts to an infinite number of ranges to all extents and purposes.

The theory that demand factor will increase in accordance with a logarithmic rule will appear more logical when it is remembered that diversity and demand factor depend upon the theory of probabilities which has logarithmic characteristics.

To get the greatest practical good from this theory it should be checked in a number of different localities by different observers and the results compared; then, from the results, a rule adopted that would permit the probably coincident demand of a number of ranges to be more accurately predicted than is possible at the present time. These results should be of sufficient accuracy to enable the various electrical rules to be based upon them, so that it would not be required that excessive feed cables be provided for the care of apartment houses equipped with electric ranges, and so that the proper sizes of feeders and transformers for serving a load of ranges would be better computed by distributing engineers.

It will be noted that the demand factors have been figured in the computations so far made on the basis of a five-minute peak. For practical purposes such a peak is unnecessarily brief, so that the effect of a 30-minute peak has

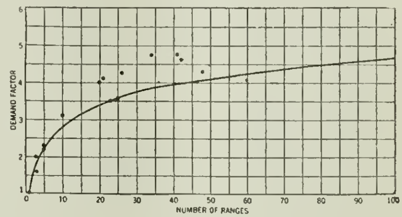

FIG. 8.

been indicated on Fig. 5 by a dotted line, which represents the results of measuring the demand by means of a demand meter of the type that integrates a load over a series of definite half-hour periods.

Integrated peaks of half-hour duration will, of course, make the demand factor greater. This should be borne in mind in comparing charts taken in different cities.

In making comparisons there should also be noted the class of people by whom the ranges are used. Those referred to in this paper are representative of all the classes that will eventually do their cooking electrically. They include families with incomes of less than $100 per month and homes in which the bill for current is a minor consideration. The apartment house dweller is, however, not as well represented as he should be. To show the effect of such consumers in helping to improve load factor, the demand factor of the ranges of one of the apartment houses in Salt Lake City is shown in Fig. 8. This demand factor, it will be seen is far

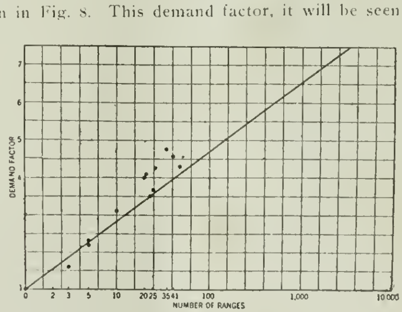

FIG. 9.

in excess of those secured from ranges installed in homes in Spokane, the city in which the individual tests were made. At first this does not seem logical, as one would think that the dwellers in the same apartment house would come from the same walk in life and would be likely to do their own cooking at the same hours. The answer probably is that they do less regular cooking than do the families in their own homes.

Another point that should be commented upon before leaving the subject of electric ranges is the average monthly consumption of the individual ranges in kilowatt-hours. This has been referred to above as being about 100 kw.-hr. It is true that the value, 100 kw.-hr., represents approximately the average condition, but to say that this is the probable consumption of any particular electric range is quite another thing. The truth of the matter is that the consumption seems to vary between the limits of 50 and 250 kw.-hr., while in exceptional cases the energy consumption of a range used by a farmer has been known to exceed 400 kw.-hr. during a single month. This condition appears generally during the season of harvest, when there is a large number of hands to feed. Attempts have been made to predict the consumption of a range by the size of the family by whom it is used.

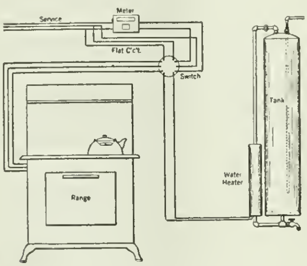

Fig. 10—Wiring Diagram for Electric Range and Water Heater Controlled by Special Switch

This the writer believes to be unsatisfactory, as there are wide variations in habits between families of equal size.

It will be noted that for the ranges observed the daily peak occurs very nearly at 6 p.m. In other words, it will coincide closely with the lighting peak. This is unfortunate, but when it is remembered that with a fair number of ranges in use, the demand factor will probably be 8, the feasibility of making this business profitable with a low rate per kilowatt-hour becomes clearer.

For instance, if we assume a monthly consumption of 100 kw.-hr. per range, an average individual demand of 5 kw. and a demand factor of 8, we get the following results with a rate of 3 cents per kw.hr. for energy:

Revenue per range per year	$36.00
Revenue per kw.-year of range demand	7.20
Revenue per kw.-year of station demand	57.60

So far this paper has dealt only with the electric range. The next point to be considered will be the heating of water for the home.

A supply of hot water is essential to the satisfactory use of the electric range. That this can, in many instances, be accomplished electrically is not questioned. The problem is, how it shall be done.

To compete with coal, wood, and gas, for hot water heating, electricity must be supplied at a very low rate. This can only be done by securing a high load factor for the service; by taking the supply from valley hours; or by limiting the use of the heater to those hours when the range is not in use.

A high load factor can be secured for this service by installing the heaters on flat rate and assuming that they will be used continuously. This has the disadvantage of superimposing their load on the existing peak. The revenue they return must then be sufficient to yield enough per kw.-year to pay for all the fixed charges depending upon maximum demand at peak.

The disadvantage of limiting the use of water heaters to the valley period of the system load is that a very large amount of hot water must be stored, as in most instances the valley hours are not of very long duration, and occur at a time when there is no need for hot water. The result is that if the hot water supply is depleted during the day there is no alternative for the consumer but to wait until the next day for more hot water. A further disadvantage is the expense of an installation to supply such a system. Time switch, large capacity heater, and large, well-insulated storage tank, all will be found to amount to a considerable sum.

The third method of limiting the use of the heater to the hours when the range is not in use has some of the advantages of both systems with less of their disadvantages; it can be controlled by a double throw switch or by a special rotary snap switch now on the market for that purpose. The diagram of wiring for such an installation is shown in Fig. 10. The effect of such a water heater load when superimposed on a load of ranges is shown in Fig. 4.

It will be seen from the curves on this figure that a load of 42 ranges gave a peak of 33.41 kw. when operated without water heaters (Curve A). When 21 of the ranges were equipped with 600-watt water heaters on double-throw switches, the peak was only increased to 37.47 kw. (Curve B).

A common rate for a 600-watt water heater operated in this fashion is $2.00 per month, and if the ranges use an average of 100 kw.-hours each per month the rate for energy being 3 cents per kw.-hr. they would return a revenue of $36.00 per year per range or a total revenue of $1,512.00 for the 42 ranges. These ranges show a demand of 33.41 kw., which means a revenue of $45.00 per kw.-year when operated without water heaters.

If 21 water heaters pay $24.00 each per year, we would get an additional revenue of $504.00, or a total of $2,016.00 from the ranges and water heaters combined. The demand is now raised to 37.47 kw., which gives a return of $53.70 per kw.-year. It is conceivable that the addition of such a water heading load might make an otherwise unprofitable installation of ranges profitable.

Regarding the size of heater required for this purpose, there are few accurate data which can be offered. The 600-watt size appears to be the smallest that will work satisfactorily, while it is seldom that a heater larger than 1.5 kw. is required. The number of people in the family, their habits, the size of the storage tank, the system of hot water distribution, all affect the results.

Problems dealing with the electric heating of buildings are so large that they are felt to be beyond the scope of this paper. It is undoubtedly possible to secure a load of this nature when cheap power is available in a locality whose climate is not so rigorous as to make the cost of heat units the main criterion by which the efficiency of the system will be judged. The writer feels, however, that his experience is so limited in this regard that anything said by him at this time might do more harm than good to the ultimate development of this field.

Another field that will bear investigation is the question of how best to distribute for a range and water heater load. The use of individual transformers for each range with no connection between the secondary lines is objectionable by reason of the high cost of installation. The use of safety devices between transformer secondaries for providing safety to adjacent transformers connected in multiple may make it possible to secure greater benefit from the large diversity that undoubtedly does occur between different groups of these appliances.

Visited the Peterboro Plant

Mr. L. B. McFarlane, of Montreal, president of the Bell Telephone Company of Canada, and Mr. K. J. Dunstan, of Toronto, divisional manager for Ontario, recently paid a business visit to Peterboro, Ont. They were met by the local manager, Mr. G. O. Cameron, with whom they motored through the most interesting parts of the city and looked over most of the factory plants.

Lighting Our Coasts and Waterways

Wonderful progress of the past decade—The best insurance for maritime commerce—Some modern lenses

By J. F. Heffron*

The development of the lighting of coasts and waterways commenced about the year 1806, this development being, no doubt, augmented by the great destruction of vessels and consequent loss of life during the previous year.

Before this time only half a dozen "beacons" marked the coast of Scotland, and in the life of Robert Stevenson, one of the pioneer engineers who gave his attention to this matter, it is stated that the same condition existed on the coast of France. Previous to this time coast signals for night use consisted of "beacon" lights, of an open coal or wood fire, with other inflammable materials, such as pitch, burned in a brazier, on the top of buildings erected for this purpose. These beacons were very uncertain, and liable to cause mariners to make mistakes, some vessels being lost by mistaking the fire of a lime-kiln for the "beacon" light. The "beacon" at Firth of Forth was a very old one, and had been kept up for over one hundred and eighty years, being held as a private right and maintained by a tonnage on ships frequenting that harbor.

About this time Stevenson suggested the Bell Rock lighthouse, located about twelve miles from the coast of Scotland, off the Firth of Forth. The construction of this lighthouse was a great engineering feat. The work was expensive, slow, and difficult; five years were spent in its construction, and during two years of this time only eleven days' work could be done. This pioneer work on the stormy coast of Scotland set the pace for the construction of lighthouses the world over.

This matter of properly marking coasts and waterways with "beacons" of the latest and most effective design is of particular interest to Canadians, especially when we consider the inestimable value such markings are to the shipping coming to and going from our shores and using our waterways. Improvement of the water lanes of commerce in this way holds the same relation to insurance rates for shipping that, for instance, a sprinkler system, properly installed in a building, holds to fire insurance rates. If we are properly protected in this connection our insurance rates are naturally lower, and hence the cost of carrying on our business is less.

Montreal, the head of the St. Lawrence route, is one of the farthest inland harbors on this continent. Only two ports exceed it in this respect—Galveston, on the Gulf of Mexico, and one of our latest developments, Port Nelson, on Hudson Bay. The St. Lawrence route penetrates this continent from 800 to 960 miles. The route experiences some disadvantages, which are primarily caused by the nature of the St. Lawrence. It is closed by ice from November to April. It is the drainage bed of the Great Lakes, necessitating almost continuous dredging at some points, and it passes into the Atlantic at one of the most difficult sections of the coast. South of Newfoundland we encounter the fogs of the Grand Banks; to the north the tidal current beats upon a rocky coast in storm and fog. To save detour the St. Lawrence vessels follow the route north of Newfoundland, through the Straits of Belle Isle.

Canada began dredging the St. Lawrence in 1850, the channel at that time averaging 27½ feet at low water. Today a depth of 30 to 31 ft. has been attained. At its narrowest points the river has a steamship channel, 450 ft. wide and 30 ft. deep from side to side. It is interesting to note that in the days when there was practically not a lighthouse or channel buoy from Tadousac to the Straits of Belle Isle, very high insurance rates were established against the St. Lawrence route.

To-day between Montreal and Quebec we find 99 lighted and 195 can buoys; between Quebec and the Straits, 3 lightships, 80 gas buoys, 1 whistling buoy, 75 can buoys, 4 submarine bell ships, and a line of lighthouses. Telegraph lines also extend to the outer side of Belle Isle, and hydrographic survey has charted every foot of the river. It is needless to say that, with all these improvements, insurance rates have been lowered; but, in spite of these improvements, insurance rates are from 4 to 6 per cent. for steamship lines to Canada, while they are 1 to 2½ to United States ports. It would, therefore, appear that further improvements can still be made.

The new Hudson Bay railroad is also a project of unusual interest to Canadians. It hung in mid-air for almost twenty-five years, but work was started a few years ago, and it is now rapidly nearing completion. The road runs from The Pas, Manitoba, to Port Nelson, on Hudson Bay. Its completion will place the wheat fields of the three prairie provinces of Northwestern Canada from 400 (for Manitoba) to 800 miles (for Alberta) distant from ocean front on Hudson Bay. These provinces are at present from 1,200 to 2,400 miles distant from tidewater at Montreal, New York, or Philadelphia. For this reason, and also for the reason that our three transcontinental railroads are unable to carry Canada's immense wheat crop (which is increasing by leaps and bounds each year) to market, from 50 to 60 per cent. of Canada's wheat crop has been carried to market over railroads in the United States. It is to take care of this condition that the road is being built by the Dominion Government. One can readily see, also, the immense cut in freight rates that

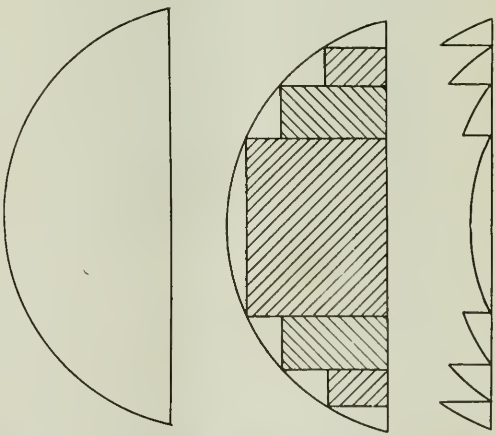

Fig. 1

Showing the development of the present lens used in lighthouse practice from a plano-convex lens. A plano-convex lens of large diameter and short focus, as shown, would be very thick and heavy, and would absorb considerable light from a beam passing through it. If this large lens were cut up into rings and part of the back ground off and the various rings telescoped together we should have a lens of about the same focus, much lighter in weight, and one which would produce less absorption from a beam of light passing through it. The result then obtained is shown by the drawing on the extreme right.

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will result. The road will be completed in about two years; the construction of several large bridges at present makes progress slow.

Port Nelson is a shallow harbor, but is being fitted for navigation by dredging. Navigation will be open from the middle of May until about the end of October. Government reports show that during the navigation season of 1914 twenty-four passages of vessels controlled by the Department of Railways and Canals, besides twelve other passages, were recorded and made through the Hudson Straits—the most difficult part of this route—without serious accident. The Straits have been navigated by fur traders since 1670, and, although we know that seven vessels were wrecked in

Fig. 2—300 mm. fixed lens with pressed sectors.

ten years, the accidents are in great measure due to causes over which we can have control—first, proper marking and charting of the channel; and, second, the use of proper vessels. Ice-jamming vessels, such as are used by the Russians in the Baltic Sea, are needed, built high and narrow, constructed of oak, not steel, to ride and crush down through any ice that may be encountered. When these are introduced, and when this uncharted sea, almost equal in area to the Mediterranean, is properly charted and marked, the high insurance rates will come down.

Although the season of navigation on Hudson Bay is also the season of the Northern long daylight, channel-marking "beacons" and lighthouses will be required; and in this connection it may be interesting to note that the Department of Marine and Fisheries has established, during 1915, occulting acetylene gas "beacon" lights, visible at a distance of eight miles, at the following points in Hudson Bay and Hudson Straits: On the cliff at the north end of Goodwin Island; on Resolution Island (Hatton Headland); at the east extremity of Wales Island; on the eastern end of Rabbit Island (at entrance to Ashe Inlet); on the west end of Charles Island; on the south end of Nottingham Island; on the northwesterly island of the Digges group. All the above are in Hudson Straits. In Hudson Bay itself the following lights were established: On the north end of Mansel Island; on the southeast point of Coats' Island; on the north end of Cape Tatnam; and on Nelson Shoal, approaching Port Nelson. This last is visible for a distance of eleven miles.

Development of Lighthouse Illumination.

When Stevenson constructed the lighthouse on Bell Rock he had no precedent to follow in regard to the matter of proper lighthouse illumination but the example of an effort made at Liverpool a few years before, of the use of parabolic mirrors, made of pieces of silvered glass, set in plaster, to reflect the light. He proceeded to try parabolic copper mirrors, silver plated, each 24 inches in diameter by 12 inches deep, seven on two sides of his apparatus for white light and five on the other two sides for red; the plan being to alternate white and red light with a longer showing of white light than red as the lantern revolved. A considerable loss of light resulted by this method, but it was a great improvement over what had been used before.

Some time previous to this experiments had been made in attempting to conserve the sun's rays with lenses, in an endeavor to utilize the rays as a source of power. Buffum, in 1784, developed a new form of "burning" lens by grinding out the solid front of the glass bull's-eye so as to form "steps," or rings (see Fig. 1). Condorcet built up this form, composed of separate rings, each ring being a section of a sphere, but it was the ingenious French physicist, Augustin Fresnel, who, in 1822, adapted them for projection of light in lighthouse work. The Fresnel apparatus consists of a polyzonal lens enclosing the lamp, which is placed at the central focus (Figs. 2 and 5). The lens is built up of glass prisms, the central portion of which is dioptric, or refracting only, and the upper and lower portions are both reflecting and refracting, described as "catadioptric." The advantages of this system lie in the greater brilliancy owing to the fact that a large proportion of the light given out by the source is concentrated by the prisms into beams useful to the mariner, and the consequent economy in the consumption of oil or other illuminant employed. This has done away entirely with the necessity of a number of light sources, as in the case of the Bell Rock lighthouse.

This system introduced by Fresnel is the one in vogue to-day, and it is difficult to see how it can be improved. All the light, except that immediately above the flame or source of light, and all below, except that lost by the shadow of the holder of the source of light, is utilized. It would take up much more space than we have at our disposal to describe the various forms devised since Fresnel's day to project light in all varieties of directions, some, like the "range lens" (Fig. 3), for sending the rays in a round column, or bundle,

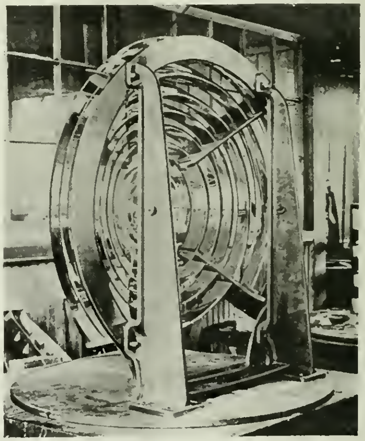


Fig. 3—Fourth order range lens, focal distance 250 mm

as it were, in one direction only. These lenses are generally employed to mark the axis or centre line of a channel. In this case two lights are necessary, and are placed a proper distance apart, usually with the rear light higher than the front, so that both lights show in line in the same vertical plane when the observer is in the centre of the channel. Other lenses are constructed in combination to project light in two or more directions only, but the system is the same in all. The principal sizes of Fresnel lenses are classified according to their order, this depending upon the inside radius or focal distance of the lens—that is, the distance from the centre of the light to the inner surface of the lens, as given in the following table:

Order.	Millimeters.	Inches.
First	920	36.2
Second	700	27.6
Third	500	19.7
Three-and-a-half	375	14.7
Fourth	250	9.8
Fifth	187.5	7.4
Sixth	150	5.9

Stevenson placed five red glasses over five reflectors on two sides of the lantern, and seven white lights on the other two sides; when the lantern revolved, the interval of red light was shorter than that of white. It seems apparent that this was done to secure a means of identification. This is most likely, as a flash seems more brilliant to the human eye than a continuous light, 9/10 seconds being the time sufficient for maximum intensity. The whole system of lighthouse practice is to use both red and white flashes with various durations and intervals of darkness and light. For instance, one light may have an interval of flash of two seconds' duration, succeeded by three seconds of darkness. This flash is quite regular, being, in fact, regulated by a clock mechanism, and is sufficient for undoubted identification, and hence enables the mariner to locate his position by referring to his chart, on which the light of observed number of flashes is recorded. (Figure 4 illustrates such a flashing lens.)

In the United States the Navesink light, at Sandy Hook, New Jersey, just south of New York harbor, is 246 feet high, and is illuminated with electric light. This is the most powerful light on this continent. This light shows each five seconds a flash of one-tenth second duration, estimated at 25,000,000 candle power. Although, on account of the curvature of the earth, the light itself cannot be seen more than 22 miles, its beam has been reported to have been observed in the sky at a distance of 70 nautical miles. Fire Island light, in the United States, is 163 feet high, flashes four seconds and eclipses 5.6 seconds, calculated 170,000 candles. Montauk Point light is 168 feet high, 130,000 candles, flashes four seconds and eclipses nine and six-tenths seconds. These are perhaps the most important lights in the United States.

The number of light stations, light vessels, and fog signals of the world, as listed in the British Admiralty List of Lights for 1915, is approximately as given in the table below. The statistics do not include the Great Lakes of this continent nor rivers above the limit of sea-going navigation, and the lights are given in greater completeness for some countries than for others:

Continents.	Light Stations.	Light Vessels.	Fog Signals.
Europe	7,335	192	779
North America	2,913	49	645
Asia	1,355	36	116
Australia and Oceania	746	3	21
Africa	519	0	10
South America	358	10	15
Totals	13,226	290	1,586

It is of interest to compare similar statistics of light stations for about 1888 (The Modern Lighthouse Service, Johnson).

Continents.	Light Stations.
Europe	3,309
North America	1,435
Asia	476
Oceania	319
Africa	219
South America	167
Total	5,925

These figures give us some idea of the importance this matter of light stations holds to the commerce of the world.

Development of Light Source.

The development of the light source used in the illumination of light stations throughout the world is of special interest to members of the trade who are engaged in the problem of securing good illumination. We can, however, only touch the subject lightly here. Argand introduced the round hollow wick much used in lighthouse work, in order to increase combustion in the middle of the flame, in addition to the outside hollow column of air; many improvements have been made in the use of the concentric wick; five wicks, placed inside each other, are used in some of the large lamps. The contracted neck chimney was introduced to further force the air in contact with the top of the flame. Both improvements were quite novel in their day, and have been ever since the guiding principle in all lamps used for all purposes.

The incandescent oil-vapor lamp, which is now generally

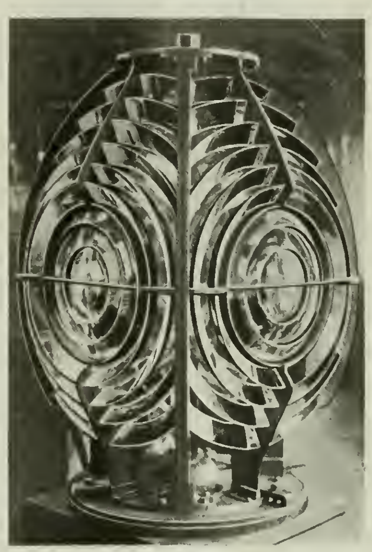


Fig. 4—Fourth order four panel flashing lens, focal length 250 mm.

employed for important lights, is of later development, and burns vaporized kerosene under an incandescent mantle.

Various other illuminants are now in use. Oil gas is extensively used, particularly for lighted buoys; acetylene gas is used for lighted buoys and unattended lighted beacons; electric arc and incandescent lights are used in some special instances. Electric lights with distant control are employed in a number of cases where a reliable source of current may be obtained. Although electrically illuminated lenses are ideal, as it is possible to make use of this light to approximate a point source, there are generally transmission difficulties to be overcome in carrying power to lighthouses, and the possibility of interrupted service from sub-stations and power-houses makes the use of electrical energy somewhat hazardous. The service rendered to a lighthouse must be continuous. In some cases electrical energy is generated within the lighthouse itself. The power plant usually consists of duplicate units, thus ensuring continuous service.

Development of Lighthouse Lenses.

The development of the light source has had considerable influence on the development of the lens. Lenses are now assembled for use with a light source approximating a point source. This has enabled the manufacturer to greatly reduce the size of the lens. Formerly the lenses approached the size of an ordinary living room, inside which there was sufficient space to hold a fair-sized card party. But with the development of the light source these large-sized lenses have become obsolete. In fact, the ideal point source has been approached so closely that a "fourth" order lens will now accomplish even more than the large early type "first" or "second" order lens, which are now little used. As the "first," "second," and "third" order lenses were constructed for use with the large flame light source, it is obviously impossible to use the more highly developed light source of the present time in the early type lens. This for the reason that the prism position in the old type lens was so arranged as to take care of light rays coming from a distributive source. Therefore a substitution of the more highly developed light source when used with the early type large lenses renders a portion of the prism ineffective, and directs the light rays to other than the useful zone. The effectiveness of the lighthouse lens, therefore, depends on the use of the proper light source.

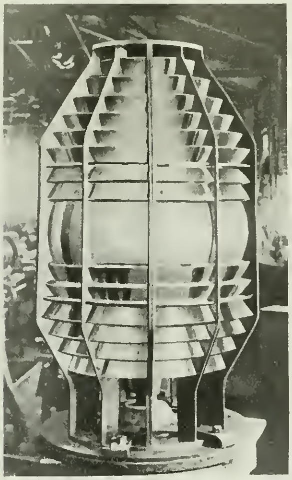


Fig. 5—Fourth order six panel fixed lens, focal distance 250 mm.

Process of Manufacture.

The process of manufacturing the best quality of glass from which to make what may be considered one of the most impressive and splendid examples of the glass-maker's art for lighthouse use is of interest. As we have seen, these lenses fulfil the functions of what may be termed optical organs; and, although the requirements as regards color, homogeneity, and freedom from other defects are not so stringent as in the case of optical glassware, still the state of purity required in the various substances forming the glass batch, which is essential to the production of glass of good color, or freedom from color, for this work makes the task of the glass manufacturer a difficult and delicate one. The attempts, for instance, of the glass manufacturer to produce the best red glass for lighthouse work has been a matter of slow development. From the first gold ruby glass was used, and, in order to be secure against excessive breakage, the glass was made about one quarter of an inch in thickness. This glass was difficult to produce without too dense a color and consequent loss of light, and also was not the best kind of red, as it contained blue. So the problem has been to produce a red glass of proper thickness which would transmit the greatest amount of red light. A very good glass of this kind (orange red) has been produced by one large glass manufacturing concern in the United States, and this glass is now being used extensively for lighthouse work.

The railroads will not use this (orange red) glass, and seem willing to sacrifice transmission of light in order to use yellow signals. Red and yellow-colored glasses lose approximately three fourths of the intensity of colorless glass in transmission, green five sixths, and blue very much more. Blue is, therefore, little used for such purposes. In order, therefore, to project red rays as far as white, the illumination must be four-fold that used for white or colorless glass; for green it must be six-fold. The red glass now approved by the United States Government Lighthouse Department transmits over 40 per cent. of the light used.

This phenomenon of the transmission of light through colored screens is known to every observing mariner. And in approaching a light of varying intensity, such as fixed varied by flashes, or alternating red and white, due allowance is always made for the inferior brightness of the less powerful part of the light, which at a distance may show flashes only or white only. Flashing lights may also show a faint continuous light, due to reflection from the lantern, in clear weather at short distances.

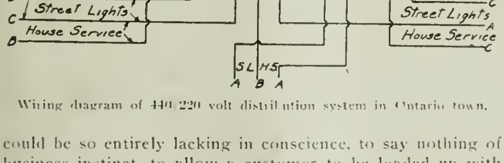
Homogeneity has been mentioned as an essential requirement in this product. Defects such as striae and air bubbles cannot be entirely avoided in the production of this glass, as these defects are bound to arise in glass which is ladled or gathered from the pot and then transferred to moulds to be shaped. In the manufacture of optical glass of the first quality, the glass is not removed from the pot, but is allowed to cool in the pot in which it is melted; afterwards the pot is broken away from the glass and hence defects are avoided. If it were attempted to manufacture the glass bodies required for lighthouse purposes in the same manner in which high-grade optical glass is produced the cost would approximate to that of the large discs used for telescope objectives, and this would, of course, be entirely prohibitive.

The reason that the same freedom from defects required in high-grade optical glass is not necessary in glassware used for lighthouse purposes arises out of the fact that lighthouse lenses are used merely to impart a desired direction to a beam of light, and are not required for the purpose of producing, as in the case of telescope objectives, sharply-defined images. Very slight irregularities in the glass are, therefore, not of such serious importance. Although lighthouse glass can, therefore, be produced by rather less elaborate means, still every care must be taken to make the glass as perfect as is possible. After the molten glass has been brought to the proper shape in iron moulds it is removed from these moulds and is properly annealed. This annealing, or cooling process, is one that must be very carefully carried out if breakage later on is to be avoided in the product. After being properly annealed the glass is cut and polished to the final shape of lenses and annular lens segments. These are then built up and held in place by metal frames, as shown in the photographs illustrating this article.

Until a few years ago it was necessary to procure all the cut glass lenses used in the lighthouse service, either from France, England, or Germany, most of the product coming from France. When the American firm of glass manufacturers now engaged in producing this glass were first approached by the United States Government with a view to ascertaining if a better lens could not be made on this continent than that furnished from abroad, by using more modern manufacturing methods, they assumed what may be termed a duty with an unknown investment, as well as unknown loss or profit, but it also answered what may be considered a challenge to manufacturers on this continent to produce high-grade articles and to run the risk involved in the endeavor. It is very gratifying to know that the modern and up-to-the-minute manufacturing methods employed on this continent have enabled us to produce lenses which are superior to those heretofore purchased abroad, and that they can be produced for the same cost or less. The essential feature of the method of manufacture employed on this continent that makes the product superior to that furnished from abroad is that the prisms are formed by machine instead of by hand. Every part is made to fit an accurate template or jig, so that all glasses are true to size, and parts of the same number are completely interchangeable. This is impossible when the prisms are made by hand, as they are made abroad; variations must always occur. The lenses produced here are also superior in another respect, as shown by a government test made in 1914, which showed the lens produced here to be 50 per cent. superior than any other lens tested. This test was based on the continued efficiency of the lens, the reason being that the glass produced here is not hydroscopic —that is, it does not absorb or take up moisture that cannot be removed by cleaning. This condition has been brought about by the combination of certain materials used in mixing the glass batch. (1) "Many improvements have been made also in pressed glass lens lanterns and buoy lantern lenses, and tests show them well adapted for many conditions of the service, at a decrease in expense over those heretofore used." We have not space at our disposal to follow these later improvements out in detail. We have, however, to thank Fresnel, the discoverer of polarized light, a genius of the first rank, for the benefit we derive at this late day, from his early work and experiments made in this connection. Let us, therefore, always look with kindly eyes on the experiments being made about us each day, with the thought in mind that although no immediately profitable result can be secured from these seemingly useless experiments, that nevertheless they may, some day, like Fresnel's early work, be of great service to humanity.

Distribution System that Retards Electrical Progress

The wiring diagram of a small Ontario town's distribution system, sufficiently out of the ordinary to be an interesting curiosity, has just been brought to our attention. So far as we know, it is the only one of its kind in Canada, and, for the sake of the citizens who have to put up with it, we sincerely hope it is. It is a mystery how such a system ever came to be installed. Of course, it is conceivable that a town council, in absolute ignorance of the requirements, may unwittingly consent to the purchase of useless equipment, but it is not easily believable that any salesman of to-day



Wiring diagram of 440/220 volt distribution system in Ontario town.

could be so entirely lacking in conscience, to say nothing of business instinct, to allow a customer to be loaded up with such material. Doubtless the matter of cost was a consideration. A glance at the wiring diagram, however, shows that it will cost much more now to reconstruct this distribution system than it would have cost to install it right in the first place. In the interval it is an arrangement which is alike unsatisfactory to the consumer and unprofitable to the municipality.

As we have the information, the town is served through a bank of three transformers, with 440/220 volt secondaries. However, as there is no demand for the higher voltage, distribution throughout the town is at 220 volts. One phase is supplied to each of three sections of the town, in an endeavor to balance up the load. Separate lead wires, however, are run for the house and street lights, using the same return—that is, three wires are run to each section. An occasional three-phase motor is used, in which case a fourth wire is run, and the motor connected on to one of the lighting circuits. Since the system is a small one, this naturally seriously unbalances the load.

The basis of the whole trouble, of course, lies in the transformers, which should have been 220/110. It is likely, too, when the change is made, that larger copper will have to be run throughout the town. Until the change is made, however, there is little possibility of supplying the citizens with those modern necessities—irons, toasters, vacuum sweepers, percolators, and so on—which, of course, are standardized around 110 volts. The series lighting, also, or the use of 220 volt lamps, must be a continual annoyance, to say nothing of the added expense.

The whole matter merely emphasizes the mess municipal authorities are liable to get themselves and their citizens into by failure to consult competent engineers before installing their work. Fortunately their number is decreasing.

Annual Financial Review

Many a successful man in the electrical business owes that success to his ability, at some critical time or other in his career, to furnish sufficient security in the form of good stocks or bonds to secure the co-operation of his banker. Within recent years, indeed, this practice of business men of every kind putting a certain percentage each year into some liquid form of investment in no way connected with their own line of business has tended to stabilize trade in general, and is now coming to be looked upon as one of the best forms of insurance against financial difficulties that so frequently follow the inevitable lean years. Strange as it may appear, however, these knights of industry, so prominent in their own field of manufacturing, operating, contracting, or what-not, often know little of finance, and, if they invest at all, must do so without first-hand knowledge and on the advice of someone who may not be entirely disinterested or whose judgment may be at fault. To men in business life who wish to invest against a rainy day and who believe in knowing the history and past performances of any security before placing their money, we recommend a study of the "Annual Financial Review," compiled by Mr. W. R. Houston, of Houston Standard Publications, Toronto Stock Exchange Building, Toronto. The 1916 issue is just off the press. It is a carefully revised resume of facts regarding Canadian securities, than which there are no more promising to be found the world over. This book does not advise or predict. It is a bald statement of what Canadian stocks have done in the past, the best, and indeed the only, data on which estimates may be based of future performances. The price is $6.00 net. By the habitual investor it will be found to contain information of great value as a foundation on which to base his decisions. In the man who does not yet know the joy of receiving his first dividend cheque it may perhaps be the means of arousing an interest in sound investments which will help him to spend his declining years in greater comfort and peace of mind.

Have Joined the 245th

Lieut. Clement Saye, secretary-treasurer of the Northern Electric Company, and Lieut. H. D. Rolland, of the traffic department of the Bell Telephone Company, have joined the 245th Battalion Canadian Grenadier Guards, now being organized in Montreal.

Underground Distribution Systems

A practical man's general review, before the A.I.E.E., of an important phase of Central Station Work—A growing demand for this type of construction.

By G. J. Newton

The following facts and suggestions are based on many years' experience with underground distribution systems, and are stated in the following article with the intention of showing the importance of careful and intelligent design as related, not only to the first cost, but to the economical operation and ultimate value of the completed system.

An inspection of many systems has made it evident to the writer that improper design is responsible for more faults than is poor construction, and it is with a sincere desire to aid others interested in this work, to avoid such mistakes in the future, that these suggestions are offered.

No two systems are entirely alike, and the conditions are different in every place; it is, therefore, impossible to formulate any definite rules that will apply under all conditions. The engineer must be guided by good judgment, based on experience, and a thorough study of the conditions in order to secure satisfactory results.

Owing to the increasing demand for electrical energy, and the serious objections to the unsightly and dangerous overhead wires and poles, underground systems of distribution have become a necessity in many places where the expense of this class of service would not have been considered warranted under former conditions.

Underground distribution is very expensive, as compared with overhead construction, and in many cases, particularly in the smaller cities, the first cost is of vital importance; a carefully worked out design is therefore necessary in order to derive the greatest benefit from the money expended. Many of the present systems have not been designed with care, and attention to detail, that their importance deserves and frequently the cost of the system has been entirely out of proportion to its ultimate value.

If it were possible to design and install an underground system at the start of an electrical undertaking the problem would be much simplified, as the station and consumers' equipment could be selected, and the whole system designed for the most efficient results. Unfortunately the conditions are never so favorable, and the distribution engineer is confronted with many conditions over which he has no control, but must consider in making his plans.

Distribution problems are, therefore, usually very complex and permit of several methods of being solved. It is only by a careful study of the conditions and foresight as to the future requirements of the system that a satisfactory, economical and efficient design can be developed.

The condition under which underground cables and equipment operate are more severe than on overhead systems and a thorough knowledge of these conditions is absolutely necessary, and must be kept in mind, in selecting cables and equipment and designing the conduit system for their installation. Overhead wires can be, and frequently are, operated far above their rated capacity, without any serious danger, but underground cables and equipment must be operated within certain definite limits in order to avoid serious damage, if not total destruction.

Economy of distribution is equally as important as economy in production, particularly at the present time, when practically all public utility companies are regulated, to a greater or less extent, by state or municipal commissions. First cost is not, therefore, the only factor that should be considered, as economical operation and reliability of service are equally as important in the financial success and growth of the business.

Except in the large companies, there is probably no branch of the business that has been given less thought and study than underground work; in many cases the principal object evidently has been to get the wires out of sight at the least possible expense, with no attempt being made to improve the system of distribution and little or no regard for the future development of this class of service. The operation of an underground system when properly designed, installed, and maintained, guarantees the most reliable and efficient service of any method of distribution ever employed; the financial benefit, directly due to this class of service is, in many cases, a proof of the wisdom of its installation.

While it is admitted that underground systems are expensive to install, still it must be remembered that a conduit system is a permanent structure, has little or no depreciation; on the contrary it will increase in value as the importance of the section it serves is developed. Considering the first cost, permanent nature of the undertaking, and importance of economical and reliable service, it is advisable to make a thorough study of the conditions and future requirements of the service on which to base a design of the proposed system.

In the designing of an underground distribution system there is one important fact that must always be considered—the system should be designed to serve the entire district that can reasonably be expected to ever require this

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SIZE			10	25	40	50	60	80	100				WATTS
LIGHTING				40		20	110						8600
SIGN			90						5				1400

APPLIANCES

10 Desk Fans	660
3 Irons	300
TOTAL LIGHTING LOAD	10960

POWER

2 - 5 HP 220 Volt 3φ Motors	10000
1 - 10 HP 220 Volt 3φ Motor	10000
TOTAL POWER LOAD	20 Kw

L SERVICE 105 ft #4 · 3 Conductor	TRANSFORMER 14 A
P SERVICE 110 ft #4 · 3 Conductor	TRANSFORMER 14 A · B · C

Fig. 1—Sample Record Card.

class of service. Such a design permits of a systematic scheme being developed for the whole district, uniform methods of construction, and standardization of equipment.

If this method is followed it is then possible to install any section, from time to time as the service demands, and each completed section will form a part of the whole general scheme and eventually develop into a system rather than a collection of more or less useful sections of conduit.

It is not the object of this article to show each step in the design of any particular system, but rather to point out certain important features to be kept in mind and offer suggestions as to the general method to be adopted; it is only by a thorough study of each case that the best methods can be determined.

The first step in designing an underground distribution system is to secure an accurate load record for each consumer in the proposed underground district. This record should be kept on cards similar to Fig. 1; where there is a large power load in the district it is advisable to make separate records for the lighting and power loads, using different colored cards for each record.

The card shown in Fig. 1 is simply a sample, and the best arrangement of the inventory on the cards will depend on the requirements of each particular system. The reverse side of the cards can be used for showing the number and location of the transformer supplying the service lateral, consumers' fuse box and other information connected with each consumer's service. These cards if properly corrected will form a permanent record of great value in making future changes and balancing the load on the distribution system.

A careful inspection should be made of each building to determine the most suitable location for the new underground lateral in order to reduce the cost of changing the inside wiring as much as possible. Except in the case of very heavy loads or consumers where emergency service must be provided for, it is advisable to supply all of the consumers in a building from one lighting and one power lateral; this reduces the number of laterals, handholes, and fuse boxes and permits using the least amount of copper by taking advantage of the diversity of a group of consumers.

The lighting and power load can be plotted on one drawing or the loads can be plotted on separate plans, the latter method is best as the plans for each system can then be kept separate. The load maps for each system should show the total load, both in the underground district and outside of it, to be supplied by cables in the conduit system from the power house so that ample conduit space can be provided and the most suitable routes and sizes of feeders determined.

Having the lighting and power loads and a map showing the street light system, the next step is to determine the most suitable plan of distribution to be adopted; this may be called the critical point in the design of a distribution system, for on the decision depends not only the first cost of the installation but the reliable, efficient and economical operation of the distribution system. There are two general schemes of distribution:

Two General Schemes

1. To supply the whole city from one power house.
2. Divide the city into districts and supply each from sub-stations, or rather from the power house and sub-stations.

In many of the older systems the first method was used and a large number of ducts were installed, in one trench from the power house, to serve the whole city, or at least that portion that was to be supplied by underground eventually. This necessitated providing a large number of spare ducts, a large percentage of which remained idle for years and not infrequently resulted in too many ducts in some places and too few in others.

Not only was the first cost of such a system excessive, but the manholes were almost invariably too small to accommodate the number of cables that could have been installed in all of the ducts had there ever been use for them. The most serious objection to this plan is that the losses due to the heating of so many cables in one conduit run are excessive and materially reduce the carrying capacity of the cables, particularly in cables occupying the inner ducts.

Another serious objection to this method is that a burnout on one cable is practically certain to damage adjacent cables and cause interruption of service over a considerable area. Faults on underground systems usually affect more consumers than on an overhead system and require more time to repair, therefore, no system should be considered that does not permit being sectionalized and have reasonable emergency facilities provided for restoring service with the least possible delay.

The objections to the first plan, as stated above, preclude its adoption except in very small cities where the area to be served by underground distribution is limited, and the total number of ducts installed in one trench will not be excessive.

The second method of distribution, when properly designed, avoids all of the objectionable features of the first method and is particularly adapted to the modern practice of installing sub-stations supplied by high-tension feeders, as each district is practically operated separate from the others and with suitable emergency feeders and switching equipment permits each district to assist the others in case of necessity.

The old saying "That you should not put all of your eggs in one basket" is particularly true if we change the words slightly—"You should not put all your feeders in one trench or manhole." and the distribution engineer will be wise to keep this warning in mind as far as the requirements of the case will permit.

Reliable service and economical distribution are absolutely necessary for the financial success of every light and power company. Reliability depends on the following conditions:

Factors Controlling Reliable Service

1. The best material, equipment and workmanship.
2. Proper selection of material and equipment for the service it is to supply.
3. Efficient protective apparatus, judiciously installed.
4. Sectionalizing apparatus properly located.
5. Continuity of supply, by feeders over different routes or an arrangement that will provide at least two sources of supply for the network.
6. Regular and systematic inspection of the distribution system by competent men.
7. Accurate plans and records of the distribution system so that changes, additions and extensions can be made to the best advantage with the least possibility of error.

Economical operation depends upon a reasonable first cost, in addition to all of the above conditions, and where a system is designed at first for a whole city (keeping in mind future sub-stations) it is possible to reduce the number of ducts and manholes to a minimum, install sections as the business warrants and extend the ultimate cost over a considerable period.

Keeping the above facts in mind the actual design of an underground distribution system should be made on the following general plan. After making the load maps for the lighting and power systems and also a map showing the location of the street lights it is a good plan to first lay out the street light circuits.

The location of the street lights is determined by the city authorities and can seldom be altered enough to materially change the conduit arrangement, therefore, by designing this system first it will give a general idea of where the conduit must be installed and keeping this plan in mind it is frequently possible to arrange the secondary mains so as to utilize the same routes (particularly in alleys and the less important streets) so as to avoid considerable conduit construction.

The proposed location of the laterals in each building should be shown on the plan for the secondary systems for light and power. A study of these locations, together with the street light conduit layout, will often show where slight changes in one or the other will permit considerable saving.

(Continued in Sept. 15th Issue)

Electric Railways

The Field of the One-Man Car — Interesting Discussion before the West Virginia Public Utilities Association

By J. B. Irwin*

It has been stated that lightweight, one-man cars are now in use on 100 railways in this country alone. This is a comparative recent development in the electric railway industry, and it is desirable to learn the various reasons for their adoption and to study the traffic conditions encountered and results accomplished so that the proper field for this type of car may be more definitely established.

Through the courtesy of the Southern Illinois Public utilities Company the writer recently had the opportunity to become familiar with the railway conditions in Anderson, S.C. These are strikingly similar to the conditions in Corpus Christi, Tex., as described in a paper by D. R. Locker, presented before the meeting of the Southwestern Electrical and Gas Association last May.

Corpus Christi has a population of about 20,000, with ten miles of track, while that of Anderson is less by perhaps 5,000, but the track mileage is the same. Both railways have been recently subjected to a very heavy track reconstruction expenses on account of the paving of the principal city streets, and the operating revenues of both have suffered by reason of the automobile traffic.

Both companies decided that the lightweight, one-man car offered the best prospect for increasing net earnings, and, now that one-man operation has been tried out, are well satisfied with the change.

In Corpus Christi the headways, which were previously fifteen and twenty minutes, have been cut in half, with an increase of only 6 per cent. in operating expense, while the earnings have increased 30 per cent. In making the change the Corpus Christi Railway and Light Company purchased eight new cars, weighing 12,000 pounds, seating twenty-six passengers, and equipped with air brakes and Westinghouse "Wee" motors.

In the case of Anderson, the Southern Illinois Public Utilities Company was able to shift some of the larger cars to another of its properties and purchased five new lightweight cars for local one-man operation. On two of these new cars "Wee" motors were installed, and on the other three cars the electrical equipment was transferred from the old cars. These motors are of 19 h.p., rating at 600 volts, and weigh 890 pounds each. They are of the smallest standard type yet placed on the market. Some of the old cars were retained for one of the Anderson lines having comparatively heavy traffic, on on this line it was found necessary to place a second man on the car during certain hours on Saturday and Sunday, but otherwise there has been no difficulty in collecting fares without interference with schedules. The cars previously used weighed about 24,000 pounds, and seated 32 passengers, while the new cars weigh 17,000 pounds and seat 24, with additional movable seats for six on the platform. As the traffic is very light and stops not numerous it was not considered necessary to equip the cars with air brakes.

Lines of short headway and heavy traffic appear at present to be beyond the field of usefulness of the one-man car. With large, crowded cars one-man operation would increase the time of stops to such an extent that schedules would be lengthened and street congestion made worse. It has not yet been shown just where the limit of size for one-man operation is. Granting that there must be some limit to the traffic handling capacity of one-man cars, beyond which conditions would be uneconomic or intolerable, the question of their field of application becomes involved with considerations of headway, street congestion, schedules, character of traffic, etc.

Although the one-man car is best fitted for light service, it is probable that the future will witness a gradual extension of its field. There are some periods of the day on all except the very heaviest trunk lines when the big cars are run half empty or when headways are increased to the point where considerable revenue is sacrificed. At such times the smaller one-man cars could be used to advantage if there was some way to take care of the rush-hour traffic without congestion or sacrifice of economy. It has already been found feasible to use a second man for the rush hours only, and probably under certain conditions it will be found practical to have the conductor ride the cars and collect fares in the down-town zone and transfer from outbound to inbound cars at certain points.

A possible future method of taking care of the rush hour may be to couple two smaller motor cars together to be controlled by one man, while the second man collects the fares. The entrance would be at the front of the first car, and the exits would be at the rear of the first car and the front of the second car. The second man would collect the fares at the rear end of the first car as the passengers passed this point, whether they got off or went into the second car.

A similar scheme of fare collection is in successful use on large single-unit cars in Cleveland and other places, and "articulated" cars made of two small cars permanently coupled together have been used in many places, but it remains to be seen whether a platform construction can be developed that will be suitable for communication between cars that have to take sharp curves of city street car lines.

*General Engineer Westinghouse Electric & Mfg. Co.

Montreal Tramways Building Conduits

The City of Montreal having decided that the high tension conduits should be owned, operated, and controlled by the power companies, the Montreal Tramways Company have just placed contracts for the construction of a high-tension 13,200 v. conduit system to inter-connect their several power houses and sub-stations on the Island of Montreal. The tenders have been let to G. M. Gest, Limited, Montreal, and Quinlan & Robertson, Limited, Montreal, each contracting firm building approximately half of the total system, which it is expected will be completed this year. Specifications and tender forms have been issued for the necessary cables. The conduits will be of vitrified-clay "Camp" duct, 4½ in. round bore. The manholes will be of brick construction.

Taking the Public Into Your Confidence

How One of the Largest Railway Systems in the World Avoided a Strike —The Power of Public Opinion

The people of New York have been passing through an anxious time since the threat was made recently to call a general strike of street railway employees. The trend of modern public utility operation is shown, however, in the attitude of the New York Railways Company, which endeavored through carefully written newspaper advertisements to present the matter in its correct light before their citizen-patrons. The moral effect of these advertisements was undoubted. Below we reproduce one of them, a type of a number appearing during the strike crisis:

Shall New York Street Railways Be Run for the People of New York?

To the People of New York City:

The threat to tie up the street railroads of this city is your problem.

A definite expression of public opinion will be overwhelming.

We believe we are profoundly right, and we want the public of this city to know why.

* * *

See what is threatened:

An organization from another city, in order to bolster up its side of a dispute in a neighboring community, seeks to stop the very life-blood of the City of New York.

There are no differences between our men and ourselves. It is not even claimed that there are.

But this alien organization proposes to call a strike anyway!

* * *

We are not fighting labor unions or the principles of organization.

Our problem is a simple one—but very practical.

It is this: We are responsible to the people of New York for providing safe, prompt, and continuous transportation service.

For that responsibility we are held vigorously to account by public opinion, reinforced by a Public Service Commission with drastic powers.

The very life of the city depends upon the continuity of our operations. Disrupt it, and New York is prostrate.

* * *

Our men are being threatened and intimidated by the Amalgamated Association of Street and Electric Railway Employees, an organization with interests in various parts of the United States.

Its main offices are in another city.

Its interests are not primarily the interests of the people of New York, of the transportation companies within its borders, or the men they employ.

* * *

To accept the regime of this organization would immediately make the operation of the street railroads of New York a prey to the orders, the prejudices, and the disputes of the officers of an alien organization with alien interests, working for alien purposes, and with no responsibility whatever to this community.

Our men want to stay by their jobs. A careful canvass makes that clear.

There is no question, however, of the purpose of this organization, without consultation with or authority from our own employees to call a strike on the lines of the New York Railways, with a hope that through threats and intimidation our men may be induced to stay away from their work.

We are ready, and have always been ready, to meet with our men to discuss our mutual interests.

* * *

The management of these lines has worked harmoniously with its men for many years.

We have recognized the impossibility of providing the service the people demand unless men and officers co-operated heartily.

Our men themselves know that we want to share with them the increased prosperity of the company.

We have increased wages twice this year.

During the past several years we have made other increases, as well as constantly adjusted working conditions so as to make them more favorable.

But this alien organization, to serve its own ends, now proposes to throttle the daily life of this great city in spite of all that.

* * *

It would be impossible for us to recognize or to deal with this organization without stultifying ourselves in the performance of our supreme duty to the people of this city.

We wish to make it clear, therefore, that we cannot and will not have any dealings whatsoever with this alien organization, although our willingness to meet with our own men stands—and will stand.

* * *

The public interest in this situation far transcends that of any corporation or its employees.

We are gravely conscious of our duty to leave no step untaken that will avoid an interruption of transportation service.

We are relying upon the loyalty of the uniformed employees of this company to co-operate with us in maintaining the service we are obliged to give to the people of New York.

The men may, on their part, rely upon us to do everything in our power to see to it that their interests and safety are protected to the full extent of the law.

* * *

The city authorities of New York have assured us of their determination to preserve order and give ample police protection to our passengers and employees.

With such protection there will be no doubt of our ability to maintain our service—and maintain it with our loyal, uniformed employees.

* * *

If every man in New York makes up his mind that in so far as his influence is concerned he will not tolerate an interruption of traffic on the street railways of this city, there won't be any question as to what will happen.

NEW YORK RAILWAYS COMPANY,

Theodore P. Shonts, President.

The Dealer and Contractor

A Trial Concentric Wiring Installation at Chicago —Does Not Promise to Revolutionize the Contracting Business

An experimental installation of concentric wiring has been made by the Commonwealth Edison Company in the "two-flat" building at 3424 North Troy Street, Chicago. The building selected for the experiment belongs to the company, having been acquired with some other property, and had never been wired. It contains two flats, one above the other, and a basement. Each flat consists of an entrance hall or vestibule, a living room, two bedrooms, a kitchen, a pantry, and a bathroom. The construction department of the company did the wiring.

The building has been wired for a total of twenty lighting and two wall switch outlets for twenty-four lamps. Complying with the city's requirements, two circuits for each flat were installed. This is based on the rule that the wiring shall provide a capacity for 0.75 watt per square foot of floor space.

Each of the flats was wired for seven ceiling outlets, one baseboard outlet, one wall outlet, and one wall-switch. The total number of lamps in each flat is eleven. There are two outlets and two lamps in the basement. Distribution of outlets, switches, and lamps for each meter was made according to the following table:

Location	Ceiling outlets	Baseboard outlets	Wall outlets	Wall switches	No. of lamps
Hall	1-1				1
Parlor	1-3	1-1		1	4
Front bedroom	1-1				1
Rear bedroom	1-1				1
Kitchen	1-1		1-1		2
Pantry	1-1				1
Bathroom	1-1				1
Basement	1-1				1
Total	8	1	1	1	12

The cost of the material used for this wiring job was as follows:

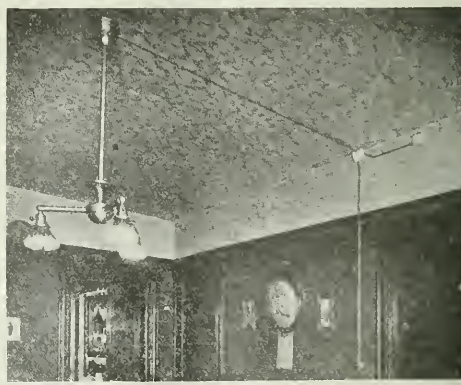
Material (concentric)	$28.23
Material (standard)	3.18
Material (service)	7.49
	$38.90

The labor used on this job amounted to 83½ hours—33 hours wireman's time and 50½ hours helper's time.

The cost of the fixtures used was $39.86, the remaining item of cost being 84 cents for carfare and expenses. The amount of concentric wire used was 345 feet.

It was found that the job had cost more than would have been the case if the wiring had been done under the present practice, using flexible metallic conduit and armored cable. The same job was figured on this basis, and the material came to $24.73, with 66 hours of labor, divided into 33 hours of the wireman's time and 33 hours of the helper's time. The fixtures and the carfare and miscellaneous expense would be practically the same in both cases.

It is not thought strange that the first interior wiring job using the concentric wiring method should cost more than the older and well-established method. The cost of concentric wiring is bound to decrease after the wiremen become more familiar with the use of concentric materials. Further, it is evident that where a number of completed buildings are to be wired, larger quantities of material will be ordered, and naturally a better price for material will be secured in view of the quantity required. With more experience in this class of work it is, of course, to be expected that the hours of labor per job will be substantially reduced. Again, as will be observed by reference to the pictures, the quality of fixtures used is rather better than might be expected in an installation of this character. The cost of the fixtures has nothing to do with the comparative cost, however, for the same amount is given in each case; but the use of simpler fixtures would reduce the absolute cost. One



Concentric construction in living room, showing wall-switch control of ceiling fixture.

man who has given considerable attention to the subject believes that when large quantities are used the cost of concentric material will be reduced at least 25 per cent. below the present figure, while he thinks that when the workmen get accustomed to handling the concentric wire the labor cost will be about one-third of the labor cost on the experimental installation.

The above description is taken from the Electrical World. The article further adds that the men in the Commonwealth Edison Company, who have made a study of the subject, have no expectation that the simpler methods of interior wiring will revolutionize existing practice. Rather, it seems likely that the simple concentric wiring with exposed circuits will be used for only a particular class of building, such, perhaps, as small houses, or old houses, where the cost of wiring must be moderate if electricity is to be used at all.

Adv. Suggestions for Elec. Contractors

Nos. 13, 14, 15 and 16 of a series worked out by the Society for Electrical Development. Any contractor may change the wording to suit his own case. Consecutive advertising will educate the public to distinguish good work from bad

You always know where to find us

The responsible and established electrical contractor, of course, maintains a store or shop where he may be found—whether you want him to estimate on work or to talk about work under way or completed.

There are, however, some contractors of a less stable character—here to-day, gone to-morrow.

Very often a contractor of this kind has his office "under his hat."

And how annoying it is to try to find this man! Perhaps he has done a job for you which has "gone wrong." But where is he? "He **may** be here this afternoon," or, perhaps, "he'll be there to-morrow." But **you** haven't the time to run after him!

For this reason, as well as for many others, you should employ a permanently located, reputable electrical contractor.

(Names and Addresses of Contractors.)

"In a Workmanlike manner"

These words appear in most specifications for electrical work as well as for bricklaying, carpentry, painting, etc. If the spirit as well as the letter of this injunction is followed, a thoroughly pleasing as well as substantial job results.

To a responsible electrical contractor the words "In a workmanlike manner" mean not only mechanically and electrically correct—but good to look at as well.

Good workmanship is the result of long experience, careful supervision, and confidence created by knowledge.

Your electrical work will be done "In a workmanlike manner" if done by one of the undersigned contractors.

(Names and Addresses of Contractors.)

"If a man makes a better mouse trap than his neighbor the world will make a beaten path to his door."

Years ago—many for some of us, few for others—when we started in the electrical business, we resolved to give better value in electrical work than our short-sighted competitors thought necessary. Varying years of successful business have proven that we were right in believing that the public would appreciate quality at a fair price rather than cheapness.

Wiring which we installed when we were young is still giving good service. So it will be with the work we do for you now.

Our work is considerably better than the "insurance code" requires as a minimum standard. That is why you will want us to wire the house you live in. There will be a large "factor of safety."

We give a full dollar's worth of electrical value for every dollar you spend. And remember, our prices are as low as is consistent with best possible work.

(Names and Addresses of Contractors.)

— not like a bull in a china shop

No, indeed. That is not the way our wiremen will go at your home when they wire it for electricity.

But instead they will come quietly with drop cloths to cover your furniture and carpets—to catch any little dirt which may fall. They will "fish" the wires under the floors, up through the walls without smashing the plaster in the parlor or tearing the paper in the front hall.

And the work which is out of sight, under the floors, inside the partitions, will be just as good as that which you and the inspectors can see.

We employ our wiremen because of their thorough knowledge of their trade. They can be trusted to treat kindly the finest residence.

You see, we have built our business and reputation to **last**—on doing only the best work and on giving a full dollar's worth of value for every dollar received.

(Names and Addresses of Contractors.)

Cost of Cooking in Apartment Houses—A Fruitful Field for the Contractor

Some useful figures on the consumption of electricity used for cooking in apartment houses are given in the last issue of the Electrical World. The figures refer to the Boulevard Apartments, Detroit, where there are 29 apartments on five floors. The readings were taken during the months of June and July, and though the period to which they refer varies, when averaged they give a fair idea of the consumption that might be expected by people living under these conditions. The maximum consumption was 4.4 kw.h. per day. Of a total of 1554 days covered by these readings the average total consumption works out at 2.52 kw.h. per day. The consumption for cooking and for other purposes worked out approximately in the ratio of 4 to 1. The average number of persons in each family was somewhere between 2 and 3.

Figures on Consumption and Cost of Electric Cooking by 29 Electric Range Users, Boulevard Apartments, Detroit

Floor	Apartment	Period of observation No. of days	Kw.-hr. consumed other than by range	Kw.-hr. consumed by range	Range Kw. h. consumption per day
First	1	63	26	167	2.65
First	2	52	15	23	.44
First	3	59	38	55	.93
First	4	48	9	107	2.23
First	5	63	53	160	2.54
First	8	35	51	137	3.91
Second .. .	1	62	31	77	1.24
Second	2	50	17	108	2.16
Second	3	62	31	98	1.58
Second	4	60	18	117	1.95
Second	5	63	43	119	1.89
Second	6	30	18	90	3.00
Second	7	37	74	26	.70
Second	8	62	78	159	2.56
Third	1	59	19	63	1.07
Third	3	60	22	265	4.42
Third	5	45	10	80	1.78
Third	6	60	11	57	.95
Third	7	48	22	44	.92
Third	8	45	20	112	2.48
Fourth	1	59	9	98	1.68
Fourth	4	63	25	171	2.71
Fourth	5	62	43	201	3.24
Fourth	6	62	22	168	2.71
Fourth	7	63	21	99	1.57
Fourth	8	62	38	196	3.16
Basement ..	5	35	12	53	1.51
Basement ..	7	35	16	2	.06
Basement..	Front	50	7	69	1.38
Total .. .	29	1554	799	3121	57.42

Average number of days 53.6
Average daily consumption other than range, kw.h. .514
Average range consumption per day per ap't., kw.h. 2.0

An Electric Bullet Probe

The determination of the exact position of a foreign body, such as a bullet or piece of shell in a wound, has always been a matter of considerable difficulty. Even an X-ray photograph is frequently vague, and sometimes actually misleading, and therefore any instrument which will indicate more definitely the position of these bodies, and so supplement the information given by the X-rays, cannot fail to be exceedingly valuable.

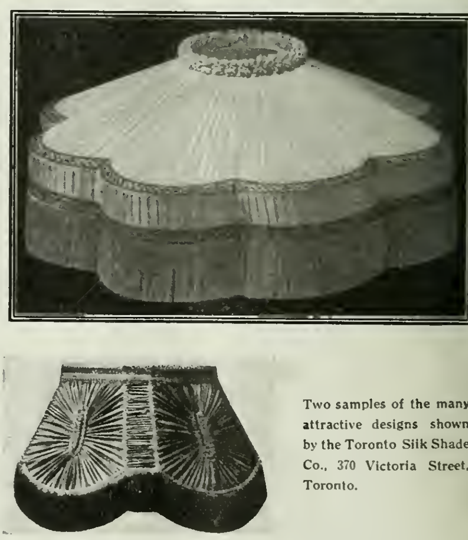
An electric bullet probe, designed for this purpose is described in the Electrical Review, London, England. The complete instrument consists of a fine metal probe and a contact wire of the same metal, both of which are connected by flexible leads to a galvanometer. The contact wire is placed in the edge of the wound, in good contact with the tissues, and the probe is employed in the usual way. Since the probe and contact are both of the same metal, there is no difference of potential between them when they are inserted in the wound, and, consequently, no deflection of the galvanometer. As soon, however, as the probe touches some other piece of metal in the wound a voltaic cell is formed, of which the metal constitutes one pole and the contact in the edge of the wound the other, the blood being the electrolyte. Consequently, a current flows through the galvanometer and deflects the pointer. The instrument is, therefore, simple and self-contained, no battery or other accessories being required.

The extent of the galvanometer deflection depends on the size and nature of the metallic body touched by the probe. The great sensitiveness of the instrument is shown by the fact that the presence of a small piece of metal measuring only a millimetre or so in any direction causes a deflection of 10 degrees or 20 degrees (about 3 cm. on the galvanometer scale), while for larger pieces, the size of a bullet, the pointer is thrown completely off the scale. As long as the probe is not in contact with any metallic body the pointer remains steady. It is evident that by means of this instrument the presence of even a small piece of metal is distinctly indicated by a comparatively large deflection of the pointer, while the absence of any deflection is a clear proof that no metal has been touched by the probe.

The probes are made in various thicknesses for different uses, and can be very fine when necessary. The probe and contacts and the portions of the leads which may come near the patient can readily be sterilized.

The Pleasant View Telephone Company, Limited, have obtained a charter.

The Clavering Telephone Company, Limited, have obtained a charter.

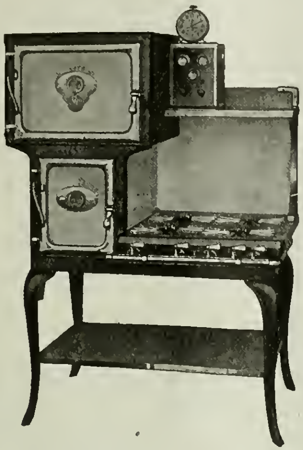


Two samples of the many attractive designs shown by the Toronto Silk Shade Co., 370 Victoria Street, Toronto.

What is New in Electrical Equipment

Electric Range with Gas Stove Top

For use in localities where the cost of current is high and where as a result stove top heating by electricity, which requires a continuous application of heat, is too expensive, a line of combination gas and electric ranges has recently been introduced by the Westinghouse Electric & Mfg. Company. The fireless cooker principle is employed for the ovens,



which are heated by electricity. A thermostat and a clock are furnished, so that meals may be cooked automatically. The food to be cooked may be put in the oven at any time of day and the clock set for automatically starting the current at a determined hour, and the thermostat set to turn the current off when a proper temperature has been reached. Cooking will then proceed as in a fireless cooker, with self-contained heat.

B. C. Electric Co-operates with Electrical Contractors and Dealers

To assist the electrical contractors and dealers as far as possible in enabling them to display their apparatus before the company's consumers, the British Columbia Electric, in

Night photo of section of B. C. E. R. (Victoria branch) showrooms.

making alterations recently to their general offices in Victoria, B.C., in order to better serve their patrons, set aside a large area of its ground floor space for the sole purpose of giving ample accommodation for the various firms to put in a general assortment of large and small apparatus. Show cases, display platforms, tables, etc., have been provided, and much interest has been taken by the trade in the new departure. A very complete line of appliances has been assembled and are constantly under demonstration.

From the accompanying photograph an idea can be formed of the arrangements made. Circular leather seats, in convenient positions to view the showrooms, have been provided, and form a feature much appreciated by the company's patrons. Neat racks have also been provided for manufacturers', jobbers', and dealers' advertising matter, and are placed in suitable locations in the demonstration rooms.

During the week—5th to 10th June—special efforts were made to bring before the public the many useful electrical conveniences obtainable for the home. Cooking was carried out daily on electric ranges and refreshments were served to all persons present. The new model Cabinet ranges came in for particular attention. The average afternoon daily attendance was 500 people, mostly ladies. Many sales of the various appliances have resulted from the week's undertaking, and much general information imparted and literature handed out during the course of fthe campaign.

As nearly ten thousand of the company's consumers personally call each month at the offices to transact business in the matter of payment of accounts, exchange of lamps, etc., it has been decided to set aside one week in each month as an "at home" week, during which period some appliance will be specialized on. In this manner it is felt the majority of the company's consumers will be brought personally closely in touch with the many useful electrical appliances on the market and which may be obtained locally at any of the electrical stores.

A. T. Goward is the Victoria manager for the British Columbia Electric, and S. J. Halls is in charge of light and power sales department.

Electrical Workers Strike for Longer Hours.

Usually, in the case of a strike of electricians, the cry is for shorter hours and more pay, but the wiremen at Camp Borden, Ont., recently set a surprising precedent by demanding that they be allowed to work fourteen hours a day instead of ten. Their request was complied with.

Demand for Small Plants

The Main Electric Manufacturing Company, manufacturers of isolated electric light and power plants, advise us that they have been enjoying exceptionally good business during the past few months. The Main battery charging outfit for private and public garages, which they have recently added to their line, is stated to have met with immediate success.

City Sales Office and Warerooms

The advertisement of W. H. Banfield & Sons, Limited, on page 40 of our August 15 issue, which read "Sales office and showrooms" 120 Adelaide Street West, should have read "City sales office and showroom." The city sales office and showroom is maintained only for the convenience of city customers and outside customers visiting the city. All mail should be addressed to General Offices and Factories, 372-386 Pape Avenue, Toronto, Ont.

New Books

Standards for Electric Service.—Circular No. 56, by the Bureau of Standards, Department of Commerce, Washington, designed to assist state or city commissions to standardize their rules and regulations for the control of public utilities. The scope of the work may be gathered from the following chapters: 1. The adequacy and safety of electric service. 2. Meters and instruments. 3. Standardizing laboratories of state public service commissions. 4. Rules and regulations for electric service, as adopted by state commissions; 5. Suggested rules for the regulation of electric service by state commissions. 6. The regulation of electric service by city ordinance. 7. Suggested ordinances for the regulation of electric service in towns and cities. The Bureau of Standards has asked us to call the attention of our readers to this publication and to advise them that this is now ready for distribution, and may be obtained free on request to the bureau.

Trade Publications

Centrifugal Pumps.—Bulletin No. 9, issued by the Pelton Water Wheel Company, describing, with illustrations, the Pelton-Doble centrifugal pump.

Condulets.—Bulletin No. 1F, issued by the Crouse-Hinds Company of Canada and effective September 15, describing fuse service entrance condulets. These are illustrated and fully described in the bulletin. The Crouse-Hinds Company are also distributing Bulletin No. 1C, effective September 1, describing narrow panels. This is a supplement to Panel and Cabinet Bulletin No. 1; illustrated throughout with complete descriptions and price lists.

C. G. E. Publications—An Epoch in Railway Electrification, being an illustrated description of the Chicago, Milwaukee and St. Paul Railway. Bulletin No. 45603—describing and illustrating graded shunt resistance multigap lightning arresters for alternating current constant potential circuits.

And then, Some

The electric range is fascinating, chummy, homey, Utopian, and every other fancy adjective you can think of! It is guaranteed to remove work, worry, and widowhood, and make Monday morning seem like Saturday afternoon—with birdies singing in the tree tops. Electric cooking is delicious, fattening, eugenic, god-like, ferocious, and ten times better than Mother used to make.—From Daisy Dayload, house organ of Hughes Electric Heating Company.

The Hughes Electric Heating Company have purchased a piece of land comprising 111,000 square feet of ground in Chicago, on which will be erected a modern factory plant, calculated to cost approximately $150,000.

The operation of the Laurentide Power Company, Grand' Mere, P.Q., has been taken over by the Shawinigan Water and Power Company. The layout of the new plant has been modified to suit the requirements of the Shawinigan Company.

The town of St. Lambert, P.Q., has just inaugurated a new street lighting system. The lamps employed are 250 watts, and are erected in the principal streets of the town, along the water front, and on the Desauliers Boulevard.

Obituary

Mr. Angus W. McIsaac, for two years city inspector of electric wiring at Sydney, N. S., is dead. For thirteen years previous to accepting the position with the city he had been in charge of the power station of the Cape Breton Electric Company.

Condensed Department

Publisher's Notice

Advertisements under "Situation Wanted" or "Situation Vacant" are charged at two cents a word per insertion, minimum charge 50 cents.

Advertisements for tenders, equipment, wanted or for sale, etc., or miscellaneous, are charged at $2.10 per inch.

All advertisements must be in the publisher's hands by the 10th or 23rd of the month to insure insertion in the subsequent issue.

1000 ½ in. x 12 in. National Solid Arc Carbons. 44 No. 14 Inner Arc Globes for A. B. Series 6.6 Arc Lamps. Best offer accepted. Box 429, Electrical News, Toronto, Ont. 16-t.f.

WANTED

A POSITION AS SUPERINTENDENT or Inspector of Hydro Electric Plant. (Canadian) 14 years' experience, 7 mechanical, 7 electrical and some in civil engineering. At present in charge of Hydro Electric plant with high head and high voltage. Box 437, Electrical News, Toronto. 17

WANTED, POSITION AS CHIEF ELECTRICIAN, or one of responsibility, either on construction or maintenance; thoroughly competent; 9 years' experience in A. C. and D. C. equipment of power and industrial plants; technically trained and can furnish excellent references; at present employed, but desires a change. Box 433, Electrical News, Toronto, Ont. 16-16

Electrics in Dairy Service

The old adage "cleanliness is a virtue," certainly applies to the electric vehicle from which is eliminated the dirt and grime of oil and grease so much in evidence in other types of motor cars.

It is significant that eight dairy companies in London use electric vehicles for dairy work. They are an essential item in the "clean milk" campaign.

Besides being a splendid advertisement because of its dignified and neat appearance, the electric is superior to the horse in that it is capable of more speed, an important factor in this service, and at the same time holds its own against the horse as well as the gasoline truck because of its economy of operation, and the absence of disagreeable odors. In the dairy service which necessitates early deliveries and many stops within a short space of time, the electric is the chosen vehicle.

The Electric Vehicle Section of the National Electric Light Association has secured interesting information from many dairies in the United States which are operating electrics especially designed for this service, and all are more than satisfied with the efficiency and economy of the electric.

Current News and Notes

Danforth, Ont.

According to the report submitted to the Scarboro Township Council on the Hydro extension from Danforth to Agincourt, power will be supplied to Danforth at $19.25 per h.p., the cost of construction being borne by the municipality.

Dunnville, Ont.

The use of Hydro power is contemplated, and the town council propose to borrow $53,000 to cover its installation and buy out the plant of the existing company. A by-law providing for these measures will be submitted to the ratepayers.

Eugenia, Ont.

The cost of the construction of the Hydro transmission line to Collingwood will be $4,000, it is estimated. Copper wire is to be used instead of aluminum on account of the high price of the latter. At Collingwood the sub-station will probably have to be enlarged and additional apparatus installed.

Merrickville, Ont.

A by-law for the loaning of $30,000 to the Rideau Power Company was defeated by a majority of 85 to 6.

Montreal, Que.

The Eugene F. Phillips Electrical Works, Limited, Montreal, have been awarded by the Toronto Hydro-electric Commission a contract for the supply and installation of approximately two miles of 3/0 B and S three conductor paper insulated lead covered cable, for a working pressure of 13,200 v.

The Raymond Construction Company, Montreal, have been awarded a contract for the superstructure of the boiler room in connection with the new sub-station of the Montreal Tramways Company at Hochelaga. It will be of reinforced and brick construction, 87 ft. x 152 ft. The Canadian General Electric Company are supplying the electrical equipment. The Tramways Company have let a contract for extending their St. Denis sub-station, and it is also expected that contracts for additional sub-stations will be shortly let.

The Quebec Public Utilities Commission, sitting in Montreal on August 15, heard arguments on the question of the liability for the cost of the spare ducts installed in the underground system of the Electrical Commission. The arguments were of a legal character, and turned upon the interpretation of the portions of the civic charter affecting the Electrical Commission. Each company is charged 3½c per duct foot per annum for the ducts used. The city also pays for the ducts it uses. The question at issue was whether the city should bear the entire cost of these spare ducts (which the city is obliged to put in), on the ground that it is the owner of the conduits, or whether the cost should be divided among the various power and signal companies. The city contended that the companies are liable under the charter for the entire cost of the conduits, while the companies argued that they are liable only for the ducts reserved for their particular use. It was not reasonable that the companies should have to pay the cost of ducts for which they have no use. If this were done, the annual rental charges would have to be increased, and to this they objected. Judgment was reserved.

Renfrew, Ont.

The council have decided that it is advisable to at once proceed with the First Chute development, and a by-law is being prepared for submission to the ratepayers. The Hydro Commission, which at first did not favor the plan, are now said to sanction it. Mr. O'Brien also proposes to develop power at Calabogie, and it is possible that the council will later negotiate with him for a supply of power should it be required.

The shareholders of the Shamrock and Renfrew Telephone Association recently held a meeting in the office of Chown & Geale, when President Quilty presented in writing a careful summary of the year's affairs of the company. The report of the auditor, Mr. Hugh Macdonald, showed a balance on hand sufficient to pay a dividend of 5 per cent. to the shareholders and leave something on hand for the promotion of the business. Requests for service to the various mines opened up in the Mt. St. Patrick district were considered, and the president was authorized to take such steps as he thought wise to get the directors of the Shamrock and Renfrew and Grattan telephone companies together to consider if an amicable arrangement could be effected to connect up the lines of the two companies to give better service to the mines, into Renfrew, and to outside points.

Sherbrooke, Que.

Four members of the Sherbrooke Council have been appointed to confer with a representative of the Street Railway Company and two members of the Board of Trade on the question of the conditions, price, etc., under which the railway could be purchased by the city.

The City of Sherbrooke, Que., has awarded a contract for three generators, each of 1,000 kv.a. rating, to the Canadian General Electric Company, at $34,500. The contract for a new concrete dam, to replace the present rock-filled structure on the Magog River, has been given to Messrs. MacBean and Williams, Montreal; price, $59,358. The equipment and dam are in connection with improvements to the city power plant. Mr. M. A. Sammett, Montreal, is the consulting engineer.

St. John, N.B.

The department of public safety of St. John, N.B., have under consideration a complete new lighting system for the city, which it is planned to have in operation by the early fall. The plans provide for the installation of between 600 and 650 new nitrogen lamps of both 600 and 300 candle-power, to replace the 372 arc lights and 97 100-watt lights now in use. The contract for the old system expired July 1, and the new contract, as soon as the type of lamp is approved by the city, will be submitted to the St. John Railway Company. This contract will cover a period of ten years, and will be on the basis of what is known as "cost service," providing so much for the energy supplied, installation, and maintenance.

Toronto, Ont.

Mayor T. L. Church, of Toronto, president of the Hydro-electric power Union, and Mr. J. W. Lyon, of Guelph, president of the Hydro-radial Association, conferred with Sir Adam Beck at the provincial Hydro-electric offices recently. Preliminary arrangements were made by both presidents for the calling of a meeting of all the municipalities interested to secure an expression of opinion from the delegates as to the course to pursue to have the power project removed altogether from politics. It was proposed to hold this general meeting in Toronto during the exhibition, arranging, if possible, to have a "Hydro-electric Day" at the big fair. They also stated that it was arranged to submit by-laws in all the municipalities in the Niagara district to empower the municipalities to enter into contracts with the commission for the purpose of generating and developing power on behalf of the former.

Vancouver, B.C.

Supplementary letters patent have been issued reducing the capital stock of the "Western Canada Power Company, Limited," from $10,000,000 to $6,000,000.

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ADVERTISEMENTS

Orders for advertising should reach the office of publication not later than the 5th and 20th of the month. Changes in advertisements will be made whenever desired, without cost to the advertiser.

SUBSCRIBERS

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Extend Our Electric Markets

Now that European countries are otherwise engaged, it would appear to be an opportune time for our electrical manufacturers of every kind to consider immediately how they may place their products on foreign markets where competition has heretofore been too keen for us. As has been frequently pointed out, the value of a "Made in Canada" slogan is very much circumscribed if the market is confined to our own Dominion. If this slogan really stands for "quality" and "service" it should find its greatest usefulness outside our own borders. One of the greatest mistakes our manufacturers have made in the past, we believe, has been in trying to hold the home market entirely for themselves, for by so doing they have automatically shut themselves out from other more profitable and populous markets. United States manufacturers constantly claim that there is much less profit to be made in Canada, even at the higher prices prevailing, on account of the limited demand spread over such a large area. It is opening a sore, of course, to discuss the interchange of products with the United States on a mutually advantageous basis, but the wisest of men change their opinions sometimes, and on every side there is evidence that our manufacturers are themselves coming to look upon this idea with favor—a change of heart probably born of the feeling that our products have the quality behind them that will sell them against any competition. It will always be true that the cost of production, and therefore the selling price, is regulated by demand, and for that very reason we ought to do everything in our power to extend our markets.

Little as we now respect our European enemy, we cannot but admit the success of the German governmental policy of assistance to her manufacturers, and the German policy has always been diametrically opposed to the Canadian policy. Here in Canada our governments have encouraged the manufacturers to stay at home by making it difficult for outsiders to come into the home market. Over in Germany, on the other hand, they have assisted the marketing of home products abroad, leaving the home market to take care of itself. This it automatically did, because the greater quantity of production kept the prices low enough at home to kill all competition from outside. Thus at the same time the people of Germany enjoyed low prices, and the factories of Germany prospered because of their extended markets.

* * *

As against this, we in Canada have always paid abnormally high prices for most of our manufactured products, and Canadian factory products are strangers in almost every country in the world except our own.

* * *

But the present time is surely an exceptionally favorable one to profit by our own mistakes and take advantage of world markets that at the moment are going begging, and it is distinctly encouraging to note that our Dominion Government is meeting, some time in the near future, with manufacturers of every kind from all points in Canada, having in view a discussion on how our products can best be placed in those markets which formerly were supplied from Europe, especially from the central powers, with which we are at war. It is important that we should act promptly in this matter, for there is no shadow of doubt that commercial competition will be keener than ever after the war. This being so, it is scarcely possible to overestimate the advantages of having our products established before the war ends.

* * *

The date of this convention has not yet been announced, but a quantity of literature has been, and is being, sent out, calling upon manufacturers to consider this question thoughtfully and carefully, so that they may come to the convention prepared to discuss ways and means. We trust that manufacturers will unanimously take advantage of this opportunity offered by the government, as it indicates the latter's willingness at least to consider supplying such support as is necessary to place Canadian products on foreign markets under conditions that will make the business attractive and profitable.

Day of Electric Heating is Near.

With the present rates in various cities and towns in Canada, the dream of house-heating by electricity at a cost comparable with a coal-hot-water heating system, bids fair to be realized. The situation to-day would appear to be fairly summed up as follows: Figuring 1 pound of coal as the equivalent of 13,000 B.t.u., the cost of 1,000 B.t.u. produced by coal at $8 a ton is 4/130c. The best managed house furnaces, however, probably never give a higher efficiency than 60 per cent., and, taken throughout the whole season, this figure may be conservatively placed at 40 per cent. This brings the cost of a thousand B.t.u., produced by coal, to 1/13, or .077 cents.

The heat equivalent of a kilowatt-hour is 3,412 B.t.u. Given a rate of .9c 1,000 B.t.u. produced by electric energy costs .263c. That is, the cost of electric heating is 3.41 times as great as that of coal heating.

Now this load is not materially different from a water tank heating load, for which at least one city in Canada is giving a ¼c (continuous) rate. It is true the water-heating proposition is on a yearly basis, while the house-heating demand will be seasonal, but it is probably not unreasonable to expect that in the near future this rate, at least, will be obtainable. Such a rate will reduce the cost of 1,000 B.t.u. produced electrically to .147c, and bring the cost ratio between electric heating and coal heating down to 1.9.

With electric heat costing less than twice as much as coal heating, let us further consider the arguments in favor of electricity:

To begin with, there are many men of average means, for one reason or another tending their own furnaces, who would gladly add a sum equivalent to what the coal now costs them if they could thereby be released entirely of the worry, labor, and filth attendant on the shovelling of coal, constant running up and downstairs to readjust dampers, removing and perhaps sifting ashes, cleaning out the furnace, and so on, with the incident depreciation in both good temper and good clothes. But the householder would further get deliverance from those awful days when the coal delivery men take charge (generally twice a year and often three times), which necessitates a general housecleaning inside, leaves your lawn and the exterior of your home in a state of disrepair, and finally finds the man of the house on hands and knees crawling over the top of the coal bin to lock the cellar window. And this is not nearly all. Every year the coal dealers keep their customers on the rack with reports of coal shortages and threats of increased prices (which, to do them justice, generally materialize), and you pay for your coal in advance, six to nine months, and further add to the cost.

Compare with all this the electrically-heated house. The coal bin and the furnace room are entirely eliminated, and, if they can ever be got clean enough, may be used for other more wholesome purposes. Every room in the electric home has its own heating equipment. The temperature is automatically controlled, and in a moment may be adjusted so that any room may take on and maintain any predetermined temperature to suit the whim or the wish of the occupant. No attention other than this is required, night or day, winter or summer. There is no worry in advance. You pay after you enjoy the warmth—not months before. You eliminate one of the biggest possible fire risks—a furnace with pipes out of repair, and also the cleaning of the smoke pipe, which frequently gets blocked and fills the house with poisonous gas.

There is, too, a greater latitude allowed for the exercise of economy in the heating of your home. In the average house certain rooms are used but rarely. With the coal-hot-water furnace all these rooms must be kept at about the same temperature. Not so with electric heating. One room may be maintained constantly at 70 degrees and the next to it, if necessary, at 40 degrees, without in any way disarranging the system. Actual operation in the few homes where electric heating has been tried out has shown unexpected economies in this direction.

The use of electricity for heating our homes, just as its use for cooking our meals, has been handicapped, first by cost, and second, by prejudice, or, perhaps, undue conservatism. Little by little the householder is learning that to cook with electricity often costs less and always produces a better-finished product. Within the near future cooking by electricity will have become as much a matter of course as the use of the telephone is to-day. Electric water heating is already with us, and electric house heating is next. If our current could possibly be reduced to ¼c per kw. h., the actual cost of heating by electricity would be less than with coal. The tendency seems to be for electric current to get cheaper. It also seems to be the tendency that coal is getting more expensive. Long before this low rate is available, however, it seems only reasonable that the many advantages of electric heating, just as with electric cooking, should make its use general among that class of people who are able and willing to incur a little extra expense for a very considerably increased measure of comfort and luxury.

Toronto Electric Luncheon

The Toronto Electrical Luncheon Club resumed its weekly sittings after the summer holidays on Friday, Sept. 1, Mr. Frank T. Groome in the chair. The first luncheon was held at the Technical School, and the after-entertainment consisted in an inspection of that splendidly equipped institution, with Dr. A. C. McKay, the principal of the school, as host. All future luncheons, however, will be held, as last year, in the Prince George Hotel, and arrangements have been made several weeks in advance for short addresses to follow. The speaker of the second luncheon—Sept. 8—was Mr. F. A. Gaby, chief engineer Hydro-electric Power Commission of Ontario, on "Hydro Transmission." On Sept. 15 Mr. A. Munro Grier, K.C., vice-president and secretary of the Canadian Niagara Power Company, will speak on "Philosophy and National Character." The speaker for Sept. 22 will be Lieut.-Col. Frederic Nicholls, president and general manager of the Canadian General Electric Company, who has chosen the interesting subject, "Pioneer Days in Power Development in Canada." On the last Friday of the month—Sept. 29—Mr. Wills Maclachlan, inspector of the Electrical Employers' Association, will tell the club about what Canadian central station men are doing in connection with accident prevention and resuscitation from electrical shock.

Every electrical man resident in the city, or who happens to be in the city on any Friday, or who may think it worth while journeying to Toronto to spend an hour with the hundred or so "boys" who meet together at that time because they are more interested in electricity than in anything else in the world, will be cordially welcomed. Prince George Hotel, 12.30, every Friday.

Fires Due to Electricity

The following excerpt from the last annual report of the Committee on Electricity of the New York Board of Fire Underwriters is of interest in showing a classification of causes and losses due to fires attributed to electricity.

"One hundred and fifty-four fires of those investigated were attributable to electricity, and caused an aggregate loss estimated at $68,993.08. These fires may be classified as follows: 6 due to sparks from commutators of electric motors—damage $665; 7 due to grounding of conductors on gas pipes at fixtures—damage $215; 9 due to grounding of conductors inside of conduits and where in contact with other metal work—damage $915; 4 due to overheating of defective splices in wires—damage $870; 23 due to short circuits developing in flexible cords, elevator cables, etc—damage $26,076.40; 1 due to sparks from opening of switches—damage $5; 10 due to acccidental short circuits between wires of opposite polarity, caused principally by careless workmen—damage $240; 8 due to flammable material in close contact with incandescent lamps—damage $9,008.90; 5 due to short circuits in incandescent lamps and sockets—damage $6,372.71; 4 due to breakdown of insulation in transformers located either in vaults or on poles—damage $25; 2 due to operation of fuses igniting flammable material—damage $100; 8 due to ignition of films in motion picture booths—damage $130; 27 due to overheated electric irons being left in contact with flammable material—damage $21,822.94; 7 due to electric current following into buildings over metal conduits to ground connection inside of buildings—damage $70; 15 due to short circuits in field and armature coils of motors—damage $792; 7 due to moisture causing short circuits or grounds on wires—damage $300; 7 due to defective contacts, switches on control devices—damage $1,095.13; 1 due to defective amateur wireless telegraph equipment—damage $15; 3 due to defective electric automobile starting device—damage $275.

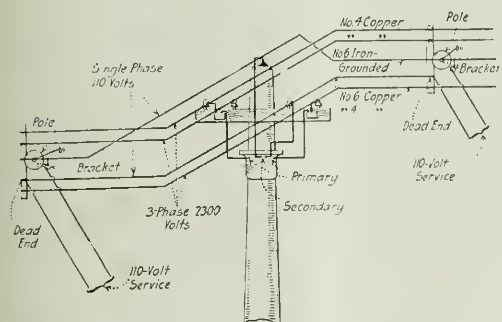
"Of the total estimated loss given above $40,433.43 is directly chargeable to new electric equipments or additions and extensions made to original equipments without the knowledge or approval of this department, thus leaving $28,559.65 as representing the loss from electrical equipments, which, according to our records, were supposed to be in safe and satisfactory condition."

First Meeting Toronto Section A.I.E.E.

The Toronto section of the American Institute of Electrical Engineers will begin their regular monthly meetings on the evening of Sept. 22, at 8 o'clock, in the rooms of the Engineers' Club, 96 King Street West, Toronto. The speaker of the first evening will be Mr. H. M. Hobart, consulting engineer, General Electric Company, Schenectady, N.Y., who will talk on the subject of "Electric Machinery Specifications Based on Modern Standards." The chairman of the section, Mr. E. T. Brandon, and the secretary, Mr. Wills Maclachlan, have been in touch with a number of leading men in the United States and Canada, and it is expected that an unusually attractive programme will be arranged for the coming winter. Announcements will be made later, as soon as the dates and speakers have been arranged.

Saving Secondary Circuit Copper by use of Overhead

On a five-mile, 2300-volt, delta-connected, three-phase line operated by the Marion (Ind.) Light & Heating Company, and described in the Electrical World, the overhead ground wire has been utilized as the return circuit for secondary lines serving farm customers. With the connections shown in the accompanying diagram two farm customers are served by a single transformer placed equidistant between their houses, the only addition to the existing pole line being a single secondary wire, the service leads and insulators. As will be noted from the sketch, one side of the transformer



secondary is connected to the ground wire, which is grounded at every other pole. The other side of the transformer secondary is connected to a fourth No. 6 copper wire which is strung between the two farm houses. Without sectionalizing the overhead ground wire the services are taken off as indicated. The longest run of secondary line on which this practice has been tried is 0.25 mile. Experience to date indicates that in addition to saving cross-arm space, transformers and copper wire, this scheme gives less trouble with lightning since there are fewer transformers to be damaged.

Improved Fire Alarm System for Rossland

Installation of a new fire alarm storage battery equipment for the Rossland fire department was completed last month. The installation consists of a two-circuit switchboard, a protector board for the protection of the apparatus against lightning or heavy currents, a battery rack having 68 accumulators, or battery cells, and a box transmitter for the handling of telephone alarms.

Current supplied for the charging of the batteries is from the West Kootenay Power and Light Company's wires, running to a single-phase 110-volt one horse power motor, which operates a direct connected generator.

The contract price of the equipment installed was $1,500, and is much more economical and efficient than the old gravity system.

There has also been installed within the past year five new alarm boxes of the latest type, which makes a total now of 28 boxes. These are well distributed over the city.

Cost of Generating Power

Vancouver, B.C., August 24, 1916.

Editor Electrical News:

The article by Mr. H. C. Scott in the August 15 number of your paper, headed "The Cost of Generating Electrical Power," is in spots hardly fair to the hydro-electrical development of power. There are in the West many powers capable of development at the switchboard for $75 per kilowatt capacity, and some very large powers which could be developed for considerably less than that amount.

A few years ago steam plants could not be built for $55 to $75 per kw. capacity, and it appears that Mr. Scott is comparing the very latest figures in steam to hydro-electric plants built some years ago.

Whatever, the conditions may be in the East, they are certainly not the same in some parts of the West, and, under the same conditions of financing and engineering hydro-electric plants can be built in many cases equally as cheap as the most modern steam plant, so that the interest charge is the same in both cases, while the operating costs are very much less. Thus, under the same capital investment the hydro-electric plant could operate advantageously over the steam plant under any condition of load.

Many—in fact, most—hydro-electrical developments in the past have been badly handled from a financial viewpoint, but in the future the same careful attention will be given to their development as is given to a steam development, and under such conditions the powers that are developed will compare favorably with the most up-to-date steam development; but every water power will not be capable of cheap development, and careful analysis will be necessary in each case.

As you say in your editorial, an engineer will understand that Mr. Scott is speaking of the average water power development, remote from the point where the power is to be used; but, unfortunately, a layman may read the article and become suspicious of powers in which he may have been interested only after a great deal of time and expense.

In your editorial you also refer to a case where the carrying charges on the capital expenditures have overtaxed the earning capacity of a hydro-electrical plant to the extent of necessitating a reorganization of the capitalization of the company. We of the coast recognize at once to which company you refer, and would suggest that it be not pointed out as an example of efficient hydro-electrical construction without some explanation as to how this company came to be in such a condition. The conditions of financing and constructing this plant should be investigated and the result made public, as at present its condition is giving a black eye in financial circles to other power propositions which, under proper financing and engineering, could be developed as cheaply as foreign power developments, and would greatly extend the use of electrical power on this continent.

Yours truly,

W. R. Bonnycastle.

Underground Distribution Systems

A practical man's general review, before the A.I.E.E., of an important phase of Central Station Work—A growing demand for this type of construction (Continued)

By G. J. Newton

Owing to the fact that the grouping of consumers, in a district, will usually be different on an underground system than it was on the original overhead system it is practically impossible accurately to determine what the demand and diversity factors will be for the new system. A distribution system for either lighting or power usually consists of the following sub-divisions:

Primary feeders to centers of distribution: secondary feeders supplying the transformers; secondary mains supplying the service laterals; service laterals supplying the consumers. In small systems the secondary feeders are not required, as the transformers are connected directly to the primary feeders.

The size of cables to use for the laterals is easily determined; the principal object is to restrict the number of sizes of cable as much as possible, using about three sizes for the whole system, and if possible, making the largest size used for laterals the same as one of the sizes used for secondary mains.

Aside from the laterals it is evident that the secondary mains receive less benefit from the diversity factor than any other part of the system. It is also evident that any increase in the load will directly affect the mains which must be large enough to maintain satisfactory voltage for all consumers connected to them.

On the one hand is the diversity factor tending to reduce the size of the mains and on the other hand the probable increase in load which must be provided for, tending to increase the size of the mains. As not only the first cost but the interest on the investment depends on the size of the copper, it is important that these two conditions be given careful consideration and it is in cases of this kind that the engineer must be guided by experience and his knowledge of the situation.

There is one point that should be remembered in determining the size of cable to install for secondary mains, particularly where they serve a number of consumers in a business district. Owing to the fact that the service laterals are spliced directly to the mains at frequent intervals it is very expensive to replace them and the old cable, being in short lengths, is of little or no use except for its junk value; it is therefore advisable to make all secondary mains of ample size to provide for the total load that can reasonably be expected and use the best kind of cable, either varnished cambric or rubber insulated, for all secondary mains and laterals that terminate in junction or fuse boxes.

The load in the district should be divided as equally as possible into a suitable number of distribution centres so that one size and style of cable can be used for all of the feeders, as this permits standardizing the equipment and requires less cable being kept in stock for emergency purposes.

The feeders being generally small cable and having few or no taps on them can easily be replaced by larger cable and the old cable is in sufficient lengths to be used elsewhere. Instead of installing a larger cable to replace a loaded one it is generally better to install an additional feeder to another centre of distribution, using the standard size of cable. Where the requirements of the system demand the use of two-conductor cable it is advisable to have it made up in round form instead of flat or figure 8 style, as it is practically impossible to train this latter style without kinking it. A careful study of the conditions under which underground distribution systems operate particularly in medium size or smaller cities, has convinced the writer that the safest guarantee of reliable, efficient, and economical operation is to install cable and equipment, as far as the conditions will permit, under the following general rules:

Service Laterals

Use either cambric or rubber insulated cable, spliced directly to the secondary mains, and terminated in watertight fuse boxes on the consumer's property. The number of laterals taken out at one splice will depend on the system: for single-conductor cables four laterals can be taken out, but two is about the limit where three conductor mains and laterals are used.

Secondary Mains

Make these cables of ample size to provide for all the growth that can reasonably be expected. Use either varnished cambric or rubber insulated cable for all secondary work where cables terminate in subway equipment.

Primary Feeders

These cables derive the most benefit from the diversity factor, are comparatively long lengths, and have few taps on them, therefore are less subject to damage than the rest of the cables and are easily replaced with small financial loss. Small reserve capacity is all that need be provided for this class of cables.

Paper insulated cable can be used to advantage frequently at considerable saving provided that the ends are properly terminated in compound-filled potheads or varnished cambric or rubber insulated tails used for connecting to the equipment. Personally, the writer does not approve of using any paper insulated cable on distribution systems, except in cases where the emergency facilities are such that the failure of a feeder cannot cause a serious interruption to the service.

In small companies where competent cable men are not always available, the use of paper insulated cable on the distribution system is not advisable; it is, however, well suited for high-tension feeders and tie-lines.

Subway Equipment

Due to the liability of being submerged occasionally and the limited space usually available for its installation, subway equipment is probably the most prolific cause of trouble on underground distribution systems, and the greatest care must be used in selecting and installing it. The best insurance against trouble from this cause is to provide reliable sewer connections to all manholes and vaults in which subway equipment is located. Separate the primary and secondary equipment by placing the transformers, primary fuses and switches in a vault, preferably located under the sidewalk adjacent to the manhole in which the secondary junction boxes are located. This arrangement reduces the length of the secondary mains, which are usually large, expensive cable, and lessens the liability of a burnout on the primary equipment damaging the secondary network. See Fig. 2.

The object in placing the vaults under the sidewalk is that it is seldom possible to secure sufficient room in the street; also there is less liability of the vaults being flooded from surface water and they are more accessible in the winter when the ground is covered with ice and snow. This method of construction is more expensive than placing all of the equipment in the manholes but the added security is well worth the expense on an important installation.

Subway transformers should not be set on the floor of the vault, but should be raised so that the air can circulate under and around them. Where more than 200 kw. of transformer capacity has to be installed in one vault it is advisable to provide ventilating pipes from the vault to a pole or side of a nearby building. Subway junction and fuse boxes should not have slate or marble bases, but use ebonite or similar material that will not absorb moisture. All boxes should be subjected to an insulation test before being installed. Barriers should be provided between terminals of opposite polarity.

The iron work of all subway equipment should be permanently grounded to a reliable ground rod, plate, or if possible, to the city water pipe system. In large vaults, where there is considerable equipment, at least two ground connections should be provided.

Installing Cable

Assuming that all cable has passed the usual factory test, it is seldom necessary to subject it to another test before being installed unless there is some evidence that it has been damaged in transit. The conditions under which the cable is purchased and installed will, however, generally decide this point. Use skids in loading and unloading reels, never drop them off the truck. Place reels as near the point where they are to be used as possible. When reels must be left on the street for some time they should be securely blocked or preferably wired to a pole to prevent their being rolled about. Care should be taken not to place reels where they will interfere with hydrants, or obstruct manholes, water gates or traffic.

Never handle paper insulated cable when it is cold. In cold weather it should be kept in a warm place until it is to be installed. Paper cable should not be bent shorter than eight times its diameter and should be warmed before bending. Always provide sufficient men and power to safely handle cable during installation; when the cable is started in

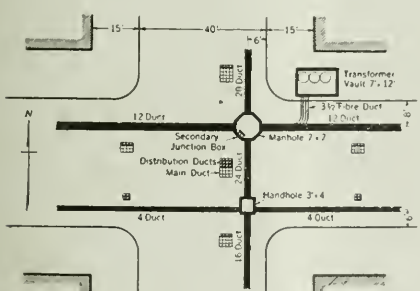


Fig. 2

the conduit try to maintain an even steady rate of pulling. For heavy cable it is advisable to use grease or powdered soapstone. Ends of cables should be kept until ready to be spliced. Cables should not be left hanging from the duct mouth, but should be supported on hangers with as little bending as possible. The final bending and training of the cables should be done by the splicer when joining the sections.

When installing a new system, all lengths of cable should be bonded together temporarily as soon as they are installed. As soon as the cable system is completely connected up tests for electrolysis should be made of the whole system and proper measures taken to protect the cables in case of necessity. The arrangement of cables and equipment in the manholes and vaults must be carefully planned to secure neatness and ample space in which to work and operate the equipment with safety. All cables and equipment should be plainly marked showing the operating voltage and system it is used for. Where single conductor cables are used on three phase circuits they should be distinguished by different colors, as this will prevent mistakes in making changes as only cables of like colors should be connected together. While it is admitted that it is impossible to install a system that will be entirely free from trouble, it is possible, by carefully designing the system to prevent many of the faults that are a constant source of trouble on many systems.

Conduit System

The conduit system should be designed to serve the electrical distribution system as previously designed. This statement may, at first, appear to be a self evident fact, but unfortunately many conduit systems are not arranged to properly, and economically provide facilities for installing the proposed cable system. It is not an uncommon practice to install a conduit system based on a general assumption of the actual requirements of the electrical system. The writer has seen conduit systems in which it was absolutely impossible to install the distribution system as it had to be operated, and which had to be partially rebuilt before the cables and equipment could be installed. These are no doubt exceptional cases, but it shows the importance of a definite method of procedure in designing an underground distribution system. It is a common practice in designing conduit systems to select streets or alleys having the cheapest pavement in which to locate the conduit, and then attempt to fit the electrical distribution to this location, and the result is invariably unsatisfactory and the saving in the cost in repaving is frequently exceeded by the additional cost of cables, and the total cost of the system thus increased. It should be realized that a properly designed and constructed conduit system is a valuable property, and a permanent structure having little or no depreciation, and its importance in the supply of electrical energy warrants the greatest care being taken in its design and construction.

Conduit systems that are to serve high-tension or tie-lines between sub-stations can be located so as to avoid the more expensive pavements, but conduit used exclusively for distribution systems should be located so as to best serve the electrical requirements regardless of the kind of pavement on the streets or alleys. In a conduit system used exclusively for distribution (where all wires must be placed underground) the best location is usually in the streets. In cities having an alley in each block there is a strong tendency to locate the conduit in the alley. The desire to utilize the alleys is based on the fact that the pavement is usually less expensive, and as the majority of pole lines are in the alleys the buildings are supplied from the rear, therefore if the conduit is located in the alley there will be less expense for changing the inside wiring to meet the new distribution system. At first sight these advantages appear so great as to warrant the selection of the alley; there are, however, serious disadvantages to this location.

Do Not Use Alleys for Underground Work

The alleys are usually from 16 to 20 feet wide and are generally fairly well occupied by water, gas and sewer facilities, and not infrequently, by one or two telephone conduit systems (which are usually installed before the electric light wires are placed underground) and the space available is, therefore, very limited. The rear building line is very irregular, many buildings do not extend back to the alley, and frequently there are small sheds or extensions in the rear of the main buildings. The length of rear laterals would be greater than front ones and the difficulties and cost of installation considerably more; the greatest objection is that the rear laterals would not be permanent in many places but would have to be changed whenever any new building construction or changes were made.

Where alleys are located in the business section of a city they are usually used by the merchants for receiving and shipping goods and are subjected to a heavy traffic, considering the limited space. The merchants are practically all consumers of electric power and will strongly resent any interruption to their trucking facilities.

Owing to the limited space in the alleys, and the amount of traffic, it is practically impossible to store any material in them, consequently all material used on the conduit system must be stored in the adjacent streets and usually wheeled in by hand. This work and the excavation for manholes, removal of surplus material, etc., will practically close the alley to traffic and the inconvenience of doing the work will greatly increase the cost of construction.

There is another serious objection to using the alleys. An average block, in cities having alleys, is about 300 by 300 feet, and usually has at least twelve separate buildings in it, in the business section there are generally more. When the distribution system is located in the alleys all of the buildings in a block are supplied from one secondary main which practically doubles its size, and the number of laterals that must be connected to it require frequent handholes in order to reduce the length of the laterals. This entails more complicated and expensive splices, cuts the main into short lengths, and in case of serious trouble puts the whole block out of service.

At a general rule, with the single exception of requiring less conduit, the alley construction is less desirable than a system installed in the streets. This statement applies to the business district of a city. Where overhead laterals can be used in a residential section the alleys are preferable for the location of the conduit, and as the traffic and obstructions are usually considerably less in such sections, the construction cost will be correspondingly less, depending on the pavement.

Before making the conduit design it is necessary to plot the location of all car tracks and existing sub-surface obstructions, in order to determine the most suitable location for the new system. While it is known that the records of sub-surface conditions are seldom accurate, still, a study of these records and the location of water gates, sewer manholes and other surface indications will permit a fairly accurate map being prepared.

Where there is any doubt regarding space being available for the conduit and manholes it is advisable to dig test holes, and if possible they should be dug at the points where it is proposed to locate manholes.

The design of an underground distribution system is not a difficult matter if handled in a systematic manner, and the result obtained from a thorough study of the conditions will fully warrant the engineering expense necessary to prepare accurate plans covering every detail of the work.

Electrical Equipment of a Foreign Submarine

The following description of the electrical equipment in a modern foreign submarine indicates once more the preeminent place occupied by electricity in this war. Wonderful, however, as the enemy submarines are, electrically and otherwise, it is also now apparent that that same wonderful agent has been used skillfully and effectively by the British Admiralty to detect and capture these powerful enemy weapons almost as soon as they are launched. This being the case, there has been an ample supply of specimens from which to study the anatomy of this new species, and the article reproduced may therefore be taken as entirely authentic. It is written by Mr. Norman H. Wood, and appears in a recent issue of the Electrical Review, of London, England.

When running on the surface this vessel has a displacement of about 180 tons, and is propelled by a 6-cylinder double-acting reversible Diesel oil engine of 350 h.p. and 450 r.p.m. The maximum surface speed is about 12.5 knots, and the cruising speed 10 knots, with a radius of action of 950 miles. In the submerged condition the submarine is driven by means of a storage battery in connection with an electric motor of 330 h.p. at 115 volts and 460 r.p.m., which imparts an under-water speed of about 9 knots for 1½ hours, or 8 knots for 3 hours. Diving and emerging are effected by filling or emptying the ballast tanks, distributed fore and aft and at the sides of the battery tank. Two tanks for trimming are fitted, connected with each other and the sea; an auxiliary buoyancy tank is also provided to compensate for alterations in weight during the voyage. A complete pumping equipment comprising two main bilge pumps of 26 h.p. each and one auxiliary bilge pump of 8 h.p., together with one hand pump, is fitted, all of which will work at a depth of 60 metres.

The storage battery, situated amidships in a special steel tank, consists of 60 cells connected in series and arranged in four longitudinal rows of 15 cells each, as with this arrangement the magnetic effect on the projector compass is practically nil. The plates of the individual cells are of lead, but as they are called upon to withstand repeated heavy discharges, the positives are of the large-surface type, whilst the negatives are pasted. Grooved wood separators are inserted between the plates, and a space of 600 mm. is allowed between the lower edges of the plates and the container bottoms to collect any mud that may accumulate. The containers are of special vulcanite composition, with watertight covers, on each of which is mounted a large inspection plug carrying a small non-return valve and flexible rubber connection. Running just above each longitudinal row of cells is a vulcanite pipe, the forward end of which is closed, whilst the after-end joins up to a common pipe connected, through a non-return battery valve, to two electrically-driven exhaust fans. The flexible tube fitted to the cover of each cell joins up to the overhead pipe, so that if either fan is running the explosive gases are sucked away from each individual cell and thrown overboard, whilst air from the tank is admitted into the cell through the small inlet valve. Each individual cell, as well as the battery tank itself, is thereby perfectly ventilated, and the possibility of an internal explosion is entirely removed. The officers' quarters lavatory is connected to the forward end of the battery tank through a special lead-coated vent pipe with screw-down flap cover, which is opened when the fans are running. The floor and sides of the tank up to a height of 110 mm. are covered with 2-mm. sheet lead, soldered at the corners to form an acid-tight tray, and over this and completely up the sides is placed a covering of 2-mm. 20-megohm rubber sheeting vulcanized directly on to the metal. The rubber covering is applied to all other fixed metal parts in the tank, and those parts which, owing to battery repairs, removals, etc., cannot be permanently fixed, are treated with three coats of anti-sulphuric enamel. The battery tank cover is of five-ply wood, impregnated with acid-proof enamel, and over the whole is stretched a 3-mm. thick seamless rubber sheet, secured to the upper sides of the tank, with small teak channels and screw-down clips, whereby the whole tank is rendered gas and watertight. The capacity of the battery is as follows:

3,100 ampere-hours or 350.76 kw.-hours at the 1-hour discharge rate.

4,610 ampere-hours or 525.54 kw.-hours at the 3-hour discharge rate.

5,980 ampere-hours or 699.66 kw. hours at the 10-hour discharge rate.

The battery can be discharged at the 1-hour rate without excessive heating taking place; further, the vessel can assume an angle of 25 degrees in any direction without acid running out of the cells. The total weight of battery and connections is 37,000 kg. The battery ventilating valve placed between the fan trunk and the tank top is of the automatic non-return-flap type, with a small cock and run-off pipe to drain away any liquid that may accumulate there. The connections between the individual cells are of h.c. copper, electrically coated with lead, the same type being used for the conductors between the battery and main motor fuses. The latter leads are covered with 2-mm. para rubber vulcanized directly on the metal, and protected with a sheathing of 1-mm. sheet bronze soldered at the seams. Where these leads pass through the 7-in. channel at the after-end of the tank, gunmetal glands with rubber packing are fitted to prevent ingress of sea water. The cells are arranged in two groups of 30 in series, with the middle wire permanently connected at their junction point, and earthed through an ammeter in conjunction with a small overload cutout. To check the efficiency of the battery, two ammeters reading to 3,000 and two ampere-hour-meters registering to 9,999 are placed in circuit with the main leads, the latter meters being of the double-dial type fitted with ratchet and pawl gear, which automatically enables them to register charge and discharge currents. Each of them is also fitted with a small winding gear to enable the dials to be quickly reset to zero if desired. The ammeters are of the long-scale illuminated-dial type, and have each a double-pole change-over switch, operated by hand, to enable them to register charge and discharge currents. An illuminated-dial voltmeter and switch are also provided. The main propelling motor is of the 8-pole shunt-wound type, with one armature but two separate windings and two brush-rocker sets placed one at each side of the common field, with interpole and compensating windings fitted to prevent sparking and surging when starting up. The full output capacity is 330 b.h.p. at 460 r.p.m., at 115 volts, for 1½ hours, with a temperature rise of 50 degrees C. allowed. Cooling is effected by natural draught, and as seamless mica only is used for armature insulation, the whole is rendered practically non-hygroscopic and capable of withstanding any temperature up to 90 degrees C. The cast steel yoke has its bearings secured to the lower half with light steel sheets screwed on to the bearing arms, to prevent splash water from the bilges reaching the commutators. The solid shaft is ground up from 3 per cent. nickel-steel, with a minimum diameter of 120 mm. in the bearings, as it is required to transmit the full power of the oil engine when the boat is running on the surface. A thrust collar is fitted in each bearing to take up the weight of the armature in the event of the boat assuming a list to fore or aft.

The motor is connected to the engine and tail shafting through claw-couplings, either of which can be thrown in or out quickly. When running on the surface both couplings are connected up, and the motor, driven by a dynamo, is used to charge the battery, but when diving or running submerged the engine is uncoupled, and the submarine is propelled by the motor. There are, however, isolated instances when it is desirable to charge the battery when the boat is at anchor or in dock, in which case the motor is coupled to the engine but uncoupled from the tail shaft, and driven as a dynamo in the usual way, the field being excited directly from the battery. When driven thus, the machine is capable of giving 750 amps. at 165 volts, or 1,500 amps. at 140 volts continuously, which ensures the battery being fully charged in about four to five hours. This motor can be run in either direction, or driven as a dynamo without any brush regulation; further, sparking is not set up at any load, even with a variation in pressure from 160 to 105 volts due to the battery voltage sinking on discharge. The complete weight of the motor in running order is 6,880 kg. The machine is started, stopped, and regulated by the manipulation of four quick-break change-over knife switches and a shunt regulator; no starting rheostat is installed.

To start, the shore charging switch is first of all placed in the "down" position, and current is at once sent through the shunt windings; it is thus quite impossible to start the motor upon an open field. The armature windings are now placed in series across the half battery pressure, and an instantaneous current of about 3,000 amps. passing through them causes the armature to revolve and reach a final speed of 85 r.p.m. By means of the shunt regulator the speed is increased to the utmost, the shunt resistance is quickly cut out, and, at the same time, the armature windings are placed in series across the full battery pressure, with a speed of 165 r.p.m. Again the shunt resistance is all switched in slowly, then cut out, and the armature windings are placed in parallel across the full battery, with a resultant speed of 330 r.p.m. The speed can now be adjusted at will up to 460 r.p.m. With this arrangement a continuous regulation from 85 to 460 r.p.m. is possible without interfering in any way with the lighting and auxiliary circuits, a most important point. To protect the motor against wrong switching whilst starting up, constant overloads, etc., double-pole fuses, and automatic overload releases fitted with overload and time-limit relays are provided. The 3,000-amp. fuses are of pure silver wire, enclosed in a very light watertight steel case, carrying on the underside two small bronze safety valves, controlled by springs, etc., to release any gas pressure that may be set up in the event of the fuses blowing.

(To be continued.)

Storage Battery Lighting Outfit for Manhole Work

The Commonwealth Edison Company of Chicago have adopted as part of their standard equipment a small storage battery lighting outfit for use while splicing cables or doing other work in manholes. This device eliminates the danger of taking an open flame into a manhole which might contain gas. The outfit is compactly contained in a standard 10 in. by 12 in. japanned pressed steel box and provided with two 25 ft. cords, with plugs, lamps, and shields. Six-volt lamps are used, and the total outfit weighs about 40 pounds.

Electric Range Campaign

The Boston Edison Company carried on during the month of August a campaign for the introduction of a certain type of electric range which ordinarily sold at $20, but which during that month was reduced to $15, in instalments —$3 down and $2 monthly. The primary object of the campaign is understood to have been to induce householders to have a separate circuit installed for electric appliances. With this entering wedge is was believed that the introduction of other household appliances would be much easier. The Boston Edison Company give a 2-cent rate for cooking, heating, and refrigeration.

Mr. A. Parent, the civic lighting superintendent of Montreal, is submitting a report on the extension of the new lighting system to St. Lawrence Boulevard, between Craig and Sherbrooke Streets. It is proposed to install 30 standards and lamps of the same pattern as those now in use in other parts of the city. The estimated cost of these and the cables is $8,500.

Electric Railways

Text of Agreement Between Electric Railway Company and Employees

Below we print the text of the recent agreement entered into between the Ottawa Electric Railway Company and their employees. The arrangement is for two years. It is noticeable that there is, throughout the agreement, an evident desire on the part of the company to contribute in every way possible to the comfort and prosperity of the employees. Agreements framed on this basis ought to be productive of a very friendly feeling of co-operation between all parties concerned:

Witnesseth that for the purpose of enabling harmonious operation of the company's system for the period hereinafter set out the parties hereto mutually agree as follows, that is to say:

1. The company agrees that its general superintendent or acting superintendent will receive a committee of the parties of the second part, hereinafter called the "Grievance Committee," at any reasonable time, to discuss any matters arising out of this agreement or any other matters which may arise and which may apear to be not provided for by this agreement.

2. For motormen and conductors all runs shall be divided into regular and relief runs, and shall conform as nearly as possible to a nine-hour day.

3. The superintendent of the company will prepare as soon as possible and post in the men's waiting-room a list of employees in order of seniority, together with a schedule of runs. Motormen and conductors shall then have the right, subject always to the satisfaction of the superintendent, to choose such runs as they may prefer, the senior men on the list to have first choice, and so from time to time until all have chosen. Any man failing to make his choice within a time satisfactory to the superintendent shall forfeit his right to make such choice, and may be allocated to such route as the superintendent may think proper.

4. Employees who are members of any committee of the employees, or who are officers of any association of the employees, or delegates to conventions of street railway men, shall be entitled to leave of absence for the purpose of attending conventions or of doing such committee work or other work as may be necessary, without losing any privilege of seniority.

5. Clothing for conductors and motormen shall consist as follows:

Summer—Full suit, coat, vest, and trousers.

Winter — Trousers every year, overcoat every second year.

All conductors and motormen must be so provided, the company to pay full cost of such clothing for all men in service over one year, and half the cost of those in their service first year, said uniforms to be supplied not later than 1st of May and 15th of October in each year. After any article of clothing has been in the possession of a conductor or motorman for a period of three months it shall become his absolute property.

All uniform caps and badges will be supplied by the company without charge.

6. In the case of an employee being guilty of violating the rules of the company he shall be warned, when off duty, by the superintendent, against a recurrence of the same offence; and, in the event of the employee being suspended his case shall be dealt with by the superintendent, save that any employee suspended or discharged shall have the right to appeal to the president in person, or through the grievance committee of the employees, and any employee suspended or discharged and who, upon investigation, is found not guilty of sufficient cause to warrant such suspension or discharge, shall be reinstated to his former position and be paid in full for all lost time caused by such suspension or discharge.

7. That cars shall be sent out each morning and night for the purpose of conveying employees to and from their work. Said cars to be run on Somerset, Bank, Hull, St. Patrick, Sussex, and Gladstone lines.

8. The company shall, where practicable, and subject to regulations of the company, provide suitable seats for motormen and conductors on all cars, and where seats of a fixed design are used, said seats shall be placed in a position where convenient for motormen and conductors' use in the proper discharge of his duty.

9. All cars shall be equipped each morning, before taken out, with sand, switch bars, brooms, dusters, or any other necessary articles, and all cars, cushions, and windows shall be cleaned and in proper condition to go upon the street each morning, said equipping and cleaning of cars to be done by shed men employed for that purpose.

10. Employees shall be given free transportation at all times and on all lines of the Ottawa Electric Railway.

11. That the company will not call on any conductor or motorman to perform extra work in excess of his regular schedule day's work of nine hours except in cases of necessity. Men will not be expected to work beyond a full day's work unless they are agreeable to do so.

12. Motormen and conductors who consent to run extras or trippers before or after day's work shall be paid double time for same.

13. All spare men who show up at the shed for work at 6 o'clock in the morning or 6 o'clock in the evening and who fail to procure work shall be allowed one hour for so turning up at either morning or evening.

14. Any shop or shed man who works upon a Sunday and who gives at least one day's notice of his desire to be allowed off for one day during that week shall be so allowed, or, if practicable, in the opinion of the superintendent.

15. Conductors and motormen required to work on the following holidays, viz., New Year's Day, 24th May, Dominion Day, Christmas Day, Civic Holiday, Thanksgiving Day, Labor Day, will be paid at Sunday rate.

16. The company will supply conductors with tickets and change to the extent of thirty-five dollars ($35). All students practising as conductors shall be required to furnish their own change.

17. The company agrees to furnish a bulletin board in the conductors' and motormen's waiting-room, upon which

employees are to be permitted to post notices of meetings of employees or of any other matters affecting the welfare of employees.

18. Wages for conductors and motormen shall be as follows:

First year's service—26 cents per hour for week days.

Second year's service—27 cents per hour for week days.

Third year's service and upwards—30c per hour for week days.

In addition to the foregoing rates, 4 cents per hour extra to be paid for Sunday work.

19. Nine hours shall constitute a day's work for all shop and shed men, and the schedule of time shall be so arranged as to allow one hour off for dinner. No shop or shed men shall be required to work more than the regular day's work of nine hours except in case of necessity. The present shop rules will not be amended except after conference with the grievance committee.

20. Shop and shed men working on Sundays shall receive 4 cents per hour in addition to their regular rate of wage. No man shall work out of his regular turn unless at the request of a representative of the company, and in the event of his so working on Sunday out of his regular turn he shall be paid one and one-half time.

21. Should any shop or shed men be required to work all night he shall be paid double time from 6 p.m. to 6 a.m.

22. Shop and shed men shall be paid Sunday rate of 4 cents per hour extra for work on all legal holidays.

23. All shop and shed men shall receive an increase of 3 cents per hour in excess of the wages which they are receiving at the date of this agreement. Any shop or shed men called upon to work for more than nine hours in any day shall be paid at the rate of time and a half for such excess service, except in the event of his being required to work all night, when he shall be paid as required by section 21.

24. The company has no objection to any employee being a member of Division 279, Amalgamated Association of Street and Electric Railway Employees of America, and will not discriminate against any employee by reason of his being a member of that organization.

25. Sunday hours of conductors and motormen are to remain as they are at present.

26. The pits in the sheds shall be equipped with board platforms.

27. The schedule of running times shall be so rearranged as to provide for a lay-over of two minutes at the end of each run.

28. All conductors and motormen shall be entitled to not more than three months' leave of absence in any one year without losing seniority, provided, however, that no conductor or motorman shall receive leave of absence unless his reason for applying for such leave is satisfactory to the superintendent, and is for a time which is satisfactory to the superintendent, and further provided that the number applying for leave of absence shall not at any time, in the opinion of the superintendent, interfere with the practical working of the company's system.

29. The paying of the men shall be commenced at 2 o'clock in the afternoon, instead of at 4 o'clock, as heretofore.

30. This agreement and the provisions hereof shall continue in force and shall be binding on the respective parties hereto until the last day of the month of June, A.D. one thousand nine hundred and eighteen (1918), and so from year to year after unless and until either party hereto desires a change in this agreement or any portion thereof, in which case such party shall notify the other party hereto of the desired change at least thirty (30) days prior to the ending of any year. A notice given to the Minister of Labor under the provisions of the Industrial Act, 1907, and amendments thereto shall be treated as a notice under this section.

Street Car Traffic Conditions in Vancouver

Adversity is a great chastener, and even haughty corporations come under the rod occasionally. A few years ago street car conductors of many cities were notoriously careless of the rights of the travelling public, and the fact that most of them continued to hold their jobs meant that in the opinion of the then management the contributor of the humble nickel was not of much account. Insolence or carlessness on the part of any body of employees is unerringly traceable to the man or men at the head of affairs—it is but the reflection of a policy or lack of policy .

The coming of the jitney vehicle was undoubtedly hailed with gratification by thousands of Vancouver citizens, who were dissatisfied with many things connected with the service afforded by the British Columbia Electric Railway. Some hundreds, perhaps, patronized the jits each day because of the quicker service they afforded the passenger, but thousands claimed they did so because of their personal disapproval of B.C.E.R. methods. A considerable change has come over the policy of this company, however, and to-day the patrons of the B.C.E.R. are treated with proper courtesy and consideration. All employees have been served with instructions to conciliate their patrons in every way possible consistent with reason. The change has already produced results for the company.

Some Ancient History.

In its efforts to get closer to the people the railway management recently launched "The Buzzer," a four-page weekly leaflet devoted to company affairs. In the issue for August 25 there appeared, under the above heading, the following reply to a citizen's complaint about the poor car service on Broadway West line to Kitsilano suburb:

"It is a chronic state in some people to be kicking. They kick about the street car service just as they kick about the weather, collections, the groery bill, or the milkman. The man who lives on a line with a three-minute service kicks just the same as the man with the five or the eight or the twelve-minute service. Like poets, kickers are born, not made.

"These days, when we are talking of the greater Vancouver of the future, let us not shut our eyes to the past. Our population—within the city limits—in 1912 was 122,100; at the end of 1915 the civic census placed the population at 97,995.

"In spite of that decrease—caused by the exodus of soldiers and others—this company is giving more service at the present day than it was in 1912. Let us prove it by the average daily street car mileage for the last five years: 1912, 16,063 miles; 1913, 18,891 miles; 1914, 19,232 miles; 1915, 18,077 miles; 1916, 18,376 miles.

"Although the 1916 figures are less than those of 1913 and 1914, the service given fills the needs of the travelling public more. Read what General Superintendent W. G. Murrin said recently: 'During June, 1916, 564,907 car miles were operated, as compared with 557,072 car miles in June, 1915. This increase has taken place when people want the service, and means actually more than appears from the bare figures.'

"These figures prove that we are honestly endeavoring to give this district a good street car service, in spite of the smaller number of people living here. Moreover, a few years ago we were rapidly extending our lines until we now have 102.07 miles of city track in and around Vancouver, besides interurban track on our own rights-of-way, which serves city and suburban districts. These lines can't be taken up again. Interest has to be paid on the expenditure just the same as if they were bringing in the revenue they were planned to bring in.

"'Well, why did you build the lines?' you may ask

"Public demand in most cases caused us to do so. In many instances we built lines into the outskirts before roads were opened up or graded. Private capital provided arteries of travel before public funds could be obtained.

"We are operating them now—at a loss. We are operating all of our lines at a loss and not complaining about it. But we do want our patrons to understand that there must be some relation between the revenue obtained and the operating expenses and interest on the investment.

"The frequency of cars on each line is worked out mathematically, according to exact checks upon the travel. Of course, in the non-rush hours far more seats are provided than there are passengers, for the reason that to cut down the service to meet the traffic would cause great inconvenience to car users. In any case, as many cars are operated as possible, consistent with the traffic and the expense of operation."

London and Port Stanley Railway

According to a recent statement by Sir Adam Beck, the gross earnings of the London and Port Stanley Railway for July, 1916, were $42,700. This compares with $23,442 in 1915. After operating and fixed charges have been met, net earnings are $17,770, as compared with $3,400 a year ago. The total number of persons carried in July this year was 165,000, as compared with 64,000 in 1915. Sir Adam also stated that the fares in July, 1916, were 22 per cent. lower than a year ago, though the rate of wages has been increased 12 per cent. He also said that the number of passengers carried by the L. and P. S. during the twelve months ending July 31, 1916, was 548,316, which compares with 132,699 carried by the Pere Marquette during the last year of its operation of this line. The London commission anticipates a number of improvements to the line and at the Port Stanley terminus. One of the suggestions is the double tracking of twelve miles of road, which, it is said, the increasing traffic will make necessary.

Personals

Mr. De Gaspe Beaubien, consulting engineer, Montreal, has been on a visit to France.

Mr. A. E. Pickering, formerly manager of the Sault Ste. Marie water and light department, is now in charge of the Great Lakes Power Company's plant.

Mr. J. C. Reston, municipal electrician for South Vancouver, tendered his resignation July 29, having secured a more lucrative appointment in Northern, B.C.

Mr. Lawford Grant, sales manager of the Eugene F. Phillips Electrical Works, Montreal, has been appointed assistant general manager and assistant treasurer, with a seat on the board of directors.

Mr. A. P. Broadhead has been appointed superintendent of the Drummondville, P.Q., section of the Southern Canada Power Company, with headquarters at Drummondville. Mr. Broadhead was formerly electrical engineer of the St. Lawrence Brick Company, Laprairie, Que., and prior to that assistant superintendent of the Montreal Light, Heat, and Power Company.

Mr. S. Bingham Hood, for many years distribution engineer for the Toronto Electric Light Company, has resigned to accept a similar position with the Northern States Power Company, Minneapolis. Mr. Hood will be widely remembered in Canada as the author of a number of very excellent papers on the subject of distribution, read from time to time before the Canadian Electrical Association at their annual conventions.

Mr. George R. Archdeacon has been appointed general manager of the Canadian Hart Accumulator Company, the head office of which is situated at St. Johns, Que. Mr. Archdeacon is an associate member of the Institution of Electrical Engineers. He has had over fifteen years' engineering experience, and was formerly upon the staff of Messrs. Ferranti, Ltd., and the Chloride Electrical Storage Company, Ltd., England. Mr. Archdeacon has travelled extensively in Europe and South America, and has only recently returned from China.

Trade Publications

Sockets—Form 1065 by Pass & Seymour, Inc., Solvay, N.Y., revised price sheet for P. & S. aluminum shell sockets.

Ajax-O-Lite—Booklets 96 and 97, issued by the Macbeth-Evans Glass Company, Pittsburgh, Pa., describing, with illustrations, Ajax-O-Lite for commercial and hospital lighting.

Westinghouse Auto-Starters—Circular No. H-7001, issued by the Canadian Westinghouse Company, Hamilton, describing auto starters for squirrel-cage induction motors. The circular is well illustrated, including wiring diagrams for the two-phase and three-phase types.

Storage Batteries—Catalogue issued by the Canadian National Carbon Co., 265 Adelaide Street West, describing the Eveready non-sulphating storage battery. This battery is sold with positive guarantee to be free from injurious sulphation during its life.

Electric Railway Materials—Catalogue No. 3 of the Drew Electric and Manufacturing Company, designers and manufacturers of electric railway materials, Indianapolis, Ind. This catalogue consists of 200 pages of well illustrated matter of interest to every railway man. C. E. A. Carr Company, 2 Toronto Street, Toronto, are Canadian representatives.

C.G.E. Publications—Bulletin 66025, describing G-E round pattern d.c. current instruments for switchboard service; **bulletin 46253,** describing and illustrating polyphase watthour meters; **bulletin 45105,** describing and illustrating small transformers and auto transformers; **bulletin X-228,** describing modern transformers for use in large systems; **War Munitions**—small booklet describing and illustrating process of manufacture of war munitions.

Automobile Lamps—Booklet issued by the Canadian National Carbon Company, 265 Adelaide Street West, Toronto, describing Eveready Mazda automobile lamps. This is a most complete, illustrated catalogue, covering the lamp equipment for 1914, 1915 and 1916 cars of practically every description. A large portion of the booklet is given over to the listing of the lamp equipment of the various automobiles, so that at a glance one may see the size and type of lamp best suited to any motor.

Industrial Signals—Booklet by the Benjamin Electric Manufacturing Company of Canada, Ltd., describing Benjamin industrial signal equipment for factory calls and fire alarms. The booklet is well illustrated, including wiring diagrams showing the proper method of installing the equipment. There is also included a couple of pages of wiring data, giving formula for determining sizes of copper wire needed; dimensions, resistances, and safe carrying capacity of copper wires; conduit sizes for different size wires, and a wiring table suitable for 30-volt battery for distances up to 500 feet and signals up to 30 in number.

C. S. C. E. Studying Montreal Problems

A committee of the Canadian Society of Civil Engineers is engaged in studying the plans of the Montreal aqueduct scheme, particularly in relation to the proposed hydro-electric development. The Controllers have placed the plans and information at the disposal of the Committee, who will make a report—without cost to the city. The hydro-electric development has been strongly criticised as extravagant as to capital and maintenance cost. The Board of Control have decided to ask manufacturers of turbines to make preliminary reports on the necessary equipment; these will be submitted to a consulting hydraulic engineer, and tenders called in the spring.

The Dealer and Contractor

Concentric Wiring — Will it really help us to extend the field of Electric operations—Merits being discussed impartially.

At the recent annual convention of the National Electrical Contractors' Association, one of the subjects upon which information was most eagerly sought was concentric wiring. Apparently the delegates approached the question with an open mind. No one appeared willing to take a definite stand in its favor, nor on the other hand was there any very decidedly expressed objection. Those who appear to favor this system most seem to consider it from the point of view of developing and extending the electrical contracting business. There is a large field at the present time which it is very difficult to reach if the existing standards and methods have to be used and the search seems to be for a system of installation that will bring the smaller consumers into the fold at a price attractive to themselves and yet sufficient to net the contractor a small return. Among those who had studied the situation the longest, the opinion was generally expressed that concentric wiring appeared to offer more advantages than any other new system that had been studied. However, the session broke up without the delegates coming to any decision whatever as to the merits of the new system.

We in Canada have had no opportunity to judge of the merits of concentric wiring, though we are interested in extending electricity to buildings not now using it, just as much as other countries are. For this reason the discussion before the National Convention will be of interest to all Canadian contractors, and we are printing a running review of what was said, taken from a current issue of the association's mouthpiece, the National Electrical Contractor. Also, we reproduce a photograph of the concentric wiring installation exhibit shown during the convention. This installation, though made of material modelled closely on the lines of the material used in Europe, nevertheless differs in certain important features. The insulation surrounding the inner wire is thicker, as is also the outer conducting metal. Inseparably tied up with the use of this concentric wire is the question of proper grounding on which some interesting statements were made in the following discussion:

Ernest McCleary, who for many years has been Chairman of the Code Committee of the N.E.C.A., in opening the Concentric Wiring discussion said in part: "In arranging for this session this morning we distinctly stated that we approached the subject of concentric wiring with open minds, and with no opinions.

It has been my policy, during the fifteen years that I have been in this association work, to never allow myself, as chairman of a committee, to come to a decision on any subject on which I might be called upon, as chairman, to cast the deciding vote, until the final discussion and evidence was all in. I am exactly in that position this morning, and Mr. Peet, I think, is in the same position. We are here for the purpose of having you tell us your opinion of concentric wiring."

C. R. Newman of Passaic, N. J., said he understood concentric wiring to be intended for small, cheap work, and if adopted would result only in making the work of electrical contractors more complicated, because of the additional fittings.

James R. Strong explained that the committee investigating concentric wiring is now called "Committee on Electrical Wiring Systems." Mr. Strong said: "Probably nothing has caused so much of a stir among the electrical fraternity as bare grounded return involved in this concentric wiring proposition."

He told of when concentric wiring came up anew a few months ago, how the manufacturers objected to the immediate introduction of concentric wiring, because it involved the most radical changes in the electrical business in our time.

Mr. Strong, continuing, said:

"The proposition as put forward was that bare grounded returns should be utilized on branch circuits for exposed work.

In the first place I should say that the Underwriters appointed a committee two or three years ago to consider the question, and that committee formulated a tentative set of rules, which recommended to the meeting of the Underwriters, not to go into the Code, but to be used in case any Underwriters' jurisdiction wished to try it out; that it should be used only by special permission of the Underwriters having jurisdiction, and if used, should be installed along the lines of those tentative rules. The tentative rules limited its use to branch circuits which were exposed. That should be very clearly understood.

I am not going to attempt to tell you of all the other tentative rules, but it provided for a continuous bare armor, of a proper conductivity, and other minor requirements, which it doesn't seem to me to be so essential that I should mention them here.

Then the meetings of the manufacturers came along, and they appointed this committee which is now called the Committee on Electrical Wiring Systems, to endeavor to find out what it was all about, because it was plain, on the surface, that it revolutionized things. It made one-wire fittings, one-wire fixtures, and put everything on the one-wire basis, and many people said "If it is good for branch circuits, if it is safety you are after, and it is safe if properly grounded, why limit it to exposed work?"

It is necessary to go to the bottom of this and find out all about it, and so the manufacturers appointed a committee of about twenty—I am not accurate as to that number—supposed to represent all interests—the United States Government, through its Bureau of Standards, and the Underwriters, Manufacturers, Contractors, Jobbers, and others. It was the idea that everybody should be represented on that committee, now known as the Committee on Electrical Wiring Systems.

A Permanent Ground

That committee made a decision that the first thing to determine was the possibility of a successful and permanent ground, because it was pretty generally admitted that if the ground was good and permanent, the safety to life feature was more secure, if there was only one side to the circuit. If every fixture, every cut-out, and every exposed part was permanently and positively connected to the ground you couldn't get a shock from it. That was admitted.

But the question of a permanent and satisfactory ground had been up before the Underwriters, and the National Electrical Contractors' Association experts, for years, and not one of them had yet been able to determine what was a permanent and satisfactory ground. Therefore the Committee on Electrical Wiring Systems determined that the first thing to do was to see if it was possible to find out something about a satisfactory ground. They had specified in the Code grounds for varying conditions. They had not, as I understand it, gone to the limit and said that "you must connect with a water pipe," or something of that kind—they didn't say that that was the only ground that was acceptable, because in many instances that is not attainable. Therefore, it is a big question.

The motion was then made to appoint another committee, and a committee was named 'to study and report on the subject of bare grounded return wiring systems.'

That introduces the idea that I mentioned earlier—that if this is good for a branch circuit, why isn't it good for the whole thing? This second sub-committee has not yet reported. Perhaps the chairman of that second sub-committee, who is here present, may feel called upon to enlighten you on this subject. It is up to him to say.

Now, so much for the matter of history of this proposition. I have endeavored, up to date, to maintain an open mind on this subject; but latterly that has become a rather difficult proposition; and it has been impossible for me to look into it, and not form some opinions.

Whether it is proper, or not, for me to express any opinions on this subject here, is a question, but I think I can state my observation of two trial installations that were put in, and what I think of those installations.

In the city of Boston the central station company secured permission from the authorities to put in three installations. I saw one of them, in a workingman's house in the suburbs of Boston. There were about ten or fifteen lights on three floors of a small house. I went there in company with many experts in that line, some of whom I see here present, and perhaps they would like to tell you something about it. There were three or four circuits running out from a panel board, and it was in the early stages, when the proper fittings had not been completed, and the grounds were provided by little loops of metal around the arms. I have also recently seen a trial installation here in New York.

A Limited Field

The thing that I see to these small exposed installations of concentric wiring, is, first, that its use is necessarily very limited. It is, perhaps, a little more economical to install, but if it were in my own property and I wanted exposed work, and couldn't afford to pay the price of proper exposed work, I would prefer to use a good job of cleat work, or porcelain knob exposed work, as far as appearance goes, than this concentric wiring system.

It seems to me that the danger is in the breaking of the return conductor, because of the very thin tube of metal that is on the outside. The material is rather stiff, and if once bent it can not be straightened without cracking the outer covering. That has been my observation of it. I have seen in the trial installations, several places where the covering of the concentric wire was cracked, although not altogether broken.

I have also seen, in connection with one of the trial installations, an attempt by an amateur, to extend the system; and I assure you that the extension system by the amateur was not a thing that any of you would like to have on your own property.

I think that this whole subject must be treated in a broader way than the mere question of concentric wiring.

It doesn't follow that the bare grounded return must be exposed. It is perfectly possible that the bare grounded return can be run with an insulated conductor, and protected from injury. That is what I mean when I say that this is a broader question than the limiting of this system to branch circuits. And I don't think it is fair for us to throw down the entire system, until these men who are investigating the thing from an expert standpoint, come around and tell us whether the ground can be maintained, whether the effects of electrolysis from the grounded return are such that it can not be properly used; and other questions like that. I take the position that if this bare-grounded return is feasible and is safer to life, the economies that we are all looking for, to extend the usefulness of our electrical work, the economies that the central station is looking for, will be much greater and the work will be proportionately extended if such economies are realized by applying this bare-grounded return to the whole system.

Now, gentlemen, that is about the whole story. I think we are talking about the very small thing in this question when we describe this whole thing as concentric wiring, because I don't believe that the majority of the contractors' customers will want exposed work. I think the demand for that kind of work is very limited, and therefore, as it is at present limited by the rules, the use of this material will be very small.

As to comparing the costs—I haven't much data, because we haven't installed any of it, and haven't been able to get accurate figures. However, I know that I was told in Boston that the installation I saw there was installed by the most expert workmen in that line in the city, and every technical and electrical expert in the city, including the city officials, and every high official of the Edison Company, in Bóston, had visited the installation, and there was no way of telling what the cost of that installation was.

Will It Cost Less?

Now, we hear that it is going to cost less money. I believe that if the central stations want to extend their systems, they could go into the workmen's cottages in the suburbs and install a good job of exposed knob and tube work and get away with it, and the workmen will think just as much of it as if it was conduit, or anything else that was exposed. I don't believe that the saving in a six-light installation in a workman's suburban house, on this concentric wiring proposition, over a metal molding job, or an exposed conduit job, will amount to enough to make all this talk worth while.

I have heard the experts of the lighting companies say that they were only talking about safety. Before they got through talking about the thing everyone said that the object of this movement was to extend the use of the central stations' lines. So there must be another reason than safety. It is a question of economy. Now, for the small economies that are supposed to be effected by this thing, I don't think the whole tea party should be upset to this extent; but I do think that if these committees, who are experts on the subject, can conscientiously say that a bare-grounded return system is a good thing, we can go to the one-wire system and save a lot of money and get, possibly, just as good a job."

Mr. McCleary then said:

"On the question of grounding, I see several of my old friends who have been on this Electrical Committee for years, and I think, if it is necessary, they will bear me out in the statement that the Electrical Committee, from the Underwriters' end of it, have been ready for years to accept a requirement for grounding. But the obstacle that has been in the road of such a requirement has been the inability of the committee to get the central station interests and the American Institute of Electrical Engineers together, upon a proper specification to be put in the Code."

H. R. Sargent, of Schenectady, Managing Engineer, Wiring Supplies Department, General Electric Company, was asked to say a few words.

Mr. Sargent replied:

The Situation in Europe

The central stations brought to the attention of the General Electric Company, sometime ago, the fact that in some cities perhaps only ten per cent. of the houses were wired, and that there were a great many houses that should be wired, and that they wanted the increased load on their lines. It was also brought to our attention that some of the present systems were unsightly and possibly expensive.

The speaker went abroad and looked over some of the systems in Europe. Mr. Doane, of Nela Park, also went abroad and inspected some of the systems; and when he came back the matter was talked over, and I had made up a small board of concentric wiring fittings, using the wire as made abroad. I also had made up a set of fittings with twin wires in a metal sheath. I had a complete set of fittings made for both systems. These boards were presented to the committee of the Underwriters, of which Mr. Blood was chairman, and if I remember right the concensus of opinion was that the better system to adopt in this country was the concentric system, and that was the way the decision was made as to the best system to be adopted in this country, in order to reach these small houses. The only object, as originally laid out, was to reach these smaller houses, in which the owners were unwilling to have conduit used and were unwilling to have any of the expensive systems installed; and they were, possibly, unwilling to have cleat work put in, because it is unsightly to a certain extent.

I have seen a great many houses abroad, in which this concentric system is installed, and the wire is run right along the moldings, and is not unsightly.

I will admit that, as Mr. Strong has stated, the installations in those buildings in Boston are rather crude. They are pioneer jobs in this country.

Better Insulation

We developed the wire, and in this committee of which I spoke, it was decided that the wire should have better insulation than that used abroad. Abroad the insulation is very thin, and it is very small wire, so that it was decided to make the complete conductor as near the Code requirements as possible. We therefore added to the covering, which made the wire a little larger and a little more expensive.

So that to-day I am not prepared to say that this system is going to prove materially cheaper than any existing system; but I would say that in my opinion, if properly installed it is going to be neater than the knob and tube or molding systems.

I think that safety to life is another factor in favor of the concentric wiring system. Mr. Blood feels that the grounded system is a step in advance, from a safety to life standpoint.

I think that if many of these houses, especially in the West, can be wired with this system, it is really handing the contractor something that he has not had before and can not obtain with any existing system.

Now, if this system has merely demonstrated the fact that some new system must be worked out, it will have served its purpose.

The General Electric Company has absolutely no interest in pushing this system. We haven't pushed it. We have made up some fittings, but we haven't voluntarily distributed any pamphlets. We have gotten up some pamphlets, but have held them at the home office, subject to distribution on request. I wish to state that we are here to co-operate with you in this matter, and are willing to assist you in getting the proper system, and to enlarge your business, and the electrical industry in every respect."

Mr. McCleary then said: "I want to say to you, gentlemen, that in approaching Mr. Sargent, at Schenectady, he said to me, 'Now, Mr. McCleary, you can have anything we have, with this one proviso, that you make it perfectly plain and clear to the members of your organization, that the General Electric Company is not standing sponsor for, and is not advocating the adoption of this system. We will come to your convention, and will give you whatever information we have, but we want it understood that we are not standing sponsor for this system.' We are ready to manufacture the materials if there is a demand for them."

A Serious Objection

F. F. Valinoti, Louisville, said: "We have a very serious objection to that method of wiring, as far as it has gone. It may develop into a grounded return system, as Mr. Strong referred to, which will, of course, require further thought and consideration, and would probably be a good thing. But just the plain old concentric wiring, as we have seen it, we don't think will accomplish the purpose. It seems that the primary purpose is to reduce the cost of wiring and to get more consumers for the central stations, and we contractors have to do it, and the central stations won't give a thing. We must give up everything, so that they can get more 'juice' on their lines.

We went into an agreement with our central station in Louisville, on a house-wiring proposition, about two years ago. They put on a house-wiring campaign, and I want to show you how far they got in helping the contractor. We went into this campaign, our prices very low. I think some of the jobs ran as low as twelve dollars, twenty-five per cent. to be paid within ten days after the completion of the job, and the balance to be paid in twelve monthly payments. We had to carry the accounts, some of them as low as seventy-five cents a month, and it would cost us eighty cents a month to collect them. For a four-room house, I think at that time we were getting about ten dollars, and we have some pretty rigid rules in Louisville; they require us to put in material that they don't require in other parts of the country. Now, suppose we take concentric wiring—it may be a little cheaper, and that house may run eight dollars. But is that any inducement to the owner to wire the house, when he has twelve months in which to pay for it? He would just as soon pay sixty cents a month as fifty cents, and have concealed work.

We have houses in Louisville that will never be wired, if you do it for nothing, for the simple reason that the people are afraid of that monthly bill that the central station sends them."

Geo. E. Wheeler, New York City, said: "In all this talk about concentric wiring there is one thing that we, as contractors, must remember, and that is the cost of furnishing meters by the central stations. They can't very well get out of that dollar charge. We, in New York City, have had a little experience in this proposition. Since the first of this year we have had the chance to buy meters from the Edison Company, buy the juice at wholesale, and sell at retail to the tenants of buildings. The Edison Company has had considerable experience in that business, and the most of the trouble experienced is in the cost of maintaining and reading those meters.

Applies Where Flat Rate Given

I find that in Europe—from reading up on the subject—that concentric wiring is only applied to those places where the central station can give a flat rate for the current. As soon as you attempt to put a meter in service and bill it monthly and collect from the customer, you are up against it, and you have to charge a dollar a month minimum.

So far, for the first six months of this year, after buying the meters at a low price—paying not over ten dollars for any meter—and the meter being installed, not having to install it ourselves, we find that our operating cost is forty-eight cents for maintaining and reading each meter.

So that the lighting companies are up against it in that respect. They must have a minimum charge. The other alternative is to use concentric wiring, which is what it is, when you get right down to it—cheap house wiring, wherever they cannot afford to pay for the better method of wiring.

Until we get the system established as they have it in Europe, it is hardly worth while talking about it or taking it up. I don't see how the lighting companies can reduce or eliminate that minimum charge that they have to make.

M. E. Arnold, of Philadelphia, asked Mr. Sargent: "In the investigation made by the General Electric Company in Europe, did they find that the concentric wiring system extended any further than the branch circuits, or was the idea with which it was installed, that of reducing the cost of installation only? Or was the degree of safety any greater than that in the regular wiring system?"

Mr. Sargent: "The installations that I visited over there —particularly in England—were in separate buildings, and in some cases comparatively small buildings, and the wire generally used only for branch circuits.

There was one place in Waterloo where there are fifteen or twenty brick buildings side by side, and in each building there are, as I remember, four lights, and the wire is run along the fronts of those buildings and a tap is taken right in through the wall to each dwelling.

Another place where I saw it was in the college buildings, I think in Oxford University, and I believe it was put in there on account of the looks of the installation. They have sold brick walls there and the plastering is put directly on the walls, precluding the possibility of fishing, and cleat work would not have looked well. They told me that the cost of the installation was about the same as molding work would have been. Does that answer the question?"

Mr. Arnold asked: "Was the degree of safety considered, in a general sense, above that of the general wiring system?"

Mr. Sargent replied: "No, I couldn't say that the safety proposition was considered above that of a general wiring system.

The wire over there did not appeal to me at all. The insulated circuit wire was covered with one-thirty-second inch rubber with a wrapper of cotton and a metal sheath, and the insulation was very poor. But I would say that the engineers who installed the system, and to whom I talked, thought it was very satisfactory and very safe.

Edward Kunkel, Davenport, Iowa, said: "There are two points that appear to me to be very important in this discussion, and I confess that I am not clear on them:

The first is as to the character of the metal sheath—the mechanical strength; and second, the method of grounding in these cheap installations.

My thought would be that to get a proper grounding would increase the cost of such installation beyond that of the ordinary knob and tube job.

Those two points I would like to be enlightened upon."

Mr. McCleary: "I think I can answer your question, that the character of the metal sheath will be such as to meet the approval of the Laboratories, after the Electrical Committee has prescribed a set of specifications which will have to be met. I have no fear about this being ample and sufficient, when it comes through the Electrical Committee.

As to the method of grounding—there has been a special committee appointed to consider the whole system of grounding."

Concrete Examples

Mr. McCleary: "I will now ask a man to speak who has probably devoted as much time to the subject and has as much personal knowledge of it as any other man in this country. I am going to ask Mr. Hale, of Boston, to tell you all he can on this subject in five minutes. Gentlemen, this is Mr. Hale, of Boston, whose principal pleasure in life, now, is to talk about concentric wiring!"

R. S. Hale said: "I had come here with the intention of not talking, but as I have been called upon, I wish to endorse what Mr. Strong has said—especially what he said about this concentric wiring proposition being merely a portion of a very broad subject. The whole question, itself, is very much broader than the concentric wiring proposition.

The reason this matter came up was, of course, because the central stations wanted to extend their business and increase the number of their customers, and extend their service.

On visits abroad we found that in some places the use of electricity was very much more expensive than it is here. I can best illustrate this by taking one particular town of about three hundred thousand inhabitants, where the rate was 9.8 cents per kilowatt hour, and in addition to that the customer had to pay a meter rent of one dollar and a quarter a year, and on top of that he had to buy his lamps, and in addition he had to pay a tax on the lamps. So that those customers were paying twelve or thirteen cents per kilowatt hour for electricity. In spite of all that the man who was getting wages of ten or twelve dollars a week was using electric light. The lighting company had about sixty thousand customers in that town, and they were figuring, not on how many customers they had, but how many there were left that they could get. Practically everybody in the town was using electricity. In this town the rate was a meter rate.

I found that in some towns they were charging a flat rate of so much per lamp, but the question of flat rate didn't seem to be tied up to the question of these other wiring systems.

The only reason that we could see, why so many more people were using electricity than in towns of similar size in this country, was because of the cheap wiring system.

We looked up these different systems, to find out what they were. There are a great many of them. I forget some of the names. We brought some samples of a great many of them over with us and took the best of them to the manufacturers—Mr. Sargent representing them, perhaps more than anyone else—and to some of the wire people, and we also went to the Underwriters, and as a result they suggested the trying out of this particular system, under certain rules that were laid down by Mr. Blood's committee, of which Mr. Strong was a member.

Suggestions

As I have said, I want to endorse Mr. Strong's statement that this is a very broad question. Up to the present time we have not had any great encouragement in it. We have had an immense number of suggestions that we ought to do something else. One of them, for instance, was that we ought to omit the minimum charge. However, I call your attention to the fact that in New York City there is no such charge. That proposition was also answered by Mr. Wheeler, when he said that it cost forty-eight cents to maintain a meter; and also by the contractor, who said it cost eighty cents to collect the bill for wiring.

Now, the concentric wiring proposition is merely one of the methods. I believe, myself, that this system which has been worked out, as far as it has gone, by the manufacturers and the committee of the Underwriters, is the best thing to try, but what I do want to ask is that we should try to develop something. If the concentric system doesn't meet with your approval, let us have something else. Let us make progress in some way.

Adv. Suggestions for Elec. Contractors

The last four of a series worked out by the Society for Electrical Development. Any contractor may change the wording to suit local conditions. Consecutive advertising will educate the public to distinguish good work from bad

"A little knowledge is a dangerous thing"

Every day sees men "going into business for themselves" not only without sufficient training in the most elementary business principles, but with a totally insufficient knowledge of their profession. You know the result!

Unfortunately the electrical construction field is not exempt from the demoralizing influence of this class of contractors.

But **you**, as a buyer of electrical work, can be protected from future loss and trouble. Look into the standing of your electrical contractor **before** you employ him. A deficiency found either in business "head" or technical knowledge should be a danger signal to you.

(Names and Addresses of Contractors.)

Make it easier to rent that house

"Is it wired for Electricity?" This is one of the first questions asked by the vast majority of prospective tenants. How will you answer it? If you can say "yes" the house will already be half rented, for of all modern improvements Electricity is recognized as the first and greatest.

Arrange to have your property all put on the "Wired for Electricity" list. The increased rental will quickly pay for this small investment.

Many real estate men so appreciate the value of Electric Service that they do not attempt to rent or sell a house without first wiring it for Electricity.

See that **your** property has Electric Service before the renting season is upon you.

One of the following thoroughly reliable and competent contractors will be glad to estimate on wiring one or more of your houses the **right** way.

(Names and Addresses of Contractors.)

If *you* were buying a house

Wouldn't you give greater consideration to the house which had Electric Lights? Buyers naturally want property which is really up to date—and that means property which is wired for Electricity.

Here is a simple problem: Suppose you have a cottage to sell—are asking $$2,500 for it, with no takers. It's ten to one you could get at least $2,700 for it if it were wired for electricity — couldn't you? **And it would be much easier to sell.** The total cost of wiring need not exceed $70.

The answer to that problem is that it pays to wire property for Electric Service before attempting to rent or sell. The cost of wiring is always more than offset by the higher price the property will bring.

It will pay you, too, to have this wiring installed by a competent and dependable contractor—one of the undersigned will be glad to give you an idea of the cost or a definite estimate.

(Names and Addresses of Contractors.)

While you are on your vacation

While your house is unoccupied is really the best time to have it wired for Electricity. Responsible contractors may be relied on to treat your house just as carefully as if you were at home. A few days of uninterrupted work by competent wiremen will make your home thoroughly modern. And by having the work done while your house is vacant you will not be inconvenienced in the least.

What a pleasant surprise if your wife could return from an outing to find the comforts and conveniences of electricity waiting in **her** home!

We'll keep your secret if you want to plan a surprise.

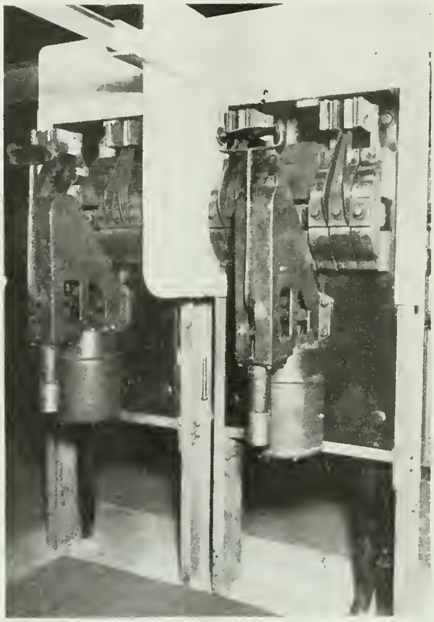
See one of the dependable, competent contractors listed below. Any one of them will do the work **right**.

(Names and Addresses of Contractors.)

What is New in Electrical Equipment

Largest Circuit-Breakers Give Excellent Service

What are said to be the largest circuit-breakers ever built have been in continuous service for over two years in the Sherman Street sub-station of the Commonwealth Edison Company, Chicago. These breakers are connected directly onto the heavy copper direct-current leads carrying 20,000 amperes from the larger of the two rotary converters in this sub-station. This machine is a 5,000 kilowatt unit, convert-



Record circuit breakers in Chicago sub-station.

ing three-phase, 25-cycle current into 250-volt direct current. The two breakers, front view of which is shown herewith, are mounted on adjoining panels, each 54 inches high by 30 inches wide.

These circuit-breakers are of the overload and reserve-current type. They are remote-controlled from an operating board, which is mounted on a gallery overlooking the rotary converters. The operation is by means of two solenoids. The closing action is very positive and powerful. If the circuit-breaker is to be opened or closed by the operator at the control board, he needs merely to throw a small control switch either up or down. This energizes the opening or closing magnets, and produces almost instantaneous operation of the breaker. It is also possible to trip the breaker by hand by pushing a release button under the opening coil. As it may be necessary to close the breaker by hand, an exceptionally long closing handle is provided. This operates through a set of levers, in order that sufficient pressure may be exerted to completely close the contacts.

Normally the breakers are not used to open and close the circuit under load, because if the rotary is to be either put into or out of commission, the load is gradually transferred. Under excess load, however, the breaker opens automatically, the release coil being energized from a relay on the control board. Likewise on reverse current—that is, if the alternating current supply to the rotary converter should go down or fail, the circuit-breakers will open, and thereby prevent running of the rotary as an inverted machine fed from the direct current side.

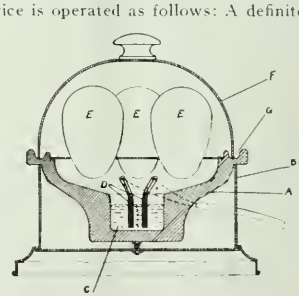
These breakers are of the type C, manufactured by Albert and J. M. Anderson Manufacturing Company, Boston, Mass. A similar but smaller set of these breakers, rated at 14,000 amperes, is also installed in this sub-station. A large number of breakers of this type are being used in power plants and sub-stations, with very excellent results. The Anderson Company is prepared to build breakers of this type carrying currents of 25,000 amperes and over

Cooker That Operates on Electrolysis Principle

A cooking device which depends upon the heat developed by electrolysis of water rather than on that produced by the resistance of wires, has been placed on the market recently by the Ruvio Electric Company. The device is used principally for cooking eggs, but may be also utilized for such things as warming nursing bottles. Since the food placed in the device is cooked or warmed by the steam generated by electrolysis of water and is not immersed in the water itself, only a small amount of water need be heated, consequently the energy consumption is relatively low. Furthermore, the amount of water may be adjusted so that it will be entirely converted into steam at the end of a definite period, thus automatically shutting off the current and preventing overcooking of the food.

The device consists of a nickel-plated base, B, in which rests a porcelain dish, A, having a dome-shaped cover. In the centre of the dish is a small well, C, which serves as a receptacle for the water which is to be converted into steam by electrolysis. To prevent the formation of metallic salts, carbon electrodes are employed. The groove G, in which cover F rests, is of sufficient capacity to hold as much water as the well C. Thus, as the water is evaporated and then condensed by cover F it will be deposited in the Groove G and not permit the device to continue operating indefinitely. A perforated metal plate resting on the top of the porcelain dish is provided to hold eggs while they are being cooked.

The device is operated as follows: A definite quantity of



water, depending on the length of time the food is supposed to cook, is measured in a receptacle furnished with the device and poured into the well C. The receptacle is gradnated in lengths of time the device is desired to operate. Holes, which may be covered by the fingers, are provided at different points, so the measure may be filled to the desired level easily. When the water is poured into the receptacle C, current will pass between the carbon electrodes, causing the water to boil almost immediately. The resistance of the water is reduced by the absorption of salts, with which the carbon electrodes are impregnated. Thus salt never has to be added to the water to make it a conductor.

It may be pointed out that not more than 1½ teaspoonfuls of water need to be boiled to cook four eggs, as compared with the kettle full when using other methods. The improved economy must therefore be obvious. To insure cooking the eggs uniformly regardless of size or number, the tray holding them is arranged so that the steam condensed on the surface of the eggs will run back into the well C. As soon as their surfaces become heated to the temperature of the steam, however, condensation will no longer occur on their surfaces, but will take place on the inside of the cover and will run down into groove G, where it will remain. Thus the water will finally be deposited in the groove and the current automatically turned off.

Improved Design Induction Feeder Voltage Regulator

After considerable engineering and experimental work, with a view to improving the electrical performance and mechanical details, the Westinghouse Electric and Manufacturing Company, East Pittsburgh, Pa., has placed on the market the improved design feeder voltage regulator illustrated. This is a single-phase induction regulator, known as the type C, for 2,300 volts, 60 cycles, 10 per cent. regulation, and it is standardized in all ratings from 5¾ kv.a. to 69 kv.a. The refinements secured in this new design have increased the reliability of the regulator in service, and have simplified and decreased the expense of the wiring necessary for installing accessories for automatic operation, in addition to improving the electrical efficiency. Figs. 1 and 2 show respectively the regulator removed from tank and mounted in tank complete. The rotor is wound with form-wound coils, as shown by Fig. 1 and constitutes the primary element. The short-circuiting coils in the rotor are formed from a large number of turns of relatively small size enameled copper wire, thus reducing the watts loss in these windings without decreasing the neutralizing effect for which they are provided. The stator core, with the secondary windings in place, is shown in Fig. 3. This core is of the frameless construction so largely used in the construction of induction motors. With this form of construction the cross-section of the stator core is increased without a corresponding increase in size of other parts and of floor space, resulting in a decrease of iron loss and exciting current. Further, the insulating oil in which the regulator is immersed in the tank comes in direct contact with all surfaces of the stator core, with more efficient cooling effect. In a regulator the insulation of windings is of vital importance because of the severe conditions of operation. The coils for both primary and secondary are, therefore, carefully insulated and impregnated, and are assembled in open slots. They are held by fibre wedges, driven in small grooves at the top edges of the slots. Heavily insulated steel bracing rings are assembled around the exposed ends of the stator coils at both ends of the core. These rings are bound to the coils with cord, and greatly stiffen the coils against distortion from mechanical shock caused by current surges in the feeder during periods of line disturbance or short circuit. This feature is an important one, increasing the protection to the coil insulation and the factor of safety of the regulator in service. An electrically controlled switch or auxiliary relay for the operating motor, formerly mounted separately from the regulator, is now mounted directly on the regular top cover and includes the limit switch. This arrangement cuts down the number of wires required in the control circuit for automatic operation and simplifies and lessens the expense of installation. The chance of failure in the control circuit is correspondingly lessened as well, and inspection of the wiring is made easy. The operating motor is provided with a quick-acting magnetic brake as heretofore, but the operating mechanism has been changed, so that the regulator now requires only 10 seconds for the complete range of travel from maximum buck to maximum boost, 20 per cent. regulation. The regulator is made as a unit, and may be quickly removed from the tank by simply unbolting the top cover, thus making inspection and repairs comparatively simple. The tank is formed from sheet steel walls, with oxy-acetylene welded seams and with top and bottom flanges cast on to the walls. This type of tank is the same as that used with Westinghouse oil insulated self-cooled transformers.

New Hubbell Oil Lamp Attachment

The illustration herewith represents the new Hubbell oil lamp attachment, an ingenious arrangement by which any lamp having a common burner, either flat wick or central type, may be transformed to an electric lamp. As illustrated, it is sprung down in the same manner as a lamp chimney would be, and the current is taken from any near-by socket or Hubbell receptacle. If desired, the lamp may be immediately re-converted for use with oil, as the attachment of this device does not interfere with the original design in any way. The new fixture is furnished with 7 ft. of cord and the new style porcelain attachment plug recently described in the Electrical News.


Fig. 1—Removed from tank.

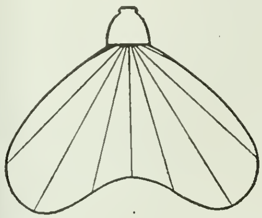

Fig. 2 Mounted.


Fig. 3 Stator coil.

New Hubbell lamp attachment.

Direct Lighting Reflector

The National X-Ray Reflector Company have just placed on the market a new reflector for the direct lighting of large interiors with type C lamps. This is a powerful distributing reflector of the deep bowl type, which hides the lamp from view. It is furnished with an adjustable holder, which can be made to fit any Mogul socket or type suspension, and is an ideal unit for lighting large areas economically. The type illustrated is known as No. 580, which is the largest of three reflectors of this type, the other two of which are



New direct reflector for type C lamps—Distribution curve also shown.

known as Nos. 570 and 575. The reflectors are designed for placing at the ceiling, thus avoiding drop-cords and reducing lamp breakage, as well as economizing the time of workers who no longer need to fix their individual lights. The No. 580 reflector unit is suitable for 300, 400, and 500 watt type C lamps.

Individual Auto-transformers

The high efficiency of the 15 and 20-amp. Mazda series lamps has made them very popular for street illumination. To operate them from standard 6.6 or 7.5 amp. constant current series circuits individual auto-transformers have been commonly employed. Recently, however, due to a number of inherent advantages, there has been a considerable demand for a small series transformer to operate a single lamp by stepping up the line current to the higher current required by the lamp. Some of the advantages claimed for these individual series transformers for ornamental street lighting systems are as follows:

1. As they insulate the pole and lamp from the high-tension circuit the use of series lamps is permitted in municipalities where ordinances are in force which prohibit high-tension wires being carried on poles in the business district.

2. They save the expense of high-voltage conductors, heavy insulation, and high-tension absolute cutouts in the pole, a saving which materially assists in liquidating the difference between the first cost of auto-transformers and series transformers, the latter being naturally somewhat higher priced.

3. On account of the low secondary voltage of these series transformers the lamps are as safe to handle as if they were on a multiple circuit.

4. No film cutout is required, as each lamp is independent of the others in the circuit. In case of an accident to one or more, the remainder of the lamps on the circuit burn without interruption.

5. These series transformers allow the use of lamps where a series system is desirable and high potential impracticable—for instance, where it is necessary to mount lamps upon telephone poles.

6. They also make it possible to provide lighting on bridges or other places where high potential is not allowed.

7. They protect the lamps from surges in the line.

8. They are a valuable adjunct to "Safety First" in ornamental street lighting.

A complete list of this class of transformers has been put on the market by the Canadian General Electric Company.

The Buffalo office of the National Metal Molding Company, Pittsburgh, during the absence of Mr. L. S. Montgomery, now on the Mexican border with Troop I., First Cavalry, N.Y.N.G., will be temporarily in charge of Mr. C. L. Corbin, who has been transferred from Pittsburgh.

The Eugene F. Phillips Electrical Works, Limited, Montreal, have obtained a contract from the Montreal Public Service Corporation for the supply and installation of about two miles of 3-conductor, 5,000 volt, paper insulated, lead covered cable. This is for use in the civic conduit system.

The Montreal Tramways Company have let a contract to the Northern Electric Company for the supply and installation of a quantity of 13,200 volt, 3-conductor, paper insulated, lead covered cable. This is in connection with the system being constructed to inter-connect the Tramways Company's power stations and sub-stations on the Island of Montreal.

Lieut. Simpson Killed in France

Word reached Toronto within the past fortnight that Lieut. J. D. Simpson had been killed in action. Before his enlistment Lieut. Simpson was a traveller for the Canadian Crocker Wheeler Company, Limited, of St. Catharines. He was one of the most popular salesmen on the road and was very widely known. For a number of years he covered the

The late J. D. Simpson

Northern Ontario field for this company. He was an engineer, being a graduate of a Scotch University. Lieut. Simpson was first attached to the 75th Battalion, but later transferred to No. 1 Tunneling Company of the Royal Engineers, Canadian Expeditionary Force, and went overseas about nine months ago. His home before coming to Canada was in Berwick, Scotland.

The Six-in-One Fuse Plug

The failure of electric lights or electrical service is due, in 85 cases out of 100, to an accidental blowout of a fuse. If new fuses of the right amperage were always at hand to immediately replace the blown fuse, much discomfort and annoyance would be avoided. The six-in-one fuse plug, illus-

trated herewith, is simply what its name implies—six fuses in one plug, made in amperages from 3 to 30 for 125 maximum voltage. It fits any standard installation, is self-contained, and non-refillable. The manufacturers claim that the "Six-in-One" is the only fuse plug on the market to-day which will safeguard the consumer against accidentally replacing a fuse of low denomination for one of high amperage. The Northern Electric Company have been appointed the exclusive selling agents for the "Six-in-One" fuse plug in Canada, and they anticipate a record demand, especially from dealers and central stations.

New Modern Factory in Kitchener

Few of those who knew of the modest beginning which characterized the start of the enterprise that is now known as the Onward Manufacturing Company, in Kitchener, Ont., thought that in the short space of seven years the business would so far outgrow the repeatedly increased factory facilities as to make necessary the building of the new structure that is now in process of erection on East King Street. In these strenuous times it is the steady, persistent advances in the history of a business that go farthest toward the permanence and stability of the institution, and the constantly increasing volume of business that has come to the Onward, in Kitchener, has at last made it necessary to provide factory facilities sufficient to properly handle the work that is being done.

The new structure is 100 feet long and 50 feet wide, and will be two storey and basement, electric lighted, steam heated, and with every facility for the manufacture and shipping of the several lines in which the Onward Company are now engaged. In this plant the Eureka electric vacuum cleaner will be built, the Onward Manufacturing Company having just secured the license for the manufacture and sale of the Eureka in Canada. Another important line, which will form a considerable part of the output of the new factory, are the Onward sliding furniture shoes and Onward slides, which are fast replacing the use of the old style castors on all kinds of wood furniture and metal pads. The Eden line of electrically operated washing and wringing machines will also be built in this factory. With the increased space which the new building will make available, the company expect to be able to take care of the increased volume of business they are receiving.

Inter-comm-Telephone in Large Factory

The Flint Varnish & Color Works have just installed a twelve station Stromberg Carlson inter-communicating telephone system. This system is so arranged that the manager or superintendent can be called to any phone on the system by a general alarm button which rings every phone. Eleven desk and one wall telephones make up the equipment; as many conversations can be carried on at one time as there are stations, without cross talk. Private telephone systems are being installed in many of the new factories, as the managers realize that a private telephone system saves time and money.

The addition to the factory of the Robbins & Myers Company, Springfield, Ohio, which was started early in 1916, was completed September 1st. The equipment is now being installed and a part of it is in operation. The new building is of the same construction as the older buildings, concrete with steel window sashes and wood floors. It is 62 feet in width, 436 feet in length and has five floors, showing a total of about 135,000 square feet. With the completion of this building ground has been broken for another building which will be erected immediately adjoining the building just completed.

Factory of Onward Manufacturing Company, Kitchener, Ont.

Current News and Notes

Barrie, Ont.

The Bell Telephone Company are building a new exchange in Barrie, the equipment for which is to be supplied by the Northern Electric Company. Central energy is to be provided and the contract calls for completion of the work by November.

Chatham, N.B.

The town council of Chatham, N.B., have under consideration the choice of an electric plant to replace the one recently destroyed by fire. Sentiment seems to be strongly in favor of the purchase of a 200 h.p. Diesel unit direct connected to the generator. Steam power is also being considered.

Hamilton, Ont.

Differences between the electrical workers and contractors of Hamilton, Ont., still remain unsettled, despite the fact that the strike is of several months' standing. The contractors have offered to compromise at 45 cents an hour, but the men demand 50 cents and a closed shop. All the strikers are working on jobs of their own throughout the city and claim that they can easily get 50 cents an hour in such cities as Toronto, St. Catharines, etc., and indications are that it will be a long drawn-out struggle.

Huntsville, Ont.

Hydro-electric power was officially turned on in Huntsville, Ont., on August 24.

Kingston, Ont.

It is rumored that the Canadian Pacific Railway Company will electrify its line between Kingston and Renfrew in the near future. It is stated that a power plant will be installed on the Mississippi River back of Sharbot Lake to develop power for this project as well as to supply current to the city of Kingston and vicinity.

London, Ont.

The London Electric Company, London, Ont., have leased space in the Alma Block in which they will install their general offices and an electric appliance showroom.

Lyall, Man.

A by-law authorizing the expenditure of $8,000 for a local electric light and power plant was recently carried.

Montreal, Que.

Work has been started on the $20,000 extension to the St. Denis sub-station of the Montreal Tramways Company.

The Montreal Builders' Exchange have requested the Board of Control to insert in the new tramways franchise which the company are seeking, a clause providing for the transportation of builders' supplies and other material. This is on condition that these facilities shall not interfere with the passenger traffic.

In a recent monthly report of the Bell Telephone System some interesting figures were presented regarding the extent of the company's operations throughout the world. On July 31 last the company had 19,122,921 miles of wire, enough to girdle the earth 765 times, an increase of 1,177,390 miles over the same date in 1915. The company had 9,549,630 stations, 6,290,826 owned and 3,258,808 connected, an increase of 665,892 over a year ago.

The growth of revenues was apace with the expansion in equipment, for gross earnings for the seven months totalled nearly $150,000,000, a gain of more than $15,000,000 over the corresponding period in 1915. Depreciation absorbed $28,000,000, an increase of $2,500,000. Operating income after taxes was $41,717,000, a gain of $5,512,000, or more than 15 per cent.

Nelson, B. C.

A new 8,000 h.p. unit is being installed by the West Kootenay Power and Light Company at No. 2 Bonnington Falls plant, near Nelson. The new unit will raise the total horse power of this plant to 32,000. The company's No. 1 plant at Bonnington develops 4,000 h.p. and the Cascade plant 3,000 h.p. The new unit is required to supply power for the operation of the new smelter at Trail and the development of various new mining properties in Kootenay and the Boundary country.

Orillia, Ont.

The Treasurer's monthly report shows light receipts to August 10th to be $22,955 and the power receipts $21,979, a total of $44,935. The light receipts have fallen off $2,315, due to reduction in rates, and the power receipts have increased $4,944, making a net increase of $2,629.

Regina, Sask.

The Houston-Tallman Company, Limited, have been awarded contracts to construct rural telephone systems for Tribune, Bromhead and West Tribune Rural Telephone Companies. This company are also building six exchange systems for the Saskatchewan Government.

Renfrew, Ont.

By a majority of 64 the ratepayers of Renfrew, Ont., rejected the proposal of the town council to arrange with the Hydro-electric Power Commission for the development of the First Chute on the Bonnechere River.

A. A. Wright is disposing of the Renfrew Electric Light plant to Mr. T. A. Low. Mr. Wright, some thirty years ago, harnessed the Bonnechere River to crude machinery and pioneered the way in electrical development in Renfrew and eastern Ontario. In the first instance only a half dozen or so arc lights were installed to light the existing dark streets.

St. Marys, Ont.

At a recent meeting of the town council of St. Marys, Ont., a discussion took place regarding the repairing of the steam boilers at the town power house. As Hydro power has failed a number of times recently it is thought best to be equipped for any possible emergency. A number of the councillors are in favor of buying a gasoline engine outfit instead of using steam power.

Toronto, Ont.

The Provincial Hydro Commission will spend somewhere in the region of $1,000,000 in doubling the equipment at the Toronto station.

Vancouver, B.C.

Electrical workers in the mechanical department of the British Columbia Telephone Company, Vancouver, are pressing for an increase in wages and the excision of certain clauses in the agreement now existing between the company and the men.

Winnipeg, Man.

The Canadian Hart Accumulator Company have opened an office in Winnipeg, which will be in charge of Mr. C. W. Knighton, who is acting as representative of this company for Winnipeg and the Western district.

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Lighting Progress of a Year

In looking back over the past twelve months it is difficult to place one's finger on any very striking illumination announcements, although it is comparatively easy to recall a number of minor developments, which, taken together, have advanced the art of good lighting a step. Little by little, the general public are realizing the value of proper lighting, and at the same time it is more and more coming to be realized that good lighting is possible only when the work is carried out along carefully planned lines by men who understand. In a word, illuminating engineering—in fact—is gradually coming to be a recognized necessity and a reasonable possibility.

* * *

It may be that extensions in the uses to which light has been put during the past year represent the most noticeable developments. For example, flood lighting. The marvellous lighting effects obtained at the Panama-Pacific exposition have undoubtedly been responsible for the increased use of flood lighting at many other places on this continent. This development has been possible because of the lighting units of high intensity and efficiency now commonly used, aided by specially designed reflectors. Many public buildings in the United States now have their exteriors permanently illuminated in this way, to which has recently been added the wonder of a night spectacle of Niagara Falls, which now rivals, in beauty, the sunlight view.

* * *

Street lighting appears to have reached its highest efficiency, to date, in the single lamp standard using gas-filled units with the latest type of diffusing glassware. This does not mean that such lamps as the arc or mercury vapour are obsolete, but rather that they now find their greatest usefulness in meeting special conditions in work shops, factories, yards, etc. The ornamental cluster except as an ornament, has outlived its one-time popularity.

* * *

Lighting in the home is slowly but surely getting away from the direct system. Both semi-indirect and totally indirect have grown in popularity, because the people are gradually getting accustomed to these somewhat novel ornaments, and also because they are realizing that greater physical comfort accompanies their use. This development is being helped in many localities by the greatly reduced cost of current, which now makes the monthly bills for even a proper illumination almost negligible.

* * *

Possibly it is in the greater attention now being given to factory lighting that the most noticeable change has come over the general public. The idea of "safety first" has taken a firm hold on our citizens and they have learned, in the main, that well-lighted working conditions mean safe working conditions. It is also gradually being borne in upon our hard-headed captains of industry that good lighting means greater efficiency and greater capacity on the part of the workman, and with these, a better product. From his point of view good lighting is nothing more nor less than good business.

* * *

Summed up, the progress of the past twelve months is such as might reasonably be expected to follow the campaign of education that has been going on steadily for some years. It is the evidence of appreciation and the application of what we already know rather than the supply of any new information. It indicates the dawn of that "brighter" day when the illuminating engineer is receiving credit for his pioneering. For of all the factors that enter into our lives, tending to keep us fit and efficient for our day's work, it is doubtful if any single one plays a more important part than "good lighting."

The Canadian Finance Minister asked for a loan of $100,000,000—the response is more than twice that amount, without any sign of effort. That is the kind of co-operation that helps the allies and discourages our enemies in the same ratio.

Lignite for Profitable Power Generation

Mr. E. A. Hanson, city electrical engineer, Saskatoon, Sask., recently presented an interesting report to the Royal Commission, at its sitting in that city, on the profitable use of lignite for the generation of cheap power. It was pointed out by Mr. Hanson that in the past, using imported coal for power development, 65.5 per cent. of the total amount paid for fuel represented freight charges; the balance of 34.5 per cent. being the actual cost of fuel at the mine. A portion of this report follows:

"It has been established by scientific investigation (See Mr. S. M. Darling's report on carbonation and briquetting of lignite) that the vast quantities of lignite in the coal fields of this province can be profitably utilized for generating cheap power, and we would call your attention to the expediency of taking immediate action to realize the great practical benefits to be derived from this undeveloped natural resource.

Establishment of Industries

"The many industries which the people of the West have almost ceased to think about, owing to the prohibitive power cost, would become practical questions and accomplished facts with the advent of cheap power produced in our own lignite fields.

Paper Industry

"The visible supply of paper is even now giving concern to all those who depend upon cheap paper for the profitable conduct of their business. Cheap power would pave the way to the establishment of a paper industry here. The quantity of straw which is annually destroyed in this country would form the basis of this industry which is so urgently needed all over the country at the present time.

Fuel Cost

Insofar as the cities themselves are concerned, I should like to bring to your notice a few facts which are taken from the operating results of our own utility in this city. I refer to our electrical department.

"In the year 1913 we paid for fuel a total of $145,509, of which $83,155 was paid for freight, the remaining $62,350 being the actual value of the coal at the mine. In 1914 the figures were $104,230 total fuel cost, $68,302 freight cost, leaving $35,928 as the actual value of the fuel. The figures for 1915 were $86,745 total cost, $69,044 freight cost, and $17,700 actual fuel value. In this connection I would like you to note the fact that the 1914 costs were less than 1913, and 1915 was again less than 1914. The amount paid for freight in each case was correspondingly lower. The reason for this lowered cost is due to the fact that we gradually became able to successfully burn lignite. The total cost for the three years mentioned is as follows:

"Total cost, $336,485, freight cost $220,502, net fuel cost $115,983, or, in other words, 65.5 per cent. of the total amount paid for fuel represented freight charges, while the remaining 34.5 per cent. was the actual fuel value received; that is, the cost of fuel at the mine.

Inflicting Pain by a Blow in Resuscitation After Electrical Shock

Some interesting experiences in aiding resuscitation after electric shock are given in the last number of the N. E. L. A. Bulletin, by W. P. Strickland, general inspector of the New York and Queens Electric Light and Power Company, of New York City. Mr. Strickland says:

Recently one of our foremen, after climbing a pole, preparatory to stringing primary wires, received a shock that caused him to fall to the ground. It is inferred that in adjusting his belt and shifting his position his spur cut out, and that to save himself he instinctively reached out and touched the wires carrying 2,300 volts. When the other linemen and ground hands reached him to all appearances the man was dead. One of the linemen, following instructions, immediately took hold of the ankles of the limp body, lifting it until the whole weight rested on the neck and then letting it fall. He then took a pair of connectors and hammered the soles of the injured man's feet without removing the shoes. Another lineman opened the man's mouth, pulled forward the swallowed tongue (which occurs in electric shock), and was about to begin the Schaefer prone method of resuscitation when the man returned to life. He was removed to the hospital, and is alive and well to-day, though suffering severely from his burns.

For the past year the writer has been teaching his men to strike the feet without removing the shoes in all cases of electric shock. Some years ago an accident occurred where a man came in contact with 6,600 volts, fell from the pole, and was restored to consciousness by this means, although he was terribly burned and died three days later. Another accident that came to the writer's attention happened in New Jersey, when a man came in contact with a wire carrying 2,200 volts. This man was struck violently on the feet, his tongue was pulled out, and he was restored to consciousness before the arrival of the doctor.

Toronto Section A. I. E. E.

The initial meeting of the Toronto Section of the American Institute of Electrical Engineers for the season 1916-1917 was held in the Engineers' Club, 96 King Street West, on Friday evening, September 22. The branch shows very evident signs of an active season ahead, the attendance of over 100 at the opening meeting indicating the interest among electrical engineers in the work of this section.

Mr. H. M. Hobart, consulting engineer, General Electric Company, Schenectady, N.Y., addressed the members on the subject "Electrical Machinery Specifications Based on Modern Standards." Mr. Hobart is a member of the committee on "Standardization" of the A. I. E. E., and described the work of that committee during the recent past, confining his remarks, however, owing to the limited time at his disposal, entirely to rotary machinery. He explained wherein the present standards of the A. I. E. E. differed from the old standards, the change having been brought about following conferences between English, American and foreign engineers in 1913 and between English and American engineers since that date. The basic change consisted in the increase of the standard ambient temperature to 40 degrees C. instead of 25 degrees C. as formerly, and the fact that the specifications are now based on a maximum temperature rather than on a maximum rise in temperature.

The speaker also described at length the latest methods of making heat tests, and explained the safety factors considered necessary where readings were taken at different points in the rotor. He then illustrated the accuracy of his formulae by reference to a test he had recently carried out on an 8,750 kv.a., 6600 volt generator.

Interesting addresses in the discussion which followed were offered by Mr. H. M. Hart, Hamilton, Professor Rosebrugh, Mr. W. A. Bucke and others. The meeting was presided over by Mr. E. T. Brandon, Chairman of the Section. Preceding Mr. Hobart's address the Secretary, Mr. Wills Maclachlan, read telegrams of regret from a number of prominent Canadian and United States engineers. Mr. E. M. Ashworth, Vice-chairman of the Section, also read a brief report on the work of the executive committee since its election to office last May.

The Chairman announced that the next meeting will be held on Friday, October 20, when Mr. C. B. Scott, Manager Bureau of Safety, Chicago, will speak on "Accident Prevention."

Hydro Transmission at Electric Club

At the second Toronto weekly electrical luncheon of the season, held at the Prince George Hotel on September 8, Mr. Gaby, chief engineer of the Hydro-electric Power Commission of Ontario, was the speaker. His address, "Hydro Transmission," was a non-technical description of the hydro-electric movement in Ontario, sketching the early history of its development and the legislative enactments leading up to its inception. Problems of design regarding transmission towers and insulators were explained. Mr. Gaby described the marvellous growth that has attended the institution of this public ownership scheme and spoke of the quality and efficiency of the Commission's equipment and apparatus. A number of lantern slides of general interest were shown throughout the address. Mr. K. J. Dunstan presided.

Qualifying the Term "Efficiency"

The Term is Ambiguous and Apt to be Misleading—Other Factors to be Considered Besides Cost

By Mr. E. N. Hyde

In almost every vocation—industrial, scientific, or professional—the degree of attainment to which progress has been made in an effort to approach perfection is referred to in terms of efficiency. These vocations often have some bearing on each other—if we examine into their fundamentals. This relationship renders the term "efficiency" more than ambiguous, if not indefinite and merely suggestive. Applied to illumination practice, the misconception of what "efficiency" means, as variously employed, is a menace, and the following applications of the term are given to illustrate how easily incorrect interpretations are likely to occur if something more specific and distinguishing than just the phrase "the efficiency of" is employed.

First let us see how many ideas can be collected from the statement "a tungsten filament incandescent lamp is more efficient than a carbon filament lamp." If we look at the catalogue rating of a 25-watt tungsten lamp we find 1.14 watts per candle power given. For the carbon lamp is given 3.1 watts per candle power. On the face of it the carbon lamp takes per candle power (3.1 ÷ 1.14) 2.71 times as much current as the tungsten, and the inference drawn is that the tungsten lamp is 2.71 times as efficient as the carbon **as a light-producing medium.** As a matter of fact, however, the figure 2.71 is not correct for use as a multiplying factor by which estimates of the superiority of the tungsten filament lamp over the carbon can be taken. It only shows how much more light on the **horizontal** is given off by the tungsten filament than is given off by the carbon filament, on the horizontal, with the vertical axis passing through bulb tip and base contact. If—and here is the fallacy of this method of comparing clearly shown—the candle powers at the nadir, i.e., the point in the vertical axis immediately below their respective tips be taken, their efficiencies are as follows: 25-watt tungsten lamps, 3 c.p.; the 49.6-watt carbon lamp, 7 c.p. If the first comparison were justified at all, then so would be the following: The tungsten lamp would be 8.3 watts per c.p., and the carbon 7.1 watts per c.p. They are both deductions made from electrical testing laboratories' curves. They cannot be reconciled, as in the latter case of nadir candle power the carbon lamp is 1.18 as great as that of the tungsten lamp.

Now, nothing has been said regarding the specific types of lamps compared, but to set aside any doubt I wish to assure my readers that the tungsten is the standard drawn wire molybdenum hook type, and the carbon, the standard oval anchored filament type. The whole sum and substance of these comparisons is based on a practice of comparing total light-giving characteristics of incandescent lamps by their **horizontal** candle powers, long since discarded by scientific societies but still imposed upon the public. The practice should be discarded by all, and will be, I think, as it is encouraging to note that slowly the term "lumens per watt" is coming into use.

Taking again the same two lamps, comparing them on the lumens per watt basis, we have their relative efficiencies in comparable figures, and these figures show that the tungsten lamp consuming 25 watts delivers 213.6 lumens (based on the curve), and the 49.6 watt carbon lamp 166.3 lumens. The efficiencies are respectively 8.54 lumens per watt for the tungsten and 3.35 lumens per watt for the carbon and the tungsten lamp is 2.54 times more efficient than the carbon. These calculations are based upon spherical reduction factors used by the United States Bureau of Standards, viz., 78 per cent. for the tungsten lamp and 82.5 per cent. for the carbon. Incidentally carbon lamps purchased by the public as 16 c.p. usually consume 3.5 watts per mean horizontal candle power, and such lamps supply only 2.96 lumens per watt. Compared with this the 25-watt tungsten lamp is commercially burning at 1.05 watts per mean horizontal candle power, and delivers 233.3 total lumens, or 9.33 lumens per watt, and it is fair to say that generally per watt the quantity of light of the tungsten (Mazda) lamp is more than three times as great as the 3.5 watt carbon lamp—and the public is so advised.

Asking your pardon for the digressions from the original theme, let us see what other construction can reasonably be placed on the phrase "a tungsten filament incandescent lamp is more efficient than a carbon lamp." Why would it not be natural to infer that you can see better by a tungsten filament lamp than a carbon filament lamp? If this were what is meant, then an object illuminated to an intensity of one foot candle by a tungsten lamp would be more clearly visualized by us than if this same object were illuminated by a carbon filament lamp to an intensity of one foot candle power. But in practice is such the case? Again the answer must be qualified. It would be just as correct to say "no" to this question as "yes." It all depends upon the object itself. If it is black and white, yes; if it is light green, violet, or even gray, yes; if it is orange or red in color, no; if a lady's face and the degree of naturalness her face will assume under the artificial light as compared with its natural expression in daylight is considered, the answer again is, no; if the object is a photographic plate, yes; if a red Turkish rug, no. I will leave it to our readers to strike their own averages, but the relative clearness of objects viewed depends on the selective absorption, and its converse the selective reflection characteristics of the object itself. It also depends on the percentum of color wave lengths in the spectrum of each illuminant. Upper spectrum colors are present in the larger percentages in light radiations from the tungsten filament lamp than in the carbon lamp, while in the latter lower spectrum radiations are very abundant. Incidentally upper spectrum wave lengths have higher actinic values than lower spectrum wave lengths, hence they are better for the purpose of photographing.

Carbon Can Be Seen Farthest

Again, we might assume that a tungsten filament lamp, if "more efficient" than a carbon lamp, can be seen from a greater distance. The answer is that such is not the case except under qualifying conditions, and under some conditions the carbon lamp is "more efficient" than the tungsten. If two lamps, one carbon and one tungsten, supply the same number of total lumens (regardless of the number of lumens per watt efficiency of each) are to be discerned from a distance through a fog, a carbon lamp will be still visible after the tungsten has disappeared, everything else being equal to effect a fair comparison. So also would it be seen to better advantage through the dust and smoke of a foundry under these conditions, the **kind** of light that radiates is not absorbed so rapidly as the radiations of the higher temperature competitor, the tungsten. But, after all, would not actual practice show that, watt for watt of current consumed, much more visual power would result by using tungsten lamps, with their greater number of lumens, than would obtain by putting these watts through carbon filaments, getting thereby better quality of light for the specific purpose, but in not enough quantity to compensate for the greater volume of poorer quality light for the purpose delivered by the tungsten lamps That question is solved by the illuminating practitioner for each specific case, but neither he nor anyone else can say tungsten lamps are more efficient than carbon lamps for long distance transmission of light and be sure he is right unless he qualifies the statement with details of conditions.

If you want a green signal lens to look green by transmitted light more green flux can be obtained from one lumen of tungsten filament light than from one lumen of carbon filament light. If, on the other hand, the lens is red or ruby, more of these colored fluxes will be secured from one lumen of carbon filament light than from the tungsten. Which is the more efficient for railroad signals and switch lamps?

In the foregoing I have referred mostly to comparisons between two types of incandescent lamps. As much or more can be said regarding the "efficiencies" of other illuminants, for instance, yellow flame lamps versus mercury tubes. Moulding clay oxides of iron, tan-bark leather, and many other objects are seen more clearly under the former illuminant than the latter, but in machine shops, blue prints, tool marks, etc., can be discerned more clearly under light radiated from the mercury tube than the yellow flame arc, and any statement regarding the "efficiencies" of these two illuminants should be qualified so as to distinctly state what kind of efficiency is intended—i.e., whether it is in lumens per watt or in the sense of these illuminants being valuable assistants in making certain objects under certain specific surroundings more clearly visualized.

Inefficient Consumption

Efficiency in illumination takes on another important aspect from the standpoint of obtaining results predetermined with the least expenditure of energy. Comparison may be made of two methods used to light a big assembly hall through the ornamental glass ceiling, which in daytime admits from a skylight above sunshine or daylight to secure daytime illumination. At night the light flux of artificial illuminants must be substituted for sunlight. Such a condition is known to the writer—a room in the capitol building of the United States at Washington is illuminated by a false translucent ceiling, through which sunlight passes in daytime and incandescent lamplight passes at night. The effect intended is obtained successfully, and from this angle is efficient, but from the standpoint of an efficient lighting installation it is a farce, if one considers the excess energy that is consumed but which could be conserved. Above the ceiling bare incandescent lamps hang with no redirecting reflectors to send the light downward onto the ceiling, whence it passes through to the room below. Were properly constructed reflectors installed so that the light of the lamp were concentrated on the ceiling, the additional light flux passing into the room below would easily be twice as much as reaches there from the bare lamps. But since with the bare lamps the effect is satisfactory as noted above, the use of the reflectors would give equally as satisfactory results with half the number of lamps burning and half the energy consumed. So we must qualify again, and say the light effects have been "efficiently" obtained, but the installation, from an energy-consuming standpoint, is a most inefficient one.

"The efficient method of lighting our church accounts for our small monthly cost of current," says a clergyman. An examination of the church interior under artificial light justifies the clergyman's remark; there are plenty of foot candles, plenty of lumens, and the bills for current are modest. But—does the interior breathe the quiet dignity of a place of worship or does it glow like the interior of a theatre? Do the sacred appointments appear in sacred beauty appropriate to their religious use or do they look as though they are on exhibition, as in a shop window? If they have lost their religious significance and become exhibits instead of emblematic of the sacred use to which they are consecrated, and sanctity throughout the church is drowned in brazen light effects, the psychological efficiency is low—distastefully, crudely, sacrilegiously low—and the thought of a small cost of current grates on and tarnishes one's conception of a sanctuary, for there is thrust upon us unwelcome materialism at the expense of spiritualism. The lighting scheme of such a church has no efficiency in the scales of psychology.

There are some more efficiencies in illuminating practice which belong to the science of physics. We have material in energy consumption figures, i.e., kilowatt hours and lumens hours, or lumens per cubic foot of acetylene, natural gas, coal and water, artificial gas, coal oil, etc., etc., with which to estimate the cost of using each. If one costs more or less than another, then, laying aside the factors of convenience, safety, etc., one may say, "from the cost standpoint candles are more efficient for me than anything else I have found so far." Well, they may be efficient as factors in financial economics of household expense, but let us consider them from the standpoint of transforming potential energy into Kinetic luminous radiations. A candle, i.e., one candle power delivered from a sperm candle consumes 86 watts. Eighty-six watts in a tungsten lamp of the 75-watt type would produce 70.6 mean spherical candles. Of all the energy used in the candle three-eighths of 1 per cent. is converted into light, i.e., luminous radiations, the balance into heat radiations. If the melting point of tungsten were reached in the 25-watt lamp first mentioned in this article, it would give 97.5 mean spherical candle power, but at 1.14 watts the mean spherical candle power is 17. Now one-fifth of 1 watt per mean horizontal candle power is melting point of tungsten, but the little firefly we see summer nights uses one-fifth of 1 watt per mean horizontal candle, and all the energy exerted to produce light actually produces light and nothing else—that is to say, no losses can be detected, and the little thing is practically 100 per cent. efficient. Measured by such a standard of efficiency as this of the firefly in its ability to convert potential energy into kinetic luminous energy, the tungsten lamp is a crude affair, and since to save his face man needs all of the many efficiencies, let us treat that word with due respect and qualify its use so that just which one we mean is unmistakably apparent.

St. Lambert Street Lighting

The town of St. Lambert, P.Q., has put into operation an addition to the street lighting. The town, some months ago, gave a contract to G. M. Gest, Limited, Montreal, for an underground lighting system for Victoria Avenue and Elm Street, and the addition just inaugurated is a further installment of improved lighting, although by means of overhead wires. The central portion of the town was formerly lighted with 16 c.p. lamps; these have been replaced by 250 kw. nitrogen filled lamps, on 130 Arcadian brackets with 18-in. radial bowl bodies and large Holophane refractors made by the Geo. Cutter Company, South Bend, Indiana. The brackets are of 1¼ in. pipe, with a four-foot projection, attached to wooden poles. The entire frontage along the River St. Lawrence is lighted in this way. In the outlying portions of the town, hitherto unlighted, 16 c.p. lights have been installed, on gooseneck brackets, on wooden poles, about 250 feet apart. Power is supplied by the Waterman Pen Company. The greater part of the material, including the Cutter fixtures, was supplied by Dawson & Company, Montreal; the work of installing being done under the supervision of Mr. H. A. Gibeau, the town engineer.

It is announced that the Halifax Power Company, a concern which proposed to enter into competition for the supply of hydro-electric energy in Halifax, has found it impossible to finance the project. The Halifax Power Company had made a contract with the city of Halifax to supply lighting for the streets and civic buildings for $30,000 a year for twenty-five years.

Notes From the Hand Book of a Lighting Man

Contains Some Information Not Usually Found in Text Books on Good Lighting —A Technical Discussion with a Decidedly Practical Turn

The editor of this journal has long desired of the writer that he should furnish him with an article on "Illumination." It is perhaps largely due to a desire to retain the friendship of the editor, and that he might risk the loss of no subscribers, that he has been met by a firm refusal every time. It is just possible that there is also another good reason why his requests have never been met with in the affirmative, and this may be the remembrance of other articles which have appeared from time to time within the covers of the Electrical News, of such superior type, as to entirely eclipse the modest attainments of the "Lighting Man."

These little notes (should they ever attain to the dignity of the printed page) will be found to contain nothing of "sine" or "cosine," very little, perhaps, of a technical nature at all, but their aim is to leave the reader with a definite impression (should he read these wandering remarks to the end), that a "Lighting Man" even, who loves his work and who tries earnestly to arrive at such a solution of a given problem that when carried into effect will help to comfortably brighten and lighten the daily task of his fellowman, can render humanity at large a real and lasting service.

And, after all—Life is Service. The one who progresses is the one who gives his fellow beings a little more—a little better—Service.

So much of the deep, dark, mysterious and profound has been written around and about the much used term "Illumination" (for the greater part profusely illustrated with equally mysterious curves, charts, etc.), that the humble "Lighting Man" wonders if there can possibly be even one other of equally simple tastes among all the readers of this journal who would care to allow his thoughts for only a brief period to be directed along channels not quite so visionary.

Let it be said right here that we cannot in any degree dispense with the technical, the scientific, or the imaginative, but rather the reverse. It does, however, seem at times to the decided notion of the "Lighting Man," that comparatively few can find the time, or possess the inclination, to give the concentrated attention that is such a prime necessity to the intelligent reading and understanding of the majority of articles that are written on the subject "Illumination."

This mental view of the situation has been a gradual outcome of having interviewed all classes of business men and a very large number, over a period of about ten years, at the time of their maximum interest in the subject.

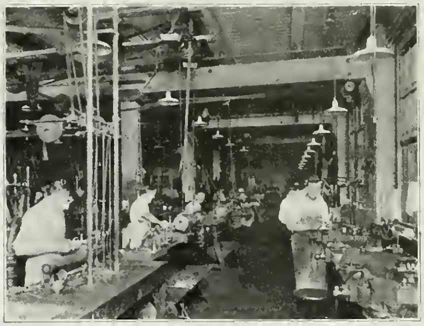
While the "Lighting Man" admits (because of an intense interest in the matter) of having studied the technical and scientific side somewhat himself, it has at the same time been his unqualified experience that the engineering of illumination is about eighty-five per cent. common sense and good judgment and the remainder equal parts of knowledge (born of past experience in wrestling with lighting problems) and technical education.

What tremendous horsepower of energy is ofttimes exerted to surcharge the circumambient atmosphere with phrases that simply bristle with such words as "eye-strain," "foot-candles," "scientifically designed," "visual acuity," "lumens," "spectrum," etc., by the salesman who really means "You should use Blank and Brown's pressed glass shades, bowls, brackets, or what not." All of which has made many a man with a certain particular place on his hands to light up, wish in his heart that he could discover an expert without prejudice.

An expert without prejudice. What does this involve? In the mind of the "Lighting Man" it seems to be a regarding of the problem from the point of view of the purchaser on the part of the salesman, or to be only another way of interpreting—Ideal Service. This thought may be illustrated by a relation of one or two actual incidents that came under his personal notice during the last few years. In Ottawa, the owner of a fairly large furnishing store was extremely dissatisfied with the illumination of his windows, which were very large, both in depth and length. Hearing that the "Lighting Man" was in town (through the kind offices of a friend connected with the central station), the store owner sent for him. A visit was made to the store and an inspection of the window lighting was entered into at once. It was quickly seen that a re-equipping of these windows with reflectors in which the "Lighting Man" had an immediate interest would make an order for a bill of goods of an appreciable size, and the store owner was just on tip-toe with anxiety to buy anything he was advised was right. On the other hand, however, it was seen that the reflectors already installed were of an excellent and high-class character, with an interior reflecting surface of the mirror type. The installation as regards correct spacing, size of lamps, etc., indicated careful thought, and could hardly be improved upon. The only thing which rendered the resultant illumination so unfortunately ineffective was the complete lack of suitable background, and yet no one seemed to realize this factor. Where ignorance was so blissful, it did seem folly to "put them wise," and the temptation to the "Lighting Man" was very real to throw out the equipment of the rival manufacturer and install his own. However, the decision was made in the other direction and the advice was given to provide the very necessary background, leaving the lighting equipment just as it was. It is still there, plus the background, and the "Lighting Man" is still minus the order for equipment he could so easily have had; but he is happy in the thought of having rendered an appreciable service, at the same time acting broadmindedly and without prejudice.

Entirely Unsuitable

The writer by no means wishes to create an impression of being the only exponent of such noble deeds of self-sacrifice, feeling very sure that there are others who daily act from similar motives, but knowing also that there have been cases where lighting equipment has been sold and installed that was entirely unsuitable, architecturally, and had little or no chance of being a success even from the elementary or primal standpoint of illumination. It is a sad fact that the great majority of those with whom the perplexed factory or store owner, or office building superintendent essays to consult are commercially affiliated with some particular manufacturer of lighting devices. It should also be remembered that the best illuminating engineers are to-day those associated with the leading manufacturers of scientifically designed lighting equipment, or have perhaps elected to sever the connection they once had, in order to enter the field on their own account as independent consulting engineers. Even in the latter event, the previous training is apt to leave its definite impression as to the merits of some particular device. So the result is a situation bristling with difficulties for the man who is anxious to obtain a system of illumination entirely modern and particularly the most desirable for his own especial needs, for this man says, regardless apparently of everything except his own personal anxious need to make a sale (and who in these strenuously competitive days can blame him), "use my accurately calculated dish with a lid suspended over it and your problem is solved forever." The next man comes along and urges the installation of a sample wonder-worker with an adjustable curve, (photometric tests to order by mail). These are followed in turn by a man who advocates, we'll say, the use of a ball, because that's the way the Creator designed the earth's light source, the sun, and, therefore, it must be right. "Anyway," he quickly ruminates, "we've got an awful bunch of 'em in stock and we've simply got to place them somewhere." So in apparently endless procession (so the "Lighting Man" has been many a time despairingly informed), do they come, all good men and true, in themselves, but laboring under the handicap of having one particular article to put on the market irrespective of whether that market at the moment be represented by a government building, a paper mill or a Greek shoe-shine parlor, so that the prospective investor in illumination finds it impossible to obtain advice without prejudice and ends by throwing up his hands in despair, ultimately disposing of the matter, perhaps, by simply taking that article among the many submitted which will cost him the least in initial outlay, or using bare lamps.




Factory scenes—On the left, by day, on the right, by night Photos not retouched in any way.

The last resort is unfortunately one not infrequently fallen back upon.

The "Lighting Man" says "unfortunately" advisedly, for nearly all, if not quite all, the better illuminating devices on the market have considerable merit and each one is capable of working out to better advantage than any other, **when correctly installed under conditions for which it is most particularly suited, and probably was originally designed to meet.**

Throughout a long experience with such things, however, the "Lighting Man" has never yet seen any unit, no matter how genuine or extravagant the claims that were made for it, or how clever or otherwise be the sales campaign waged on it, that ever began to prove itself the alpha and omega of fixture manufacture, or the cure for all lighting ills. The facts are altogether to the contrary and there is no doubt whatsoever that each problem in illumination requires special and individual consideration, and in some isolated cases which crop up from time to time an entirely original solution is found necessary and must ultimately be discovered in order to successfully deal with the situation.

As an illustration of this point, the case of the lighting of the head offices, in Toronto, of one of the world's largest insurance companies, comes to mind. This office is approximately one hundred feet long, by seventy-five feet wide, with a ceiling eighteen feet above the floor, and divided into unequal sections by very deep beams. In most cases this kind of office would present no insuperable difficulties, but in this one instance it was absolutely out of the question to figure on any kind of lighting that depended on the light source being located elsewhere than at, on, or in the walls. All the usual fixtures had been shown and all the usual arguments advanced, but to no avail, when apparently someone suggested that probably the "Lighting Man," if referred to, would be able to arrive at a solution, so the well-known firm of consulting engineers in charge of the work extended the courtesy of the opportunity to co-operate with them, and an entirely original suggestion was ultimately made and enthusiastically received, and it is at the moment of writing in process of being carried out. While, as before stated, the suggestion was quite original, it was very simple, and of that peculiar variety that makes one wonder he never thought of it before.

The moral in all this, from the point of view of the ultimate consumer, is, perhaps, that it would be the height of wisdom, whenever any question or problem of the sort comes up, to consult with one man, whom he has reason to believe is big enough, broad enough and who has the necessary knowledge to recommend that which he knows in his heart to be the right thing, even though some other line would carry with it a greater percentage of material gain.

Such a frank and sincere manner of dealing with the problem, if based on a thorough understanding of the subject, practical and theoretical, would net the consumer the maximum in real service, without prejudice.

TABLE 1.—RAPID METHOD OF CALCULATION

$$\text{Total light in Lumens} = \frac{\text{Sq. ft. (Area of room)} \times \text{Foot Candles}}{.45}$$

From table below lumens from all sizes of lamps may be obtained.

Approximate Total Flux in Lumens of 110-Volt Lamps

Lamp, Watts	Watts per M. H. C.	Watts per M. S. C.	Approx. Total Flux in Lumens
25 Mazda B	1.05	1.35	230
40 Mazda B	1.03	1.32	380
60 Mazda B	1.00	1.28	590
100 Mazda B	.95	1.22	1,000
100 Mazda C	....	1.00	1,300
200 Mazda C	....	.90	2,800
300 Mazda C	....	.82	4,600
400 Mazda C	....	.82	6,100
500 Mazda C	....	.78	8,100
750 Mazda C	....	.74	13,000
1,000 Mazda C	....	.70	18,000

While the skeptical will question the possibility of finding such a man, the "Lighting Man" thinks it would be found comparatively easy of accomplishment.

On the other hand, there may be a situation where the man who desires to equip an office or factory under his charge with modern lighting may feel it unneedful to call in even one man to his assistance, but would much prefer to carry out the work himself, feeling, however, that some simple method of calculating illumination would be of value if available. A large company engaged in the manufacture of materials very widely used in commercial lighting has recently published a very clever and well designed folder which has within its pages about the clearest and most easily understood formula for this purpose the writer has ever seen. Particularly since the advent of the nitrogen lamp. This chart is reproduced herewith for the benefit of those who may find it of service. It has been the experience of the "Lighting Man," however, that no matter how clever and versatile a man may ordinarily be, if he is a good factory manager, owner, or superintendent, or a good architect, or whatever his specialty may be, it is too much to expect that he will be a good illuminating engineer too. It usually seems true that the man who tries to know all about everything, in the final analysis actually knows little about anything. So it is held to be sound advice given by one Toronto expert: "Consult a Specialist."

Somewhere earlier in these rambling and discursive "notes" a reference was made to the length of time the "Lighting Man" had applied himself to the practical and theoretical study of this intensely interesting subject. While it would seem that specialization involves hardship in the earlier days for the student, no matter what line he focuses his energies upon, it would seem equally sure that close attention to one line of endeavor will in the long run provide its own adequate reward. The "Lighting Man" has found that practical experience with lighting-fixture manufacturers, lamp works, scientifically calculated reflector producers and central station organizations, has been not only valuable, but absolutely necessary to one desiring a well-balanced under-

From this photograph the results of a system of general illumination are shown. Room 1,066 feet long, 66 feet wide. Shallow bowl type reflectors 10 feet high, 11 feet 6 inches apart. The intensity is high and uniform. Note the absence of glare and shadows. Photo taken at night by the illumination from the lamps and reflectors only and not retouched.

standing of the many sides and points of view to be considered in solving a lighting problem, to say nothing of the tremendous importance that architecture plays in the designing of any lighting equipment that aims to be correct. Any one of these phases, if neglected, is apt to so militate against the entire scheme as to perhaps entirely obliterate the good results anticipated and probably to make the whole installation figuratively, if not literally, ineffective.

The lighting in the main office of a huge textile corporation in eastern Canada was an eminent and conspicuous success, viewed architecturally, (and in the daytime); it was also one to delight the heart of any fixture manufacturer, as there were many first-class specimens of bronze castings displayed. The lamp man also had cause for a warming of the heart towards it, and, for reasons which will appear later, perhaps, it will be observed the central station man would be the last one to complain. The office is one of such great length and width as to require a considerable number of outlets, so we will only consider (for the sake of our illustration of the point previously brought up) one particular section or bay as being typical. Each bay is about

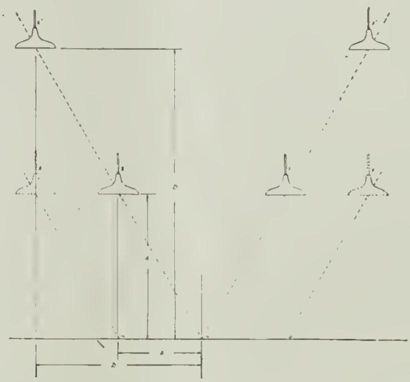


Chart B shows that the proper ratio between spacing distance and mounting height must be observed to obtain uniform illumination. Suppose two reflectors, X and Y, are 2 A' feet apart and A feet high. Their distributions will then secure uniform illumination. If the reflectors are moved farther apart to position X' Y', the points of maximum distribution occur at M and O, causing a dark spot between, and non-uniform illumination. When reflectors are located as X' and Y', they must have a mounting height B, in order to obtain uniform illumination. Larger lamps must necessarily be used to obtain the same intensity as when reflectors are located as X and Y.

eighteen by twenty feet, with a ceiling height of about twenty-three feet, lighted from a single outlet in the centre from which the fixture before spoken of is suspended. This last sentence should be read as meaning to convey the original intention and not the literal truth, for therein lies the secret of the joy of the central station man, and the employment of scores of desk lamps, which for reasons of unsightliness, cumbersomeness and probably eyestrain, led to the calling in of the "Lighting Man."

These fixtures were of expensive, heavy cast, single pendant type and hanging from the ceiling to a total length of about thirty inches to the sockets, which were four in number and equipped with one 100-watt lamp in each, or four per fixture and one large sixteen inch C. R. I. ball covering the whole number of lamps and sockets. This outfit being installed less than three feet from the ceiling to the centre of the lamp filament, and the ball having no powers of reflection or refraction, there was no agency to carry the light rays down to the tops of the desks below, but rather upon investigation it was discovered that all useful illumination ceased a little more than nine feet above the floor. A recommendation was made to simply change the ball for another one properly designed to meet the needs of just such a condition, which was done, and found entirely satisfactory. Further, since the story of this particular job is being recounted, it may as well be told in full, though briefly. The satisfactory adjustment of the office lighting led to the "Lighting Man" being introduced to the mills of this corporation, which afforded ample opportunity for his finest work. Many and varied problems of a most interesting character were met with, which though here and there seeming like a Waterloo, were eventually worked out to a successful ending—an entirely satisfied general manager and staff and an order for the "Lighting Man" for upwards of twenty-five thousand reflectors. And all is not told yet, for so pleased was the president of this company and the general manager, that they voluntarily signed a cheque liberally covering all expenses the "Lighting Man" had been put to in rendering them this real service and gave him the same with the order. Specialization pays dividends eventually without doubt, for many others had already been consulted concerning the lighting spoken of without suggesting a satisfactory remedy, which all came most likely from looking at the problem from some one angle and one angle only. The very finest angle of all in the mind of the "Lighting Man" is that which gives consideration to the discovery of that one particular solution of the problem in hand that will give the maximum service for the greatest number of years to those whose hope it is to receive help and benefit from the change or innovation. Also it is true that while many a successful lighting layout has been made on blue prints in the office of the architect or engineer, or in the engineering department of an equipment manufacturer without an actual view of the plant under consideration at all, it is, after a wide experience of all these means to the end, the positive impression of the "Lighting Man" that the happiest ultimate consumer is he who can arrange for the personal call on the part of an expert without prejudice. As most owners of buildings know, there are many local conditions which are extremely unlikely to appear on any blueprint.

The Illustrations

The illustrations herewith, giving a day view and night view of a typical section of a machine shop, graphically portray the ideal results following the visit of an expert to this particular plant. These cuts are especially chosen for the reason that if there is one place more than another that does not readily lend itself to a treatment in "good lighting" by mail it surely is a machine shop. There is also probably no department in the industrial field that, as a rule, displays so many varieties of applied ideas as to the best method of obtaining correct illumination. Each workman's light is pretty sure to be higher or lower than his neighbor's, also as likely to be throwing more light directly in his eyes than on his work. These are conditions that CAN be remedied, and many a skilled workman who formerly thought it absolutely necessary to be his own engineer is now happy to share the more cheerful conditions of general illumination with his fellow-workmen. This last statement, by the way, is not to be taken as an argument that general illumination is the one and only desirable scheme for a machine shop. That would hardly be "common-sense," would it? But it has been the experience of the "Lighting Man" that this form of lighting is in the majority of cases quite adequate and that in exceptional cases only are local lights required.

As a final and closing "note." It may be definitely stated that there is no reason in the world why any office, home, store, factory or church, should not be as well lighted and illuminated as the machine shop shown herewith and in a manner just as suitable and lasting.

To Wage Campaign for New Members

The Toronto Section of the American Institute of Electrical Engineers is preparing to wage an active campaign, during the next few weeks, for new members, very little effort having been made in this direction for some time. Out-of-town engineers who may care to become associated with this Institute or who wish to become familiar with its work, and who may not be reached by the impending canvass, are requested to communicate with the Secretary of Toronto Section, Mr. Wills Maclachlan, Excelsior Life Building, Toronto.

Bagging the First Zeppelin — An Eye-Witness Account of this Important Success

On the night of September 2nd there were many signs for those who could read them that an air raid was probable. It was not, however, until shortly after 2 a.m. on Sunday morning that the writer of this note knew that probability had turned into actuality. On learning that guns were firing in the distance he looked out and saw, not for the first time, a Zeppelin well held by a dozen search light beams. She was several miles off and high up in the sky, over the northern outskirts of London. She was slowly twisting and turning, while all around, above and below, small electric flashes seemed to be bursting out of the air. She appeared to be bathed in shrapnel as she was in light, and to be manoeuvring to alter and confuse the range.

The night was cloudy but calm, although heavy rain had fallen within the previous twelve hours. It was clearly the endeavor of the airship to hide herself from her enemies by striving to rise behind a neighboring bank of clouds. For a time she seemed from the writer's point of observation to have succeeded in so doing, although, no doubt, the view from other angles was different. For a few moments her escape seemed probable, but suddenly the cloud bank between her and the writer's eyes was tinged with a faint reddish glow. It rapidly spread, until the whole sky seemed to be turned to an orange color, increasing every moment in brightness. The cause for a few brief seconds remained a mystery. Then, dropping from behind the veil of cloud, there appeared a gigantic fiery candle, falling wick end downwards. The blazing aircraft fell, or so it seemed, quite slowly. The lower end appeared white hot, and from this blood-red streamers trailed far upwards into the sky. In the moment of her destruction the Zeppelin appeared a fiery mass, swollen to ten times her normal volume.

She was lost to sight behind a horizon of trees, and soon afterwards—probably when she reached the ground near Enfield—a new and intense glare seemed to come from her. This quickly died down, and the night became dark again. No one thought of the terrible death to which a score or so of Germans had been sent. As the blazing wreck fell to earth a strange, angry cheer came from all parts of London, and was echoed at odd moments afterwards from different quarters as the news was telephoned through to those who had not actually seen the destruction of the airship. It was the first definite expression of popular feeling which London had given way to since the war broke out, and in the eeriness of the night hours it seemed to have behind it two years of accumulated force and meaning.

The airship thus destroyed was one of thirteen which attempted to raid London and certain of the Midland centres. Only three, of which this was one, succeeded in approaching the outskirts of London. The total damage caused amounted to the deaths of two people, injuries to thirteen, and slight damage to some private property. The airship destroyed was composed of a noticeably large amount of wood—a fact which the authorities seem to suggest is an indication of the shortage of aluminum in Germany. It is hoped that certain portions of the framework of the airship may be reconstructed. Not only much wood, but a great quantity of wire, entered into her design. It seems to be established that she bore the number L21 and that she carried a crew of sixteen. It is now permissible to state that the chief factor in her destruction was an aeroplane of the Royal Flying Corps piloted by Lieut. William Robinson—since awarded the Victoria Cross. That an aeroplane was responsible for the welcome result was obvious, we believe, to all who saw the incident.—The Engineer, London.

Pioneer Days in Power Development

As Recently as 1897 Exclusive Rights to Develop Power From Niagara at a Dollar a Horse-power Year Rental Were Going Begging—First Machine of "Wood"—An Interesting Page of Electrical History

By Lt.-Col. Frederic Nicholls*

It seems almost incongruous to speak of "pioneer days" in connection with electrical development, for do not the lay newspapers always speak of electricity as being still in its infancy, and is it not almost as incongruous to select me to address you on the subject of pioneering as that would seem to indicate that the narrator lived only in the long ago, whereas I feel equal to almost the youngest man in the audience, and am able to make the same retort as a pioneer farmer once made to a tourist who asked him if he had lived all his life in that locality, to which query the farmer replied, "Not yit"?

Up to the year 1888 I had not been connected with electrical development in a commercial way, although for years previously I had quite a large experimental electrical laboratory, which, before the days of generators and motors, was operated by Bunson batteries, one of my developments being the automatic electric discharge of a small cannon at noon on each day. In 1887 I first gave my attention to electricity as a field for profitable investment, and commenced to study the situation from that viewpoint. At that time Mr. J. J. Wright, who is entitled to the honor of the initial development in Toronto, was manager of the Toronto Electric Light Company, which company operated the street lighting system by means of arc lights, and the only incandescent lights were a few series lamps, operated through the arc lighting circuits.

Having formed the opinion that the multiple system of distribution for private service was bound to experience an enormous development, on account of its safety and flexibility, I discussed the matter with a number of gentlemen, prominent citizens of Toronto, which finally resulted in ten of us subscribing one thousand dollars each, or ten thousand dollars in all, to provide a fund to cover expenses of further enquiry.

The first investigation was of the Heisler system, with headquarters in St. Louis. At that time I was not as conversant as I am now with details of construction, and when I questioned the safety of the apparatus I was asked to put my hand on a commutator, which I did after having seen someone else do it first. Being still sceptical, and not having at the time sufficient technical knowledge to understand how the poles of a series wound machine could be safely handled, they brought into conference a professor of Washington University, in St. Louis, who was evidently interested in the enterprise, but when I asked him to handle the outgoing poles of the generator he promptly declined, and said we had better try it on a dog. I subsequently learned that I had handled the poles of the exciter, which was operated on the same shaft as the rotor of the generator.

Having eliminated the Heisler system, I next visited Pittsburg, and investigated what was then the new Westinghouse system of alternating current distribution. At that time not only all electrical journals, but the daily press, were carrying on a vigorous and sometimes bitter controversy as to the respective merits of the direct as against the alternating current system, the various arguments pro and con being familiar to you all. For some years, however, the danger factor of high tension alternating currents retarded the advance of this branch of the business, and the fact that New York State had passed a law providing for the execution of murderers by the deadly alternating current made its commercial introduction very difficult. After full consideration, I formed the opinion that public aversion would be rapidly overcome, and therefore, before leaving Pittsburgh, secured a proposition from the Westinghouse Company for the installation of a moderate-sized plant, which I advised them I would submit to my associates on my return to Toronto, but that I was first going to New York to investigate the Edison three-wire underground system.

My next visit was to the Edison offices in New York, of which company Mr. Samuel Insull, now president of the Chicago Edison Company, was then vice-president, and, to make a long story short, I also secured from them a proposition for a Toronto installation, so that my associates would have the choice of either of the two leading systems then on the market. On my return I found a letter awaiting me from the Westinghouse Company, advising that subsequent to my visit to Pittsburgh a representative of the Consumers' Gas Company had called on them to negotiate for the installation of a plant in Toronto, and that, inasmuch as the Consumers' Gas Company was a wealthy and established corporation and I was only promoting the formation of a new company that would find it impossible to exist against the competition of the gas company, they begged to withdraw their proposals, as they had entered into a contract with the gas company guaranteeing them the exclusive rights to the use of Westinghouse apparatus in this city.

Adopted Underground System

Fortunately for our enterprise, my associates decided that in any event they would adopt the low tension underground system of distribution, having in view the difficulty of securing a new franchise for the erection of overhead poles. We, therefore, organized the Toronto Incandescent Electric Light Company, and applied to the City Council for an underground franchise, which was granted. In the meantime the Consumers' Gas Company, who had purchased the rights from the Westinghouse Company to use the alternating system of overhead distribution, had also applied for a franchise to erect poles and string wires, and for several months there was an interesting fight before the City Council in reference to our respective systems; but the underground system finally won, and the gas company were refused a franchise. Our little syndicate, therefore, with a capital of $10,000, was able to hold its own against the more powerful corporation; and, under the direction of the men who first subscribed this modest sum, this and kindred electrical enterprises have been organized and developed, until very many millions of capital are profitably invested.

Our next activity was the organization of the Toronto Construction and Electrical Supply Company, with a capital of $50,000, which was incorporated on the 11th of February, 1891. We formed an alliance with the Thomson-Houston Electric Company, of Boston, and acted as their sole agents in Canada, in competition with the Edison Electric Company, which company at that early date was the principal vendor in Canada of electrical apparatus. From the start our company was very successful, and had become the dominant factor in the sale of apparatus in Canada by the time the Thomas-Houston Company and the Edison Company became merged into the present General Electric Company of New York. As the Canadian interests were still in oppo-

*President and General Manager Canadian General Electric Company, before The Electric Club of Toronto.

sition. I entered into negotiations for the purchase of all the Edison Company's interests in Canada, including their Peterboro works, and their lamp factory, which was then located in Hamilton. An agreement having been reached, the Canadian General Electric Company was organized on the 5th of September, 1892, and since that date the investment of the original $50,000 in the Toronto Construction and Electrical Supply Company, the parent company of the Canadian General Electric Company, has grown to over twenty milllion dollars.

Having now briefly referred to "pioneer days" in promotion and organization of pioneer companies that have done much to blaze a pioneer's trail in the development of electrical industry in Canada, I will deal with some early reminiscences. Only those of us who are accustomed in the present day to tendering on able specifications prepared by competent electrical engineers can appreciate the humor of the efforts of the pioneer salesmen, and the ludicrous mistakes that were the rule rather than the exception. The earlier salesmen's battles were mostly with municipal councils, as the series arc lighting system for street lighting was developed many years before the multiple system, and as neither agents nor councillors had any real technical knowledge, the victory generally rested with the agent who was able to most impress the members of the council, not so much in regard to efficiency, power factor, durability, etc., which are all essential in these days, but by the agent's versatility and ability to conduct them on the longest and liveliest tour of inspection of other plants. A single instance of the value of a reputation for reliability may suffice to illustrate:

The Wood Arc System

We at that period had secured the Canadian rights to sell the arc lighting generator designed by Mr. Wood, of the Fort Wayne Electric Company, and the "Wood arc" was exploited vigorously under the sales name of the "Wood System." On one occasion there was a very vigorous battle for the sale of a street lighting plant to a town in Western Ontario. The councillors that year probably enjoyed more trips of investigation than any other council from the beginning of the world till the present day, as each competing company must have expended more than the gross value of the apparatus in escorting successive deputations to see other plants in operation over an area from New York to Chicago and all the intermediate territory. There were no prohibition laws in those days. The chorus girl chorused, drank champagne, and ate broiled live lobster with the same gusto as I am told on unimpeachable authority that they do even unto the present day—and the hours succeeding the end of the day before. Finally, however, the Wood arc system was chosen, and my company awarded the contract. A day or two after the mayor called on me and paid my company a sincere compliment in the following way. He said: "Well, Mr. Nicholls, our council gave your company the contract principally for the reason that you are a Canadian company, and we want to keep our money in Canada; and, secondly, because your being in Canada will enable us to get after you more easily. Had your company, however, not been thoroughly responsible our committee might not have chosen the Wood system, as they can't clearly understand how you can make a satisfactory machine out of wood."

In the pioneer days the cost of apparatus was governed almost entirely by the cost of selling, and the few companies who undertook to reform these methods had a hard row to hoe for a long time, but to-day the percentage of sales cost is relatively very low, and, thanks to good engineering and fair specifications, competitors are on an equal basis.

In regard to electric power sales, as distinct from electric power development or generation, a great change has taken place. As mentioned, the first development was in the direction of series arc lighting, then multiple arc incandescent lighting, and last, but by no means least, the distribution of electric power for mechanical purposes. I may safely say that Toronto led the rest of Canada in this development, and a great deal of skillful pioneer work was done. Like all new departures, it had to overcome prejudice and opposition from those interested in the sale of other methods of power production, but perhaps the greatest obstacle to surmount was the not unnatural opposition of the engineers and firemen employed in existing plants, for the reason that one of the most important sales arguments in favor of electric power was the economy in operation and the saving in labor, in addition to its flexibility. One by one, however, new customers were obtained, and a 3 h.p. Eddy motor, which we called the Mascot, was loaned out for demonstration purposes on many occasions and hardly ever failed to convince the sceptics; and from those days until the present the power end of a distributing station has continued growing in its percentage proportion to total output, and has also greatly assisted economical operation by making possible the flattening out of the peak load and resulting in an average diagram dear to the heart of the operating engineer.

Big Machines of 50 H.P.

The pioneer development of supplying electrical power for distributing circuits dealt only with small units, mostly from 1 to 50 horse power, but the success of these preliminary installations paved the way for bigger things. In the beginning the generating capacity of central stations did not permit sales of power in large units, and even at a later stage, when the public were convinced, orders for moderately large units had to be declined on account of the difficulties of regulation. I well remember the brain fag ensuing from our decision to install electric power to operate the printing presses of the Toronto Globe, in substitution for their steam engine plant, and the relief from worry when the installation proved to be a success. Since those days the use of electric power has grown by leaps and bounds, so that to-day, with the resources of mighty Niagara at our command there is no problem that electrical engineers are not prepared to undertake; and, looking back over a vista of such a comparatively few years, I am amazed at the progress that has been made, and frankly express my own pride and satisfaction in having been privileged to keep step in synchronism with the onward strides of the electrical industry.

As the electrical industry, particularly in Toronto, is vitally concerned with the development of power at Niagara, perhaps a few reminiscences relating to matters antecedent to even the pioneer development may prove of interest. Shortly after the Queen Victoria Niagara Falls Park Commission was appointed by the Ontario Government it made an agreement with Col. Shaw, United States consul at Manchester, England, and representing a body of English capitalists, which agreement conveyed the exclusive right to develop unlimited power on the Canadian side of the Niagara River for a period of one hundred years. The consideration to be paid was an annual sum of $25,000 and the obligation to develop an ultimate total of 25,000 h.p., of which 10,000 h.p. was to be ready for use by the first day of May, 1897.

No Faith in Niagara

After Col. Shaw had made one or two annual payments he failed to organize a company that would undertake to advance the money for construction, as little faith had the capitalist in those days in the feasibility of electrical transmission, and therefore a priceless franchise went begging. When two out of the five years had expired during which development of the first 10,000 h.p. was to be completed, Col. Shaw called on me in Toronto and discussed the situation, and, after a protracted negotiation which lasted into the early hours of the morning, I secured from Col. Shaw an option which provided for the transfer of his interests. At that time the Canadian General Electric Company had recently been organized, and I submitted the option for the consideration of our directors, who, being all men of enterprise and vision, agreed to undertake the work provided the General Electric Company of Schenectady, who at that time owned a financial interest in the Canadian company, would eiher join us or approve of our doing so. I at once visited the headquarters of the General Electric Company, but, sad to relate, found them quite unresponsive, and therefore had to abandon my option on the most valuable franchise ever granted in this province.

Subsequently Col. Shaw associated himself with the late W. B. Rankine and others, which resulted in the organization of the present Canadian Niagara Power Company, which company, not being prepared at the time to go ahead with the prompt development called for under the terms of their franchise, surrendered their sole and exclusive rights to use for one hundred years the waters of the Niagara River within the limits of the park.

A new and strictly limited agreement with the Canadian Niagara Power Company was entered into, and later the Ontario Power Company also secured a concession, and therefore at that date all the privileges on the Canadian side were being operated by United States capital, and Canadians had no part in their magnificent birthright, but the following year Sir William Mackenzie, Sir Henry Pellatt, and myself decided to remove the international reproach that Canadians had not sufficient enterprise to develop our own natural resources, and therefore organized the Electric Development Company, with the history of which you are all perfectly familiar.

Another of the earliest power developments at Niagara Falls was the installation of the Niagara Falls Park and River Railway. The contract for the electrical equipment was carried out under specifications prepared by the late W. T. Jennings, C.E., and I can well remember the day of the official opening of the road, standing proudly alongside one of the 300 h.p. generators and telling the guests that these were the largest machines ever built in the country, and that to produce a machine of such great power was a feat of no mean importance. It was only a few years afterwards that I was present at the official opening of one of the present great power houses at Niagara Falls, and again I stood alongside of a machine of 12,000 h.p. that had been manufactured at our Peterboro works, but I experienced no such thrill as on the former occasion of the 300 h.p. development—in other words, "the pie was not as mother used to make," and the crescendo scale of achievement in matters electrical had cloyed the appetite.

Nothing so Quick as Electricity

The world moves quickly, but no branch of industry has moved so quickly as the one with which we are all associated, and, to quote an ex-president of the National Electric Light Association: "The only parallel was when the world was created in six days out of nothing."

All of us living in Toronto have seen the marvellous development of Niagara Power since the pioneer days of which I have spoken. In addition to the great plants at present in operation, another and greater is to be constructed by the Ontario Hydro-Electric Power Commission, and therefore a few additional facts may not weary you.

In February, 1892, President C. R. Huntley of the National Electric Light Association, in his opening address, said: "The question may, therefore, be asked: 'If Niagara power is developed, how far will it be possible to transmit, not theoretically or in an experimental way, but commercially, so as to insure a fair dividend to the investor?'"

In June of 1897 only five years after and the year of my own presidency of the association, I said in my opening address:

"When we consider that only five years since many of us were in attendance at the fifteenth convention, and listened to the discussion that followed Dr. Carl Hering's paper on 'Transmission of Power,' even the most sanguine of us little imagined that in half a decade we should be holding our twentieth convention at Niagara Falls, principally with the object of seeing and realizing the actual application of motive power derived from the falls to some of the most novel and important industries of the time. To harness Niagara had long been dreamed, but is now an actuality, and who can foretell the resultant progress and advance that we may be destined to celebrate within the next few years."

While the above facts show the tremendous development in the generation and transmission of electric power, it must be remembered that the power thus generated and transmitted could not have found a market had it not been for the invention and development of the modern induction motor. The two outstanding names connected with this branch of the electrical industry are those of William Stanley and Nikola Tesla. So short a time back as 1892 Mr. Stanley, in an address, prefaced his remarks:

"It is not my purpose in the present paper to enter minutely into the details of the various attempts which inventors made to produce an operative motor. The historian who is collecting data necessary to trace the rise and growth of the alternating current motor will find out that the subject has been pursued by men of science in all parts of the civilized world, and he will be obliged to chronicle the fact that up to the present year no thoroughly practical motor system has been worked out."

We Are Just Beginning to Learn

I was warned, Mr. Chairman, that any address given at the luncheons of the Electrical Club must not exceed fifteen, or at the most twenty, minutes, and I will not trespass much longer on your patience. From such a mass of material available it has been difficult to hurriedly make such suitable selection as I thought might possibly interest you, but the judgment is in your hands. Having started from such small beginnings at a time, however, when they loomed rather large when surrounded by other equally modest efforts, I can say that, apart from the income derived, my connection with the development and growth of the electrical industry has been veritably a labor of love. I do not believe that there is any other branch of industrial activity the pursuit of which is more entrancing. It is the unknown that captivates, the possibilities that allure, and electrical science has greater unknown heights for the discoverer to explore and the development and application of what has already been accomplished has greater possibilities than any known branch of science or industry. All of you gentlemen, in your chosen profession, may feel that you are exploring new fields daily. Sometimes you may climb and nearly surmount a height, only to meet some unexpected obstacle, but persistence has, and always will, find a new path, just as electricity itself always finds a path of least resistance.

It has been my privilege to address you on "Pioneer Days in Power Development," but the days in years to come will still be "pioneer days." We are only on the threshold of power development, and the possibilities of future invention and discovery in the field of electric science are limited only by the imagination. A single generation has seen the commercial development of electric light, electric railways, the telephone, the phonograph, and wireless telegraphy, any one of which, if even hinted at in what we are pleased to call the "good old days," would have been sufficient grounds for burning at the stake for witchcraft.

In the face of such modern miracles can we conclude that we have reached the limit of advancement? I think not, and venture to prophesy that in the future will be celebrated greater marvels than in the past, and it rests with all of us present to-day, Mr. Chairman, to continue our activities and to see to it that we bear our full share of responsibility for the advancement and development of the electrical industry, with which we are all proud to be associated.

Recent Developments in the Lighting Field

Extracts from a Report of the Committee on Progress of the Illuminating Engineering Society Presented at Annual Convention September 18-20

ELECTRIC INCANDESCENT LAMPS

During the past year the old carbon lamp has almost dropped out of sight and the Gem lamp is rapidly losing its former importance. The sale of tungsten lamps has reached 79 per cent. of the total number of lamps sold. The introduction of the 50-watt 105-125-volt vacuum tungsten lamp will undoubtedly increase this percentage during the coming year. A 75-watt size for the same voltage range which can be burned in any position has been added to the list of gas-filled lamps and a range from 200 to 1,000 watts has been provided in the gas-filled lamps for the 200- to 250-volt circuits. The tungsten lamp in a blue bulb approximating daylight is now available in sizes ranging from 75 to 600 watts. The use of gas-filled lamps has also been extended to automobile headlights which, in conjunction with low voltage lighting circuits, are available in sizes ranging from 12 to 100 candlepower.

Miniature

For automobiles thirteen different types of lamps are now on the market including tubular, mushroom and dome lights, steering, pilot, head, tail, side and dash lights. Miniature lamps for various kinds of hand lanterns and run from portable batteries, have been developed and have come into extensive use. These should be distinguished from the well-known flash-light type and are available for use with all sizes of dry batteries, in current range from 0.5 to 1.25 amperes. The approval of electric lamp outfits for miner's use has created a demand which has been met by the development of a line of miniature lamps for this special purpose. The use of miniature lamps for special decorative purposes is also growing. Abroad tungsten lamps for alternating current circuits in connection with house transformers are now listed in units as small as five candlepower.

Developments during the year have been largely in refinements in manufacture. Special attention has been paid to the development of concentrated filament lamps suitable for projection purposes in connection with flood-lighting equipments, stereopticans, and headlights. The high candlepower gas-filled tungsten lamps in suitable reflecting devices are rapidly coming into favor for stage-lighting equipment. Work is being done on high wattage tungsten lamps for use in moving picture machines to replace arc lamps. Reflector lenses and other accessories have been designed and while nothing has been standardized, practical equipments have been produced which are equivalent if not superior in illuminating power to the ordinary arc projection in the average moving picture house.

Manufacturing

A method, proposed and patented, for preventing the deposit of volatilized tungsten in the bulb of the gas-filled lamp, uses an electrically charged grid placed above the filament. Another method claims that the use of a mixture of argon and nitrogen or other neutral gas causes less blackening than in the case of lamps filled with pure argon.

Patents have been granted covering the satisfactory use of alloys of zirconium and iron in the making of tough, malleable and ductile lamp filaments, by simultaneous reduction of the oxides. The zirconium percentage varies between 40 and 90. The iron may be replaced by other metals of the iron group. It is claimed that in addition to the qualities previously mentioned, the alloys resist chemical action and are little liable to oxidation. A patent has also been granted a Swiss inventor covering the preparation of tungsten for lamp filaments. By means of a resistance furnace the tungsten is fused to a perfectly liquid condition and then rapidly cooled by an air blast. It is claimed that this process makes the tungsten exceedingly malleable and ductile. Equations have been worked out and published with data, from which, it is claimed, tungsten lamps may be designed, and specifications have been given for a proposed primary standard lamp made up with a tungsten filament whose properties are predicated and in view of present refinements in manufacture it is expected such a standard could be made accurately reproducible.

An opal dip to cut down the intrinsic brilliancy of the 50- and 60-watt sizes of tungsten lamps is coming into use and indicates an appreciation of the principles of glare-elimination advocated by this society.

Standardization

The American Society of Mechanical Engineers has recommended that the dimensions of the threads of the screw shells in electric sockets and lamp bases be standardized. Twenty-seven out of thirty-eight of the largest manufacturers have approved this recommendation.

The efforts of a number of years to standardize incandescent lamp voltages in order to bring about economies in manufacture, distribution and utilization have finally resulted in a co-operative action. The Ohio Electric Light Association having made a careful investigation through a committee, has recommended to its member companies the standardization of their circuits for either 110, 115 or 120 volts. A committee of the National Electric Light Association has been appointed to consider the question.

Rating

The question of rating lamps on a mean spherical candlepower basis which has been agitated in this country ever since the Bureau of Standards began to press the idea in 1904, has apparently been settled, as the gas-filled tungsten lamps have been so rated since last September and the efficiencies of all vacuum tungsten lamps are now so specified. The introduction of the former lamps might be said to have forced the issue, since their mean horizontal candlepower is affected by rotation, blackening of the bulb and change in shape of the filament. It has been recommended by this society, the National Electric Light Association Lamp Committee and the American Institute of Electrical Engineers that the rating be made in terms of lumens, since the latter has the additional advantage of being applicable to the light delivered on a plane to be illuminated as well as to the total light emitted. A survey of the railroad engineers has brought out the fact that the great majority are overwhelmingly in favor of the change from the mean horizontal to the mean spherical nominal rating, and to the lumen for actual rating.

Applications

The color of the gas-filled tungsten lamp has been found enough "whiter" than the vacuum lamps, to enable its use in zinc refineries for distinguishing between "black jack" (dark zinc ore) and lead. The higher wattage lamps are used for this purpose. In general the tendency to increase the intensity of illumination used for many purposes has followed as a result of the recent improvements in the incandescent electric lamp.

Physics

The characteristics of tungsten filaments as functions of temperature have been studied by several observers. Thus experimental data have been obtained and published on the relation between volts, amperes, and candlepower as functions of the temperature and dimensions of the filament. Work has been done and preliminary reports made on the relation between the true, "brightness" and "color" temperatures.

A study of the inside of glowing helically coiled tungsten filaments indicates that the increased brightness of the interior is due in large part at least, to internal reflections and not to a higher temperature. It was found that the temperature difference between the inside and outside was not more than four degrees.

The "over-shooting" in candlepower in tungsten lamps has been tested by actual photometric measurements. By means of contacts operated by a pendulum, the lamp was switched on and a shutter in the eyepiece of the photometer was opened for a fraction of a second, a known and adjustable period after the contact for the lamp had been made. By making repeated trials the voltage on a calibrated lamp was adjusted to give equality of candlepower for the moment of exposure. The conclusion drawn was that in vacuum tungsten lamps there is a small over-shooting due to the heating-up of the central portions of the filament at a greater rate than the end portions, and that there is a noticeable over-shooting in a gas-filled lamp though not very marked, as only 6 per cent. was observed with a filament 0.0065 in. in diameter.

ARC LAMPS

In the field of arc lamps the most striking developments have been in the use of materials other than carbon for the electrodes. Among others might be mentioned a patent disclosing a method whereby not only the color but the steadiness is stated to be improved. Titanium oxide instead of the carbide and sodium fluoride instead of calcium fluoride are used. The addition of barium fluoride makes the color whiter and increases the stability. Reference is also made to the introduction of fluxes of cerium fluoride and thorium nitride. Mechanical improvements and the standardization of parts have characterized progress in the luminous arc lamp.

Tungsten Arc

The arc between tungsten electrodes in an inert gas referred to in last year's report has been perfected and put on the market abroad. The difficulty in starting, has been overcome by the use of three leading-in wires, one of which makes connection to an ionizing circuit which is connected after the arc starts. It is claimed that lamps have been made with a life of 500 hours and further experiments are under way to increase this. The intrinsic brilliancy is given as 10,000 candles per square inch when operating at 0.5 watt per candle. The color of the lamp can be made to vary from a bright yellow to a very intense white, the brilliancy limits under these conditions being from 400 to 30,000 candles per square inch. An entirely different type of arc, although using tungsten electrodes, is suggested in the results of the experimental research described before this Society last November. The principle involved consists in providing the material for the arc, not from the electrodes but from a surrounding gas or vapor. The experimental lamp used had an arc chamber at the centre of which the arc was drawn between two tungsten electrodes, 0.3 in. in diameter. Among the vapors experimented with were the tetrachlorides of antimony, carbon and titanium, stannic chloride, titanium bromochloride, etc.

A portable arc-lamp lighting unit for use in motion picture photography carries two sets of carbons with automatic feed and equipped to run on either alternating or direct current.

Vapor Lamps

The use of cadmium in vapor lamps is not new, but in the past such lamps have not been very satisfactory, either from the standpoint of operation or life. A new type has been developed which is constructed of quartz, runs at a high temperature on an ordinary direct current lighting circuit, and has a life claimed to be over 100 hours. The main features of this new type consist in the means provided for preventing the vapor from sticking to the quartz surface; the removal of the oxide and dissolved gases from the cadmium; and the seals for the leading-in wires. The adherence to the quartz surface is prevented by the introduction of finely powdered zirconia. The lamp is made in the form of an inverted U, has a terminal voltage of about 30 and takes a current around 5 amperes. A new lamp in which the vapor from zinc chloride or zinc bromide is used at atmospheric pressure has been patented abroad and described by Professor Nernst. It is claimed that the color of the light is white and the efficiency similar to that of the mercury vapor lamp. As in the case of the latter, the inclusion of air or some other foreign gases is prejudicial. However, an atmosphere of aluminum chloride or titanium chloride makes the arc more stable and an atmosphere of nitrogen is harmless.

A new method of automatically feeding the gas to the Moore carbon dioxide tube lamp has been described. Inside the tube and directly behind each electrode is placed a small glass bulb containing calcium carbide with heating wires embedded in it, by which the right quantity of gas is automatically generated. Spectrophotometric data has also been obtained on this lamp.

Through a redesign and improved construction of auxiliaries the power factor of alternating current mercury vapor lamps has been increased from its former value in the neighborhood of fifty per cent. to about eighty-seven per cent. These new lamps have been found to operate satisfactorily on 25-cycle circuits.

Electrodes

Experiments have been made to determine the rate of consumption of carbons in direct current arc lamps as a function of the current and of the arc length. It was found that the loss per coulomb for a given current density increases with increasing arc length until a nearly constant value is reached at about 8 mm. For long arcs the loss per coulomb decreases with increasing current; for very short arcs (order of 0.1 mm.) at all current strengths from 2 to 100 amperes, the loss per coulomb from the cathode is constant and about 3.2×10^{-5} gm., remarkably near the electrochemical equivalent of tetravalent carbon.

Rating

The agitation regarding the mean spherical candlepower rating of glow lamps has raised the question of arc lamp rating, and in Germany it has been proposed that arc lamps also be rated for mean spherical candlepower. It has been suggested that this would be a retrograde step since what is desired in the case of these lamps is to know what light is emitted downward and what light in addition is emitted above and is available for redirection by reflectors.

LAMPS FOR PROJECTION PURPOSES

Hand Lamps

A novelty in hand or pocket lamps has been brought out in which the power is provided by the muscular activity of the user. The thumb of the hand which holds the lamp moves a lever over a circular path and winds up a spring whose elasticity is made to actuate a small dynamo having permanent magnets for a field source. Enough power is preserved in the spring to keep the lamp burning for a minute without further winding. The lamp used is in form and luminous power similar to the ordinary hand variety actuated by a dry battery. A new portable lamp employs two tungsten lamps backed by a mirror, thus greatly increasing the amount of light available without increasing the size of the equipment. Among the novelties in portable lamps may be mentioned one carried in the end of the handle of an umbrella. The handle is detachable and also contains the battery which operates the lamp. By combining a surface gauge with a small flashlight and battery, an indicator has been devised for machinists which not only announces where surface irregularities are found but throws a beam of light which shows just where they occur.

Searchlights

It might at first sight appear to the layman that providing an extra source of illumination at a fire would be like "carrying coals to New Castle," but there have been many cases where additional light has been desirable to permit the removal of valuable material, to penetrate smoke, etc. In such cases, the gas or electric supply is not ordinarily available and a searchlight truck provided with a special type of battery has been developed to meet this specific need. It consists of a waterproof 20-inch projector on a trunion mounting and fitted with a 35-volt 750-watt focussing type gas-filled tungsten lamp. A hand wheel focusing device enables the beam of light to be quickly and easily spread out or concentrated.

Automobile Lights

Efforts are still being made to solve the problem of dimming automobile headlights in city use. One of the many of recent design is made in a conical form of strong, flexible, transparent material. It is provided with a seam through the centre, making it collapsible when not in use. It is slipped on over the headlight and permits the uninterrupted projection of the rays of the lamp through an opening in the bottom, but diffuses such rays as would ordinarily blind approaching drivers. So many dimmers for headlights have been brought out that a Massachusetts automobile club recently carried out a series of tests to see how many dimming devices come within the specifications of the new state law. It was found that many commonly used appliances do not comply with the requirements. The club intends to continue these tests from time to time. By means of an outside set-screw focusing adjustment, an automobile searchlight has been developed which, it is claimed, can be used with any style of vacuum or gas-filled tungsten lamp and can be fixed instantly, without removal from its position, for any type of beam desired. A novel signal lamp for use by automobilists consists of a brown celluloid hand inside of which is a tubular battery lamp with a special reflector which spreads the light uniformly through the hand. The device is held out on either side to indicate stopping or turning, just as in the daytime the human hand is used for this purpose.

Signal Lights

A device installed in some of the government light houses, automatically replaces a burned-out lamp with a new one in a fraction of a second. Three lamps are arranged 120 degs. apart about a circle. Only the one in focus is lighted. When it burns out an electromagnetic device operates, swinging one of the other lamps into place, where it is lighted. In places where oil is used as the illuminant, mantles have been almost universally adopted. Pressure burners are employed and a very high candlepower obtained. A new system of night storm warnings has been worked out by the United States Weather Bureau. It consists of three lanterns in a vertical line instead of the two formerly employed. By this arrangement, it will be possible to indicate the expected direction of the wind to the nearest quadrant. Experiments by the bureau show that 4 feet must separate the lanterns for every mile the observer is distant in order that each light may be seen separately by the naked eye. A high candlepower gas-filled tungsten lamp is being tried out as a source and the system will be first used on the Great Lakes.

In the triangulation work of the Coast and Geodetic Survey Department of the Government, it is necessary to establish bases which may be from 10 to 100 miles apart. To make the positions visible to the observers on clear days, sunlight is reflected from mirrors and on clear nights a specially constructed acetylene lamp has been used. To increase the effectiveness of this work, experiments have been made and a new electric lamp with a very highly concentrated filament in a gas-filled bulb has been developed. An automobile headlight is used as a reflector and the lamp is operated from dry cells. With two additional bulbs, three different intensities are obtained.

A new electric lantern is shaped somewhat like a large watch, is provided with a bail and has an easel-like support for holding it in an upright position. It can be adjusted so that it produces a small searchlight beam or general illumination and it is operated by a flashlight battery.

Miners' Lamps

Owing to two accidents resulting from the use of miners' electric lamps of the approved type, an order has been issued in England prohibiting the use, in such lamps, of spring terminals liable to be bent over. Electric lamps already in use must be refitted with rigid terminals. It is reported that the use of electric lamps has not developed to the extent expected. Difficulties are still experienced which will have to be overcome before the old type of oil lamp is completely discarded.

FLOOD LIGHTING

The availability of lighting units of high intensity, together with specially designed reflectors, has caused an enormous increase in that type of spectacular illumination which has become known as "flood lighting." In a discussion before the Chicago section of this society, reference was made to the possibility of the production of novel effects; the elimination of glare; operation at relatively low cost; use of flexible units; illumination of the entire front of a building instead of only parts of it, etc. As a medium for expressing civic pride this form of display lighting is becoming widely used.

Some public buildings using this form of temporary or permanent illumination were as follows: The Massachusetts State House in Boston was flooded by means of two batteries of 500-watt lamps consisting of 74 units; two locations being used to reach the faces of the wings and also to throw light behind the column in front of the building, thereby avoiding the flat appearance sometimes occurring when a building is lighted from the front only. Color effects were obtained by the use of gelatine screens. The new municipal building of Waterbury, Conn., was lighted to an intensity of 4 foot-candles by means of ten 500-watt projector units mounted on a roof 150 feet away. The illumination of the Court House and the tower of the Federal Building, Plymouth, Mass.; ten projector units being employed. The entire exterior of the Arkansas State Capitol is now illuminated by flood lighting through the use of thirty 500-watt units.

San Francisco has been experimenting with flood lighting for use in connection with the new civic centre, and at the Fourth of July celebration used eight 18-inch projectors provided with diffusing lenses to give an oblong shaped beam. The main illumination is provided by 500-watt units located in the one case 250 feet and in the other 300 feet away. The new Kern County Court House at Fresno, Cal., has been flood-lighted by the use of five 500-watt units placed approximately 750 feet from the building on the top of a three-storey structure. An installation of 300 projector units of the

500-watt size was installed to illuminate the Philadelphia City Hall.

Commercial Buildings

Flood lighting from other buildings is used to illuminate the new thirteen-storey Hill Building in St. Paul, Minn. In Indianapolis a fifteen-storey bank building is flood-lighted above the third floor; 76 projectors are used to light the main front and 24 the other two sides, all being equipped with 250-watt units. The Columbus, Ohio, Athletic Club was flood-lighted by means of twenty-four 500-watt projector units mounted on a platform at the top of two 65-foot poles.

The effective illumination of stores has been accomplished by lamps and projectors located on the buildings themselves, some being concealed on the marquee which projects the width of the sidewalk just above the first storey. Other units at the top of the buildings are concealed in the belt cornices.

Monuments

The most unique proposal in connection with flood lighting is that of illuminating the Statue of Liberty in New York Harbor, to be financed by popular and congressional subscriptions. The flood lighting of monuments and statues has been given an enormous impetus since the announcement of this project, other notable installations were the Soldiers' Monument of Indianapolis, Ind., flood lighted by means of beams from 100 projectors placed on the roofs of adjacent buildings, and the flood lighting of Niagara Falls, New York, by fifty reflector units, the light penetrating even the darkest parts of the rolling mists.

Amusements

The illumination of Sheepshead Bay automobile speedway, New York, marks the most pretentious experiment tried for night-time outdoor sports and races. The interior field of 160 acres is lighted by 224 flood-light projectors on poles spaced 100 feet apart on alternate sides of the track, the lamp being 30 feet above the track. The space just opposite the grandstand is further illuminated to about 3 foot-candles by 114 additional projectors located at the top of the stand. The projectors along the track are arranged so that they can be readily turned upon the race course, but the light sources are hidden from the eyes of the drivers, projecting their beams in the same direction as the speeding machines.

Patterned after the spectacular effects obtained at the Panama-Pacific Exposition the Municipal Christmas tree at Chicago was illuminated entirely by five large searchlights and a number of smaller units. Color screens were used on some of the reflectors. Outdoor theatres, stadiums, rinks toboggan slides, etc., were successfully illuminated by flood-lighting units at Schenectady, New York.

The practicability of flood lighting for bathing beaches has been amply demonstrated in Chicago. At Diversy Beach eighteen projectors with 500-watt lamps are used mounted on a frame work. Each projector has a swiveling base for adjustment. The installation is on the top of the highest bath house and between 6 and 7 acres are illuminated. It is proposed to add a tower on which will be mounted a concentrated flood-lighting projector which normally will be directed on the diving platform, but will be turned at will to aid in rescue work if necessary. Another beach employs two steel towers, 85 feet high, 775 feet apart and 100 feet from the edge of the water. Ten projectors will be mounted on platforms on the top of the towers and 1,000-watt lamps will be used. The area illuminated will be 11 or 12 acres. Among other such installations are those at Seal Beach, Cal.; Hot Springs, Ark., and Trenton, N.J.

Flags

A big 30-foot silk flag on top of a twenty-storey building in Chicago has been satisfactorily lighted by using two 500 watt units trained on the blue star field and from two to four 250-watt units to light the stripes. A novel method of illuminating a flag mounted on a private residence consists in the use of two tungsten lamps in reflectors placed on the piazza roof and invisible from the street.

Industrial flood-lighting is pushing its way into a large number of varied activities. Night work in the harvesting of ice is not new, but the problem of satisfactorily lighting an ice field has in the past, been difficult. Very good results have been obtained using portable 1,000-watt lamps in projectors closed with a wire glass front making them rugged, storm and weather proof. Flood lighting was used to advantage when the gruesome task of recovering bodies from the steamer Eastland had to be carried on at night. Flood-lighting projectors are being used in connection with night work on the construction of buildings, for loading operations at wharves, and for the illumination of signs. Placement of the source in front of or at the edge of the sign is still an open question.

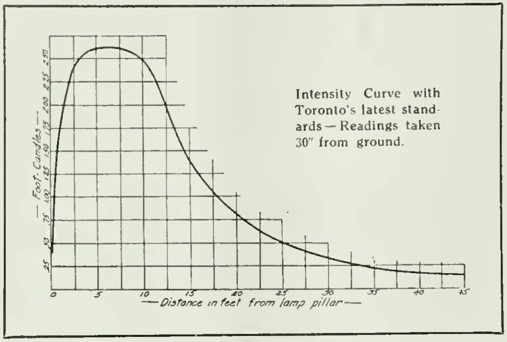
Street Lighting at its Best

What may probably be considered as the most generally efficient street lighting system which has been developed up to the present time is that which has been recently installed in the city of Toronto on Toronto Street and Richmond Street, where the Toronto Hydro-electric System have

Latest Type of Standard on Toronto Streets.

erected single lamp pillars, placed opposite, approximately 90 feet apart, on both sides of the street. The appearance of this latest unit is shown in the accompanying photograph. The lamps are at a height of 15 feet above the sidewalk and are of the gas-filled type, consuming 500 watts at 115 volts. The pillars are fed by underground cables, 3 core, paper insulated, lead covered, laid in single clay ducts along both sides of the street. These cables also supply the regular commercial lighting in this section. For this reason each pillar is controlled by a switch in the base and is individually turned on and off. The wiring in the pillar is of the twin paper insulated type.

The life of these lamps to date is stated to have been very satisfactory, due in large measure to an improvement in the design of the pillar head, which provides efficient ventilation and at the same time prevents sleet and rain



Intensity Curve with Toronto's latest standards — Readings taken 30" from ground.

from entering and adversely affecting the lamp during the stormy seasons.

The lamp globe is made of an opalescent glass and covered by a special netting for safety purposes in case of breakage. This netting is shown in the illustration. The fixture is equipped with a good commercial reflector and the lamp is installed tip downward.

Some idea of the efficiency of these units may be gained from the curve shown in the line drawing herewith. This curve is drawn from the following table of light intensities:—

Distance from lamp pillar	Foot candles
5 ft.	2.6
10 ft.	2.5
15 ft.	1.4
20 ft.	.8
25 ft.	.5
30 ft.	.35
35 ft.	.23
40 ft.	.16
45 ft.	.13

Large Order for War Cables

The Standard Underground Cable Company of Canada, Limited, Hamilton, Ont., is at work on a large order of field telephone cable. The extensive use made of electricity on a modern battle field for signalling to, and otherwise communicating with widely scattered bodies of troops, renders electrical conductors a vital factor in the handling of armies, and tbe frequent destruction and rapid deterioration of such systems of conductors in this service necessitates an enormous and continuous supply. A large order for seamless copper tubes to be used as shrapnel bands has also recently been received. As material of this character is not manufactured anywhere in Canada at the present time, the Standard Company will fill the order with tubes manufactured by its associate company in the United States, which is supplying large quantities of copper, brass and bronze products, both direct to the allied governments and indirectly through contractors.

The Bell Telephone Company are building new exchanges at Galt and Oshawa, Ont., and Levis, P.Q., and are also making a large addition to the exchange at Windsor, Ont.

Industrial Lighting

Lighting which provides the workman with the best illumination possible, costs less than 1 per cent. of his wage, and increases his output at least 10 per cent. These statements are based upon extended observation and are generally accepted without debate.

The man and his work form a working unit. Obviously good light would increase their output, cut down the cost of production, improve the quality of their workmanship and decrease the liability to accident.

Requirements for Efficient Lighting

(1) Proper intensity for class of work performed.

(2) Light from the proper direction to avoid shadows

(3) Good diffusion to cut down both glare and shadows. (Glare unfavorably affects the eyes).

(4) Elimination of drop cords, which are at once inefficient and unsightly.

Reflectors

Reflectors are designed for certain sizes and types of lamps. Sixty-watt lamps will not give proper distribution in 100-watt reflectors and vice versa. For economical and efficient illumination, care must therefore be taken to select the proper reflectors as well as lamps. After the correct reflector has been purchased, it is essential that the correct spacing and mounting distances be observed when making the installation, for these two items bear a constant ratio, which, when disturbed, likewise disturbs the uniformity of illumination.

Porcelain enamel is the best finish for reflectors used with Mazda "C" lamps, because the heat does not crack, discolor or blister it. All approved reflectors are ventilated where necessary to secure proper results. The requirements in each case are determined by exhaustive tests with electrical implements.

Lighting Systems

(1) Localized.

(2) General.

(3) Combined General and Localized.

(4) Modified General.

Localized lighting should be used only in exceptional cases, as for example, on work inside of boilers or in machining the inside of large castings. The chief objections to localized lighting are high maintenance, liability to shorts, eyestrain, and wasted time in moving the light source.

General Lighting has to do with uniform illumination from light sources of the same size, uniformly installed. High efficiency lamps may be utilized, thus making the system economical. It is preferable for machine shops, factories, assembly floors, etc.

Combined General and Localized Lighting is used where only a small amount of general illumination is desired, supplemented by localized lighting where a higher intensity is needed.

Modified General Lighting is, generally speaking, the preferable system, in that it combines the good points of all the other types, while eliminating the bad features of the localized type. Reflectors are all of the same height with uniform spacing, with larger lamps and reflectors where higher intensity than that demanded by ordinary conditions is desired.

Some Notes on the Measurement of Light

By Mr. E.V. Pannell

The modern science of illumination, or "good lighting," is vitally dependent upon the means employed to compare and measure the value of the various sources of light in use. Strictly speaking, there is no practical means of measuring the intensity light, the nearest approximation being the determination of illumination or light received on a plane reflecting surface. All methods of photometry or light measurement may be reduced to a comparison of this kind. The unit of intensity still referred to in England and America is the standard candle of spermaceti wax, weighing 2¾ ounces, and burning at the rate of 4½ ounces per hour. This candle normally gives a flame 1⅞ inches high and yields one candle power. The candle is, of course, purely a unit and not a standard of comparison; the latter purpose is filled more conveniently by some form of standard lamp of definite candle power.

Two different types of standard lamp are widely used at the present day in light laboratories; one is the Hefner lamp, burning amyl acetate, and the other is the Pentane vapor lamp. The first named is most widely used in Europe; it has an intensity of .91 candles, and its appearance is shown by the illustration. The eyepiece is provided with a hairline across the lens, by use of which the tip of the flame can be adjusted to the standard height of 1½ inches. One candle power is produced with a flame of 1⅞ inches, but it is usually preferable to work at the standard value of .91 c.p. and make the necessary correction. The chief disadvantages of the lamp are its reddish flame, which renders it difficult to balance against a white tungsten filament, and the variation of intensity with humidity and carbon dioxide.

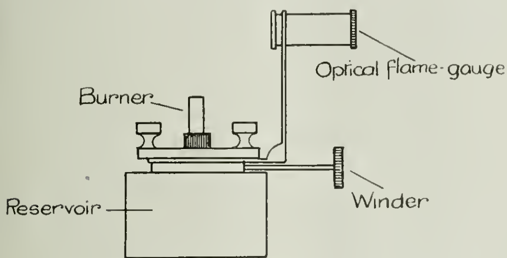


Fig. 1.—The Hefner amyl acetate standard lamp, .91 candle power.

The regular form of pentane lamp is of 10 candle intensity and burns with a white flame. When once started up it vaporises its own fuel (a distillate of coal oil), thus no wick is necessary. For these reasons the lamp is preferred in many laboratories to the amyl acetate standard, and it is adopted by the Board of Trade and National Physical Laboratories in England; also being used at the Bureau of Standards in Washington. In using the lamp it will be noticed that the chimney tube can be raised or lowered, varying the amount of flame visible. Gauges are supplied to adjust this flame opening, thus making it possible to secure several different values of candle power with the same lamp and rates of burning. For actual testing work these standard lamps are never employed, the practice being to use secondary standards, consisting of tungsten lamps carefully calibrated for the purpose.

It will be interesting now to consider the relation between light intensity and illumination. If K be a standard candle and A be a small surface situated one foot distant, then the illumination on A will be approximately one foot candle. Now, at two feet distance it is obvious that the light flux radiating out from the candle will cover an area just four times as great, so that the illumination is now only .25 foot candle. Thus doubling the distance gives one quarter the illumination. A drop light suspended four feet above a table will give four times the illumination at the point immediately below if it is lowered to two feet distant. This is the

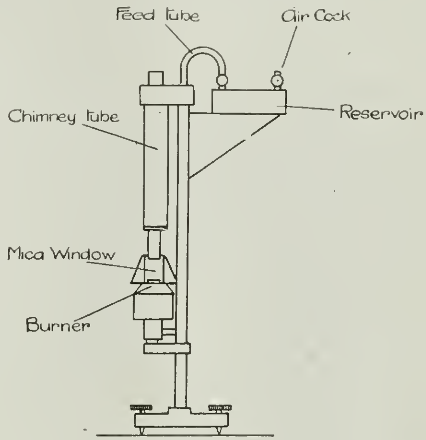


Fig. 2.—Standard 10 c.p. Pentane lamp used in light measurements.

"inverse square" law of illumination; $I = K/d^2$ where I is the illumination per unit area of a surface which is perpendicular to the rays of light, K is the intensity of the source, and d the distance from the source.

Suppose we want by some means to collect all the illumination which is obtainable from a standard candle. Obviously it will be necessary to put the candle in the centre of a sphere, then the surface will be everywhere normal to the rays of light. Then if the radius of the globe is one foot, the illumination all over its inside surface will be one foot candle. The area of this surface is 4π, and, multiplying this constant by the illumination, we obtain the total light received by the surface, or, in other words, the total light emitted by the candle. The unit of this light flux is the lumen, and there are 4π, or 12.57 lumens, emitted by every source per candle power intensity. The introduction of this 4π constant into the unit eliminates it in many subsequent calculations, so that the lumen is a very practical quantity. One lumen spread over a surface of one square metre is the international standard of illumination; the Lux, which is less than one-ninth part of a foot candle.

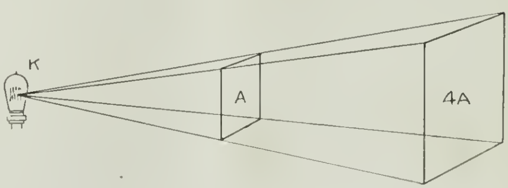


Fig. 3.—Illustrating the law of inverse squares which governs illumination.

Reverting now to the actual light measurement, or pho tometry, this usually consists in obtaining illumination from both the standard and test lamps simultaneously upon two surfaces very close together. Certain adjustments are made to bring the two illuminations to equality, at which point balance is obtained and the candle power of the test lamp calculated in the terms of the standard. Generally the two lamps are at opposite ends of a graduated bench, between them being the photometer head on a movable carriage. The latter is moved to a position between the lamps until the

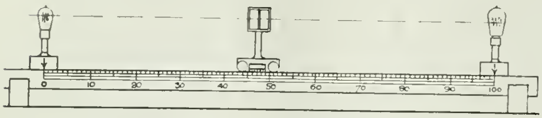


Fig. 4.—Simple form of 100 in. photometer bench with Bunsen screen.

illuminations appear equal, when the intensities will be inversely proportional to the square of the distances along the bench. In Fig. 4 a photometer of this type is shown, and the following results of a test reading illustrate a typical calculation:

Standard lamp No. 42K, 105 volts, .27 amps.
Test lamp No. 144, 105 volts, .20 amps.
Length of bench, 100 inches.
Balance (from standard), 57.7 inches.
Candle power, standard, $= 28.20$.
Candle power, test, $= 28.20 \times (42.3/57.7)^2$.
$= 15.20$.

It will be noted that a very small error in reading balance will be magnified in the calculation, owing to the square law, particularly if the balance is far from the centre of the bench. For this reason great care is necessary in taking readings to ensure that no stray light reaches the photometer and that the photometer head is in proper adjustment.

Very many types of photometer head are in use, and one of the earliest still survives in the shape of the Bunsen or grease-spot screen. This consists of a screen of white paper about 6 inches square, mounted in a frame on the carriage in such a way that one side is illuminated by the standard and the other by the test lamp. In the centre of the screen is a translucent spot, produced by the application of linseed oil or some other means; the spot is about 1 inch diameter, and

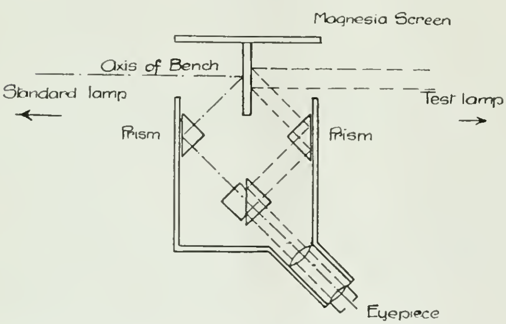


Fig 5.—Plan in section of the Lummer Brodhun Photometer head.

appears brighter than the screen at high illuminations and darker at lower values of lighting. When the carriage is moved so that the spot appears equally bright upon both sides it is obvious that the illumination on both sides of the screen is equal and balance is reached. To assist the observer the screen is mounted between two mirrors, each inclined about 60 degrees, so that both sides can be seen at once.

A more elaborate form of photometer is in use by the name of the Lummer-Brodhun. This is shown in sectional plan in Fig. 5. The two prisms P and Q are the really important part of the apparatus; they are ground into contact at their centre, thus transmitting light, whilst elsewhere they are out of contact, thus reflecting light. In this way the light from one side of the screen is transmitted into the eyepiece in the shape of a small circle, whilst the light from the other end is reflected in and surrounds it. The two illuminations being in such close proximity, it is a simple matter to judge the balance. This photometer is considered by many to be the most perfect yet devised, and it is in use in most light laboratories, including that of the Hydro-electric Commission in Toronto.

Aside from the actual light-measuring appliances, it is necessary to take careful readings of voltage and current on both the test and standard lamps. The candle power of a lamp varies as the sixth power of the voltage at its terminals, and for this reason a rheostat is necessary for regulating the lamp pressure and a voltmeter or potentiometer for reading it.

The candle power as measured in one direction along a bench does not properly define the power of a light source, because, owing to the shape of lamp and filament, light is not emitted equally in all directions. It is usual to keep the test lamp spinning on its axis by means of a motor; in this way the mean horizontal candle power is obtained. It is obviously impossible to spin the lamp around its horizontal axis,

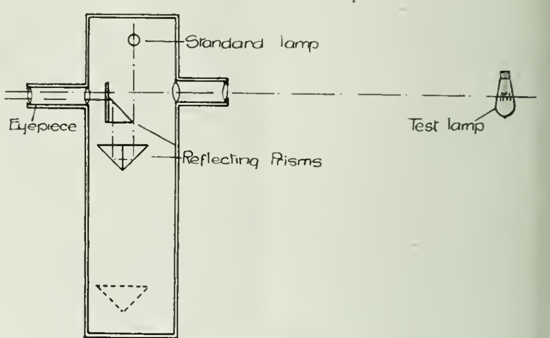


Fig. 6.—Elementary Portable Photometer.

however, so a tilting carriage is employed to hold the lamp at any angle with the vertical, in order to read the various candle powers in the vertical plane. The average of all these readings is, of course, the mean spherical candle power, and, if multiplied by 12.57, is the flux in lumens. For ordinary routine tests the mean horizontal c.p. usually suffices, being multiplied by a reduction factor of about 80 per cent. to obtain the mean spherical value. By using an integrating or sphere photometer the latter can be obtained at one reading. The sphere is about six feet in diameter, having a smooth interior surface, carefully whitened with magnesia or barium sulphate. The test lamp is hung in the centre, and its light is reflected from side to side, being diffused all over the inside of the globe. If a small window is opened in the wall of the latter and the light photometered along a bench, the true spherical c.p. is at once obtained. This gives no information as to the distribution of the lamp, and so is inferior to a series of tests made on the lamp when inclined at different angles. In the case of arc lamps especially, owing to the uneven distribution it is essential to obtain the polar curve, and this is generally determined by suspending the arc over a mirror at the end of the bench, the mirror being inclined so as to send the light along the bench axis. By swinging the arc around the mirror and adjusting the latter, the intensity at different angles may be balanced up, due allowance being made for the extra distance involved and also for the absorption of the glass.

The most practical tests are those made with the lamps actually in service upon the street or other location. For this purpose a portable photometer is necessary; and, without, of course, being as accurate as the laboratory type, the portable photometer, or illuminometer, is now in very general use. The illustration shows the basic principles of such an instrument. Illumination from the test lamp outside and the standard lamp inside are both received upon a ground glass screen, side by side. The light from the standard is reflected from a prism, which can be moved along a scale until balance is obtained, and this scale is so calibrated as to read the illumination direct in foot candles. Such an illuminometer as this can be taken into the street and readings observed beneath and at various distances from a street lamp, thus enabling the distribution curve to be plotted. Similar tests can be taken with different types of reflector and diffuser applied to the test lamp, and a mass of valuable data obtained in a very short time. The wide use of portable photometers in recent years has had much to do with the improvements in street illumination.

New Nitrogen Fixture

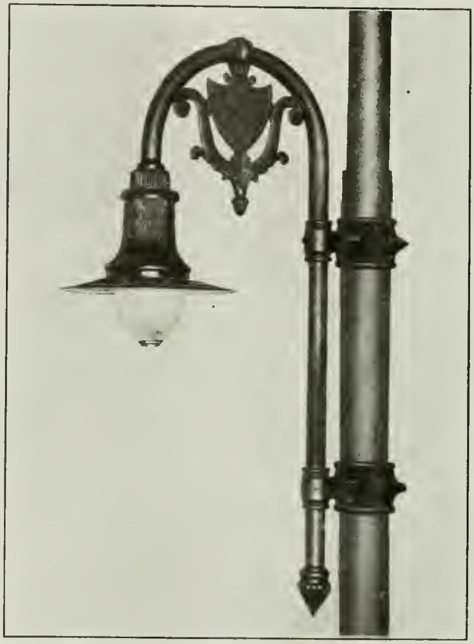
The advent of the high efficiency nitrogen lamp has undoubtedly been a great help to engineers in providing improved street lighting equipment. A great many different devices have been developed for the purpose of properly supporting such nitrogen lamps as are required for street lighting and for distributing the light in an efficient manner. Now that a great number of installations have been made of nitrogen units, a comparison of the different systems is possible.

Experience has shown that the series system has many advantages over the multiple system for operating nitrogen lamps. A great advantage of the series system arises out of the inherently uniform method of regulation in this type of circuit. The variation of current in a series circuit is so slight that the power supplied to the lamp units is practically constant and can be easily maintained at the proper rating of the lamp.

On the other hand a multiple circuit is more or less at the mercy of the amount of power which may be used apart from the particular lighting circuit, the line voltage varying with the demand for power and thus power supplied to each lighting unit is variable owing to the fluctuations in the terminal voltage. Comparisons between the two systems, however, have to be very carefully considered in order to arrive at a fair comparison, because in either system the lamps may easily be run under or over the manufacturers' rating, and thus prolong or reduce the natural life of the lamps to any limit, which might destroy the value of comparative data. This is truly a case where "comparisons are odious," unless all the data is thoroughly known. Where, however, all the data has been carefully considered and proper value put on the various conditions, a marked advantage has been shown in favor of the series system.

Possibly the most difficult question to satisfactorily settle in connection with street lighting of any kind, and one which has been prominently brought to the front in connection with nitrogen units is the method of distribution of the light. At one time the artistic effect was the principal object to be gained, and thus the five-light cluster became popular. Later on people realized that the purpose of a lighting unit was not to ornament the street, which was already oftentimes over-embellished by forests of telegraph and electric light poles and street railway poles, but rather to do its work of illumination in the most business-like manner, and whatever support was needed for the lighting fixture, such as the pole or bracket, should be of the simplest outline, artistic in appearance, but serviceable.

It is possible for each illuminating engineer to have his own particular doctrine backed up by all sorts of facts, and install his lighting system based upon his particular theories, and there may be as many theories as there are engineers. The advantages of uniform distribution of light may be promoted by one man, of contrasting and silhouette effects by another; some may make great efforts to eliminate "glare" and the overall effect of his lighting may suffer thereby. Another may consider "glare" a matter of secondary importance, and he may bend his efforts towards directing the rays from the lamp so as to distribute the light more uniformly over the whole surface lighting area. Many other effects met with in illuminating engineering may be cited, each item being considered of certain importance by the designer. Probably none of the engineers among themselves really are agreed on what is the perfect form of illumination.



Fixture suitable for variety of purposes.

The fixture manufacturer has undoubtedly to meet the demands of the illuminating engineer. He has to meet the demands of the public and presumably he has some ideas of his own, and between the whole lot he may have considerable difficulty in manufacturing a fixture which will in any measure meet the approval of everyone interested.

The fixture which is shown in the figure has the advantage of being, to a certain extent, capable of being used for a number of different purposes. It can be used with or without a reflector and it may be used without glassware of any kind, or with plain glassware made of Lumo or Monax, or may be used with a double prismatic unit, without any more trouble than is required to remove the fittings in the lower part of the fixture.

The designers of this fixture are not by any means suggesting that any one of the three or four combinations of glassware and fixture is to be preferred. It may be that either one has its special and particular use, but perhaps after all the verdict of the public which has to live with the lighting fixture day by day is the one which should be most considered by the illuminating engineer. Whatever the arrangement of glassware and reflectors may be and, as pointed out, these elements are strictly interchangeable in this unit, it is well to note that the body of this fixture is made of especially thin high grade gray cast iron finished on the outside in baked black enamel. The detail of design is such that ample provision is made for ventilation without incurring the risk of getting moisture into the fixture in such a manner as to drop onto the glass walls of the lamp. The fixture is made for service on both multiple and series circuits. In the latter case an interior type of porcelain insulator effectively keeps the live part of the lamp off the ground. In both series or multiple types the socket is so supported as to be readily adjustable to accommodate any size of lamp up to 1,000 c.p. and the adjustment can be made by simply turning a thumb screw located in the body of the fixture.

One of the great advantages of this type of fixture is its ruggedness and entire absence of parts which could possibly become defective with ordinary wear and tear, thus the maintenance is reduced to a minimum. This fixture has been designed by the firm of A. H. Winter Joyner, Ltd., Toronto.

Some Recent Developments in Incandescent Lamp Manufacture

By A. R. Dennington

Three-quarters of a century have passed into history since the development of the incandescent lamp, and in that time there have been constant study and effort on the part of a large number of people to improve both the lamp itself and the methods for making it. As is usual in the development of new lines of endeavor, there was a period of years when there were practically no improvements made. When incandescent lamps had to be operated from primary batteries there was no commercial pressure for making the lamp more efficient and more serviceable. At this stage there was greater opportunity for improving the methods of generating electrical energy than there was for utilizing the energy. With the invention of a dynamo that could produce electrical energy on a commercial scale the situation regarding incandescent lamps changed. Even to-day the most efficient methods known for transforming electrical energy into light are relatively inefficient. This fact is evident when it is considered that at one-half watt per candle power the luminous efficiency is less than 10 per cent.—that is, less than 10 per cent. of the power supplied to the lamp is given out as radiant energy in the form of light. With every improvement in the incandescent lamp has come a stronger demand for something still better. This is due to improvements in other illuminants with which the electric incandescent lamp must compete and also to the increasing demand for better illumination of homes, offices, and industrial plants.

The carbon filament lamp, which until about six years ago held undisputed almost the entire incandescent lamp field, became of commercial importance about the year 1880. For a period of a quarter of a century the improvement in the carbon lamp consisted of a constant refining of details, which resulted in more uniform performance and in changes of efficiency, from 7 to 3.1 watts per candle. The metallized filament lamp brought the specific consumption down to 2.5 watts per candle, and at the present time this represents the best commercial practice for carbon.

Inventors in searching for a material to withstand a higher temperature than carbon for an incandescent lamp filament naturally turned to the metals having high melting points and low cost of production. Platinum was one of the earliest metals used as an incandescent filament, but its high cost and the large amount of power required to bring it to incandescence both operated to eliminate it from commercial use. Tantalum and tungsten were both used as filament material in 1906. Tantalum gained recognition first because it is the more easily worked, but as it has a lower melting point than tungsten, and also disintegrates rapidly on alternating current circuits, it was soon displaced. Since tungsten was first used as a filament material it has maintained its supremacy, owing to its extremely high melting point, fairly low cost, stability in both alternating and direct current circuits and its mechanical strength.

Production of Ductile Tungsten.

Tungsten filament was first produced by forcing under great pressure a mixture of tungsten powder and some carbonaceous binding material through a die. A metallic thread was produced which was converted into a wire of pure tungsten by passing electric current through it in an atmosphere of hydrogen. In this way the particles of tungsten were sintered together by a process of incipient fusion and the binding material was burned out. Filaments produced in this way are extremely brittle, and cannot be bent cold. A few inches of filament were formed in a loop or hairpin shape, and a series of these hairpins was mounted in a lamp. Each loop was secured to the supporting wires by melting the latter into a bead around the filament by means of an electric arc. Later a process of forming the filament into greater lengths was developed, and a single piece of filament was looped over the supports on the lamp mount.

During the period when the squirted tungsten filament was used in lamps there were constant endeavors to produce a filament by a process of mechanically working the metal. Many difficulties presented themselves and had to be overcome. Tungsten had long been regarded as a non-ductile metal. All efforts to roll or draw it had proved futile, and it was only after wonderful perseverance that the problem was solved.

Yellow oxide of tungsten, which is an article of commerce, is the raw material from which ductile tungsten is made. The oxide is purified, then given a heat treatment, and finally is reduced to pure metallic tungsten in a furnace filled with hydrogen. A weighed quantity of the powdered metal is spread evenly in a mould in a hydraulic press and is compressed into a stick or slug. This slug is very fragile, as no binding material is used, and it must be supported along its entire length until after it is heated in a furnace. The heating sinters the particles of tungsten slightly, and the slug is strengthened sufficiently to be handled easily. The next step in the preparation of the material is heating the slug to a very high temperature by passing electric current through it in a closed chamber filled with hydrogen. After this treatment the slug is converted into a coherent bar and is ready for the mechanical working which is necessary in order to develop the property of ductility.

The square slug is converted to a round section and is reduced in diameter by a swaging process. A swaging machine (Fig. 1) consists of a cast iron case (a), within which is a rotating head having cams which throw a series of hammers toward the centre opening (b). The hammers are arranged to act upon split dies (c), which are selected to give the size of bar desired. The slug is heated to a high temperature, and is inserted quickly into the swaging machine and quickly withdrawn. Special care is necessary in the swaging operation to prevent breaking the slug. Reductions in size are made very gradually and the temperatures at which the metal is worked are carefully controlled. With continued working the metal becomes more ductile, and at the stage where the swaging process is abandoned and the drawing process begins the wire can be bent at ordinary room temperature.

In the drawing of tungsten wire the methods which had been used previously for wire manufacture were found inadequate. The production of wire of 1.5 mils diameter was considered as proof of excellent workmanship and methods, and such wire was exhibited as a curiosity. When it is considered that filament for a 25 watt lamp is only about 1 mil in diameter and that for a 10 watt lamp is only slightly more than one-half mil, the problem encountered in the commercial production of tungsten filament may be appreciated.

The wire is drawn through dies made of pierced diamonds. Both the die and the wire are heated, and the reduction in size or draft at each die is very small, being .1 mil, or even only .05 mil for the smaller size of wire. With repeated working the strength of the tungsten wire increases so that in sizes used in lamps the tensile strength of the filament is equal to that of the finest steel. After a lamp has been burned for some time the filament tends to become more brittle, but it rarely, even under the most severe conditions, becomes as brittle as the pressed filament of the tungsten lamps first made.

The wires for supporting the lamp filament are now made of molybdenem, or tungsten, in place of copper, nickel, or special alloys, which were formerly used. The change in the material makes possible the use of small flexible supports, as they will not cause discoloration or give other troubles

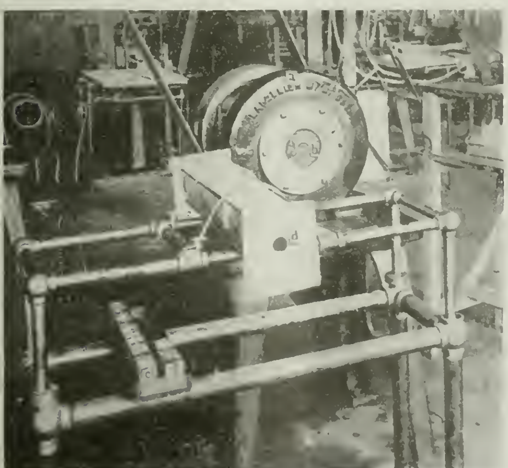


Fig. 1.

because of contact with the heated filament. Also the filament is cooled less by the small supports than it would be by the larger ones, thus making the lamp more efficient. The fact that the supports are flexible is also an advantage, as the filament is protected somewhat from shocks and is permitted to expand and contract freely.

Gas Filled Lamps.

By far the greatest change which has been made in incandescent lamps recently is the use of an inert gas in the bulb. This has made possible the construction of lamps of high candle power and low specific consumption, and has very materially broadened the field of usefulness of incandescent lamps. Many cities have replaced the street arcs with the new high efficiency Mazda C lamps with marked economy and decided improvement in illumination. Other uses for the new type of lamp are for headlights, for searchlights, for flood lights, and even for motion picture projectors.

There are two main effects produced by an inert gas in

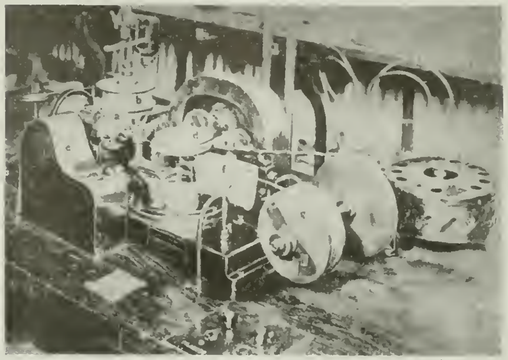


Fig. 2.

the bulb of a lamp. The first of these effects is the reduction of filament evaporation at extremely high temperatures, thus very largely eliminating the blackening of the bulb and the disintegrating of the filament. The effect of the gas pressure on the evaporation of the tungsten filament is analogous to the effect of atmospheric pressure on the boiling point of water—the greater the pressure the higher the temperature required to produce boiling.

The second effect of the gas is the carrying away of the heat of the filament by the convection currents set up in the gas. This effect is undesirable, and should be minimized as much as possible. If steps were not taken to reduce the cooling effects of the gas the temperature of the filament could not be increased enough to offset the convection loss, and the gas-filled lamp would be less efficient than the vacuum lamp. By coiling the filament into close spirals the area exposed to the effective cooling action of the gas is greatly reduced and the efficiency of the lamp is increased.

The coiling of the filament is done by means of a special machine (Fig. 2). The spool of filament is carried on a rotating head (a), through the centre of which passes the mandrel wire from the spool (b) and pulley (c). The mandrel is pulled continuously through by the drum (d), the speed of this drum relative to the speed of the head (a) determining the number of turns per inch of the spiral. A heater (f) is provided for annealing the coil as it passes to the drum (g), which is driven by a friction spring (h). The winding machine is arranged to give a space between coils or sections of coils, and in this way the length of the coil can be accurately determined, as the space is made after a definite number of turns.

Where the length of the coil is not too great the simplest form for mounting it in a lamp is the arc of a circle, with the coil supported at a number of points by radial anchors inserted in a central glass button. Long coils, such as are used in lamps of high wattage, cannot be conveniently mounted in this form, as the diameter of the circle that the coil would form would be so great that it could not be passed through the neck of the bulb. Large coils are therefore shaped into a series of loops arranged in a vertical position and mounted on an arc of such diameter that the filament will pass easily into the bulb. Owing to the current of hot gas rising vertically from the filament it is essential that glass parts of the lamp be kept at some distance away, to prevent them from overheating and softening.

The process of exhausting incandescent lamps has been modified somewhat so as to result in a saving of time. The time element has been such as to limit the production of lamps from exhaust equipment which occupied a great deal of space in the factory and in many instances determined the maximum output of the manufacturer.

Simplifying the exhaust process has made possible the use of exhaust machines which require that the operator only place the lamps in position and receive the completed lamp as it is delivered after being tipped off. Each lamp receives exactly the same treatment, and, therefore, the machine can produce a more uniform quality of lamps that can be obtained from non-automatic equipment which brings the human element into the process.

The process of exhausting gas-filled lamps is similar to that of vacuum lamps. When the bulb is thoroughly exhausted the desired quantity of gas is slowly admitted. The pressure of the gas is adjusted so that when the lamp is burning the pressure inside the bulb is slightly less than that of the atmosphere outside.

Spherical Photometry.

One of the most recently changed processes connected with incandescent lamp manufacture is that of photometry or candle power measurement. As long as all lamps were of

Fig. 3.

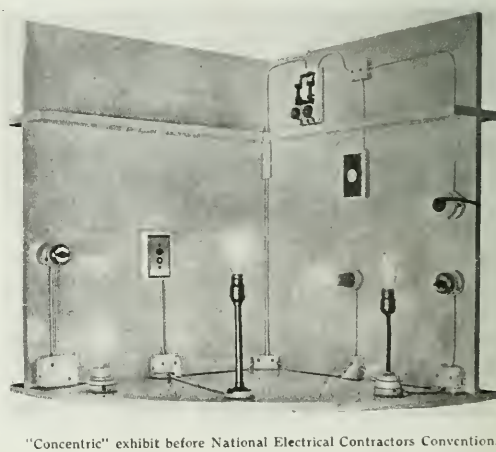
essentially the same construction and filament arrangement very fair comparisons of efficiency on a watts per candle basis could be made by measuring the mean horizontal candle power. However, with the advent of the gas-filled lamp, with its closely-coiled filament arranged in various ways, it was evident that the mean horizontal candle power was not a fair measure because of the different distribution of light in space from filaments arranged differently. The total light flux is the useful flux, as practically all modern lamps are installed in reflectors, which modify the distribution of light so as to get the desired illumination on the working plane. Measurement of the total flux is made by means of a spherical photometer (Fig. 3). The lamp (a) to be measured is placed in a holder and the door (b) of the sphere is closed. The inside of the sphere is painted white, and the light from the lamp is reflected and diffused so that the illumination at all points on the inner surface of the sphere is uniform. This intensity of illumination is measured at a translucent window placed opposite the end of photometer bar. Direct light from the filament is prevented from striking this window by means of a small shield inside the sphere. The spherical candle power rating of a lamp is usually less than the mean horizontal candle power rating. Where the filament of the lamp is arranged in the arc of a circle the mean horizontal candle power cannot be accurately determined because one part of the filament may be hidden by another part.

How to Sell an Idea

"How to Sell an Idea" is the title of a very interesting handbook on electric cooking just published by the Society for Electrical Development. It is intended for electric range salesmen and those contemplating range campaigns. Society members are receiving it this week. To others it will be mailed free upon request. There is nothing dry about it. From beginning to end the little 32-page booklet is full of snap, and not only contains a summary of good concrete ideas for selling electric ranges, but it is well worth reading for the very human angle it takes. So far as known it is the only booklet of its kind that has been published. A surprising fact developed recently in analyzing rates for electric cooking of 5c. and under in 3,300 communities. It was found that, contrary to the general impression, 1,884 communities in the eastern part of the country have cooking rates, as against 1,260 in the western part. In other words, 624 more eastern communities have a 5c. or less cooking rate than in the far west, where hydro-electric power is so well developed. The Society will soon have ready for distribution another booklet on electric cooking, this one for the public. It sells electric ranges from a new angle—just as the Society has done in its new salesmen's booklet "How to Sell an Idea."

Will Exhibit at Winnipeg

The National Electric Heating Company, of Toronto, will exhibit at the Winnipeg Electrical Show, which is being held October 9-14. Their exhibit will include a complete line of ranges, circulating water heaters, stoves, air and luminous type radiators. This company's new electric automobile hood heater is receiving considerable attention, also a circulating electric water heater recently placed on the market. The exhibit promises to be very interesting to central station and new-business managers. A cordial invitation is extended to the electrical fraternity to visit the National booth. The exhibit will be in charge of E. I. Williams, sales manager.



"Concentric" exhibit before National Electrical Contractors Convention.

How to Put On a Local Electric Show

A Writer in "Electrical Merchandising" Tells How to Make the "Show" a Success—Not Necessarily an Expensive Affair

In laying plans for an electric show the first thing to do is to get a list of guarantors. Then, with consideration for the size of your town or city, determine the amount of money which must be spent to put on an adequate show. Get the interested firms, picked from the list of guarantors, to pledge the amount. The sums should be proportioned, asking from each according to the size of his business. Out of a total of, say, $5,000 guaranteed, the central station—the greatest gainer from such a show—will, perhaps, pledge $1,000. Jobbers and the larger local manufacturers can be expected to sign for $200 to $300, and some contractors will agree to pay from $50 to $100.

That guarantors be obtained first is important, for this precaution not only insures funds to carry on the show, but also automatically produces a group of show boosters. After men have pledged money to a venture they no longer regard it apathetically. Moreover, when you know about how much money you have to spend, you can make up a fairly accurate budget of expenditures from estimates and actual bids on work. The original budget and the final expenditure for the Milwaukee 1915 show differed materially in only one item—the outlay for publicity. At the outset the Milwaukee folk planned to spend $1,500 for publicity. Later they decided they could not afford this amount so they spent only about $700. So much for getting under way.

Selecting Committees and the Manager

The next thing to do is to form a corporation and name it. Under the law this action is desirable, since in a partnership each partner, in event of suits for damages, is liable for all or any part of a judgment; in an incorporation each stockholder is liable only in proportion to the amount of his interest in the company. So it is a good plan to incorporate for mutual protection and to make the organization an "incorporation not for profit" to avoid paying an incorporation fee.

Then it is time to get organized, to appoint your committees and to select a manager. You may appoint whatever committees local conditions demand, but regardless of local conditions or anything else, do not fail to secure the services of an energetic show manager.

Even though at the beginning someone has volunteered for each bit of work foreseen, there must be a head man to act as a clearing house, to handle all of the details, to take upon himself those myriad last-minute tasks that always crop up when every working committee is loaded to the guards and no new committees are to be had.

The manager must be ready to assume these duties. Consequently he must be paid. Preferably his salary should be based, however, on the extent of the profits from the show.

The big job, of course, is to sell exhibit space, and here again the general manager comes in handy. The central station company may be asked to take the biggest space. Twenty per cent. of the entire hall may not be too much for it. Jobbers and local electrical manufacturers should be asked to take the next larger booths; and smaller and less expensive space can be offered to contractors, to dealers, and also to department stores handling electrical goods.

Fit the space to the people of your town. If your smallest booth lists at $50 and someone can afford only $25, don't quibble, cut a booth in two.

It is certainly understood that the general manager should have a large committee to help him sell space. The advantages of a large space selling committee are many; the man who will not purchase when first approached, can, usually, be "sold" if enough of his friends in turn solicit him.

Besides "getting the name on the dotted line," the solicitors should secure 25 per cent. of the contract price at the time of closing the contract. Strict adherence to this plan prevents exhibitors from backing out and prevents regrettable and disastrous mistakes in the budget making. The other 75 per cent. of the cost of exhibit space may be collected at any time before the show opens. Furthermore, along this idea of getting money in early, it may be added that $400 or $500 should be deposited to the credit of the show incorporation right at the start. The required amount can easily be secured from a few of the largest guarantors, since their space bills will be much larger than this amount. This $400 or $500 fund will prove mighty handy.

How to Handle the Publicity

It has already been suggested that such committees be appointed as local conditions demand, but whatever the local conditions a good publicity committee is demanded. Its membership should include the advertising managers of the public-service company, the larger jobbers and any other available buyers of large newspaper space. This will give the committee weight with the newspapers, and while these men may or may not write the copy, they should conduct all advertising negotiations.

It is a good plan for this committee not to select any single paper as the official organ of the show; if they do one paper will be a booster for the show and all others will be indifferent to it. On the other hand, if the representatives of all the papers are told that each will receive his just share of the appropriation; that the committee does not know in advance just how much money it can spend for the show itself, but that it will aid in securing electrical advertising from individuals; that a list of prospects for Electric Page contributors will be furnished, and that either data or already written stories for the reading columns of these pages will be supplied, newspaper support will be assured. If any individual advertiser among the dealers balks at spending money in this Electric Page advertising, advise him to spend his Christmas appropriation just before show week. It will prove a good business for him to do it.

Setting the Opening Date

It is not wise to start the active newspaper publicity campaign more than a week in advance of the opening date. A few little items may be given for publication a month in advance, but about one week is the limit to which steady, every-day-hit-'em-again advertising and news stories can be fed to the newspapers and to the public for success. When the opening date really arrives the newspapers can be depended upon to cover the show—for then it will be news.

The experience of Milwaukee last year demonstrated the advisability of setting the opening date on Saturday. Sunday is the day on which newspapers have most reading space available for news stories, have the greatest circulation, and have, therefore, the best opportunity for heralding the week's great electrical event to the people.

The interest of the newspapers in this opening night can be increased by the "special invitation stunt"—that is, making the first night an occasion when the exhibitors formally invite those among their acquaintance who constitute the town's well-known people. Many an important personage receiving a formal invitation to the opening of the electric show from the head of one of the city's large electrical firms, will turn out in evening clothes, whereas he might otherwise have passed up the event entirely. When the newspaper men see Mr. and Mrs. Important Personage, their beautifully gowned daughters and their friends among those present on opening night, the show immediately takes on a "front page" aspect regardless of what news value it may have possessed before.

Complimentary Tickets for Everybody

Whether the show, after the first night, shall be free or shall have an admission charge is another important question. "Primarily, we believe the object of the show was to present the advantages of electrical goods to as many people as possible," say the Milwaukee men, "so our show was free. But to reach the man who will not attend a free show but will attend anything on a 'complimentary,' we issued admission tickets—100,000, of them. These the exhibitors distributed to friends and customers, typing on a blank space provided, 'Compliments of The Milwaukee Electric Railway & Light Company,' or whatever the name of the donor might be. After this wide distribution of complimentary tickets with electric lighting bills and in other ways, when a man approached the door without a ticket he was passed in. Such a plan brings the crowds. It also 'passes on' the expense of selling or distributing tickets to individual exhibitors."

Early in the plans, it is advised, a good location for the show should be selected. Well-known public or semi-public auditoriums are perhaps best. Empty store buildings on the main street and on car lines come next. Sometimes a building owner will give one week's rent free if the store room is restored to its original condition, minus dirt.

Then comes the job of dividing the space and finding the price for it. Booths 10 x 10 feet at $1 a square foot represent "a fair buy." Next, the booths must be erected and decorations put up. It is well in this connection to remember that open booths are best for large equipment, and booths with a tight railing and a counter serve best for smaller appliances.

The decorations should be put up by the show company itself to insure uniformity and to save money. In letting contracts on this work the exhibits committee should put a clause in the booth builders' and decorators' contracts requiring that after the show all walls, booth material, etc., be restored to their original condition. This will insure the removal of all tacks from woodwork and walls. Money may also be saved by contracting with the carpenter who builds the booths to take back the used material after the show.

Have Somebody Coach the Exhibitors

While this work is going on someone must "push" the exhibitors in the work of getting their displays ready. It leaves a bad impression if the show is opened with half-completed or empty booths. Exhibitors should be coached, first, on the necessity of getting the display set on time; second, on the advisability of providing an intelligent attendant for the booth at all times; third, on the value of motion in the display itself, and, fourth, on the fact that the public comes to learn, either by reading placards or by asking questions.

It must be the work of someone, therefore, to encourage the use of exhibits that show "how it works" and tell "how much it costs to operate."

There are many things like this which must be looked after. They are details, of course; but they are important. Some of them are: Music, of which there should be an ample supply (say, $300 worth on the basis outlined); flowers, without which the show will look flat; drinking water, which does not cost much but must be available; fire extinguishers, which can generally be borrowed but must be guarded against theft; rest-room facilities for both sexes; clever exhibit arrangement, placing the most interesting sights farthest from the entrance; electric light and power service, which should be sold to exhibitors at flat rates to avoid unnecessary wiring and building expense; plans for closing the doors against more visitors when the room becomes comfortably full; spectacular or human-sympathy advertising, such as bringing in all inmates of the orphans' home and treating them to candy en route; providing adequate word-of-mouth and placard advertising of the fact that prizes are given away each day; and, finally, a provision for a meeting of the guarantors and exhibitors after the show.

TABLE OF EXPENDITURES, MILWAUKEE ELECTRIC SHOW

Advertising (posters, invitations, imprint on posters, etc.)	$1,500
Booths and interior decoration	550
Music	186
Wiring—Interior	275
Extras	75
Street wiring	100
Watchman	85
Cleaning	45
Telephone	19
Rent (free)	....
Stairway, door, arches, extras	185
Postage	30
Office help	200
Electricity	150
Rest-room attendants	30
Signs for booths	45
Letter service	26
Building rent	30
Window cleaning	10
Burdick & Allen	13
Lamps for arches	90
Lamps for booth	20
Messenger service and delivery	20
	$3,684
Extras for labor, decorations, carpenter and incidentals	250
	$3,934
Salary of manager	500
	$4,434

After the Show is Over

How this after-the-show meeting of the guarantors and exhibitors is conducted is generally determined by the results of the show itself. The following partial report of the general manager of Milwaukee's 1915 show, given herewith, points out what results may be expected from an electric show.

The report read in part: "The exhibition has brought about a closer relationship in the electrical industry here and has provided a far more congenial and co-operative condition than ever existed before. As many of you know, we had some difficult problems to overcome before success was assured, and some of the exhibitors were quite reluctant to participate, not seeing the final results as did some of us. These people have assured us, however, that they will not be caught waiting for a second request to participate in future expositions.

"We had a total of thirty-two exhibitors who paid for their exhibit space prior to the opening of the show the total sum of $4,005. There were, in addition, eighteen institutions which contributed the total sum of $115, making the total revenue derived from the sale of space and from contributions the sum of $4,120.

"Vouchers and receipts for all the expenditures are in the hands of the treasurer with the exception of about $10, which is accounted for, but for which no receipts were taken.

Total amount received	$4,120.00
Total amount expended	3,105.38
Balance cash on hand	$1,014.62
Discount	1.75
	$1,016.37

"The attendance for the week amounted to 63,000. This does not include the number entering without tickets, which is variously estimated by committee members from 5,000 to 12,000. It is my opinion that about 6,000 passed through the doors in this manner, bringing the total attendance to 63,000 by actual count and to an estimated total of 69,000 people.

"The sales for the week are somewhat of an uncertain quantity. I have been able to check definitely only about $32,000 of business. From time to time since the closing of the show, however, various reports have come to me which bring the total sales close to the $50,000 mark."

Milwaukee's success with her electric show of 1915 has been repeated in a score of other cities and, whether the financial balance in the auditors' accountings for each of these has been on one side of the ledger or the other, there can be no doubt that in every case the public has profited from its attendance at the show by a better understanding of electrical appliances, while the local electrical industry has benefited from direct and indirect sales and from a new realization of the meaning of co-operation for all time for everything electrical.

1916 Report of the Committee on Nomenclature and Standards of the Illuminating Engineering Society—Definitions

1. Luminous Flux is radiant power evaluated according to its visibility; i. e., its capacity to produce the sensation of light.

2. The visibility, $K\lambda$ of radiation, of a particular wave-length, is the ratio of the luminous flux to the radiant power producing it.

3. The mean value of the visibility, K_m, over any range of wave-lengths, or for the whole visible spectrum of any source, is the ratio of the total luminous flux (in lumens) to the total radiant power (in ergs per second, but more commonly in watts).

4. The luminous intensity, I, of a point source of light is the solid angular density of the luminous flux emitted by the source in the direction considered; or it is the flux per unit solid angle from that source.

Defining equation:

$$I = \frac{dF}{d\omega}$$

or, if the intensity is uniform,

$$I = \frac{F}{\omega},$$

where ω is the solid angle.

5. Strictly speaking no point source exists, but any source of dimensions which are negligibly small by comparison with the distance at which it is observed may be treated as a point source.

6. Illumination, on a surface, is the luminous flux-density on that surface, or the flux per unit of intercepting area.

Defining equation:

$$E = \frac{dF}{dS},$$

or, when uniform,

$$E = \frac{F}{S},$$

where S is the area of the intercepting surface.

7. Candle—the unit of luminous intensity maintained by the national laboratories of France, Great Britain, and the United States.[1]

8. Candlepower—luminous intensity expressed in candles.

9. Lumen—the unit of luminous flux, equal to the flux emitted in a unit solid angle (steradian) by a point source of one candlepower.[2]

10. Lux—a unit of illumination equal to one lumen per square meter. The cgs. unit of illumination is one lumen per square centimeter. For this unit Blondel has proposed the name "Phot." One millilumen per square centimeter (milliphot) is a practical derivative of the cgs. system. One foot-candle is one lumen per square foot and is equal to 1.0764 milliphots.

The milliphot is recommended for scientific records.

11. Exposure—the product of an illumination by the time. Blondel has proposed the name "phot-second" for the unit of exposure in the cgs. system. The microphot second (0.000001 phot-second) is a convenient unit for photographic plate exposure.

12. Specific luminous radiation, E'—the luminous flux-density emitted by a surface, or the flux emitted per unit of emissive area. It is expressed in lumens per square centimeter.

Defining equation:

For surfaces obeying Lambert's cosine law of emission,

$$E' = \pi b_o.$$

13. Brightness, b, of an element of a luminous surface from a given position, may be expressed in terms of the luminous intensity per unit area of the surface projected on a plane perpendicular to the line of sight, and including only a surface of dimensions negligibly small in comparison with the distance at which it is observed. It is measured in candles per square centimeter of the projected area.

Defining equation:

$$b = \frac{dI}{dS\cos\theta}.$$

(where θ is the angle between the normal to the surface and the line of sight).

14. Normal brightness, b_o, of an element of a surface (sometimes called specific luminous intensity) is the brightness taken in a direction normal to the surface.[3]

Defining equation:

$$b_o = \frac{dI}{dS},$$

or, when uniform,

$$b_o = \frac{I}{S}.$$

15. Brightness may also be expressed in terms of the specific luminous radiation of an ideal surface of perfect diffusing qualities, i. e., one obeying Lambert's cosine law.

16. Lambert—the cgs. unit of brightness, the brightness of a perfectly diffusing surface radiating or reflecting one lumen per square centimeter. This is equivalent to the brightness of a perfectly diffusing surface having a coefficient of reflection equal to unity and an illumination of one phot. For most purposes, the millilambert (0.001 lambert) is the preferable practical unit.

A perfectly diffusing surface emitting one lumen per square foot will have a brightness of 1.076 millilamberts.

Brightness expressed in candles per square centimeter may be reduced to lamberts by multiplying by $\pi = 3.14$.

Brightness expressed in candles per square inch may be reduced to foot-candle brightness by multiplying by the factor $144\pi = 452$.

Brightness expressed in candles per square inch may be reduced to lamberts by multiplying by $\pi/6.45 = 0.4868$.

In practice, no surface obeys exactly Lambert's cosine law of emission; hence the brightness of a surface in Lamberts is, in general, not numerically equal to its specific luminous radiation in lumens per square centimeter.

Defining equations:

$$L = \frac{dF}{dS}$$

or, when uniform,

$$L = \frac{F}{S}.$$

17. Coefficient of reflection—the ratio of the total luminous flux reflected by a surface to the total luminous flux incident upon it. It is a simple numeric. The reflection from a surface may be regular, diffuse or mixed. In perfect regular reflection, all of the flux is reflected from the surface at an angle or reflection equal to the angle of incidence. In perfect diffuse reflection the flux is reflected from the surface in all directions in accordance with Lambert's cosine law. In most practical cases there is a superposition of regular and diffuse reflection.

18. Coefficient of regular reflection is the ratio of the luminous flux reflected regularly to the total incident flux.

19. Coefficient of diffuse reflection is the ratio of the luminous flux reflected diffusely to the total incident flux.

Defining equation:

Let m be the coefficient of reflection (regular or diffuse).

Then, for any given portion of the surface,

$$m = \frac{E'}{E}.$$

20. Lamp—a generic term for an artificial source of light.

21. Primary luminous standard—a recognized standard luminous source reproducible from specifications.

22. Representative luminous standard—a standard of luminous intensity adopted as the authoritative custodian of the accepted value of the unit.

23. Reference standard—a standard calibrated in terms of the unit from either a primary or representative standard and used for the calibration of working standards.

24. Working standard—any standardized luminous source for daily use in photometry.

25. Comparison lamp—a lamp of constant but not necessarily known candlepower against which a working standard and test lamps are successively compared in a photometer.

26. Test lamp, in a photometer—a lamp to be tested.

27. Performance curve—a curve representing the behavior of a lamp in any particular (candlepower, consumption, etc.) at different periods during its life.

28. Characteristic curve—a curve expressing a relation between two variable properties of a luminous source, as candlepower and volts, candlepower and rate of fuel consumption, etc.

29. Horizontal distribution curve—a polar curve representing the luminous intensity of a lamp, or lighting unit, in a plane perpendicular to the axis of the unit, and with the unit at the origin.

30. Vertical distribution curve—a polar curve representing the luminous intensity of a lamp, or lighting unit, in a plane passing through the axis of the unit and with the unit at the origin. Unless otherwise specified, a vertical distribution curve is assumed to be an average vertical distribution curve, such as may in many cases be obtained by rotating the unit about its axis, and measuring the average intensities at the different elevations. It is recommended that in vertical distribution curves, angles of elevation shall be counted positively from the nadir as zero, to the zenith as 180 degrees. In the case of incandescent lamps, it is assumed that the vertical distribution curve is taken with the tip downward.

31. Mean horizontal candlepower of a lamp—the average candlepower in the horizontal plane passing through the luminous centre of the lamp.

It is here assumed that the lamp (or other light source) is mounted in the usual manner, or, as in the case of an incandescent lamp, with its axis of symmetry vertical.

32. Mean spherical candlepower of a lamp—the average candlepower of a lamp in all directions in space. It is equal to the total luminous flux of the lamp in lumens divided by 4π.

33. Mean hemispherical candlepower of a lamp (upper or lower—the average candlepower of a lamp in the hemisphere considered. It is equal to the total luminous flux emitted by the lamp in that hemisphere divided by 2π.

34. Mean zonal candlepower of a lamp—the average candlepower of a lamp over the given zone. It is equal to the total luminous flux emitted by the lamp in that zone divided by the solid angle of the zone.

35. Spherical reduction factor of a lamp—the ratio of the mean spherical to the mean horizontal candlepower of the lamp.[4]

36. Photometric tests in which the results are stated in candlepower should be made at such a distance from the source of light that the latter may be regarded as practically a point. Where tests are made in the measurement of lamps with reflectors, or other accessories at distances such that the inverse square law does not apply, the results should always be given as "apparent candlepower" at the distance employed, which distance should always be specifically stated.

The output of all illuminants should be expressed in lumens.

37. Illuminants should be rated upon a lumen basis instead of a candlepower basis.

38. The specific output of electric lamps should be stated in terms of lumens per watt and the specific output of illuminants depending upon combustion should be stated in lumens per British thermal unit per hour. The use of the term "efficiency" in this connection should be discouraged.

When auxiliary devices are necessarily employed in circuit with a lamp, the input should be taken to include both that in the lamp and that in the auxiliary devices. For example, the watts lost in the ballast resistance of an arc lamp are properly chargeable to the lamp.

39. The specific consumption of an electric lamp is its watt consumption per lumen. "Watts per candle" is a term used commercially in connection with electric incandescent lamps, and denotes watts per mean horizontal candle.

40. Life tests—Electric incandescent lamps of a given type may be assumed to operate under comparable conditions only when their lumens per watt consumed are the same. Life test results, in order to be compared must be either conducted under, or reduced to, comparable conditions of operation.

41. In comparing different luminous sources, not only should their candlepower be compared, but also their relative form, brightness, distribution of illumination and character of light.

42. Lamp Accessories.—A reflector is an appliance the chief use of which is to redirect the luminous flux of a lamp in a desired direction or directions.

43. A shade is an appliance the chief use of which is to diminish or to interrupt the flux of a lamp in certain directions where such flux is not desirable. The function of a shade is commonly combined with that of a reflector.

44. A globe is an enclosing appliance of clear or diffusing material the chief use of which is either to protect the lamp or to diffuse its light.

45. Photometric hints and abbreviations.

Photometric quantity	Name of unit	Symbols and defining equations	Abbreviation for name of unit
1. Luminous flux	Lumen	F, Ψ	l
2. Luminous intensity	Candle	$I = \frac{dF}{d\omega}$, $\Gamma = \frac{d\Psi}{d\omega}$	cp.
3. Illumination	Phot, foot-candle, lux	$E = \frac{dF}{dS} = \frac{I}{r^2} \cos\theta \; \beta$	ph. fc.
4. Exposure	Phot-second; Micro phot-second	Et	phs. μphs.
5. Brightness	Apparent candle per sq.cm.; Apparent candle per sq.in.; Lambert	$b = \frac{dI}{dS \cos\theta}$; $L = \frac{dF}{dS}$	—
6. Normal brightness	Candles per sq.cm.; Candles per sq.in.	$b_0 = \frac{dI}{dS}$	—
7. Specific luminous radiation	Lumens per sq.cm.; Lumens per sq.in.	$E' = \pi b_0$, β'	—
8. Coefficient of reflection	—	$m = \frac{E'}{E}$	—

9. Mean spherical candlepower[1] scp.
10. Mean lower hemispherical candlepower lcp.
11. Mean upper hemispherical candlepower ucp.
12. Meau zonal candlepower zcp.
13. Mean horizontal candlepower mhcp.
14. 1 lumen is emitted by 0.07958 spherical candlepower.
15. 1 spherical candlepower emits 12.57 lumens.
16. 1 lux = 1 lumen incident per square meter = 0.0001 phot = 0.1 milliphot.
17. 1 phot = 1 lumen incident per square centimeter = 10,000 lux = 1,000 milliphots = 1,000,000 microphots.
18. 1 milliphot = 0.001 phot = 0.929 foot-candle.
19. 1 foot-candle = 1 lumen incident per square foot = 1.076 milliphots = 10.76 lux.
20. 1 lambert = 1 lumen emitted per square centimeter of a perfectly diffusing surface.
21. 1 millilambert = 0.001 lambert.
22. 1 lumen, emitted, per square foot* = 1.076 millilamberts.
23. 1 millilambert = 0.929 lumen, emitted, per square foot.*
24. 1 lambert = 0.3183 candle per square centimeter = 2.054 candles per square inch.
25. 1 candle per square centimeter = 3.1416 lamberts.
26. 1 candle per square inch = 0.4868 lambert = 486.8 millilamberts.

* Perfect diffusion assumed.

46. Symbols.—In view of the fact that the symbols heretofore proposed by this committee conflict in some cases with symbols adopted for electric units by the International Electrotechnical Commission, it is proposed that where the possibility of any confusion exists in the use of electrical and photometrical symbols, an alternative system of symbols for photometrical quantities should be employed. These should be derived exclusively from the Greek alphabet, for instance:

Luminous intensity	Γ
Luminous flux	ψ
Illumination	β

[1] This unit, which is used also by many other countries, is frequently referred to as the international candle.

[2] A uniform source of one candle emits 4 π lumens.

[3] In practice, the brightness b of a luminous surface or element thereof is observed and not the normal brightness b_0. For surfaces for which the cosine law of emission holds, the quantities b and b_0 are equal.

[4] In the case of a uniform point-source, this factor would be unity, and for a straight cylindrical filament obeying the cosine law it would be $\pi/4$.

Big Electrical Show Arranged at Winnipeg

What promises to be the largest electrical show ever staged in Western Canada will be that to be seen on October 10 to 14 in the convention hall of the Industrial Bureau, Winnipeg. All the different electrical appliances for use in the home will be exhibited, together with a complete line of up-to-date electrical ranges, and there will be demonstrators handling these devices to show the public what kind of service can be obtained therefrom.

The interior of the convention hall will be specially decorated for the occasion. Already 27 exhibit spaces have been sold to Winnipeg firms, while Commissioner Webster, who paid a special visit to different parts in the East in order to line up a number of big eastern manufacturers of electrical appliances who intend showing their goods at the exhibition, reports that all the available space will be occupied long before the start of the show.

Winnipeg is particularly fortunate in having two progressive electric service organizations with a large surplus of electric power which have been able to strike a rate for heating and cooking purposes comparable with any in vogue at the present time in North America. These concerns will support the city's first electrical show loyally and liberally. The show will be opened on October 10 by Manitoba's new Lieutenant-Governor, Sir J. A. M. Aikins.

Upon one day, which will be set aside by the organizers, all the senior school children in the city will be taken to the exhibition, where the innumerable uses of electricity will be explained to them.

Two prizes will be offered for the best essays submitted—namely, $10 for the first and $5 for the second.

"The Goddess of Electricity" will also be abroad. The first person to identify her will receive a prize of $10. All the committee have announced in this respect was that the "goddess" is a beautiful creature, who will be awaiting each day for someone to ask "Are you the Goddess of Electricity?"

The city will have a special exhibit at the big show, according to W. R. Ingram, chairman of the Trade Expansion Committee of the Industrial Bureau.

Attracting the Public

Several hundred pencils are sharpened daily in a rotary pencil sharpener fastened outside the display window of a well-known electrical dealer. A sign just above the sharpener invites the passer-by to sharpen up his pencils and to also look in the window at the day's bargains in electrical conveniences. The dealer declares that he has sold a raft of such devices as flashlights, electric curling irons, desk lamps, flatirons, small fans and motors, heating pads, toaster stoves, electric alarm clocks, vibrators, electro-medical devices, and other similar articles to the people who flock to his window at the noon hour to point up their pencils.—Electrical Merchandising.

Among the recent transformer orders placed with the Moloney Electric Company of Canada, Limited, are the following:—three 300 kv.a., 25 cycle, 13,200 volts, for the Brampton Hydro Electric Commission; three 150 kv.a., 25 cycle, 26,400 volts, for the Paris Hydro Electric & Water Commission; three 250 kv.a., 25 cycle, 12,000 volts, for the Toronto-Suburban Railway Company; three 150 kv.a., 25 cycle, 12,000 volts, for the Toronto Power Company; one 400 kv.a., 25 cycle, 3 phase, 26,400 volts, for the Canadian Bridge Company; two 200 kv.a., 60 cycle, standard voltage, for the city of Moose Jaw, Sask.; two 100 kv.a., 60 cycle, 12,000 volts, for Calgary, Alta.

Recent estimates show that there are about 400 hydro-electric development plants in Japan.

Best Technical Training for Engineers

Notes Published in the Electric Journal of Address Before the Pittsburgh Section of the A. I. E. E.

By B. G. Lamme*

In the earlier days of the Westinghouse Electric and Manufacturing Company many young technical students were taken directly into the various departments and there trained. But in time the student problem became so large and important that an educational department was developed to meet in a systematic manner the growing needs of all departments. This educational department works in conjunction with the other departments in training and in placing them where they will have opportunities in accordance with their special abilities. While the educational department supervises the student course, yet much of the training is through representatives of the commercial, manufacturing, and engineering departments.

The following remarks represent the writer's own personal opinions, based largely upon a comparatively wide experience with the young engineers who have entered the student's course during the past five or six years. In that time this company has taken into its educational department over one thousand graduates of technical schools from all over the United States and Canada. Of these several hundred have wished to specialize in engineering, while the aim of the others has been toward the manufacturing and the commercial lines, both of which require good technical training. The electrical salesman of to-day is quite technical, regardless of how he got his training. Also the complexities of the electrical business of to-day require many high-class technical men in the manufacturing departments. As to engineering, it goes without saying that those who follow this branch of the electrical business should be technical men, if they are to advance very far. In consequence, the Westinghouse Company takes on technical graduates almost exclusively for its student's course, regardless of what branch of the electrical business they expect to follow.

The writer's personal experience has been very largely with those students who expect to follow the engineering branch of electrical manufacturing. During the past few years he has come in contact with practically all those who leaned toward engineering work. One of the most important considerations in the engineering student problem has been that of fitting the men to the kinds of work for which they are best adapted. In former years this was done in a more or less haphazard manner by trying the men out in different classes of work to see whether they would make good. This procedure proved so unsatisfactory that it became necessary to adopt some method of classifying the students according to their aptitudes and abilities, and then try each one out on that line of work for which he seemed to be best fitted. Obviously this method was in the right direction, but the primary difficulty lay in determining the characteristics of the individual students. The writer has spent quite a considerable amount of time in the past few years in studying the characteristics of the students to see whether their natural and their acquired abilities can be sufficiently recognized, during the preliminary stages of the work, to allow them to be properly directed toward that field in which they will make the best progress. In this study, in which hundreds of young men were analyzed with regard to their characteristics, many very interesting points developed, quite a number of which have a direct bearing on the subject of technical training. In the first years of this study the results were very discouraging, due largely to the fact that the young men had been brought to us in a wholesale way, regardless of their characteristics or their suitability for our engineering work. Many of them had no ideas whatever in regard to the kind of work for which they were fitted. Apparently the man who had not, at least partly, made up his mind as to his preferences or his capabilities for some given line of endeavor by the time he had gone through four years of college and then entered our course, had much difficulty in making up his mind after he had been with us a year or two. It developed, in many cases, that he was lacking in decision. This was a very predominant fact in the first few years after the writer had gotten into this work more actively. After a careful study of the situation it was recommended that an attempt be made to get a different class of college men, namely, those who had more definite ideas as to what they wanted and what they were fitted for. This policy was tried, and with great improvement in the grade of men obtained.

Born With Valuable Aptitudes

One of the most prominent features which has developed from the study of these young men is that in practically all cases the most valuable aptitudes or characteristics which they have shown were possessed by them long before they entered college. In fact, many of them have apparently possessed such aptitudes, more or less developed, from comparatively early childhood. For example, the best constructing or designing engineers all had a strong tendency toward the construction of mechanical toys and apparatus in childhood. In regard to such characteristics, the schools and the colleges have merely directed and developed to a greater extent what is already there. From this viewpoint, therefore, the college simply develops. If the tendency isn't there, it would seem that there is but little use to try to develop or cultivate it. Viewed from this standpoint, quite a large percentage of the young men who take up engineering courses in college are quite unfitted for such work. Therefore, one function of the college should be to sort out and classify the young men according to their characteristics, to discourage them from following along any line of endeavor for which they have no real aptitudes, and to direct them into more suitable lines. This applies particularly to technical schools. It might be said that in our present educational system the usual method is to educate the young men and then select the real engineers, this selection being made afterwards through bitter experience. The ideal method, apparently, would be first to select the real engineers and then to educate them. In other words, those who show a natural aptitude for engineering should be educated along technical lines.

In the technical school one of the first efforts should be toward finding the student's natural aptitudes. Some boys apparently have no leaning toward any special line of endeavor. On the other hand, many boys really have some inherent preference which, however, may not have been strongly enough developed to stand out prominently. Too often his real preference has been entirely neglected or even discouraged. In the writer's own case, as a boy, he was very frequently and severely criticized for his inclination to "waste valuable time" in trying to make what were called "useless things." However, fortunately for himself, no real pressure was brought upon him to prevent him from following his preferences or tendencies, and eventually the "call" was so strong that it took him into the very work which he wanted above all else.

On the other hand, the boy may express a preference for

* Chief Engineer Westinghouse Electric & Mfg. Co.

a line of work for which he is entirely unfitted. In other words, this preference may not be based upon natural aptitudes or characteristics and is not a real "call." It is these boys, who are unfitted for the lines which they have chosen, who are a real handicap on their classmates. The class never moves along faster than its average man, and very often at the speed of the poorest men. If these poorest men were eliminated, naturally the progress would be much faster. Apparently the present methods of training have not yet overcome this difficulty, although very many teachers recognize the evil, and are attempting to correct it. This will be referred to again later.

Coming to the technical training of the students, experience indicates that too much specialization is a mistake. He gets enough of that in after years. What is needed is a good, broad training in fundamental principles. In engineering matters, a thorough grasp of such fundamentals is worth more than anything else. By fundamentals is meant basic principles or facts. These should not be confused with theories or explanations of facts. A fact is basic, and does not change, although the theories which explain it may change many times. A thorough knowledge of basic principles will enable a direct answer to be made in many cases, even where the conditions of a problem may appear to be very complex. Take, for example, the perpetual motion fallacy in its various forms. A perpetual motion scheme may be made so complex and involved and may include so many principles and appurtenances that the best analyst may be more or less puzzled to explain the various relations clearly. But by applying the principle of conservation of energy no further explanation is necessary. This one fundamental fact covers the whole case. In the same way a thorough grasp of some basic principle will often clear up the most complex problems or situations and will allow a conclusive answer to be made. With such a grasp of fundamentals one is not liable to believe that a "pinch" of some wonderful new powder or chemical, mixed with a gallon of water, will give the equivalent of a gallon of gasoline, and at the cost of a few cents. And yet this fallacy "breaks loose" periodically, and is given wide circulation in the news of the day. What is needed in such cases is a little knowlede of fundamental principles.

The Grasp of Fundamentals

This very grasp of fundamentals accustoms the boy to think for himself. In other words, it develops his analytical ability. As one educator mentioned to the writer some time ago, "If a boy has analytical ability, there is hope for him; if he has none, he is 'punk.'" By analytical ability is not necessarily meant mathematical ability with which some people are inclined to confuse it. By analytical ability is meant the ability to analyze and draw correct conclusions from the data and facts available. This faculty can be cultivated to a considerable extent, although, in the writer's opinion, it originates rather early in life. This is considered by many as the first and foremost characteristic that an engineer must have, and therefore the schools should expend their best energies in this direction.

Allied with a grasp of basic principles is the requirement of a physical conception of such principles as distinguished from the purely mathematical. This can be cultivated, as the writer's personal experience with many students has indicated. As a concrete example of the value of a physical conception the following may be cited: Three electrical engineers, familiar with induction motor design, are given some new problem regarding the action of an induction motor. One of them immediately thinks of a "circle diagram"; the second thinks of a mathematical formula; the third thinks of flux distributions and conductors cutting them at certain speeds, etc. Assuming equal mathematical skill for these three men, the one with the physical conception of the conductors cutting fluxes has a broader means for attacking the problem than either of the others can be said to have. He can tackle a new condition with better chance of success, as he goes back to the fundamental principles of the apparatus. He thus may create, confidently, new formulae and diagrams to meet new conditions and problems.

This physical conception is closely related to the development of imaginative powers, and without such powers highly developed no engineer can expect to advance far in his profession. The man with originality, resourcefulness, or with the constructive faculties well developed, or the man who "can see through things" readily, must have strong imaginative powers. This faculty also should be developed to the utmost, but should also be directed. It begins early in some children, but, unfortunately, instead of being directed, it is too often discouraged, both at home and in the school. If the boy in the public school develops a new method of solving a problem, or reaches any conclusion by other than the well-established routine way, he is criticized more often than encouraged for his departure from the beaten track, or, rather, his instructor's particular methods.

Graduates Have Woefully Weak Spots

As stated before, the student should be well trained in fundamentals or basic principles. In many branches of engineering this means that he should have a good training in mathematics. Most of the graduates of the technical schools are woefully weak in mathematics. Apparently this is not due entirely to lack of mathematical ability on the part of the students, but largely to defective training in their earlier work. One great defect in many colleges is due to passing the entrants, in algebra and trigonometry, on the basis of their high school training. In most cases this early training in algebra is very defective, as sufficient skill is not developed in the student, and the practical side is largely neglected. Algebra and its applications to geometry, trigonometry, etc., should be taught in a more practical manner in the engineering college course, as a foundation for the higher engineering mathematics. The higher the structure is to be the stronger must be the foundation. If the engineering student is not sufficiently practised in these elementary mathematics, then he should be drilled specially as a step to further engineering work. In the practical engineering work, beyond the college, skill in the use of algebra and trigonometry is of relatively much more importance than practice in the higher mathematics, for it is needed one hundred times where the other is used once. In the writer's experience with engineers he has reached the conclusion that the principal reason why mathematics are not used more in everyday work is because the average engineers have not the necessary skill. Most of them claim that they have become "rusty" in such mathematics through disuse. However, in many cases, this excuse is worse than none at all, for the occasion for such mathematics exists in practical engineering work and has been there all along.

In the education of the engineer higher mathematics forms a very valuable part of the training. One of its uses is to show how one can do without it. In other words, if properly taught, it gives a broader grasp of methods of analysis; it tends to fix certain fundamental principles. However, as a tool in actual engineering work it is seldom required, except in rather special lines. The higher mathematics might be looked upon as a fine laboratory instrument or tool, to be used on exceptional occasions, while the ordinary mathematics should be considered as an every-day tool in engineering work, and should be ready at hand at all times.

There has been quite a fad for specialization in engineering training. The writer's personal opinion is that specialization in college training is not advisable, except possibly in a very general way. There has been a false idea in many schools that if a man specialized along some individual line of work it would advance him more rapidly when he leaves school for active work. The writer almost never asks the student in what field he specialized. It is desired to know whether he is a good analyst, if he is fairly skillful at mathematics, if he has the imaginative faculty and what goes with it. Has he initiative, resourcefulness, etc. Is he a man with a broad grasp of general principles rather than one who has made a special study of one individual subject?

In college training the time spent on commercially practical details is usually largely wasted, as it may give the student entirely wrong ideas. When a young man says that he has had a course in practical design and is positive that he can design,, the chances are about ninety-nine out of one hundred that he knows nothing about the really fundamental conditions in practical design. The chances are that he does not even know the real starting point in making up a commercial design. Even worse, if he has taken such training seriously, he may have to "unlearn" many of his ideas, if the use of this term is allowable. The mental training and the aid in grasping principles which he may have obtained through his school design is, of course, worth something, but in many cases the same time expended in other channels may produce larger results. Teaching of design should, therefore, be for the purpose of exemplifying principles rather than practice. There are, of course, some lines of specialization in colleges which lead directly to practical results afterwards. Research work is one of these. However, it is probable that if a large part of the time given to research work by the student in college were expended in acquiring a broader foundation in fundamental principles the results would be better in the end.

As referred to before, there has been one serious defect in our systems of technical training to-day, namely, it holds back the leaders and pushes the laggards, thus tending toward mediocrity as the general result. There should be some system in colleges for weeding out the "negatives" in any given line of endeavor. Many of these are simply "misapplications," to use a manufacturing company term. In some other lines they may be highly successful.

In an ideal engineering course each student should be pushed to the utmost of his capabilities. One solution of this problem would be for each teacher to assign a certain amount of extra work to his students individually, and they should report to him individually on such work, explaining to him fully what they have accomplished. Each man thus could be pushed along independently of his fellows. The weaknesses of the individual men would soon appear. If, for example, it develops that certain of the students are behind in the necessary mathematics, then steps could be taken to correct this defect. Each student would have to think more for himself and would be put more or less upon his own resources. His various characteristics could be studied and developed. He should be made to work out and apply fundamental principles. He would thus practice using his own mind. As soon as it develops that he has no mind of his own, then he could be dropped. In such a course of teaching the advancement of each man would be dependent upon himself, to a large extent. At this point a principle of mechanics can be applied rather aptly. In machines a force does work in overcoming resistance. In man the same principle holds true. No matter how much force a man may have, if no resistance is presented, no result is accomplished. And if the force is small, then the result is also liable to be small. But a smaller force overcoming a large resistance may result in greater accomplishment than a larger force with but little resistance. An unusually brilliant boy with too small a task set for him may accomplish little. His task must be enlarged to suit his abilities; for, as in machines, to obtain the greatest result the resistance, or task, must be commensurate with the force acting. Unfortunately, many good men of great capabilities accomplish practically nothing, through too little resistance, due to life being made too easy for them.

Such a course of "forcing," as indicated above, might be difficult to apply in many of the schools as constituted to-day. But the writer's personal experience indicates that the better class of men will develop rapidly under such treatment, while the laggards are eliminated more quickly. He has tried this system in general on many graduates from the technical schools, and unusually satisfactory results have been obtained.

All of the foregoing points to the fact that the mere accumulation of knowledge is not a training nor an education. The old saying that "knowledge is power" is not technically correct any more than is the statement that torque (or force) is power, to use an engineering comparison. Torque, or force, is not power, but torque in motion is power, and, to continue this comparison, knowledge in motion, or in action, is power. Activity in some form is one of the essential factors

To sum up, the colleges should aim to develop the student's characteristics, as far as practicable. They should aim to develop analytical ability, imaginative faculty, ability to do independent thinking. They should teach fundamental principles, and the course of teaching should be such as to give the individual student a real grasp of such principles. A broad, general training is most desirable for the man who has the ability to do something in the world.

Personals

Mr. A. E. Pickering, manager of the Water and Light Commission of Sault Ste. Marie, Ont., has resigned to accept an important position with the Great Lakes Power Company.

Mr. George R. Wright, formerly assistant district manager of the Canadian General Electric Company at Vancouver, succeeds Mr. J. F. S. Madden as manager at Winnipeg.

Lieut. C. H. Sclater, formerly in the employ of the Northern Electric Company, is reported as wounded. He is the eldest son of the late Mr. C. P. Sclater, at one time secretary of the Bell Telephone Company.

Mr. W. S. Guest, of the University of Toronto staff in applied science, is attending the special course of lectures in illuminating engineering in the University of Pennsylvania, including also a tour of inspection of the illumination in the principal United States cities.

Mr. F. W. Blythe, for fifteen years district manager of the Canadian Allis-Chalmers, Limited, at Winnipeg, has been promoted to the head office of this company at Toronto. At a recent luncheon of the Jovian League at Winnipeg, Mr. Blythe was presented with a magnificent walrus suitcase with solid silver fittings. Mr. Blythe left for Toronto on September 21.

Mr. J. F. S. Madden, district manager of the Canadian General Electric Company, was promoted to the head office of this company at Toronto towards the end of September. Mr. Madden, who was Winnipeg district manager of the Canadian General Electric Company for over seven years, was a very active member of the Jovian League, last year being elected its president. He was also a member of the Winnipeg branch of the Electrical Section of the Canadian Society of Civil Engineers. A very pleasing ceremony took place at the last luncheon of the Jovian Order. Mr. Madden was presented with a handsome walrus suit case with solid silver fittings in recognition of his valuable services in making this organization one of the foremost electrical associations in the Dominion.

In one Philadelphia Fire Department house there are quartered gasoline, electric and horse drawn vehicles. When the fire gong sounds, the electric vehicles are the first out of the house and, on average runs up to a mile and a half, the electrics have invariably been the first to the fire.

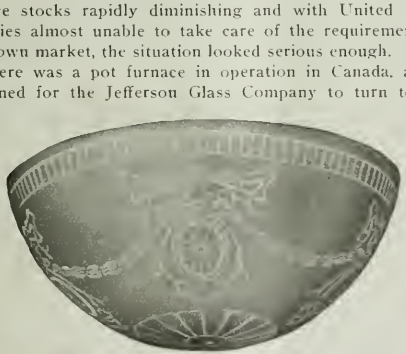
Developments in the Canadian Glassware Business As a Result of the War

The factory of the Jefferson Glass Company of Canada, Limited, situated at the corner of Gerrard Street and Carlaw Avenue, in the city of Toronto, is in a somewhat unique position among Canadian industrial concerns, as it is the only factory of its kind in this country. A special kind of furnaces is required for making the high quality of glass required for illuminating glassware, employing a number of clay crucibles or glass house pots, and in this way the Jefferson factory is distinct from the other Canadian glass factories, which all use large tank furnaces in which only the cheaper grades of glass, suitable for bottles, fruit jars, the cheaper kinds of tableware, etc., can be made.

Since the outbreak of the great European war the supply of German and Austrian glassware, with which this

Moonstone etching design for the music room.

country has for many years been flooded, has been cut off, and it has been left to this Canadian company to develop along lines which had not before been attempted in this country. Prominent among these is the manufacture of bulbs for incandescent electric lamps. Previous to the war the lamp factories of this country drew their supply of bulbs practically altogether from Austria, and soon after the war broke out Canadian factories found themselves facing what looked like a famine so far as glass was concerned. With reserve stocks rapidly diminishing and with United States factories almost unable to take care of the requirements of their own market, the situation looked serious enough. Luckily there was a pot furnace in operation in Canada, and it remained for the Jefferson Glass Company to turn to and



Negative etching design.

help the lamp people out of their serious dilemma. After a short period of experimenting a proper quality of lead glass was developed and men expert in the blowing of bulbs were brought into the country and the manufacture of bulbs started. Only some five or six thousand bulbs per day were at first made, but this company has increased its facilities to meet the demands until at the present time bulbs are being turned out at the rate of seven or eight million bulbs per annum.

No attempt has been made by the company to make the cheap colored electric shades which Germany and Austria used to dump into this country in large quantities, as the taste of the public has been calling for something of a higher

Positive etching design.

Lumo nitrogen unit for large lamps.

class. Particular attention has, therefore, been given to the development of two distinct classes of electric bowls and shades designed for residential lighting purposes. The first of these is a line of hand decorated bowls and shades in white glass. A number of beautiful floral designs have been developed and are applied by hand work of artists skilled in decorating on glass and afterwards fired in a kiln specially built for this work. A number of new shapes, both in bowls and shades, have been developed specially for this color decoration, and are blown in white glass for the purpose. The other is a line of deep etching on white glass which is supplied either in white entirely or with the raised etched design colored ivory, pink, blue, green or grey. These colored designs standing out against the white background formed by the plain parts of the bowl or shade are indeed beautiful to look upon. A cheaper line of ware made of crystal glass finished to a soft satin finish on the outside

Diana portable lamp shade.

Diana shade with apple blossom decorations.

Diana hall lantern.

and with decorations painted on the inside of each piece also gives a beautiful lighting effect for residential lighting.

The cheapening of electricity by the developments of recent years has brought the use of electricity within the reach of those of very moderate means and the Jefferson company, seeing the demand for an inexpensive type of house lighting glassware, has developed a number of sets consisting of bowls, hall lanterns, portable lamp shades and electric shades of uniform design. Any one of these sets provides a complete equipment of glassware for small houses at a very moderate cost. Specimen pieces of one of these sets, "The Diana House Lighting Set," are illustrated here; this set is supplied in white entirely or decorated with hand painted flowers if desired. Another set, "The Wild Rose Set," has a wreath of wild roses blown into each piece, and is supplied in white or with the roses tinted. This is also blown in crystal glass, satin finished outside and with the roses tinted from the inside, giving a very soft and pleasing effect.

For commercial lighting this company is still going strong on "Moonstone" glass, which is too well known to need description here. It is claimed to be the most perfect of all semi-translucent glasses and is high in popular favor. The introduction of nitrogen-filled lamps has called for a special quality of white glass on account of the very penetrating glare of the high efficiency filament which ordinary glass will not soften, unless made very thick. This increases the absorption of light and cuts down efficiency. This company has developed a glass that will reduce this glare with a minimum amount of absorption. This glass is their "Lumo," which is rapidly coming into favor for use with the nitrogen lamp.

Deep positive etching in old ivory color.

Flood Lighting Niagara Falls

To gaze upon the tumbling, seething waters of Niagara Falls is to gaze upon one of the continent's most beautiful works of nature. A pity it has been that the coming of night shut out from the visitor's eye the beauties and wonders of the falling waters that only the day could disclose. Many the would-be visitor decided against a stop-over at the Falls because his train stopped at Niagara after the sun went down. Recently, partly from altruistic motives, and partly because of business and advertising, the city of Niagara Falls, New York, appointed a committee to suggest a plan of flood lighting this city's prime attraction.

Invitations were extended to the different producers of flood lamps to submit suggestions and estimates of the cost of flood lighting Niagara. Demonstration was given in many cases and the after-dark beauties of the Falls revealed. Among others, the Western Electric Company, distributor of the Western Electric Davis Flood Lighting Unit, gave a demonstration. This demonstration showed the committee how these lamps could transform the cataracts and Falls into a scene unrivalled for splendor. The trial installation consisted of three batteries of lamps placed at as many vantage points. One battery of five lamps was placed below Prospect Point and shot its wonderful white rays across the American Falls at an upward angle. Across on Goat Island, at the crest of Luna Falls, was situated a battery of fifteen lights, sending their rays downward and across the Luna and American Cataracts. The third battery, consisting of five lights, was on the west parapet of Goat Island bridge. The latter lights played upon the rapids down to the brink of the Falls.

The effect of the illumination was wonderful, and spectators were held spellbound by the marvellous beauty of Niagara bathed in the glare of a pure white electric light—an effect no wondrous sun light could equal.

As a result of this demonstration and because of the extreme simplicity and low upkeep of the system, the contract for flood lighting the Falls was awarded to the Western Electric Company. The flood lighting unit that will be used is a standard light that this company has installed throughout the country to flood light bathing beaches, large industrial plants, railroad yards and for every use where light at night is essential. The lamp, illustrated herewith, consists of a large cast iron base, a hollow iron pipe standard and the case proper. The perfectly diffused ray is secured by means of a 1,000-watt type C standard Mazda lamp and a polished glass reflector that will neither crack nor peel under the heat of the lamp. This reflector has but one adjustment that throws the ray from the lamp in either a diffusing flood or a narrow beam.

Type of unit used in flood lighting Niagara Falls.

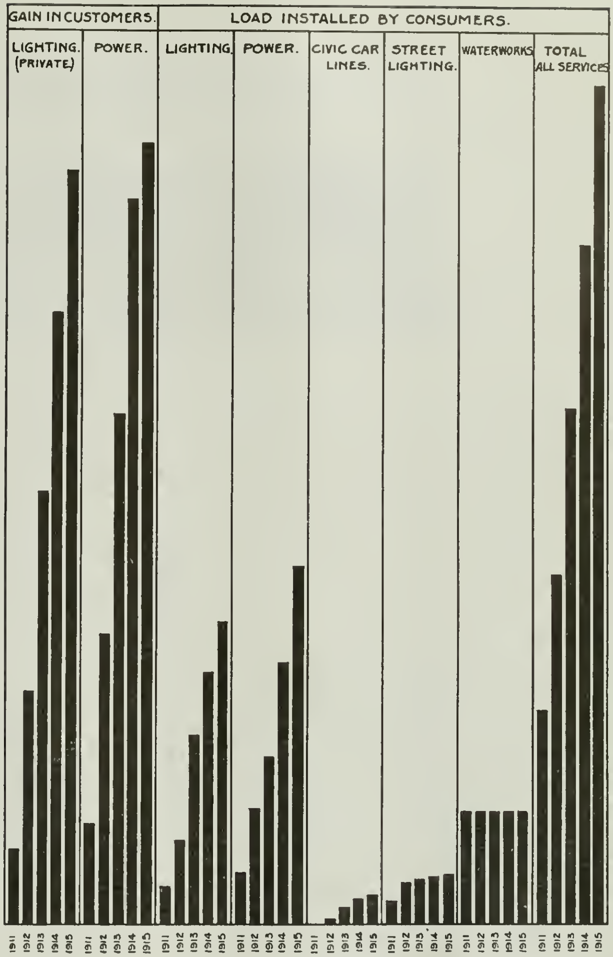
Sudan Glass is a heavy density opal designed to fill the requirements of the semi-indirect system of illumination which is generally considered to be the best for all installations where close work is required, such as schools, offices, drafting rooms and reading rooms. The Canadian General Electric Company have just issued a new pamphlet describing their 3031 Sudan, and in addition giving a considerable amount of information and data for the proper lighting of these places. A formula is given to determine the quantity of light necessary to produce a certain foot-candle intensity, and the intensity required is also given, so that the pamphlet will be of direct service in the layout of lighting systems for these purposes.

Toronto Hydro Annual Report

The fifth annual report of the Toronto Hydro Electric System is just to hand. The report is prefaced with a history and explanatory memorandum, outlining the work of organization from the year 1900 up to the present time. Then follows the report of the commissioners, containing the financial statement. The total assets are now placed at $7,816,810, including approximately $900,000 in current assets, such as stores on hand, accounts receivable, cash in bank, and so on. Liabilities are made up of bonded debt to the amount of $5,819,050, current liabilities of $899,728, and reserves of almost $1,100,000.

A specially interesting section of the report is that submitted by the General Manager, H. H. Couzens. It points out that the total kilowatt-hours sold during the year 1915 amounted to over 109,500,000, which represents an increase of more than thirty per cent. On account of the substantial reduction in rates the revenue has naturally not increased in proportion, but there is, nevertheless, an actual increase of about $100,000.

Probably the most noticeable item in the general manager's report is to the effect that in spite of the increase of over thirty per cent. in total kilowatt-hours sold, as mentioned above, the actual expenditures on operating and maintenance, excluding power purchase, is less in 1915 than in 1914. This tangible proof of efficient and economical management will doubtless be appreciated by the citizens. It is all the more noteworthy when we consider that practically every item that goes into the maintenance and operation of such a system has been increased. The net surplus for the year is slightly over $16,000, after defraying cost of operation and power purchase, interest and sinking fund charges, and a liberal allowance of a quarter of a million dollars for depreciation. The illustration herewith indicates the growth of the business of this system year by year for the past five years.



Growth of business year by year, separate services—Toronto Hydro Electric System.

A very human interest is added to the report in the honor roll of the employees that have enlisted for the war. This number totals 140 up to June 1, 1916, of which, so far as is officially known, 3 have been killed in action, 2 are reported missing, 2 have been invalided home and 4 are prisoners of war.

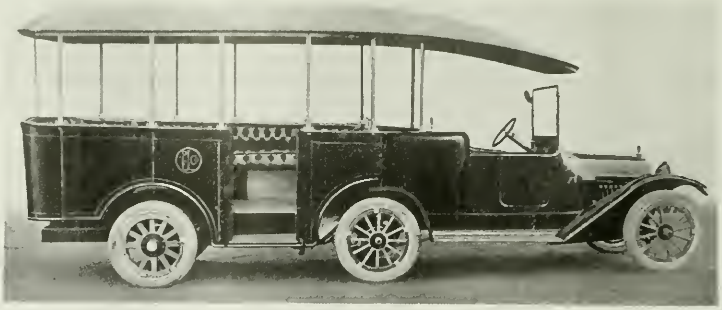
Motor Bus as Auxiliary to Street Railway

A question which is of great interest to many municipalities is the extent to which some form of motor-bus can be used to supplement the existing street car service; in outlying districts, for instance, which it is desired to connect with the existing lines, but where it is not practicable to build expensive extensions under present conditions. A number of different designs have been developed and, from time to time, described and illustrated in the Electrical News. An innovation in motor-bus construction, however, is contained in the design illustrated herewith. It is called the "Fadgl Flexible Car," and was developed by the Fadgl Flexible System, Inc., of San Francisco, Cal.

The passenger body is supported on a ball and socket joint located forward of the rear axle of the engine member, thus combining the two parts in a six-wheeled, flexible coach. An automatic steering lever connects the middle or driving axle with the hindmost axle, the latter having the same connections between wheel and axle as the ordinary automobile front axle. In this way the hindmost wheels are made to track those ahead, and thus the limiting turning radius for the entire coach is no greater than that of the four wheels of the engine member.

A feature claimed for this type of construction is that because the forward end of the passenger section is supported at one point, the rocking common to the ordinary four-wheeled car is absent. By having the motor on a separate chassis the passengers do not feel its vibration, and the connection is made convenient for speedy uncoupling, so that in the event of any breakdown on the engine member the rear section can be jacked up and another engine member coupled on in a few minutes. Spanning the flexible joint between the engine member and the passenger section are curtains, which operate on spring rollers. These curtains are to be painted with route signs.

One man operates the machine, the seating arrangements being such that passengers pay their fares on leaving. The



An innovation in motor bus construction.

first two cars built have a seating capacity of twelve in the rear section and one with the driver. These cars were built according to plans which have been worked out in detail for either twelve or twenty-passenger bodies. Any light automobile can be adapted as a motor.

The first two units, and the one shown herewith, were equipped with Chevrolet motors, developing about 30 h.p., and it is stated they are adapted to similar light engines such as the Ford, Maxwell, etc. In a cross-country test one of these cars travelled 246 miles in ten hours and thirty minutes, arriving in excellent condition and ready for immediate service.

It is believed that this coach combines the good points of the jitney, such as low operating cost, curb-loading, quick get-away, and comfort of riding, with many of the good points of the trolley, such as greater capacity, responsible management, etc. The motive power of the flexible car can be made either gasoline or electricity; in fact may be adapted to use the trolley, where such exists, and to leave the trolley and run on its own power in outlying districts.

Improved Type of Solderless Connector

The electrical department of the Frankel Display Fixture Company has recently been incorporated under the title of the Frankel Connector Company, Inc., to carry on the manufacture of Frankel solderless connectors, testing clips and other electrical specialties. The illustration shows several types of the Frankel connector. The phantom view, Fig. 1, shows the principle of the connector and how the design has permitted the use of the fewest possible parts to make a rigid connection. This simple construction, it is claimed,

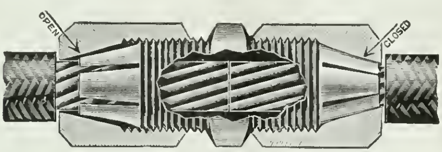


Fig. 1.

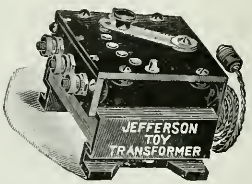
reduces the liability of the connector getting out of order and in addition provides a connection that is strong mechanically and electrically. The company is also manufacturing a line of connectors for panel boards to replace soldered terminal lugs for front and back connections.

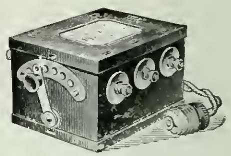
In the report containing the approval of the Frankel solderless connector, Underwriters' Laboratories, Inc., state regarding a test, "At 1000 amperes the soldered joint melted and dropped from the joint. The joint where the wires were attached to the connectors were unaffected by the test."

Flexible Toy Transformers

Jefferson flexible toy transformers are designed to be connected to the ordinary house lighting circuit for the purpose of reducing the current to suitable voltages for operating all classes of electrical toys.

The flexible features consist of a regulating switch and master connection post, by means of which a range of volt-





ages from zero to the maximum limit of the transformer is available in small and uniform steps.

The incorporation of a regulating switch and master connection post results in a very wide range of low voltages for operating and regulating the speed of electric engines, small motors, electric trains, etc. In fact, the different uses to which they may be put are unlimited, depending only on the ingenuity of the experimentor.

A large celluloid plate is fastened on the top of the transformer, showing plainly the various secondary voltages obtainable. The connections are extremely simple, and can be made instantly by any youngster. Any of the low voltages may be used singly or simultaneously. Also any number of leads of the same voltage may be used at any time.

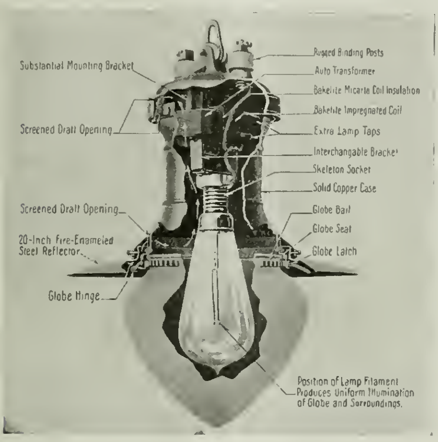
Nos. 1-2 and 3 transformers are mounted in a black enameled steel case, while the "Little Jeff" type is assembled in a cast iron frame. Each transformer is equipped with an extension cord and attachment plug, so that it can be attached to any alternating current circuit. With ordinary care transfers are guaranteed to last a lifetime. They are sold by the Northern Electric Company, Limited.

The rapidly increasing use of Hydro current in Galt, Ont., has made it necessary for the local commission to decide on doubling the present capacity. This will entail the enlargement of the sub-station. Eight hundred horsepower has been added to the load this year.

Luxsolite Street Lighting Equipment

More and more, Mazda C lamps are being utilized for street lighting, necessitating the employment of suitable fixtures if the lamps are to be used on series lighting circuits. The fixture illustrated, made by the Canadian Westinghouse Company, Limited, of Hamilton, Ontario, is designed especially for the operation of 400, 600 and 1,000 candlepower, 15 and 20 ampere Mazda C lamps on series circuits. Its low first cost and simplicity, together with its reliability, makes it a more attractive proposition than trying to modify old arc lamp cases, particularly from the standpoint of ventilation and protection from rain. The Luxsolite fixture, as it is called, can be substituted for the enclosed carbon arc lamp without change in other equipment, and will give three times the amount of light for the same power consumption.

This fixture is especially conspicuous by its screening and cleanliness. Ventilation is secured by a screened opening close to the lamp base, where the cool air is most needed. A screened outlet is provided in the top of the lamp case, thus insuring a good draft. Insects are kept out by means of these screens, and owing to the excellent ventilat-



For operating series Mazdas.

ing scheme, no hole in the bottom of the globe is necessary. The case is of solid copper, finished in black lacquer. Rugged binding posts are provided on the cast top. Either a porcelain fire-enamelled or an aluminum finished reflector may be used. A slightly opalescent globe, similar to that used with arc lamps, is employed. It is designed to be filled with light when the lamp is burning, acting as a highly efficient secondary source of light without a dazzling effect. The globe ball is hinged at one side and latched at the other in a very convenient and rugged manner, enabling the removal of the lamp with but one hand.

One of the most important parts of the fixture is the auto-transformer for enabling the use of a high current lamp on the usual low current series circuit, thereby effecting a gain in efficiency of from 20 to 30 per cent. The auto-transformer also acts as a protection, in that the surges from the line are cut down materially before getting to the lamp. When it is considered that the lamp filament burns at so high a temperature that a 30 per cent. increase in current would bring the filament to the instantaneous melting point, the fact that the auto-transformer cuts this down to such an extent that it takes a 50 per cent. increase in line current to make a 30 per cent. increase in lamp current, may readily be one of vital consideration. The lamps are relatively expensive. Only a short reduction in their average life due to surges, would pay for the additional cost of a fixture with auto-transformer. The auto-transformer, in addition, eliminates the necessity for a film cut-out, as the primary winding maintains the continuity of the circuit when the lamp burns out.

In standard practice a constant current regulator is used in connection with Luxsolite fixtures for Mazda C lamps. As before stated, these lamps are expensive, and should be given the greatest amount of protection possible. Such protection may be best afforded by the use of a constant current regulator, due to its extreme accuracy of regulation and ability to protect the lamps from surges and grounds. Furthermore, with such a regulator it is possible to operate Mazda C lamps on 25 cycle current, which was not generally true of the arc lamp systems. The high current used in the lamp itself eliminates any flicker in the light due to the low frequency.

By a slight modification, omitting the auto-transformer, and putting in a multiple socket, the same fixture can be used for yard lighting or outdoor display lighting, as it is particularly designed to protect the lamp in exposed locations.

Geyser Water Heater

The illustration herewith shows the Geyser electric water heater, a new water heating system which has been developed by the Feldman Manufacturing Company, Inc., New York. The heater, as illustrated, is for installing at the source of water supply, wherever it may be required, the bath, the

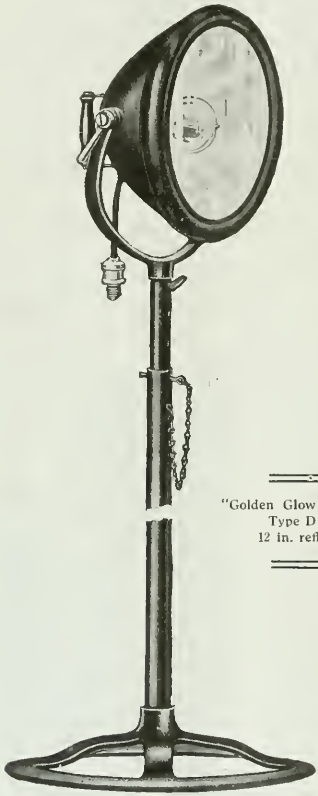
kitchen, the doctor's or dentist's office. The one faucet which is incorporated in the heater supplies both the hot and cold water. Quantity and temperature are under absolute control. When the handle is turned to the left, hot water is supplied; turned to the right hot water flows from the tap; and when in neutral position current consumption ceases. The "Geyser" is simple to attach and may be installed as a primary or auxiliary water heating system anywhere where electric current is available.

The Montreal Wednesday Electrical Luncheons will be resumed on October 4th. Several papers are being arranged for by Mr. P. T. Davies, chairman of the papers committee.

"Golden Glow" Projectors

The Electric Service Supplies Company, since its purchase of the "Golden Glow" headlight, searchlight and lamp business from the Esterline Company, Indianapolis, has perfected the "Golden Glow" Projector, a projector having all of the inherent qualities of the "Golden Glow" headlight and searchlight.

It requires very little imagination to realize the many uses of a projector of this kind for flood-lighting large areas. They have already been found particularly well adapted to flood-lighting sections of track on electric and steam roads where construction work is carried on at night, and for the



"Golden Glow" Projector
Type D L S
12 in. reflector.

lighting of docks to assist in unloading freight or for installation on small piers of motor-boat club houses, both for the general lighting of the pier and for safety in distinguishing boats a thousand feet or more from the pier. These uses and a hundred others will suggest themselves to the reader.

"Golden Glow," the trade name typical of the light projected from the "Golden Glow" reflector, is of a golden-yellow color. The principle involved centers around the effect of various light rays on the human eye. If the spectrum be analyzed it will be found that the violet, ultra violet and other high frequency rays form the blinding, dazzling, brilliant portion of the light from the ordinary incandescent or arc lamp. Illumination by such light has so long been common practice that one naturally judges a source of light by its intrinsic brilliancy rather than by its effect on the human eye.

The effect of the violet, ultra-violet and other high frequency rays, and the red rays which are mostly heat rays, is well described by Arthur J. Sweet, a recognized authority on this subject, in a paper on "The Influence of Illumination Conditions upon Eye-strain," as follows:—"In ordinary daylight vision, the yellow rays are brought to a focus on the retina, the blue rays just in front of the retina and the red rays just behind the retina. The distinct element of ordinary vision is therefore given by the yellow rays, the red rays and the blue rays serving to very slightly blur the sharp outlines of the visualized object. Of course, this blurring is too slight in degree to be detected by casual observation. It is, however, sufficient to require a considerably increased intensity of illumination on the visualized object in order that the exact outline and finer details of the object may be seen distinctly.

The effect of the blue and violet rays on the human eye is best demonstrated when one attempts to look directly into a high powered arc or incandescent lamp or the sun. It might be added, too, that the violet and blue rays in sunlight are the portion of the light which destroys bacteria and germs on the earth. Therefore, when the eye is directly exposed to high powered artificial light as is the case in present days, it is well to judge a light by its effect upon the human eye rather than by its intrinsic brilliancy.

So it was with full knowledge of the effect of the various light rays on the human eye that the "Golden Glow" reflector was produced. It is mounted from a greenish-yellow glass, ground to a true parabola by special machinery and polished and silvered as would be the finest French plate glass mirrors. The violet, ultra violet and other high frequency rays are absorbed by the glass reflector, thus projecting a powerful beam of golden-yellow light which is non-blinding and wonderfully adapted to the penetration of fog, dust, or moisture. These non-blinding and penetrating features make this unit particularly well adapted to flood-lighting where the effect of the light on the workmen's eyes is to be considered, and for illuminating piers where fog and moisture in abundance must be penetrated.

These projectors are manufactured in two sizes, the smaller size being equipped with a 9-inch diameter reflector while the larger size employs a 12-inch reflector. Concentrated filament lamps of any wattage up to 150 in G-25 bulbs having a light centre distance of 2¼ inches, may be used with the 9-inch reflector, while the 12-inch reflector takes concentrated filament lamps up to 250 watts in G-30 bulbs, having a light centre distance of 2¾ inches. They are equipped with a focusing device accessible from the outside of the shell, so that the beam of light, by this simple adjustment of the focal centre, may be concentrated in a straight beam or dispersed to cover a large area. The projector proper is mounted on a pipe standard which is adjustable in height and anchored in a large circular base of light, but durable construction. These projectors are readily portable on account of their light weight, and well balanced due to their large bases.

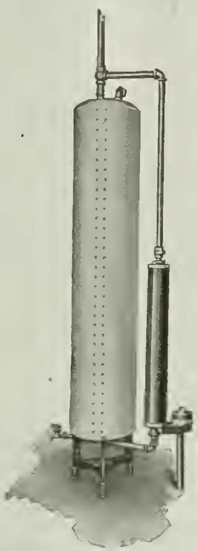
The chief counsel of the city of Montreal has ruled that the city has no power to compel the power companies to use the lanes instead of the streets for the erection of poles. The ruling is based on the ground that the lanes are private property; and the companies cannot be deprived of the right given by the Legislature to use the streets.

Mr. Gordon Kribbs, one of the engineers of the Ontario Hydro-electric Commission, was in Kingston, Ont., recently regarding the eastern Ontario power situation. It is said to be the intention of the Commission to extend its power lines westward until they meet those of the Seymour Company at Napanee.

Electric Circulation Water Heater

For heating water in the kitchen tank the National Electric Heating Company have brought out a new heater which is the result of several years' experimenting to obtain a highly efficient and reliable unit. Three heats are provided on all sizes but the 660 watt.

Owing to the varying conditions it is hard to make any definite statements as to what size heater should be used. Where electricity is cheap the company recommends the large sizes. With proper economy in operating the larger ones, due to their rapid working capacity, it is believed these will prove rather more economical; as for example, if it takes 1,000 watts an hour to heat 15 gallons of water, 2,000 watts



The new National Electric water heater.

will heat the same amount to same temperature in half an hour, theoretically, but possibly in a little less time, because of the shorter period of radiation.

The power companies' lines or size of house service may determine size of heater to be installed When an electric range is used on a three-wire system and a large heater is desired the company recommend the use of 220 volts. The following table gives the average time necessary to heat 30 gallons of water from 50 to 120 degrees F.

Watts	Time
660	7 hr. 30 m.
1000	6 hr. 00 m.
1500	3 hr. 35 m.
2000	2 hr. 30 m.
3000	1 hr. 30 m.

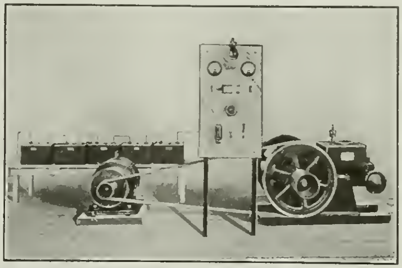
National electric water heaters are made in the following sizes:

Watts	Diam.	Length overall includ. couplings	No. of Heats
660	4 in.	18 in.	1
1000	4 in.	24 in.	3
1500	4 in.	24 in.	3
2000	4 in.	30 in.	3
3000	4 in.	36 in.	3

The installation recommended includes "non-by-pass" tee which should be connected directly above boiler, as shown in cut. This prevents cold water by-passing through heater when hot water is drawn. It is also advisable to use an insulated covering for boiler which increases the efficiency of the apparatus.

Good Light at Isolated Points

The Main Electric Company, as was anticipated, are meeting with a very considerable demand for their small isolated electric plants. These are made in sizes from 7-light up to 200-light or more. One of the plants is mounted on skids so that it may easily be carried, complete, from one point to another by two men. For farm house lighting, out-



buildings, summer homes, and at other isolated points where good light and a limited amount of power are required, these plants are now both dependable and economical. This company is placing its products through agents at various points in Canada, though a limited amount of territory is still open. It looks like a very attractive proposition for the electrical contractor or dealer who is in touch with rural communities in his vicinity.

Current Transformer for Series Street Work

A stationary coil constant current transformer has been put on the market by the Canadian General Electric Company for controlling certain classes of series street lighting where it is desirable to mount the transformer on a pole and operate it with a time switch. As this transformer has no moving parts, it is well adapted to fill this condition. In operating the high efficiency Mazda lamps it will allow a smaller variation between full load and short circuit than any device on the market, except the movable coil constant current transformer. A considerable field exists where a transformer of this kind can be used. This field can be divided into two parts, as follows:

First.—Where lighting companies run transmission lines through small villages where no lighting is done at the present time this stationary coil transformer will make it possible to install 10 to 30 incandescent lamps without necessitating an attendant to watch the operation of the transformer or lamps, the transformer being turned on and off by means of a time switch. At the present time these villages are not lighted for the reason that the cost of running special wires from the nearest central station is so high as to make it prohibitive, and it is entirely out of the question to put in a central station and employ an attendant to care for the small number of lamps that would be used in these small villages.

Second.—The transformer will be used extensively in city and suburban lighting where it does not seem desirable to run high voltage series circuits.

Briefly, the field for which this constant current transformer is particularly adapted lies along high potential transmission lines, in small villages, and with lighting plants where first cost is the determining factor. This transformer is oil-cooled, and is mounted in a cast iron tank, which is weatherproof, being provided with a gasket beneath the cover, which prevents the entrance of dust and moisture. The cover is securely clamped down by eyebolts, which serve also for lifting the transformer. To simplify installations the two primary and secondary leads are brought out of the tank. The coils have ample oil ducts, which insure a low and uniform temperature throughout the windings. The temperature rise is guaranteed not to exceed 50 degrees C. above 25 degrees C. The core and coils are subjected to the well-known vacuum drying and compound filling process, leaving the transformer in a solid moisture-proof and oilproof unit, which is securely bolted in the tank.

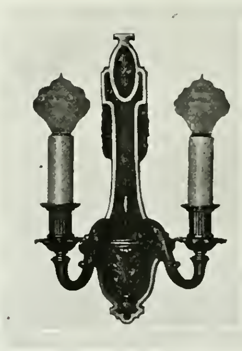
The transformer is so designed that it will not be injured when subjected to swinging or dead grounds in any parts of the secondary circuit. It is also designed so as to have an open circuit voltage, which will positively puncture the film cutout when lamp burns out. The stationary coil transformer is desirable because of the fact that it is complete in itself and has no external reactance or choke coils, as it is free from moving parts and as it requires no more attention than the ordinary lighting transformer.

Electric Engine Warmer

With the rapidly increasing use of the gasoline automobile during the winter months, chilled engines and frozen radiators are one of the serious problems of the private garage owner. To adequately heat the entire garage all winter is expensive, and, moreover, unnecessary—as the vitals of the car under the hood are the only parts which need to be protected from the extreme cold. To drain the radiator every time the car is brought in means its refilling with warm water in the morning—all of which is very inconvenient, to say nothing about the engine, which is usually so cold that it requires considerable work and priming to start it. The problem has been solved by an electric engine and radiator warmer, which is simply screwed into any lamp socket in the garage and placed down in the hood of the car between

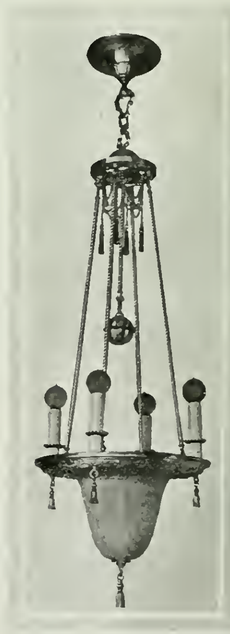
the engine and the radiator. The body of the heater contains a rugged heating element which consumes about one-tenth of a kilowatt, and gives off just enough heat to keep the radiator from freezing and the engine from causing starting trouble. The hood of the car, however, should be blanketed in severe weather to hold in the heat. The Hughes Electric Heating Company are placing one of these heating units on the market. Their heating element is enclosed in a black enameled metal shell—shaped like, and about the size of an ordinary dry cell—which is perforated to allow for circulation of the heated air from within.

Chandeliers are in great favor.



Although costlier, the solid cast fixture reflects quality.

Three of the latest types of fixture by the Tallman Brass & Metal Company, Hamilton, Ont.



Combination semi-indirect and candle fixtures are popular.

Current News and Notes

Edmonton, Alta.

The Board of Trade have adopted the report of the city council recommending that the street railway be leased for a period of twenty years, provided the city can get a company willing to pay a yearly rental sufficient to meet the payments of principal and interest, the sinking fund charges and to wipe out the deficit of the system to date. The Board also adopted the recommendation of the Civic Interests Committee against using the surplus of one public utility to wipe out the deficit of another. The contention of the committee was that it was hardly fair to load the telephone department or the electric light department with a deficit sustained by the railway company.

Hamilton, Ont.

The contract for installing the power and light mains at the new City Hospital has been let to Culley & Breay—the figure being $882.

The Hamilton Hydro-electric Board will make application to the city for the issuing of debentures of $180,000 to cover the cost of extensions. A new east-end sub-station is planned.

Mr. T. J. Stewart, Hamilton Hydro Commissioner, has announced that there will be another reduction in rates to take place in November. The Hydro finishes its year in October and the Commissioner stated there will be a surplus of about $30,000.

Montreal, Que.

At a general meeting of the Quebec Railway, Light, Heat & Power Company, Montreal, the financial statement for the fiscal year just closed showed gross receipts of over $1,750,000, representing an increase of $183,000 over the revenue of 1915. The net profits after deducting operating expenses, expenditure of $700,000, are $79,000. The surplus for this year is $215,000, an increase of $95,000.

Morrisburg, Ont.

At a recent meeting of the town council it was decided not to accept the offer of the Ontario Hydro-electric Power Commission to lease the Upper Power Plant. Though the plant is at present lying idle it was the opinion of the council that it would be to their advantage to turn down the offer

New Westminster, B.C.

The Board of Trade of New Westminster, B.C., has asked the City Council to instal an electric system for operating the gates and semaphore on the Lulu Island bridge giving access to Queensborough industrial section. At present there is an average delay of fifteen minutes whenever the swing is opened for the passage of a steamer. The swing section is already operated by electrical power, the loss of time being occasioned by having to use hand power for the gates and semaphore.

As a result of some surprising cost figures submitted by Electrician Digby, the City Council of New Westminster on August 25 signed the death warrant of the arc lamp and ordered the installation of the new nitrogen lamps all over the city system. City Electrician Digby's figures showed an estimated reduction in the cost of street lighting from $12,914, with arc lamps to $4,673 with the new system—a saving of over $8,000 per year.

Quebec, Que.

The Quebec Railway Company's surplus for the year ended June 30 last was $215,403, against $119,775 for the previous year. Earnings on the common stock are at the rate of about two per cent.

Rainy River, Ont.

The Rainy River Electric Light and Power Company have made numerous changes and improvements in their lighting system and are now developing 60 cycle current in place of 133 as formerly.

Sarnia, Ont.

Hydro-electric power was turned on in Sarnia, Ont., on September 20. Current is being received from the Kent sub-station. A new sub-station has been erected in Sarnia.

Toronto, Ont.

Mr. J. W. Purcell, assistant engineer for the Hydro-electric Power Commission of Ontario, has just returned from a trip through Oxford County and states that during a campaign of five days he received the signatures of 68 farmers on Hydro-electric extension contracts. During an eight-week campaign in north and south Norwich 48 contracts were made with farmers for Hydro power.

Waterloo, Ont.

Efforts are being made for the extension of Hydro power from Waterloo, Ont., to St. Jacobs.

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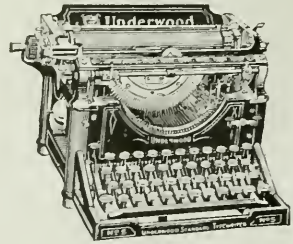

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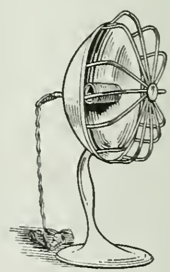

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Take a Proper Interest in Your Societies

Now that the season of society activities has come around again we should like to commend to young Canadian engineers (and some of the older ones, too,) the sentiments contained in an article which recently appeared in the Bulletin of the Oregon Society of Engineers, from which we print extracts below. One is frequently struck with the comparatively small attendance at the branch meetings of our Canadian Society of Civil Engineers and of the American Society of Electrical Engineers, the two most active of our engineering bodies, where even discussions of the most timely interest, or lectures by men of pre-eminent standing in their particular field, fail to arouse the interest of more than a small percentage of the engineers within easy reach. Now that the Canadian Society in particular, and, we hope, Canadian engineers in general, have decided to look upon life more with the eye of the business man and less with that of the sentimentalist, they would do well, we believe, to consider just how far their business interests would be served by joining in, a little more heartily, with their engineering societies' activities, getting a little better acquainted and contributing a little more to the interest of the work by verbal discussions and written contributions—in a word, doing their "bit." The societies would be more prosperous, and so, we take it, would the individuals:

"Many engineers have a notion that acquaintanceship with other engineers, while agreeable enough, so far as it goes, doesn't really amount to anything where dollars and cents are concerned; and these deluded individuals are expending their substance in 'putting up a front' and otherwise cultivating the acquaintance of men of other professions.

"Now I am not going to say anything against the other professions, nor the men in them, but I honestly believe that for practical purposes the acquaintance of one engineer is worth to an engineer that of half a dozen other men. In my own case it has proved true. Total strangers have walked into my office and given me better jobs than I knew were available—sent to me by engineer friends—while the best that I could get out of the other acquaintances might be a chance to stake out a lot—at half price—as a neighborly act, you know. And they make a fellow feel at the same time that they are giving him the work largely as an act of charity.

"There are four or five hundred engineers in and around Portland. How many of them do you know? How many of them know you? If you were asked to design a bridge or a power station, and were too busy or didn't know how, could you recommend a man to do the work? Or to reverse the case, how many of the five hundred engineers in this vicinity know your specialty and your qualifications?

"I'm willing to bet that they are mighty few. Maybe it is just as well, too, for frequently those who know me tell me that I have missed my calling; and they may be right about it. Quien sabe?

"You may have missed your calling, also, in which case the greater the secrecy surrounding you, the greater will be your chances of success as an engineer.

"But supposing that you are an engineer ,and a good one, which is, after all, the only assumption that we can proceed upon, can you not see that it will be distinctly to your advantage to have all of the other good engineers in the community know what you can do and how you can do it, as well as to know some of the things that you have done in the past?

"Perhaps you are employed now, and are satisfied with the surroundings and salary, and that there is no prospect of a change. Hundreds of others have been in the same circumstances one day, and the next have been left high and dry, through no fault of their own, with no job, and no knowledge of how to get one. Wouldn't their chance of immediate re-employment have been increased greatly if they had been widely and favorably known among the engineers of their town?

"Possibly. But how could they or you achieve such a result without too great a cost?

"By joining a local engineering society, and by attending the meetings and when there by 'mixing.' Make it a point to meet one or two or a dozen new engineers every month. Find out what they have done and are doing and hope to do, and don't be too modest. Let them know who you are and what part of the world your work supports.

"Search out the chairman of the program committee and drop a hint that you have some interesting lantern slides showing a work upon which you were engaged before coming here and if properly pressed will consent to show them to the society and explain the peculiarities of the work.

"Look up the publication committee chairman and tell him that you have written, or will be glad to write, a description of some of your experiences in China or Nebraska, as the case may be, if he can use such matter to advantage—which you bet he can.

"When a subject is up for discussion upon which you are informed or 'wish information, tell what you know, or ask such questions as will bring out the information you seek. Others will thank you, and will form a favorable opinion of your professional skill."

The Electric Club Hears About "Life-Saving"

The old adage that there is "safety in numbers," is rapidly giving place to the more logical conclusion that there is much greater safety in "caution." The numerous "Safety First" campaigns which have been inaugurated in recent years have amply justified their existence, and the public, in general, appear, in some measure at least, to have actually become, by habit, more deliberate and more painstaking to avoid placing themselves amid unnecessarily dangerous surroundings. There is a vast difference, however, between the man who once or twice a day may thoughtlessly encroach on the path of the street car or automobile traffic, and the other man, who in the electric generating station, sub-station or on transmission line work is constantly within easy reach of a death-dealing agency. More than that, the man who carelessly throws himself in the way of moving traffic has an even chance that the other fellow is "looking," but with the man who lives among live wires there is no such possibility—the "other fellow" is unfailing, inexorable and instantaneous in the prosecution of his "frightfulness," as only an electric current can be.

And so, the educational work being carried along by the Electrical Employers' Association of Ontario, as outlined by their inspector, Mr. Wills Maclachlan, at last Friday's meeting of the Electric Club of Toronto, was of more than special interest to the electrical men present. Mr. Maclachlan spoke of the many dangers to which men exposed to the possibility of electric shock were liable, the frequent delays caused by preventable accidents, the financial losses entailed by such delays, the sufferings of the injured men, the privations of bereaved families and many other elements inseparably associated. He then described, briefly, the efforts of this association in recommending the use of safety devices, guarding danger points, urging operators to greater caution, and finally, by training the men in resuscitation work. Mr. Maclachlan has covered practically the whole of Ontario, offering suggestions at the various central stations and making a particularly strong point of the need for trained skill and promptness in resuscitation. In many cases regular classes have been inaugurated by Mr. Maclachlan and given preliminary training, and the companies have undertaken to see to it that a regular drill is maintained, so that in case of accident the men will have the necessary knowledge at their finger ends. An interesting feature of Mr. Maclachlan's talk before The Electric Club, was a practical demonstration of resuscitation by the Schaeffer prone method. As pointed out by the speaker, the value in this method lies not only in its simplicity but especially in the fact that it can be begun immediately—apparently the prime consideration in dealing with electric shock or drowning accidents.

The secretary, Mr. Frank T. Groome, announced that the speaker at the luncheon on Friday, October 13, would be Mr. E. N. Hyde, of Montreal, who would take as his subject, "Illumination from an architectural standpoint." Mr. H. H. Couzens, chairman of the Club for the month of October, presided.

Street Lighting Costs in Montreal

The name of Mr. Henry Holgate, Montreal, as consulting engineer of the proposed hydro-electric development at the aqueduct, has been under consideration by the Montreal Board of Control. Mr. Holgate is of opinion that the estimates of the city engineers as to the probable power to be developed are too low.

In connection with the proposed hydro-electric development, Mr. A. Parent, superintendent of civic lighting, has submitted a preliminary report to the Board of Control dealing with the cost of the new lighting system, under the hydro-electric development plan, by which the city will be supplied with energy. Mr. Parent makes it clear that his estimates for material and labor are based on present prices, and that the city will not, like a private company, be able to dispose of the surplus power. The figures only apply to the area which would be affected by a new contract to replace that with the Montreal Light, Heat & Power Company, which expires in 1920, and does not apply to certain wards where the contracts run from 1930 to 1942. Mr. Parent estimates that the city will require 3,160 horsepower for the purpose of lighting 5,000 lamps in 1920, and that the capital cost for this new system will be $1,680,000. On the assumption that the city will obtain, from the hydro-electric development, power at $15 per h.p. year (4,000 hours), the cost for arc lamps of 6.6 amp. per annum will be $77.17, against $72.70 now paid, and $73.14 for arc lamps of four amp., against $63.15. The estimate includes fixed charges on capital invested and general expenses of maintenance. Regarding the capital cost of $1,680,000, the more important details include $128,500 for land, main buildings, and sub-stations; for the construction of the overhead system for 425 miles of streets, the sum of $490,000 is put down; for the construction of an underground conduit system, the installation of cables, etc., $248,000; for the ornamental street lighting from the conduit system for 25 miles of streets, the estimate is $210,000; for equipping the shops and the lamp supplies, $525,000; and for various sundry items, including the salaries of engineers, the sum of $78,500 is estimated.

Southern Canada Power Extensions

Although there has been an enormous development in electric power for industrial purposes in the city of Montreal, comparatively little attention has been paid to the Eastern Townships of the Province of Quebec, where in recent years some very important manufactories have been established. The making of war material has intensified the demand for power, but even when conditions return to normal it is more than likely that there will be an enlarged market for current. In view of the possibilities in this direction, the Southern Canada Power Company, formed about three years ago, have made plans for developing the water powers in the district. At the present time the company operates in only a part of the territory which it is proposed to serve, obtaining power from three or four sources, one a 500 kw. plant in Drummondville. Current to the extent of 3,000 h.p. is also obtained from the Montreal Light, Heat and Power Company at Richelieu, this being distributed at St. Johns and St. Hyacinthe, and taken at 25,000 volts. At St. Hyacinthe a new sub-station of 3,000 kw. capacity has been built. The company will take 2,000 h.p. from the Shawinigan Water and Power Company, over a transmission line now being built from Windsor Mills to Sherbrooke.

The Southern Canada Power Company has been quietly extending its connections by absorbing other concerns. Thus the St. Johns Electric Light Company, the Gas, Electricity and Power Company, of St. Hyacinthe, and the lighting and power business formerly owned by the town of Drummondville were all acquired, and contracts made with various municipalities for supplying light and power. In order to carry out this business, a transmission line between St. Johns and St. Hyacinthe has been constructed, linking up St. Hilaire and Beloeil.

The company own all the water powers on the St. Francis River between Drummondville and the St. Lawrence, and the development of these will enable the company to ultimately produce about 100,000 h.p. Only a very small power at Drummondville has so far been developed; but this can be extended to a capacity of 12,000 h.p.; at Hemmings Falls, three miles above Drummondville, a further 18,000 h.p. can be developed, and with three other water powers the total of 100,000 h.p. can be reached. When the entire scheme is carried out there will be 200 miles of transmission lines in the form of a loop encircling a district with many important industrial centres.

Although the company is now taking power from the Shawinigan Company, that process will be reversed on completion of the scheme, as the Shawinigan has contracted to take from the Southern Canada Power a large block of power to serve the district south of the St. Lawrence.

Toronto Section A.I.E.E.

The Toronto Section of the A.I.E.E. has been fortunate in securing Mr. Chas. B. Scott, of Chicago, to speak to them on Friday, October 20th, on the subject of "Accident Prevention." Mr. Scott is the general manager of the Bureau of Safety. This organization has charge of the accident prevention work in a number of large public utilities, principally situated in the Central States. Among these are the Commonwealth Edison Company, of Chicago, Middle West Utilities Company, Public Service Corporation of Northern Illinois, the West Pennsylvania Traction Company, and numerous others. These companies have on their payrolls 20,000 employees. Mr. Scott first took up this work some nine years ago and has been actively engaged in accident prevention work since that time. He has been secretary of the Accident Prevention Committee of the National Electric Light Association for the last three years, is on the executive of the National Safety Council and is president of the Chicago local Safety Council. He also acted for the National Electric Light Association on the National Conference Board on safety and sanitation, and is a member of the Safety Committee of the American Gas Institute.

The work of accident prevention from a business standpoint is more or less new in Ontario and it should be of considerable interest to engineers to hear this subject discussed by a man who has been able to reduce the number of accidents in one particular company eighty per cent. and maintain it at that figure.

The meeting is to be held, as usual, in the lecture room of the Engineers' Club, 96 King Street West, at 8.15 p.m. All interested engineers are cordially invited.

Montreal Electric Lunch Club

The Montreal Weekly Electrical Luncheons were commenced for the 1916-17 season on Wednesday, October 4, at Freeman's Hotel. The luncheons were inaugurated in February last and continued until July, and in the words of a circular issued by the committee, "have been a success in promoting business friendship, as also a personal acquaintance of different companies, which has been greatly to the advantage of all concerned." The committee again represent practically every branch of the electrical industry, power and light, telephone, telegraph, manufacturing, street railway, and jobbers. At the opening lunch there was a very large attendance. The address was by Captain Dobbin, 24th Battalion, C.E.F., who in a bright speech told of his experiences at the front.

Electrical Meetings of the C.S.C.E.

During the 1916-17 session of the Canadian Society of Civil Engineers, Montreal, two meetings of the electrical section will be held—Nov. 16 and March 8. One of the papers arranged for is on "Transmission Towers," by Mr. Lesslie Thomson, of the Dominion Bridge Company. Mr. J. C. Smith is chairman, and Mr. J. de G. Beaubien vice-chairman of the electrical section.

Lieut.-Col. C. H. Mitchell Moves Up Again

Canadians everywhere must be highly gratified over the announcement, just to hand, that Lieut.-Col. Charles H. Mitchell has been promoted from the general staff of the Canadian corps in France to be first general staff officer of the general staff of the British Second Army. On the Canadian staff Col. Mitchell has done some very notable work, chiefly in charge of Intelligence, and won considerable recognition for the systematization of Intelligence for the conduct of entrenched warfare. The Canadian Intelligence system has become the model of the British and French armies

Col. Mitchell left Canada in September, 1914, on the general staff of the first Canadian division, and won his first laurels in the second battle of Ypres, his special services being recognized by his being invested with the Croix d'Officier Legion of Honor by the President of France. In August, 1915, he was promoted to first staff officer of the First Division, and in September, 1915, was made chief Intelligence officer of the general staff of the Canadian Corps, which embraced the two Canadian divisions then in France. In

Lieut.-Col. C. H. Mitchell.

June, 1916, Col. Mitchell was honored with the Distinguished Service Order for his special Intelligence operations. He has been "mentioned" several time.

The move-up from the Corps to the Army will give Col. Mitchell considerably greater scope, more especially as the second army, of which the Canadians have until lately been a part, is stationed in the Ypres district, and it is said by several authorities that he is the best informed officer of the condition on the Ypres front.

Col. Mitchell is a member of the firm of C. H. & P. H. Mitchell, Toronto, and is a well-known consulting engineer. Always a military enthusiast, he has progressed through infantry, cavalry, corps of guides, and latterly trained in the staff college, with always the Intelligence service as his goal. Peculiarly, as Col. Mitchell has often said, this service is analogous to the general duties of a consulting engineer. The reports on the situation, the scheme of action, the plans, the cost, the supervision during progress—all have their counterparts in the handling of the enemy.

Ontario Hydro-Electric and Hydro-Radial

Undertakings—Extracts from an address at the recent annual meeting of the Ontario Municipal Association

By Col. W. K. McNaught*

Mine is apparently a double-headed subject and looks as though it would take considerable time to deal with it properly. As I see it, however, these two subjects are practically "Siamese twins," and there is really only one great factor governing both of them at the present time, and that is the question of an adequate supply of hydro-electric power. What avails the erection of great manufacturing or smelting plants nickel refineries, chemical works—or the construction of electric radial railways—if we have not the power necessary to operate them?

It is true that there is a great difference of opinion, even amongst business men, as to the advisability of inaugurating great public enterprises during war time, and it goes without saying that the war must be our main business until it has been brought to a successful conclusion. Some say that the close of the war will bring such a boom to Canada as we have never before known, and we must get ready to handle the immense volume of immigration and increased business that will then come to us. Others equally competent say that we shall have to go through a period of reconstruction after peace is declared, and that for some years we shall see a great lack of employment and an era of low prices and business stagnation, during which every Canadian will be compelled to practice the most rigid economy.

Be this as it may, I venture to say that we shall be wise if we make preparations right now to vigorously prosecute, just as soon as the war is over, as many public undertakings as are commercially sound and that we are able to successfully finance. We shall at that time probably have some 300,000 men returning to Canada from the war, and these will need to be provided with work at once. We shall also have to find other employment for some 100,000 people who for the past two years have been engaged in making munitions and other war supplies of various kinds, but who will then have to find other employment. I am of the opinion, therefore, that it is our duty at this juncture to lay plans and make arrangements for needed public enterprises that can be put into operation just as soon as peace is declared.

These public enterprises will involve a great deal of investigation and planning, all of which will take considerable time. If we are wise and in earnest, this preliminary work will not be left undone until peace is declared, but should be gone on with now, when financial and economic considerations prevent us from prosecuting the construction of the works themselves.

The preliminary work I refer to is the making of surveys, drawing up working plans and specifications, and last, but not least, the purchase of the right of way for electric transmission and radial lines. These rights of way can, I am convinced, be purchased much more cheaply to-day than they can be in after years, and it would, therefore, seem to be wisdom on our part to take full advantage of present conditions in this regard. The present is not an opportune time, however, to proceed with the actual construction of great public enterprises, because labor of all kinds is not only scarce but very high in price, and the same thing can be said about the raw materials and supplies necessary for hydro-electric development or transmission, as also electric railway construction.

Prepare for Peace.

I see no reason, however, why we should not go steadily ahead with our surveys and the preparation of our working plans for all of these electric enterprises, so that when peace is declared we shall be in a position at once to furnish employment to a great many of our citizens who will then be really in need of it. Our returned soldiers will not want to eat the bread of idleness. They will neither want nor thank us for charity, but they were promised, and will expect, honest employment, and it is the duty of those of us who remain at home and whose battles they have fought to try and have this employment waiting for them when they return, and not force them to loaf around streets for weeks or months until we can get something ready for them to do. This is my personal view of the matter.

I started out by saying that the hydro-electric question that I am asked to discuss are like Siamese twins, because they are connected by a vital cord—hydro-electric power—the maintenance of the supply of which means life or death to both of them. In my opinion, the adequate supply of hydro-electric power is the greatest and most vital question before the people of Ontario to-day in connection with its future development and prosperity. Ontario has no coal, but she has enormous water powers that can be economically utilized for the benefit of the people generally, if we have the courage of our convictions and are willing to take advantage of the opportunities within our reach.

As you are all probably aware, the original policy of the Ontario Government was not to generate hydro-electric power, but simply to transmit it. Thus in connection with the Niagara, Ottawa, Port Arthur, and Brockville systems the Hydro-Electric Power Commission simply purchased power from existing generating companies and transmitted it to the municipalities interested. While this policy served its purpose in those districts it was not applicable in some of the other parts of the province, and, on the advice of the Hydro-Electric Commission, the Government adopted the more advanced policy of generating as well as transmitting hydro-electric power, and so far it has worked out in practice most satisfactorily. This principle has been put into practice at "The Big Chute," "Wasdell," "Eugenia," and "South Falls" systems. It also obtains in the Central Ontario system, purchased this year by the Government at a cost of $8,350,000, which is now under the control of and operated by the Ontario Hydro-Electric Commission. At the present time, with a couple of exceptions, the supply of power is, generally speaking, adequate, not only for present needs but for some time to come. The exceptions to this statement are the extreme southeastern part of the province, which I have termed the Brockville system, where the commission have been held up by circumstances entirely beyond their control, and the Niagara system, where the situation is most acute, not to say dangerous.

Power Situation at Niagara.

The situation at Niagara is so peculiar that I may be pardoned if I devote a few minutes to it. To do this properly it will perhaps be necessary for me to recall a few facts in connection with Niagara power that may have been forgotten by the people of Ontario. On the Ontario side of the Niagara River there are three generating power plants—the Canadian Niagara Power Company, the Ontario Power Company, and the Electric Development Company. In addition to these three there is also the Niagara Electric Railway Company, the latter being a small plant entitled to develop only 10,000 h.p. for use by the electric railways they operate, and there-

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fore not a factor in the present situation. The maximum development of these three companies when they use all the water they are entitled to, will, under their present system of development be 405,000 h.p., and I understand that their present actual combined development approximates 385,000 h.p.

These companies claim that under Ontario legislation they have the right to export one-half of all the power they generate, or 202,500 h.p., to the United States, and, as a matter of fact, they are at the present time exporting approximately 170,000 h.p. to that country. It will be apparent, therefore, from these figures that the companies are at present generating practically all the power they are entitled to generate (they are within 20,000 h.p. of it), and if the people of Southwestern Ontario are to get a satisfactory supply of additional power, it can only be obtained in one of three ways.

1. By retaining in Canada for Canada's needs the 170,000 h.p. of electric energy now exported to the United States.

2. By the generation of additional power, either by the existing companies or by the Government.

3. By a combination of both of these methods.

So far as the export of power is concerned, I have always been absolutely opposed to it in principle, and in a pamphlet I published six years ago I pointed out that the export of power never should have been allowed at all, but that, having been permitted by legislation, it would be found very difficult to get it back again when we needed it. We are up against that very proposition now, and it is not a theory, but an actual condition that confronts us. We are short of hydro-electric power in Ontario, and we are exporting 170,000 h.p. of it to the United States that we need not only badly but at once. Why in the name of common sense should we export 170,000 h.p. of hydro-electric energy to the United States and then have to import coal from that country for the purpose of generating power to take the place of that exported, for that is what we shall be compelled to do in the near future if the claims of the Niagara electric corporations are established and enforced. We must, and we probably shall, get this power back in the long run, but in fairness it must be said that it would be only a square deal to give the people of the United States who have been operating their factories with it a fair and reasonable amount of time in which to make other arrangements for power. This means, therefore, that it must come back to us gradually, and from what I know of the conditions I am confident that Ontario's demand for power will far exceed any supply that can be obtained from that source.

No More Development Under Present Plans.

So far as I can see, therefore, it is imperative that in addition to the return of this power to Canada, there shall also be a further development of power from Niagara River, and that this development must be done by and for the sole benefit of the citizens of Ontario, and not by any existing companies whose interests are naturally antagonistic to those of the people. The amount of water that can be taken from the Niagara River above the falls has been fixed by treaty for a term of years, and is, therefore, not in a position to be changed except by mutual agreement between the United States and Canada. By this treaty the United States are entitled to take 20,000 cubic feet of water per second and Canada 36,000 cubic feet of water per second from the Niagara River.

Of Canada's 36,000 cubic second feet the existing companies are entitled to use 29,400 feet, leaving 6,600 cubic feet still available for power generating purposes. To allow any of the existing companies to use this water which they could only do by enlarging their present plants, would be the height of folly, because it would entail an economic waste that the people would be foolish to allow in this day of scientific hydro-electric engineering. In this connection it is interesting to recall the fact that not so very many years ago the Electric Development Company made application for the use of all this unallotted water, which would have practically doubled their capacity. The Government very wisely refused this request, preferring to hold it in trust as a reserve for the people of the province. All of the water used by the companies at present goes through their turbines under an average head of about 155 feet (it varies from 140 to 180 feet), and at this pressure 6,600 cubic second feet of water would generate less than 100,000 h.p. of electrical energy. By conveying this water to Queenston, however, and generating power with it there, with a head of 304 feet, this same 6,600 cubic second feet will develop fully double that amount of electric energy, or over 200,000 h.p.

For this reason the Ontario Hydro-electric Power Commission are unanimously agreed that in the true interests of the people of this province any new development of power from the waters of the Niagara River should be done so as to get the very greatest amount out of it. To do otherwise would be an economic waste that could not be justified, and would be a crime against posterity, if not against the people of to-day.

Scrapping Present Plants.

It has always been a mystery to me why we ever allowed the companies to develop power at Niagara Falls instead of at Queenston, where there is a fall of over 300 feet as against the 150 or 160 feet at Niagara Falls. This is not a new discovery, for in 1891, years before any of the existing companies had commenced operations at Niagara Falls, a company had been chartered by this Province of Ontario and organized by J. R. Roaf, K.C., under the presidency of S. J. Dawson, M. P. for Algoma, one of Canada's most noted engineers, for the purpose of taking water from Chippewa Creek and conveying it to Queenston in order to develop power at that place. It was pointed out by the organizers of this company that this was the proper place for generating power from Niagara water, as they would get double the amount of power from the same amount of water developed there instead of at the falls.

The Hydro-Electric Commission have been carefully investigating this matter for several years, and they have satisfied themselves conclusively that Queenston is the proper place for generating power from the waters of the Niagara River. I think I voice the mind of the commission when I say that not only are we convinced that this theory is sound as applied to the 6,600 cubic second feet of Niagara water still unused by Ontario, but that it applies equally to every drop of water that is not being used for generating purposes at Niagara Falls.

I pointed out in a pamphlet I wrote six years ago that the time would probably come when all of the existing electric generating plants at the falls would have to be scrapped in order to utilize the water at Queenston or Jordan, where nature evidently intended it to be used for power generating purposes. Gentlemen, I was wrong in my calculations. That time is practically here now, and the sooner we start to retrieve our position by refusing to continue or enlarge an obsolete and discredited method of hydro-electric power generation the better it will be for the people of this province. The same water that is now being used to generate 385,000 h.p. of electric energy at Niagara Falls would develop nearly 800,000 h.p. at Queenston, so that if the present system is persisted in there will ultimately be a distinct loss to the province each year of 385,000 h.p. of electric energy. Turned into coal, this would mean nearly 8,000,000 tons of coal per year, which would be worth about $30,000,000 of money annually.

It will thus be seen that the scrapping of the present power plants at Niagara Falls is not a visionary theory, but a practical business proposition that must sooner or later be grappled with by the people of Ontario. Personally I am satisfied that the time will come, and that probably sooner than many of us anticipate, when our economic necessities will compel the people of this province to expropriate all of the existing Canadian power plants at Niagara Falls and utilize the water they are using to develop power at Queenston, and it is evident that such a policy would not only be a sound business proposition, but a patriotic duty in the highest interests of the province generally.

Present Needs of the Province.

I stated some time ago that even if we succeed in bringing back all the electric power that we are now exporting to the United States, the increase in the demand for power from the people of Ontario could not begin to be filled from the supply thus obtained. The commission are at present using 100,000 h.p. from the Ontario Power Company (the full amount of our contract with them) and 25,000 h.p. from the Ontario Niagara Power Company, or 125,000 h.p. in all, and we are expecting to obtain an additional 25,000 h.p. from the latter company in the near future. But this supply large as it seems, will not begin to fill the demands we have received from the municipalities served by this system, and it seems to be imperative that the construction of the new provincial generating enterprise at Queenston should be proceeded with as speedily as possible.

Much criticism has been indulged in about the supposed delay in going on with this work. In regard to this I may say that up to the present time there has been no delay whatever. There is much preliminary work, such as surveys and working plans, to be done, and the commission's engineering staff are doing this just as fast as they can, consistent with accurate and sound methods. In spite of every threatened obstacle such as "fiats" and others of that ilk, the commission long ago decided to go ahead and push this part of the work (which they estimated would take fully a year to do), so as to be ready to begin construction as soon as it was practically possible. So far there has been no delay whatever in this part of the work—and the commission do not intend that there shall be any in regard to any other part of it if they can prevent it. War or no war, this particular enterprise must be pushed on to completion if the industries of this province are not to be handicapped by a shortage of power to operate our factories and drive our radial railroads.

Use Power of Northern Latitude.

Before I leave this part of my subject I would like to point out that in my opinion a mistake is being made in endeavoring to locate electrical smelting and chemical works in this section of the province. The only available supply of hydro-electric power for this part of Ontario must come from Niagara, and, as we all know, its amount, although great, is limited. It has been conclusively proved that the per capita output of manufactories depends almost entirely upon the utilization of power per capita, and from this it is evident that "cheap power is one of the most important factors in social economics, and has a similar effect, as regards the community which enjoys it, as if it possessed natural resources of raw materials." This being the case, we should endeavor to conserve our power for the installation and development of industries employing as large a number of citizens as possible. In other words, if 1,000 h.p. of electric energy can be utilized to drive a factory employing, say, 1,000 skilled artizans it is worth far more to the province than the utilization of the same amount of power in an industry where only 100 persons are employed.

I do not want to be understood as being opposed to the installation and operation of electrical smelting or chemical works in Ontario. On the contrary, I believe that this province is the proper place for them, but they should not be located in the part of the country where the power is limited and where it will be all needed by industries requiring a large number of skilled artizans. Rather, they should be located further north, where power will be cheap and plentiful; where, if possible, supplies can be water-borne, and where the limited number of employees (mostly unskilled labor) can be readily obtained. An example of the successful working out of this policy can be found in Norway and Sweden, whose output of nitrates and smelted ores is one of the largest factors in their national prosperity.

Other Commission Activities.

Before closing, I desire to draw attention to some phases of the commission's operations of which the public have heard but little, but which are of vital importance to the success of the publicly owned hydro-electric systems and to the safety of the general public.

The first is the municipal purchasing department, organized by the commission for the purpose of supplying at cost to the municipalities interested such materials as poles, line wire, cross-arms, insulators, transformers, switches, lamps, meters, etc. Started several years ago in a small way, this department has steadily grown, until it is now doing a business of some $600,000 per year. To accommodate this ever-growing business the commission have erected an up-to-date fireproof warehouse at Toronto, in which is also housed a laboratory for testing materials and new apparatus by experts in the employ of the commission. You will be glad to know that this department has never cost the municipalities a single dollar, but has always been self-supporting. By the use of specially trained men in their purchasing department and buying in very large quantities, the commission have been able to furnish the municipalities with the best materials in the several lines they handle at a saving of from 10 to 50 per cent. on the prices they would have to pay for the same articles did they attempt to purchase them direct themselves. As an evidence of the appreciation of the municipalities in regard to the benefits of this department, I may say that 132 of the municipalities patronized it to a greater or less extent during the past year.

Another is the electrical inspection department. As you are all aware, the Ontario Hydro-electric Commission are charged with the making of rules and regulations in regard to all electrical installations in the province. The work done by the commission in this regard has been of great benefit to the public, inasmuch as it not only demands a better class of material and construction than heretofore, but by putting all electrical contractors on the same footing when tendering it gives the public an assurance that they are getting safe and durable work at fair and reasonable prices. In addition to this, at the request of the municipalities, the commission took over about a year ago all the electrical inspection of the province, and are now covering it pretty thoroughly with skilled inspectors, whose duty it is to personally examine and pass upon every electrical installation before it can be used. Under the efficient system at present in force in this department we have been able to rearrange and consolidate the districts throughout the province, so that where there were approximately 80 municipalities under inspection there are now 340 and where it required some 60 inspectors to take care of the old system it is now all handled much more efficiently with less than 50 inspectors. Many municipalities have been inspected and much of the old municipal work removed. Defective and dangerous installations are generally being taken out and a higher class of work is resulting from the persistent organization under which they are working.

Thirty-three municipalities have been given assistance with regard to ornamental street lighting systems and underground conduit construction. Plans have been drawn up and submitted, with estimates of cost; cables, conduits, lighting standards, etc., have been purchased for many of the municipalities, and the installations have been supervised during construction by the commission's engineers.

The commission, through its engineering staff, supervises a great deal of construction work for municipalities, acting in the capacity of consulting engineer. A great many problems of an engineering nature, such as pumping, street lighting, construction of distributing systems, etc., have been handled by this department during the past few years.

I have no fear whatever of the future of publicly owned hydro-electric radial railways. The people want them, and they are bound to have them just as soon as conditions are ripe for their construction. No man in Ontario has more faith in the necessity and future of publicly owned radials than I have, but I want to say a word of caution here as to the care that should be exercised in selecting their routes, for it is certain that if these are not carefully selected with a view to the future traffic conditions the results must bring discredit upon public ownership. Radial railroads will not pay simply because they are publicly owned and constructed. They must have (just as roads constructed by private corporations have) the proper location, a proper and economic construction, and, what is even more important, a reasonable assurance of a steady and profitable freight and passenger traffic.

I have often heard it stated, especially by aspirants for public office, that radials built by the commission are bound to pay simply because hydro-electric enterprises have been uniformly successful. I would like to point out, however, that the two projects are entirely different in many respects, and such statements are entirely unwarranted by the facts. In any case, whether of generation plants, transmission lines, or radial railways, I have no fear whatever of their not being constructed cheaply and efficiently. It is when construction ends and operation begins that the difference and the factor of danger enters into the matter. In the case of electric generation or transmission, as you all know, contracts that assure their profitable operation for a long term of years are signed, sealed, and delivered by the municipalities before any work is done on them whatever. Their operation is therefore guaranteed against loss, and they are bound to pay from start to finish. With radial railways, however, it is entirely different. When the road is completed the real work is only beginning, because it has then to look for traffic, and the volume of that depends largely upon the character of the country through which it runs and the class of people inhabiting it, and even more upon the amount of competition it will have to meet from existing steam or electric roads.

These vital but uncertain factors constitute the main difference between these two enterprises, and I cannot too strongly emphasize that the success or failure of our radial railroads will depend principally upon the way in which they are operated after construction. I do not want you to carry away the impression, however, that I have lost faith in publicly owned and operated radials. Far from it; but I do want to emphasize the fact that their success must mainly depend upon two things—whether they are actually needed and whether they are properly operated. I believe, however, that between the Government, the Hydro-Electric Commission, and the Municipal Electric Railway Union we shall be able to solve all these difficulties in a satisfactory and business-like manner, and that publicly owned radials in this province are destined to do a great and beneficial work for our people in revolutionizing the carrying trade of the province in the same manner, if not to the same extent, as its light and power has been revolutionized by public ownership.

Electrical Equipment of a Foreign Submarine

(Concluded from September 15)

The main fuses for the auxiliary circuit are enclosed in the same box, which is located very close to the battery tank to ensure the main battery leads being extremely short. The cut-outs are mounted side by side in an explosion-proof steel case, with the operating handles brought through the sides. The overload and time-limit relays are mounted on the front cover and set to operate at 1,300 amps. in about two to three seconds. They are, therefore, non-operative while starting up, but open should an overload last for more than the time limit stated above. In series with the solenoids is a small switch which opens with the cut-outs and releases the relays from electric pressure.

Each electrical circuit in the vessel is independently arranged with its fuses directly connected to the main battery leads, which ensures that in the event of any one set of fuses blowing no other circuit or circuits will be disturbed. The auxiliary power circuits are fed from the full battery pressure, whilst all lighting circuits are taken off the half battery pressure through double-pole change-over switches, to enable either half battery to be discharged at will, and double-pole switches to cut out the complete circuit. The general, instrument, and navigation circuits are provided with regulating resistances to maintain a constant pressure of 55 volts at any battery pressure. To prevent the boat being plunged into complete darkness, in the event of the general lighting fuses blowing, safety or police lamps are installed and fed from a separate circuit, but as no rheostat is provided in this particular circuit, the lamps are switched off during such time as the battery is on charge. Each lighting circuit is controlled from a special watertight gunmetal distribution box enclosing 6 d.p. fuses and 6 s.p. switches, and has cast on the underside three watertight sockets for portable connections; the spindles for operating the switches are brought through the front cover, which also carries a small hinged inspection flap for fuse renewals, etc.

The navigation lights comprise a masthead steaming light secured portable to the forward periscope, stern and stem anchor lights clipped to the handrails, a masthead flashing lamp secured portable to the after periscope, and the bow and stern lights. The last three lamps are fixtures built into the superstructure round about the conning tower, and fed directly from the navigation distribution box in the central station, while all portable navigation lamps are plugged on to the special box in the communication hatch behind the conning tower, to which is also connected the portable Morse key and condenser for the flashing lamp and the light in the portable compass which is used when steering from the bridge.

The Lighting

The general lighting consists of 16-c.p. metal-filament lamps enclosed in gunmetal guarded brackets bolted to the frames in the most efficient positions to avoid other internal gear, and controlled from distribution boxes in the engine room, central station, crew space, and officers' quarters; four additional 5-amp. d.p. watertight plugs are fitted in the engine room for portable lamps for small tools. Two self-contained portable magazine hand lamps, with suitable resistance to enable them to be charged from a 55-volt circuit, are carried in the central station.

Three electric hotplates of 750 watts capacity and three heats each, built into one frame, are installed in the crew space for cooking purposes; current for these is taken from a special distribution box placed just overhead, and connected to the plates through flexible portable leads.

Four portable electric radiators of 1,500 watts consumption, with three heats each, are carried to warm the officers' quarters and crew space in cold weather and special watertight d.p. sockets are fitted in these compartments to feed them. To ventilate these quarters in warm weather, two

12-in. noiseless fans with three speeds and trunnion movement are provided.

The vessel is equipped with one stern and two bow torpedo tubes firing 450-mm. Whitehead torpedoes by means of compressed air. Firing can be effected by hand or electrically. In the latter case, the firing valve lever is released by an electric solenoid energized from the lighting circuits through platinum-tipped push buttons, which are distributed in the boat in such a manner as will allow any tube to be fired from the conning tower, the central station, or at the tube itself. In each case, when not in use these buttons are secured with a padlock, the key of which is always in the possession of the Commander, to prevent the wilful firing of any tube.

Signalling Plant

A complete submarine bell signalling plant is installed, with an effective range of 12 miles; fitted with this equipment, the submarine can maintain communication with another submerged boat or similar plant on shore. Transmitting is performed by a large bronze bell placed mouth upwards in the forward superstructure, and supported by a special mechanism so arranged that the bell can be stowed below the plating when not in use, or quickly raised from the inside of the boat, clear of the superstructure, to permit the sound waves to travel out in all directions. The bell tongue is connected to a pneumatic cylinder, the slide valve of which is operated by a Morse key in conjunction with a condenser, the supply current being taken from the distribution box in the officers' quarters. The receiving plant has two special submarine microphones placed port and starboard in the lower forward part of the boat, well below the waterline. On the face of the microphone case is a circular machined groove lined with a thick rubber packing, which forms a perfectly watertight job when pressed on to the hull, through which a small hole is drilled to ensure the diaphragms always making good connection with the seawater. Two telephone receivers mounted on the same instrument box are used to collect the signals in conjunction with a 4-volt primary battery and small-change-over switch to enable either microphone to be placed in circuit. The key, condenser, and telephone receivers are conveniently mounted in the officers' quarters just above the starter for the forward 26-h.p. bilge pump motor, which arrangement allows signals to be transmitted and received very efficiently. Should the vessel accidentally sink in shallow water, the crew inside the submarine can release the safety mechanism known as the telephone buoy, by which the position of the sunken submarine can be located and telephonic communication set up between the boat and surface. The buoy itself consists of a wooden structure covered with 1/16 in. galvanized steel sheeting, and is secured to the superstructure by a screw releasing-mechanism operated by the crew inside the submarine. On top, the buoy has a hinged cover carrying a special watertight flashing lamp; on opening the cover, access is given to a portable microtelephone and pushbutton. In the boat is a second microtelephone with alarm bell and 4-volt primary battery enclosed in a light steel case, and a Morse key to flash the lamp on the buoy cover. Electrical communication is maintained through a 60-metre long 4-core cab-tire covered cable (two cores for the telephone and two for the lamp), which enters the boat and buoy through bronze stuffing glands or deck tubes. Current for the flashing lamp is taken from the distribution box in the crew space. When not in use, the 4-core cable is coiled up in a special cable locker just aft of the buoy.

Electric Pumps

The three electrically-driven pumps used for diving, emerging, trimming, etc., are arranged to pump from any tank of bilge through the main and auxiliary water service, or to pump out any torpedo tube through the auxiliary connections. By means of change-over cocks the small auxiliary pump can either draw from or discharge to any tank or bilge. For salvage purposes, pipes are fitted from the main and torpedo bilges to the top of the vessel to permit water inside the submarine to be blown out from the outside. The two large pumps placed fore and aft are of the high-speed double-rotor centrifugal type, capable of delivering 2,000 litres per minute against a head of 30 metres with the rotors in parallel, or 1,000 litres per minute against a head of 60 metres with the rotors in series at a speed of 2,000 r.p.m. The changing over of rotors from series to parallel or vice versa is performed by the manipulation of a single cock. These two pumps are directly connected to 26-h.p. shunt-wound semi-enclosed electric motors with a speed variation of 1,700 to 2,000 r.p.m. at 115 volts, the slower speed being necessary to prevent the motors being over-loaded when the pumps are working against no head; for example, when the submarine is running on the surface. A temperature rise of 30 degs. C. at the six-hour rate was specified to the motor makers with a permissible total weight of 610 kg. per motor.

The auxiliary pump is of the piston type, geared to an 8-h.p. shunt-wound totally-enclosed motor with a speed variation of 500 to 1,600 r.p.m. at 115 volts, and a temperature rise of 35 degs. C. after one hour's run at full load. This pump delivers 300 litres per minute against a head of 60 metres with a speed of 400 r.p.m. The motor, which is suspended from the frames, weighs 415 kg., and has its starter placed just overhead on the watertight bulkhead; the weight of this starter is 53 kg.

The motor coupled to the after bilge pump also drives, through a reduction gear box, the high-pressure air compressor and auxiliary manoeuvring propeller; interlocked couplings are provided to prevent both units being driven at the same time with a heavy resultant overloading of the motor. The auxiliary propeller, situated right aft in the superstructure, is intended to aim the boat when a torpedo is to be fired, and to facilitate manoeuvring when the submarine is in harbor. The starter for the forward pump motor is placed in the officers' quarters on the port side, directly opposite the motor itself, and weighs 65 kg.

Control

To enable the auxiliary propeller to be started and stopped from a position near the periscopes, and thereby directly under the supervision of the officer in charge, the controller for the after pump is housed in the central station, immediately under the main motor cut-outs. This controller, which weighs 140 kg., allows three speeds in either direction at the ¼-hour rate with its resistance enclosed in the casing, and it fitted with a separate interlocked lever to reverse the current in the armature when a change in the direction of rotation is desired. The capstan motor is of the series-wound totally-enclosed type, with an output of 2 B.h.p. at 1,600 r.p.m. and 115 volts for 15 minutes without the armature temperature rise exceeding 50 degs. C., and has a net weight of 115 kg. It is situated in the forward portion of the vessel, just under the torpedo tubes, and drives the anchor-winch and warping-bollard through worm and cog gearing, but, as the output of the motor is too small to allow these two units to be driven at the same time, the vertical driving shaft carrying the small driving wheel is fitted to allow an upward or downward movement along its axial length. This movement is controlled by a lever and hand-wheel, operated by hand power, placed close to the motor; when raised, the driving wheel engages the warping bollard; in the centre position it runs empty, and when lowered it drives the anchor winch. A friction clutch is inserted in the drive to prevent the motor being pulled up quickly or brought to a standstill when the submarine is being docked or the anchor housed. Despite the fact that the anchor winch is fitted with a tell-tale, experience has proved that such a clutch is very necessary, as the motor is too often left running after the anchor has been housed. The controller for this motor is secured to the frames on the port side of the officers' quarters, with its operating shaft extended through the shell into the superstructure to allow the motor to be started and stopped from the deck as well as the interior of the boat. Three speeds in either direction are allowed for, with the resistances and a small overload release enclosed in the controller casing. The net weight of this controller in running order is 52 kg.

Steering Motor

The semi-enclosed steering motor suspended from the upper frames on the starboard side of the crew space is of the flapper brake type, designed to give 1 B.h.p. at 1,200 r.p.m. with 115 volts continuously with a net weight of 275 kg. It drives the rudder-actuating shaft through worm gearing, on which a double clutch is fitted to enable the electrical driving gear to be cut out and steering performed by hand in the usual way. The motor is controlled by two automatic contactors operated electrically, either by a small controller or portable push-buttons. The controller is of the follow-up type, with the two outer rings connected to the hand steering wheel, and the inner quick-breaking switch coupled to the rudder-actuating shaft through a small chain. The sailor turning on the handwheel in either direction causes contact to be made by one of the outer rings in the controller with the inner quick-breaking switch by sliding over the same when a current is caused to pass through one or other of the contactors, and the motor at once starts without any resistance in circuit. The motor turning the rudder-actuating shaft causes the inner switch to revolve in the same direction as was taken by the outer rings until the zero position is reached, when it quickly snaps out, and the motor is brought to a standstill by the flapper brake.

Mechanical limits are provided on the rudder shafting to prevent the sailor overturning the controller, and platinum-tipped limit switches to protect the motor and gear when the push-buttons are in use.

The contactors are of the usual vertical type, mounted side by side in a light watertight steel case and fitted with magnetic blow-outs and renewable sparking pieces; further, a mechanical device prevents them being operated together. In parallel with each contactor is a 2½-c.p. signal lamp, colored red or green, to indicate whether the rudder is being swung to port or starboard. The controller is only called upon to deal with the current passing through the coil and lamp, about 0.55 amps., which is so small that practically no arcing takes place inside the same when in use.

The two push-buttons, mounted in a small portable, bronze box, have their tops enamelled red and green, and, in common with the controller are connected to the mains by three pin watertight plugs and sockets, with the pins of varying sizes to prevent wrong connecting up. Such a socket is fitted on the bridge, in the conning tower, and in the crew space, close to the steering motor, to permit the submarine to be steered electrically from either of these positions. A very small portable motor-driven dessicating gear is carried to dry out the periscope tubes and lenses, which, when in use, is plugged on to one of the lighting distribution boxes. All fixed cables throughout the vessel are of h.c. copper insulated with pure para rubber, taped, lead-covered, and armored with interwoven flexible steel wires impregnated with red-lead paint. They are secured to the frames with brass clips and screws in the most suitable positions to avoid other internal gear. Cables passing throug the shell are encased in copper pipes, with a stuffing-box at the lower end inside the boat, and a union connection to the fixture they are feeding. This arrangement entirely prevents ingress of seawater, and in the event of the tubes being pierced no water can percolate into the submarine. Wherever cables pass through a watertight bulkhead they are led through double-ended stuffing-boxes.

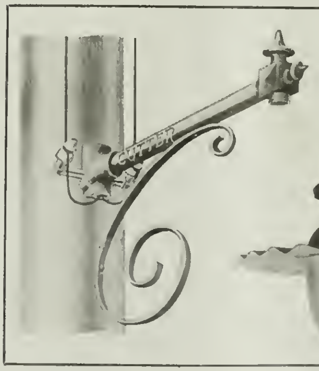
Watertight Type

Owing to the excessive amount of moisture which is always prevalent in a vessel of this class, the Navy to whose order the boat was built specified that, as far as possible, the complete electrical gear was to be of the watertight type, and in those cases where, owing to restricted weight and space, it was found necessary to install splash watertight gear, that, in the event of water reaching these units, their protecting fuses were to blow and isolate the circuits. These stipulations were rigidly enforced and carried out, so that should the boat sink in shallow water and fill, the battery would be immediately isolated electrically from such circuits and, provided the rubber cover over the battery tank received no damage, the cells could not come in contact with seawater and liberate chlorine gas.

The only switchboard in the vessel is the auxiliary, on which are mounted the switches and fuses for all motors, heating, and cooking circuits, also the change-over and double-pole switches, fuses, etc. for the various lighting circuits. The board is of the watertight type, with the switch handles taken through the cover, which also carries small inspection doors for fuse renewals, etc.

Limited Space

The greatest difficulty confronting an electrical engineer in a submarine of this size is the very limited amount of space and weight allowed. As, when running submerged, the boat depends entirely on its metacentric heights for stability, it follows that all weights must be reduced to the smallest possible limit, and that all heavy gear has to be placed as low as possible in the vessel to keep down the position of the boat's centre of gravity, and thus help to increase the metacentric heights. With this object in view, the electrical gear installed was of the very lightest possible type; wherever possible, very light steel cases were substituted for those of cast gunmetal (aluminium was not allowed owing to the corrosive effect of seawater), and the cables loaded to the utmost, particularly those feeding the main motor, where 2 amps. per mm.^{2} was allowed as a safe working standard. All motors have cast steel yokes and end brackets to reduce weight and bulk, and in all cases (except the main propelling motor) are supplied with ball bearings. The total weight of electrical gear in the submarine is about 49,600 kg.



Street units used in St. Lambert, Que. System installed under supervision of H. A. Gibeau. Equipment supplied by George Cutter Co. through Dawson & Co., Montreal.

Electric Railways

Get the Safety Habit—Have You Seen Our New Motto, "Women, Children and Safety First?" —Better to be Careful than Crippled

We hardly know how to begin this "Safety First" talk. It is not exactly a new movement, but its relative age is one reason why a great many do not take it seriously. Familiarity breeds contempt.

If by taking care, keeping your eyes open, thinking about what you are doing, and ceasing to be reckless, you could cut down your chances of losing your life or a limb by 75 per cent., WOULD YOU?

That's all "Safety First" means. Statisticians all over this continent have been figuring out the causes of accidents, which cost the country millions each year, and they say that 75 per cent. and more are AVOIDABLE. They are due to CARELESSNESS, THOUGHTLESSNESS and RECKLESSNESS. Now, the way to counteract these tendencies is for every person to make "Safety First" a habit with himself. Let him take no step, perform no act, without asking himself the question, "Am I safe?" and let him keep this up day by day, never losing sight of the fact that he is reducing thereby his chances of getting hurt.

With the growth in size of cities and the increase in the hazards of life, safety devices have kept pace well. But there are many dangers that no safety devices can protect a person from; it devolves on everyone to protect himself up to a certain point.

For instance, no device could prevent a man who crosses the street in face of danger, from getting hurt. That is why the admonition is made to TAKE CARE, THINK. We know you are in a hurry and that you cross the street a dozen, a score of times a day, but your HASTE will not do you much good if you are HURT. Don't be deluded by the fact that you have escaped so far; your turn may be next.

"Safety First" is nothing more than a habit that becomes easier the more proficient you become. In place of "taking a chance" or working with rush and bustle, proceed deliberately and carefully. You will be the gainer in time and happiness.

Now, where may you practice "Safety First"?

On the street, at home, in school, in the elevator, riding, driving, swimming and tobogganing (in season)—everywhere. Practice it as you split the kindling wood; as you jump on a street car; as you step into the elevator.

More than this, we want you not to stop at practicing "Safety First" yourself, but to pass it along to your father, mother, brothers and sisters, your friends and co-workers. You may save another's life. It devolves upon teachers to point out "Safety First" to their charges and upon all grown-ups to instill its principles in the minds of the younger ones.

Passengers, Be Wise—Stop, Look, Listen.

To this text, we want to add a few more that hold good in every activity of life:

Boys and Girls

To be safe, don't take chances.

It is dangerous to roller skate or play near the car tracks.

The careful boy or girl doesn't steal rides behind automobiles or wagons.

Be sure when coasting there is not a street car or vehicle on a cross street.

In rainy weather, be careful not to hide your view of traffic with your umbrella.

The thoughtful boy looks both ways when crossing a street; to the right until he reaches the middle, then to the left.

When riding a bicycle obey the traffic rules, not so much because you endanger someone else, but because you may be hurt by some other vehicle.

Men and Women

DON'T try to "head-off" a street car.

DON'T CROSS THE STREET DIRECTLY BEHIND A CAR WITHOUT MAKING SURE ANOTHER CAR IS NOT APPROACHING ON THE OTHER TRACK.

DON'T hesitate when you have once entered the path of vehicles. If the driver does not know your purpose, he can't always avoid you.

DON'T cross the street between blocks. Use the crossing.

DON'T walk on the railway tracks or trestles. Besides being illegal, this practice is extremely dangerous.—B.C.E.R. Buzzer.

Hoosac Tunnel Electric Locomotives

The Hoosac tunnel of the Boston and Maine Railroad is the largest electrified tunnel in America. The work of digging the tunnel was started in 1851 and completed in time for the first steam train to pass through on February 9, 1875. It is 25,081 feet long and is double tracked throughout. Until its electrification in 1911 it was always an obstructing feature to the traffic of this railroad. Under steam operation the entire tunnel was a block, only one train at a time being allowed to pass through. Under electric operation several trains are permitted in the tunnel. The electrification, which is of the Westinghouse single-phase system, has been entirely successful in operation, proven by the ease with which the heavy freight traffic of the road has ben handled. Freight trains are no longer packed three or four deep at each portal waiting for a chance to get through. As many as 77 trains a day pass through the tunnel, and regularly 71 trains pass through every 24 hours. Of these about 17 are passenger trains, the remainder freight. Up to the present time the entire traffic through this tunnel has been handled by five Baldwin-Westinghouse, 130-ton, 11,000-volt, single phase electric locomotives. Traffic, however, has increased to such an extent that it has become necessary to supplement the present equipment. Due to the great success achieved by the electric locomotives already in service, the Boston and Maine have placed an order with the Westinghouse Electric and Manufacturing Company, of East Pittsburgh, Pa., for two

Hoosac Tunnel.
Electric Locomotives.

additional 130-ton electric locomotives similar to the five now operating, of which the one illustrated is typical. The locomotives have but one cab, with two articulated trucks, each truck consisting of two pairs of 63-inch drivers and a pair of pony wheels 42 inches in diameter. Each locomotive has four 375 horse power single-phase motors of the series commutating type, with short-circuited auxiliary field windings. The gears on the locomotives are of the flexible type, which minimize vibration and prevent any strains or shocks on the teeth of the gears, also aiding the motors to start under very heavy loads. In electrifying this system the crossing of the 600-volt lines of the city railway by the 11,000-volt single catenary construction of the Boston and Maine was accomplished. This was one of the many interesting engineering features encountered in the installation of the overhead construction.

Another Single Phase Line for Switzerland

Electrification of the St. Gothard Railway, in Switzerland, has been undertaken by the Swiss Government, which is spending about $600,000 on the work this year, and will eventually spend about $7,500,000. The length of line to be electrified is about 68 miles. Two power stations are being built, one at Amsteg, where the water of the River Reuss is utilized under a head of 900 feet, and the other at Piotta, where the head of water is 2,642 feet and 39,000 h.p. will be developed. The commission appointed to investigate as to the system of electrification to be adopted has recommended a single-phase system similar to that used on the Lotschberg tunnel line.

Sherbrooke Railway Activities

The falling off of $6,700 in gross earnings of the Sherbrooke Railway & Power Company for the year ending June 30 is more than counterbalanced by the reduction in operating expenses, the net revenue standing at $66,349, as against $55,920. Mr. Clarence J. McCuaig, the president, states that the acquisition of the lighting and power business of Waterville and Compton, combined with the increased demand for power in the second half of the year, created a market in excess of the capacity of the company's hydro-electric development on the Magog River. To provide for this increased demand for power and the probable requirements in the immediate future, the directors made a contract through the Southern Canada Power Company, Limited, for the purchase of sufficient power to cover same. An extension of the power house and some of the transmission and distributing systems has been rendered necessary to handle this additional power, and this work is now nearing completion and should materially increase the earning power of the company for the current fiscal year.

Owing to increasing demands for power, the Sherbrooke Railway and Power Company have made a contract with the Shawinigan Water and Power Company for the supply of 2,000 h.p. over the transmission line between Victoriaville and Windsor Mills. A new transmission line is being constructed between the latter point and Sherbrooke. In connection with a proposal that the Sherbrooke Company extend and improve its lines, the company have asked the City Council to advance $100,000 for a period of five years, at 6 per cent. interest, a lien on the entire property being given, subject to the present mortgage indebtedness.

Is it Safe?

The London Omnibus Company has adopted the words "Is It Safe?" as a slogan instead of "Safety First," for the reason that if the question be mentally asked of oneself in a perilous moment, it instantly directs attention to the dangers present wherein the instinct of self-preservation will assert itself, and this is in most cases all that is necessary to induce watchfulness and care.

New Sub-Stations for Montreal Tramways

Two new sub-stations for the Montreal Tramways Company are to be constructed, both one storey buildings. One is to be on a site 50 x 100 at the corner of Archambault Street and Notre Dame Street East, Pointe-aux-Trembles, and the other, 100 x 100, at Cote Street, Montreal. The foundations will be of concrete and granite and the superstructures of brick and terra cotta.

Personal

Mr. J. A. Everell, superintendent of the Montmorency Division of the Quebec Railway, Light, Heat & Power Company, which is being taken over by the Dominion Government, has been appointed district passenger agent of the Canadian Government Railways, Montreal, succeeding D. McDonald, deceased. It is understood that Mr. Everell will retain his position as superintendent of the Quebec Railway, Light, Heat & Power Company.

Trade Publication

Electric Railway Materials—Catalogue No. 3, issued by the Drew Electric & Manufacturing Company, Indianapolis, Ind., designers and manufacturers of electric railway, light and power materials. The catalogue is splendidly illustrated throughout its 185 pages. The C. E. A. Carr Company, 2 Toronto Street, Toronto, are Canadian distributors.

The hydro line from the Kent sub-station to Sarnia has been completed.

The Dealer and Contractor

A Study in Office Building Lighting—Necessity for Flexibility—Paper read before Illuminating Engineering Society

By Samuel G. Hibben

The modern sky-scraper office building of to-day, peopled with thousands of tenants and managed by competent executives, is verily a city within a city. It has its problems of transportation, its corps of "white wings," its central station, and its departmental government. Its economies of operation are indirectly shared by thousands of persons, and as it improves its service it affords to each inhabitant safety, speed, health, comfort, and luxury. Its one object is to surround the twentieth century business man with the most modern facilities for intercommunication and labor, and, personified, its motto would be "Ich Dien."

That the success of the large office buildings of recent years is due in no small measure to the economical application of electricity to its transportation its intercommunication, and its artificial lighting problems, is a generally accepted fact.

We have seen, for instance, the buildings rise higher and higher in proportion to improvements in elevator design. We have seen the growing demand of tenants for telephone service, ventilation, the operation of small machinery, heating, ice water, cleaning—all of which have been met promptly or anticipated by the building manager on account of the continued advance in the applied science of electricity.

And now comes the problem of artificial illumination, a problem calling for a more exact solution than most other lighting problems, inasmuch as in the large office building any expense or any saving, however minute in the individual unit, will be multiplied thousands of times and appear upon the records as a large part of the total operating expense.

With the exception of steam heat, probably no one item of expense responds so readily to the efforts of the manager to economize as does that of artificial lighting. As to the general progress in the economics of office building lighting consider first the following figures: Building A is 10 years old, with obsolete lighting arrangements and accessories. Building B is a modern sky-scraper, giving better illumination for equally long hours:

Table I.

	Bld'g A.	Bld'g B.
Kilowatt hours per year per sq. ft. of floor area	0.92	0.60

Or take again a third representative building, using power for lighting as follows:

Table II.

Year.	Kilowatt hrs. per year.*
1911	78,492
1912	62,940
1913	43,920
1914	46,112
1915	40,500

*Nernst lamps were in use in 1912. Tungstens replaced these in 1912-13. Many type "C" Mazdas were installed in 1915.

Unquestionably there may be certain economies practised in office building lighting that appear directly on the expense records. Not so concrete, but equally certain, are those economies which though not always a decrease in operating expense, result in better quality and quantity of illumination, in pleased tenants, and, finally, for the owner, in a better scale of rentals and a higher interest on the investment. Some of the results of studies of office lighting economics are discussed in the following pages:.

A. Flexible Arrangement of Outlets.

Starting with the planning of a large office building, one of the first possible economies may be realized by a careful location of outlets. This planning is more important in office buildings than in other structures, such as stores or factories, because of the necessity of providing arrangements (1) to centralize power feeders, and have all main and branch circuits accessible, and (2) to anticipate subdivision of office space, and allow for the most flexible arrangements of different illuminated areas per unit.

Naturally it is advantageous to group the long, vertical runs of feeders in a shaft and place this shaft at the "centre of gravity" of the lighting load of the average floor. It is also virtually impossible to change long runs of branch circuits where, in fireproof construction the conduit is laid in concrete beneath marble or fine woodwork. The economic

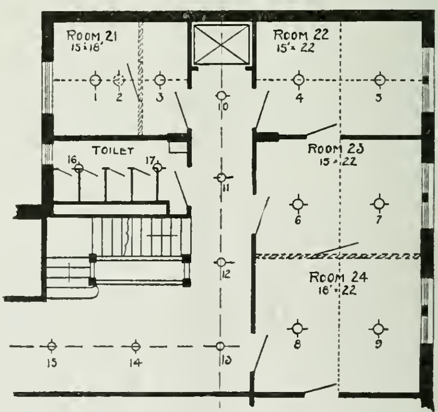


Fig 1—In Office Building of Short Term Leases.

use of copper at the present high market price for these low voltage circuits becomes of great importance, and careful attention should be given to arrangements of balanced feeder circuits.

The second necessity—proper location of outlets for future space subdivision—may be illustrated by reference to Fig. 1. The section of the floor that is shown is of a typical high office building of recent construction. Some years ago there would have been one central ceiling outlet in each room, but consider, for instance, room 21 if equipped with unit No. 2 only. Should the tenant desire a partition to be placed as shown, which is a not uncommon subdivision, the single unit would not be well placed for the larger and useless for the smaller space. Outlets Nos. 1 and 2, placed as shown, would overcome this difficulty. Similarly rooms 23 and 24, taken together or if divided, may be well lighted. The tendency in modern construction is to be liberal with ceiling

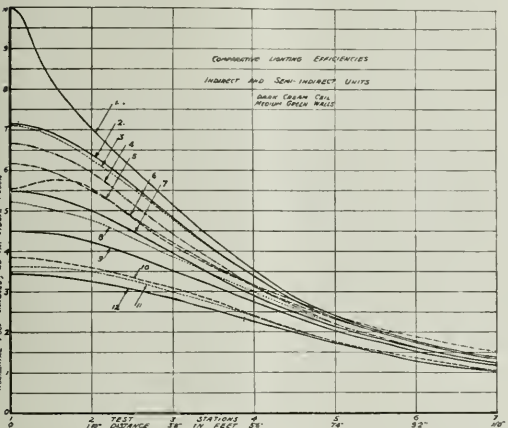


Fig. 2—Illumination curves showing differences between units of the inverted bowl type.

outlets in business offices, both for the reasons above mentioned and to secure more illumination at the room edges than is possible from the one central fixture.

B. Choice of Fixtures and Glassware.

The glassware and fixtures should be chosen under the supervision of an expert, but unfortunately this is often done by those without experience in lighting problems. How great may be the difference in intensity of illumination from different shades and reflectors is shown by Figs. 2 and 3. Such tests as are recorded by these curves were all made by the same observer and instruments, in the same size and finish of room, and with the same hanging height from ceiling to lamp filament. All glassware was cleaned and all the various units were stock samples. These were such well recognized units as are individually recommended by the respective manufacturers as the most efficient for office lighting.

Table III.—The Range in Efficiencies of Inverted Bowl Units.

Test No.	Lamp.	Fixture.	Max. illu.	Min. illu.	Av. illu.
1	200 "C"	Dome S-I	10.08	1.38	3.23
2	200 "C"	Dome S-I	7.15	1.33	3.07
3	200 "C"	Bowl S-I	7.11	1.33	...
4	200 "C"	Bowl S-I	6.81	1.33	2.95
5	200 "C"	Dome S-I	6.02	1.51	...
6	200 "C"	Bowl S-I	6.20	1.20	2.76
7	200 "C"	Bowl S-I	5.48	1.22	2.64
8	200 "C"	Bowl S-I	5.23	1.19	2.52
9	150 "B"	Dome S-I	4.20	0.77	1.85
10	200 "C"	Bowl S-I	3.85	1.03	2.14
11	200 "C"	Indirect	3.62	1.05	...
12	200 "C"	Bowl S-I	3.43	1.01	2.01
13	200 "C"	Dome S-I	5.55	1.48	2.92
14	200 "C"	Indirect	3.72	1.07	2.16
15	200 "C"	Bowl S-I	6.18	1.22	2.72
16	200 "C"	Bowl S-I	4.50	1.16	2.40
17	200 "C"	Bowl S-I	6.46	1.25	2.88

The marked differences in foot-candle efficiencies of the semi-indirect types of units may be appreciated by noting the curves of Fig. 2 and the data of Table III.

With the same candlepower lamp, used with the efficient and the inefficient glassware, there is a range from 3.23 to 2.01 average foot-candles of table-top illlumination. Expressed in another way, a certain semi-indirect lighting unit may be used that will supply 60 per cent. more illumination at the same operating expense than another of the same style. Or if enclosing globes are considered, as in Fig. 3, the maximum range is from 2.81 to 1.60 average foot-candles, where the right gives 75 per cent. more illumination than the wrong globe. Table IV. gives further comparative data:

Table IV.—The Range in Efficiencies of Enclosing Globe Units.

Test No.	Lamp.	Fixture.	Max. illu.	Min. illu.	Av. illu.
1	200 "C"	Cased globe	9.76	1.11	2.81
2	200 "C"	Cased globe	5.87	1.28	...
3	200 "C"	Cased globe	5.50	1.10	...
4	200 "C"	Lt. opal globe	6.84	1.25	2.47
5	200 "C"	Lt. opal globe	6.34	1.17	...
6	200 "C"	Lt. opal globe	4.18	1.27	...
7	200 "C"	Cased globe	5.09	1.07	2.03
8	200 "C"	Lt. opal globe	3.33	1.09	1.95
9	200 "C"	Lt. opal globe	3.20	1.02	1.85
10	200 "C"	Cased globe	2.87	0.81	1.60
11	200 "C"	Cased globe	5.72	1.04	2.03
12	200 "C"	Cased globe	5.74	1.14	2.65
13	200 "C"	Cased globe	5.98	1.31	2.53
14	200 "C"	Lt. opal globe	5.70	1.32	2.54
15	200 "C"	Lt. opal globe	4.31	1.27	2.35

Suppose that the cleaning and the first cost of the different units above mentioned be equal; and this is closely true. Then a difference of 60 per cent. in the illumination means that for equal service the unit of lower efficiency must be supplied with 60 per cent. more power and 60 per cent. larger lamps. Data from a typical modern office building of 168,000 square feet rentable area, show the annual cost for lighting power to be $8,770, and for lamps $1,035, or a total of $9,805. Surely, then, 60 per cent. of this amount, or $5,883, is a posssible economy not to be neglected.

The question of the proper choice of office lighting fix-

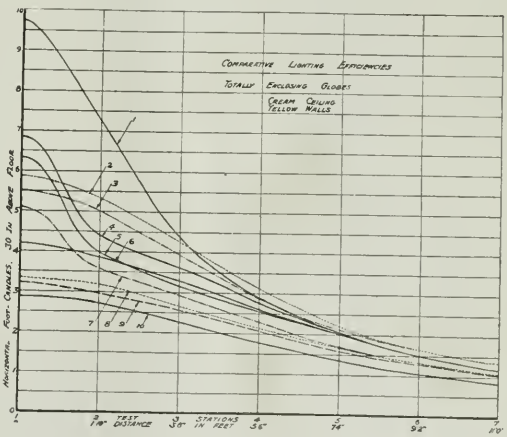


Fig. 3—Illumination curves showing differences between units of the enclosing globe type.

tures leads to entirely too many ramifications to allow of full consideration in this paper. There may be noted in passing only a few features in addition to illuminating efficiency that have a bearing upon economical operation. Above all else the glassware must be easy to clean. It must be sturdy and well hung, for the average night janitor has not the delicate fingers of a pianist. The metal of office fixtures should be of bronze or of equally suitable metal, and since the units are often adjusted for different lengths in rooms of various heights and to suit peculiar demands of tenants, the use of chain rather than rigid stem fixtures is usually preferable.

Many little "kinks" in fixture construction eventually appear in the operating expense—a matter of whether the lamp may be unscrewed without removing the glass from the supports or of a small hole drilled in the bottom of a semi-indirect bowl to allow the insertion of a finger so that the janitor may safely support the bowl with one hand.

C. Cleaning Costs.

Cleaning cost is susceptible to marked economies, and is usually the most difficult to concretely study. In order to note the importance of cleaning of lighting glassware, consider Fig. 4 illustrating a not unusual case in which the author, during the investigation of the system of one large office building, removed a semi-indirect bowl, washed it, and immediately repeated an illumination test with results as shown. The average illumination for the entire room was increased 30 per cent.

Among examples of cleaning experience the author has collected data upon two buildings as follows:

Table V.

	Building M.	Building O.
Number of rooms.......	250	
Number of fixtures......	350	900
Cleaning period.........	4 weeks	3 weeks
Routine	Scrubbing	Alternate wash and dust
Janitor's salary.........	$675.00	$720.00
Janitor's supplies.......	200.00	250.00
Total..................	875.00	970.00
Per unit per year.......	2.50	1.07
Per unit per visit........	19.2c	6.2c

These may probably be taken as two extremes of expense. The average period of cleaning for good service, especially of the semi-indirect glass bowls, is once monthly. This period, of course, will vary with the location. The author in one investigation found that it required 4.5 minutes to remove a semi-indirect glass bowl from a mixture, scrub, dry, and replace it. To shift from one unit to another probably would double this time. These figures are for specific cases only, but they may supply the foundation for a good conception of this feature of lighting economics.

The experience of the author has led him to practically

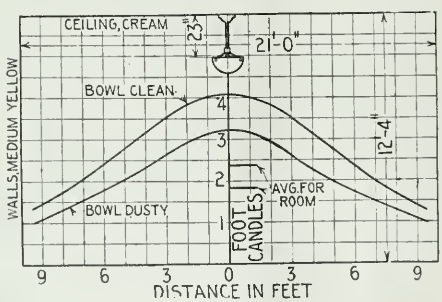


Fig. 4—Comparison of illumination with clean and dirty glassware.

condemn the use of office lighting glassware with sand-roughed surfaces, and to hesitate in recommending the use of acid-roughed (commercially known as satin-finished) glassware.

D. The Hanging Heights of Light Sources.

Indirectly connected with the economics of office lighting is the question of hanging heights of light sources. It has been the author's experience that most modern lighting units in offices with 11-ft. to 13-ft. ceilings are hung too low. Except in case of the use of very dense glass semi-indirect bowls, the effect of low-hanging is similar to the results graphically illustrated in Fig. 5. The illumination directly beneath the average semi-indirect bowl or a bowl with upper diffusing dome is increased by low hanging, but the point to be emphasized is that the room-edge illumination is not im-

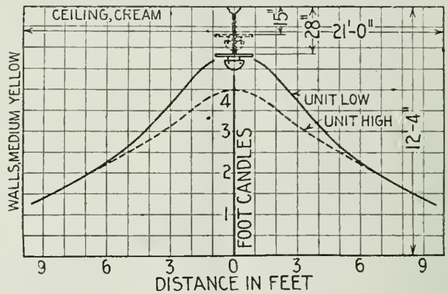


Fig. 5—Comparison of illumination at different hanging heights of light sources.

measurably affected. It is this room-edge illumination that is ordinarily most useful, for in nine out of ten cases the office desks are located against the walls.

It follows that unless photometric measurements are made previous to the purchase of fixtures money may be uselessly spent for extra lengths of fixtures that serve no useful purpose.

E. The Load Factor.

The lighting load factor of the office building is a comparatively constant one. This has resulted from inadequate provisions for natural daylight, and from the fact that weather or seasonal conditions do not seriously affect the use of artificial illumination. Office tenants often use artificial lighting during all hours of occupancy, daylight or darkness. This brings up a point of contention, namely, whether all tenants should or should not pay each for his own energy consumption. Most office building managers will claim that great savings could be effected if each tenant were individually metered. But, however justified such a charge system would be, it remains a fact that under present conditions the management must provide for and expect wasteful lighting power consumption. This is another argument for the highest utilization efficiency in office lighting systems.

F. Economic Lamp Sizes and Proper Voltage.

The most economic voltage at which to operate the lamps ought to be computed for each office building. This factor has usually been overlooked in studies of operating expenses. In the first place, the private generating plants often sell excess energy, and any means of reducing the building load or increasing the generator output allows more power to be available for sale. Now the limit of output of a generator is fixed by heating, and heating is almost entirely a function of the amperage. If the supply voltage be increased without incurring any extra expense for larger generators.

In the second place—and this is a matter of the greatest importance—the amount of light is so rapidly increased by relatively slight increases in voltage that even though the lamp life be reduced, it is not always most economical to burn lamps at their rated voltage. If energy costs 10 cents per kw.

hour the characteristic operation of a 60-watt tungsten lamp is as follows:

Table VI.

Per cent. Rated voltage.	Per cent. Rated wattage.	Per cent. Rated cp.	Per cent. Total cost light.
96	93.7	86.7	5.1 increased
97	95.3	89.9	3.7 "
98	96.9	93.2	2.3 "
99	98.4	96.5	0.9 "
100	100.0	100.0	0.0
101	101.6	103.5	0.9 decreased
102	103.2	107.2	1.9 "
103	104.8	110.8	2.7 "
104	106.4	114.6	3.3 "

From this table it is evident that for 10-cent energy it would be more economical to boost the lamps above their rated voltage. At some voltage the decreased lamp life and the extra janitor service for making lamp replacements balances the increased amount of light, and this point should be crefully determined for each condition of service and for each cost of energy.

The expense of maintaining a stock of lamps will be reduced if the variety of sizes of lamps be kept small. This is a more important economic consideration than the slightly better efficiency of the large wattage lamps over the smaller. These facts are mentioned in this connection because they are so often neglected in studies of office lighting economics.

G. Facilitating Elevator Service by Improved Illumination.

It has been mentioned before how the height of the modern office building depends upon its elevator service. Nowadays the elevator cars must run on schedule, and on a fast schedule at that. Anything that facilitates loading or unloading will better the service; hence it is within the province of an economic study to consider such means as will allow more passengers to be carried, and these with greater safety.

The writer, working along this line, studied a number of elevators and found them to be universally darker within the cars than was the case in the adjoining corridor. In entering, some passengers halted on the threshold. Others shuffled their feet and moved towards the rear of the car slowly, as though slightly confused by the difference in lighting intensity. When one considers that the daily transient population of an office building of only moderate size with possibly fifteen elevators will be 20,000 to 25,000 persons, it does not require very much delay upon the part of each traveler to hamper the efficiency of transportation.

We are familiar with the use of small bull's-eye lights at the edges of doorways, and these are of some help, no doubt, but the author would hesitate to recommend them in preference to some other methods. One of the simplest, yet always efficacious means, of bettering the car illumination is by using a white interior finish in the upper portion of the car. This method, which adds approximately $15 annually to the cleaning costs per car, will increase the useful illumination surely 25 per cent.; sometimes 40 per cent. In another car which could not be treated by interior painting excellent illumination was secured by merely backing up the diffusing glass hemisphere set in the ceiling dome with a silvered reflector. These are not new methods, yet careful attention to them means an indisputable saving.

One scheme in connection with elevator operation that is rather unusual, however, has been tried with success. Some of the lost time in elevator operation is occasioned by the inability of the operator to clearly see the edge of the floor and his inability to bring his car floor to the proper level when stopping. This particularly is the case when rising and moving along the dark face of the elevator shaft. If there is a bright band painted beneath the threshold and on the face of the shaft, say, of yellow color, then it is comparatively easy to stop the car just as this band is paralleled by the car floor.

H. The Economy of Light Interior Colorings.

No discussion of the economics of office building lighting would be complete without a brief mention of interior colors and finishes of rooms. Without going into this matter in detail, it is interesting to note the following figures, which the author has gathered from the results of a large number of tests:

1. The average increase in desk top illumination caused by cream colored over green walls, with semi-indirect lighting units was found to be 17.4 per cent.

2. The average increase of ivory white over cream colored ceiling, with semi-indirect units, was found to be 11.6 per cent.

3. The average increase of cream colored over green walls, with totally enclosing globes, was found to be 26.8 per cent.

4. The combined increases caused by ivory white ceiling and cream colored walls, over a cream ceiling and green walls, using semi-indirect bowls, was found to be 31.7 per cent.

The total annual expense for lighting in a moderate-sized structure is about $15,000. If light colored interior painting will increase the illumination 30 per cent., then the monetary equivalent is $5,000 annually. Admittedly the extra cleaning of light colored walls will reduce this saving somewhat, but it has been the writer's experience to find that the average office is washed down but once each year, regardless of color. The lighter colored interior will, of course, increase the daylight illumination and shorten somewhat the hours of artificial lighting.

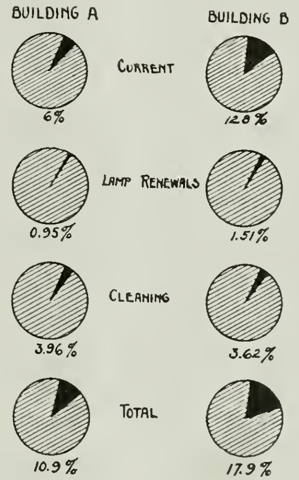


Fig. 6—Percentages of total operating expense.

I. The Relation of Lighting Expense to Total Expense.

In studying the divisions of expense incurred in office building lighting it is interesting to assemble and compare data as shown in Fig. 6. A comparison of the buildings A and B will disclose the facts that B's item of excess expense lies in the current consumption, or in the power costs. The reason for this is two-fold—there is less daylight in B; the fixtures are poorly arranged, with less flexibility in switching operations, so that several lamps are burned when a tenant really requires but one. These percentages (Fig. 6) are representative of a great many large office buildings.

A study of the economics of office building lighting is rich in variety and in the possibilities of profitable return to the manager or owner. In an ultra-modern building every item from proper colored paints to proper voltage of lamps holds possibilities of waste or of economy.

Methods of Approach and Handling of Customers in Collection Work

By A. I. Anderson*

We are hearing, and I hope learning, these days a great deal about efficiency, public opinion, system, good service, etc. The subject that has been assigned to me is "The Method of Approaching and Handling Customers in Collection Work, and the Qualifications of a Good Collector." This subject embodies all of these terms.

In order to be successful in collection work it is necessary that neatness, ability, wide-awake ideas, and prompt and courteous attention to our customers should play a very prominent part. The clerk who is careful about his personal appearance at once commands respect, whereas the lack of good appearance has the opposite effect. When called upon to wait on a customer at the counter you should endeavor to impress him with the idea that it is a pleasure to you to serve him, and not go with an air of reluctance, indicating to the customer that you do not care to be disturbed. One should bear in mind that the highest type of salesmanship is covered in selling good service. This may be the opportunity of a lifetime, and who can tell, when one is called to wait on a stranger, what might develop afterward? Each customer should be looked upon as a business enterprise, into which we are putting our capital of brains, breeding, and character, in the honest desire to build same on the most solid of foundations, the respect and confidence of the public It has been truly said: "The first impression is a lasting one." If it be a good one, you may benefit by it in many ways and, if a bad one, you may suffer by it.

One of the definitions of efficiency is the act or art of producing effects. A customer comes to the counter in a rage because of his having had the service suspended for non-payment. Personally it may not have been his fault. At least, he may be under the impression that we are the cause of his being deprived of service, which latter no one will deny to-day is a necessity. It requires one possessing a great deal of ability and diplomacy in order to handle a customer of this kind properly. It is not always the act of suspending service that so often causes unpleasant feelings, but it is often due to the lack of consideration and apparent indifference on the part of the clerk who waits upon the customer. When an explanation of our act is demanded, explain to him that such action was made necessary by his failure to pay his bill promptly, and that it not only proves an inconvenience to him but burdens the company with extra expense as well as a loss of revenue. Assure him of your prompt and best efforts in having service restored at the earliest possible moment consistent with our method of handling such cases, as soon as he complies with the requirements. Do not appear to treat this matter lightly, as it is a very serious one with the customer. The customer who has had his service suspended for the first time is particularly in a frame of mind that the approach may either cure or aggravate the matter. There is another class of customers, however, the suspension of whose service for non-payment causes no apparent inconvenience. We should try to impress upon this class the advantage of the gas discount, and also acquaint them with the location of our pay station near their homes or markets. A little personal interest in each of these cases will make the customer feel that you have at least shown a disposition to please, and this disposition should be spontaneous; if unnatural, the customer will detect, and will not be so favorably impressed.

When a request for an extension of time on payment is made, and when after considering the customer's request you decide it is not advisable to grant this extension (for instance, if an extension is asked to a date after the maturity date of the subsequent bill, this would not be advisable, as it would then make the customer two months in arrears, at the same time creating a hardship on the customer to allow two months' bills to become delinquent when they were unable to pay one, and it would be more difficult to have the account settled up to date), this should be explained to the customer with an attitude of regret, and under no condition should the customer be given the impression of assumed authority or indifference. If, however, it is a reasonable request—that is, three or four days' extension, due to sickness or lack of work—it is better to make the mistake in granting it, even though the customer has failed to keep his promise on previous occasions.

When waiting on a customer and it develops that he has some business in another department of the company and you think he would have some difficulty in finding the department, or making his business readily understood there, and possibly be referred to another department, it would be well to go with him to the clerk who should wait on him. Very often by going with a customer you can explain to the clerk in a very few words what is desired, and save both considerable time.

Do Not Overlook Courtesy

Do not overlook courtesy when handling a customer on the phone. Courtesy by telephone is a "hall-mark" of a gentleman, as it brings out the tendency of one to be abrupt and snappy when under provocation, by reason of the removal of the personal element when talking face to face. If you answer the phone and the customer should call you by name, stating that this is Mrs. Blank, you should say, "Yes, Mrs. Blank," and then take the message. If the customer is seeking information which cannot be furnished by your department, and you are uncertain as to what department she should be referred to, do not simply transfer her to some other department to get rid of the call, but rather get her phone number and tell her that you will have someone call her. For example, the customer says she is without light. What department should she be referred to? It may be a question for the general service department on account of stoppage in house piping, or some wire trouble, or the service may have been suspended for non-payment while the person was away, or it may require a new application or contract. You should go into the matter thoroughly before transferring her to any other department. This will give the customer the impression of good service.

Now, in regard to the collectors meeting our customers at their homes or places of business, let me say that the man who starts out in the morning glad that he has a duty to perform, and feels capable of doing this duty, has a decided advantage over the man who thinks he has nothing to do but ring door bells and get reports. A cheerful "Good morning" and a pleasant smile, your face cleanly shaven, a clean collar, and polished shoes have at least an advantage over the man who has a careless appearance. If it is impossible to make collections you should endeavor to ascertain when payment can be expected. Should the customer request you to grant him an extension, you should impress him with the fact that you are sent for the purpose of collecting the bill and that you have no authority to make extension.

There should be no occasion for discourteous treatment in word or action on the part of the collector at any time, and such conduct will not be tolerated by the management of our company. When you come in contact with a customer who thinks he has been treated badly, make a note of the particulars and make a report to the office, so that the company will be in a position to remedy the complaint, and leave the customer under the impression that his good-will is valued. If the matter is finally adjusted to his satisfaction, he will always remember you in the transaction. Thus the personal element of good service is established.

You should always be on the alert that the wants of our customers are taken care of. Of course, we realize that you

* In N. E. L. A. Bulletin.

have not the necessary contracts for making sales, but increasing the company's revenue should always be uppermost in your mind. Therefore, if the customer contemplates making a purchase of merchandise, inform him that you will have a solicitor call, and at the same time extend the customer an invitation to visit our stores, as we have many beautiful and useful fixtures and appliances on display.

Finally, whether we are waiting on the customer at the counter or his home or place of business, we should remember that all persons have similar likes and dislikes. As a rule, what pleases you pleases him, and what displeases you displeases him. Therefore, you can handle the case more advantageously both to the customer and the company by placing yourself in the customer's position, for then you will be governed in the discharge of your duties by the golden rule, "Do unto others as you would have them do unto you."

The real answer to many of our problems is the "honest desire and effort of each of our employees to render the best service possible, striving always to improve one's self by careful study of the methods of those who appear to be successful in pleasing the public."

B. C. Electrical Contractors have Electric Luncheon Club—85% of Members Attend

The first electrical luncheon organized by the Vancouver Branch of the British Columbia Association of Electrical Contractors and Dealers was held at the Castle Hotel, Vancouver, on Friday, the 22nd of September. This association comprises 33 members in Vancouver, including associate members; of these 28 sat down to luncheon. Amongst the associate members present were the district managers of the Canadian General Electric Company, and the Westinghouse Company, and the sales manager of the Northern Electric Company.

An excellent luncheon having been served vice-president Rankin, of the firm of Rankin & Cherrill, called upon each member present to introduce his right hand neighbor in order that each member should become acquainted with those present. At the close of this interesting function an address was delivered by Mr. E. E. Walker, sales engineer, British Columbia Electric Railway Company. Mr. Walker dwelt on the co-operation which now existed between his company and the various contractor dealers, pointing out how the company endeavored to help the dealers, and expressing the hope that the good feeling which had been brought about by the association would be far reaching. On Mr. Walker resuming his seat Mr. Little, of the Northern Electric Company, in a few well-chosen words expressed the thanks of the members to Mr. Walker for his address.

It appeared to be the unanimous opinion of the members that this, the first luncheon, had proved a great success. The only complaint seemed to be that there was too much to eat, the hotel management having put on a six-course luncheon—an extraordinarily good one for the price of fifty cents.

It is likely that these luncheons will be repeated, but this matter was to be decided at the next monthly meeting of the Association, which was held on Tuesday, October 3rd. For the guidance of any other association who may attempt a similar gathering it should be borne in mind that the whole meeting should not occupy more than one hour, as members cannot spare the time away from business. One hour will be the aim of the B. C. Association in future and if this can be done a full house may be assured.

The B. C. Association of Electrical Contractors and Dealers were represented last week at the Convention of the Washington State Association; the president, vice-president, one regular member and one associate member from Vancouver being present, while the secretary of the Victoria Chapter represented that city. Several matters of mutual interest were taken up, amongst them being the formation of a Western Conference Board, at which representatives from the various associations on the Pacific Coast could meet together to draw up plans for the welfare of the members of the various associations.

Trade Publications

Electric Fans—Catalogue No. 240 by the B. F. Sturtevant Company, Boston, describing, with illustrations, fans for practically every purpose.

Condulets—Bulletin No. 1000-F, issued by the Crouse-Hinds Company of Canada, Limited, illustrating and describing their fused service entrance condulets.

Soldering Kinks—An interesting booklet by the M. W. Dunton Company, Providence, R.I., describing various methods of overcoming difficulties met with in the soldering business.

Condulets—Catalogue No. 1000 E, issued by the Crouse-Hinds Company of Canada, Limited, and effective October 15, 1916. This is supplementary to condulet catalogue No. 1000 and No. 1000 C and describes and illustrates condulets of varied types, to the number of 460 new types and sizes.

Circuit Breaker Installations—The Cutter Electric & Manufacturing Company, Philadelphia, have prepared a very handsome book describing a large number of typical I-T-E circuit breaker installations. As stated in the introduction, this book depends for its value upon illustrations rather than intricate technical descriptions, and the illustrations are wonderfully good, many of them full-page size and some of them extending over the two full pages. In all there are some 400 illustrations. The book has 350 pages, size 11 in. by 9 in., bound in red cloth.

Regulators.—The Westinghouse Electric & Manufacturing Company have recently issued leaflet 3919 covering Polyphase Induction Feeder-Voltage Regulators for medium and large capacities. The purpose of the feeder regulator, its construction and operation are thoroughly described in this leaflet. The same company have also issued leaflet 3922 covering Equalizer Pedestals and describing this piece of apparatus in some detail.

C. G. E. Publications—Bulletin No. 46253, on polyphase watthour meters, type D-6 for house service, and type DS-6 for switchboard service; Bulletin No. 41507 A, single-phase repulsion induction constant speed motors, type RI, form C, ¼ to 20 h.p.; Bulletin 48320, speed regulating rheostats and panels for direct current motors; Bulletin No. 47900, panel boards with solid neutrals; Bulletin 46016, Thomson horizontal edgewise instruments for switchboard service, types H-2 and DH-3; Bulletin No. 48019, electric drive in pulp and paper mills; Bulletin No. 45105, small transformers and auto-transformers; Bulletin No. 43407, flood lighting and its applications; also folder describing Taylor type, Hamilton-Beach sewing machine motors.

During the first half year of 1916, the gross earnings of central stations in America reached the enormous total of over two hundred million dollars, an increase of fifteen and six-tenths per cent. over the best previous similar period.

The Interstate Electric Novelty Company of Canada, Toronto, Ont., inform us that there is expected to be a big shortage in Christmas tree outfits and decorative lamps this year, owing to the difficulty manufacturers are experiencing in securing raw materials and keeping pace with the ever increasing demand for these goods. Dealers are advised to make provision for their anticipated requirements of these lines as early as possible as there is every indication of an increased demand this season.

What is New in Electrical Equipment

Outdoor Switching and Sub-station Costs.

The accompanying illustration shows an interesting high-tension installation, comprising a 22000/2300/4000 25-cycle 900 kv.a. outdoor sub-station as a centre unit, combined with a switching installation on either side. The 22,000-volt side of the sub-station or centre unit is equipped with 3-pole air break switches, choke coils, chemical fuses, and graded resistance high-speed sphere gap lightning arresters. The 2,300/4,000-volt secondary circuits are equipped with disconnecting switches, chemical fuses, choke coils, and arresters. The cost of this centre or sub-station unit is shown in the following tabulation:

Material cost per kv.a.	$4.33
*Labor cost per kv.a.	.55
Total cost per kv.a.	4.88

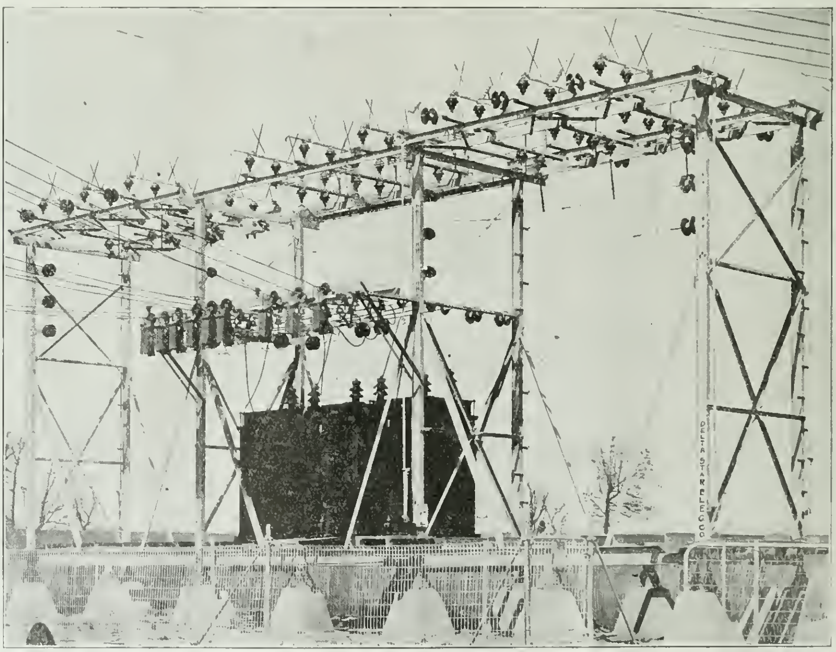
All steel and malleable iron parts of the tower, switch, and control equipment are hot galvanized. The two steel frame end units are so designed that they can later be used to support additional transformers. With an increase in capacity the kv.a. cost of the complete equipment will be correspondingly less than the cost of the initial or centre unit. The steel towers, all high-tension equipment and low-tension switches, choke coils, and fuses are of the standard type supplied by the Delta-Star Electric Company. The low tension arresters are of the Garton-Daniels type, the transformers of Westinghouse manufacture.

*This cost includes hauling of transformers. Owing to the distance and bad condition of roads, this cost was approximately one-half of the total labor cost.

Connecting Armored Cable to Sockets

Lack of a suitable means of connecting armored cord to sockets has heretofore limited its use for pendent work to a considerable extent. The growing popularity of this type of conductor is unquestioned and to enlarge its field to cover this class of work Harvey Hubbell, Inc., have produced a socket cap of special construction which admirably provides the missing link. A threaded ring swivels around a split composition bushing shaped to the metal covering of the cord. As the threaded metal ring is screwed into the aluminum top of the socket cap the composition bushings are drawn snugly around the metal casing. This operation relieves all strain on the bared conductors attached to the binding screws, enhancing the value of this device as a pendent unit. The accompanying cut shows a porcelain key socket equipped with the special strain relief cap described above.

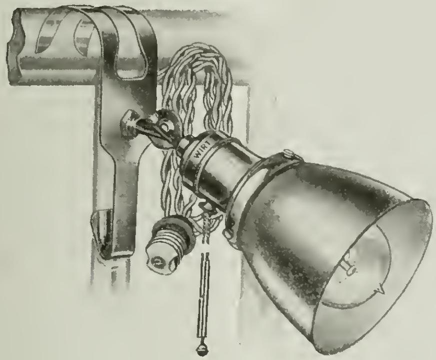
Socket cap of special construction.



Outdoor Switching Station, 22000/2300/4000 volts, 25 cycles, 900 kv.a.

New Dim-A-Lite Portable

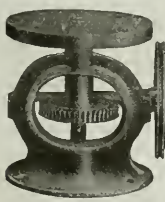
One of the newest portable lighting fixtures is the Dim-a-lite portable. This fixture consists of a special holder attachment, dimming socket, shade, cord and attachment plug. Its construction is such that it may be attached to a bed, crib, chair—in fact almost anywhere—and it may be easily moved to any particular spot in a moment. Pulling the chain gives the usual Dim-a-lite five changes of light. With a full light, it may be used for reading, and where a low or dim light is necessary for the nursery or sick room, it is



instantly available. All of the changes of light are always at command at any time to suit any requirements. This new portable should find a ready welcome in hotels, hospitals and all electrically lighted homes. The fixture is furnished in brush brass, but any other finish may be furnished. This new addition to the well-known line of devices is being put on the market throughout the Dominion by the Benjamin Electric Manufacturing Company, Toronto.

Revolving Table for Window Display

The illustration herewith shows a revolving table being marketed by Winfield H. Smith and designed for window display. This particular table has a capacity of 100 lbs. It is thoroughly well made, with machine cut gears and ball bearings to carry the weight. It is silent in operation and driven by a 1/30 h.p. motor. Screw holes are provided so that a wooden top of any size desired may be added. The



A useful idea for a contractor's or dealer's window.

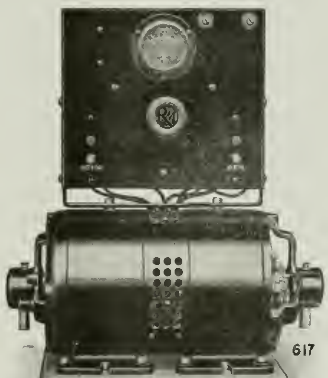
table is 6½ in. x 6½ in. x 5¾ in. high. Forty-eight turns of the belt-wheel are required to turn the table once. A moving display of this nature is a most attractive feature for any electrical contractor's or dealer's window.

"Universal" Electric Home Needs

An interesting announcement just made is to the effect that the Canadian General Electric Company has secured the right to sell exclusively in Canada, the extensive line of heating and cooking appliances manufactured by Landers Frary & Clark, of New Britain, Connecticut, under the name of "Universal." Universal electric home needs are the result of a long series of scientific experiments. Every article has been subjected to rigid competitive tests. Carefully selected materials of the highest quality only are used in the construction of the line. Attention is called to the completeness of the line of appliances, which includes American-Sheffield plate designs, tea pots, coffee percolators, toasters, coffee urn sets, etc. "Universal" appliances are made complete, heating element included, in one factory and carefully tested individually, assuring a standard uniformity of manufacture. It is the intention of the Canadian General Electric Company to carry a well assorted stock at the various branch warehouses throughout Canada, and thus will be in a position to make prompt deliveries to the trade.

New Robbins & Myers Battery-Charging Motor-Generator Outfit

A new battery-charging outfit has been developed by the Robbins & Myers Company, made especially for charging automobile and motor boat batteries. It is supplied in three sizes, 80, 150 and 250 watts. The 80 watt outfit will generate charging current in voltages up to 8 volts, and the 150 and 250 watt sets are furnished to charge up to 15 or 30 volts, as desired. The motors of these sets are furnished to operate from 115 and 230 volt direct current circuits or 110 and 220 volt alternating current of 25, 30, 40, 50 or 60 cycles. The sets are regularly furnished with a steel switchboard, which is mounted on the frame at the top. This switchboard is provided with an ammeter in the generator circuit which shows the charging amperes, a rheostat in the generator field to regulate the rate of charge, a push button switch in both the motor and generator circuits, a fuse block with fuses in the motor line and terminals for connecting the motor to the line and the generator to the battery leads. If desired the outfit can be furnished without the switch-



board. When so furnished the 80 watt and 150 watt sets are provided with 10 feet of duplex cord with detachable plug on the motor side and with 10 feet of heavy duplex cable with universal lead covered test clips on the generator side for connection to the battery. These leads are brought out through heavy insulated bushings in the frame of the machine. The 250 watt sets without switchboard are fitted with leads which are fitted with brass connectors. The 150 watt and 250 watt sets are furnished with a rheostat in the generator field for adjusting the rate of charge, but the 80 watt set without switchboard is not provided with a rheostat, as it is so designed as to give a tapering charge to the battery and a rheostat is not absolutely essential.

Current News and Notes

Collingwood, Ont.

The Hydro line which is to link in the Eugenia power system with that at the Big Chute, on the Severn River, is progressing rapidly. Poles have been set in place throughout the thirty odd miles, and the work of wiring is now going forward.

Dunnville, Ont.

The ratepayers of Dunnville, Ont., passed a by-law authorizing an agreement with the Hydro-electric Power Commission for light and power.

Galt, Ont.

A block of $12,902.79 worth of Galt Hydro-electric 20-year debentures, bearing 5½ per cent., was sold to the Canada Bond Corporation for $13,206.44. This is equivalent to a rate of 102.35.

Hamilton, Ont.

The interswitching station of the Hydro-electric Commission at Dundas, which met with a bad accident about two months ago, is entirely fitted up again.

Leamington, Ont.

The Hydro-electric Power Commission are negotiating for the purchase of the Essex County light and power plant, with a view to supplying the municipalities interested.

Montreal, Que.

The city of Montreal recently appealed from the decision of the electrical commission of that city respecting rentals and assessments for the cost and administration of the underground conduits recently installed, and the appeal by recent judgment is upheld. By this judgment, the electrical commission is directed to revise the assessments for the conduit space used by the different parties, including the city of Montreal, in such proportion and amount that the entire capital cost, as well as other expenses involved, may be assessed upon each in proportion to the amount of duct space so reserved.

Price Bros. Limited are improving their power plant at the Rimouski, P.Q., pulp mill, and have given contracts for three S. Morgan Smith turbines—one of 350 h.p. for driving generators, and two of 1,500 h.p. each for driving grinders. At the Jonquiere pulp mill of the same company three S. Morgan Smith 1,600 h.p. turbines will be installed for driving grinders.

A report by the Montreal Board of Control recommending the appropriation of $45,000 for preparing and supervising plans for a power house in connection with the proposed hydro-electric development has been referred to a special committee.

The Legislation Committee of the city of Montreal will ask the Quebec Legislature to amend the city charter so as to give power to the city to order that all wires, no matter to what company they belong, be placed upon one and the same pole and not on a pole for each company, and that the cost of expropriation of overhead material be included in the cost of constructing underground conduits.

Ottawa.

Mr. Redmond Quain, of Ottawa, Ont., passed away recently. Mr. Quain was one of the charter members of the Ottawa Electric Railway Company and a director of the Ottawa Car Manufacturing Company.

St. Alexis, Que.

A new power house, dam and penstock are being constructed at St. Alexis by the Saguenay Light and Power Company. Two generator units will be installed, the generators being direct connected to the turbines. The current will be supplied to the town of Ha Ha Bay, P. Q., for lighting and power purposes.

Toronto, Ont.

At a recent conference of the Toronto Board of Control and the civic Hydro Commission it was decided not to purchase the property and plant of the Interurban Light and Power Company.

Corporal Harry J. Guest, second son of Mr. A. E. Guest, treasurer of the Canadian General Electric Company, has been killed in action. At the time of enlistment Corporal Guest was employed with Factory Products, Limited.

Westmount, Que.

In pursuance of their policy of promoting cooking by electricity, the City of Westmount, P.Q., recently arranged for a two-days' exhibition of electric ranges, with talks and demonstrations, at the Victoria Hall. On the advice of Mr. G. W. Thompson, the civic manager, the Council recently reduced the price of current to 1½c. per kw. hour, and also sent out literature on the advantages of this method of cooking. A large number of ranges, by the Hughes Company (marketed by the Northern Electric); Moffat Stove Company, Limited, Weston, Ont.; and the McClary Manufacturing Company, London, Ont., were arranged at the sides and at the end of the hall, a portion of the centre being occupied with tables filled with a large variety of meats, pies, cakes, etc., cooked in the ranges. Representatives of the companies and several ladies were in attendance demonstrating the use of the ranges and pointing out their economic, sanitary and other values as compared with coal, gas, and wood fuels. A point was made of the saving in the matter of meat shrinkage, and in consequence the retention of the better qualities of the meat. The ranges on show comprised many designs, from the range costing $40 to the very elaborate type for a large household. In the evening, talks were given on general lines of the advantages of electric cooking. The proceeds of the sale of the food were handed over to the Westmount Soldiers' Wives' League.

Winnipeg, Man.

Official returns of the Winnipeg street railway show net earnings for the month of August of $26,375. In 1915 the average monthly earnings were $41,000.

Personals

Mr. J. A. Johnston, former district inspector of the Hydro-electric Power Commission, Brockville, Ont., has been appointed manager of the local power plant in that city.

Mr. E. A. Seath, formerly of the Canadian General Electric, has joined the sales force of Mr. W. P. Roper, Montreal, representative of the Canada Wire & Cable Company, and the Moloney Electric Company of Canada.

Mr. Godwin Shenton has resigned his position with the Lyman Tube and Supply Company, Limited, to take over the position of engineer to Messrs. Taylor & Arnold, Limited, Montreal and Winnipeg. Friends in Toronto learn with regret that this change will necessitate Mr. Shenton's removal to Montreal.

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Generation, Transmission and Application of Electricity

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The Forward March of Electric Cooking

In spite of the rapidly growing popularity of electric cooking there is comparatively little accurate data available on the lower cost of operation, the greater efficiency, the better quality of the finished product, and so on, all of which are claimed, justly we believe, for electric energy over other forms of heat for cooking. Possibly this is because there is so little uniformity in the operation of the affairs of different households, but more likely it is because this branch of the industry is so new and its development so rapid that we have not had time to settle down to the collection of statistics. In a general way, however, it is now recognized that electricity is a factor to be reckoned with in the cooking field, and, as is often the case with new developments, we are just beginning to collect data to prove the fact after the fact has actually established itself.

The scarcity of dependable information makes the smallest contribution doubly welcome, and electrical men will read with interest the information contained in a paper prepared by Mr. H. O. Swoboda for the Electrical Review, extracts from which we publish elsewhere. This article covers no new ground on the advantages or refinements of electric cooking, but does contain a quantity of useful data on the influence the rate situation is exerting on this development, as well as some interesting figures on current consumption in different homes of various countries. As might be expected, of course, there is a wide diversity of consumption, even under what would appear to be similar conditions, but this, as we said above, is inevitable when dealing with various individualities. The average, at least, shows the possibilities, and this average, as shown by the article quoted, is highly encouraging to the advocate of electric cooking.

* * *

It is well to point out, however, that favorable as the figures in this article most certainly are, they do not even fairly represent the case for many Canadian municipalities, where the cost of current is often considerably less than may be found anywhere in the United States. It will be noticed, by reference to the table reproduced in the article, that Toronto's rates are the lowest, for large consumption, of any city quoted. By large consumption we mean such as would apply to the average family using electricity for cooking, say, from 100 to 300 kw.h. per month. Yet there are very many places in Canada where the cost of current is little greater than in Toronto, and a number of municipalities give equally low rates. With these low rates the monthly bill of $3.50 spoken of in Mr. Swoboda's paper as a fair average would be reduced to about $2.25, and this, in fact, is very close to what the monthly charges for an average family in Toronto and other municipalities with about the same rates, actually work out to. This includes both lighting and cooking.

As an example, we may quote one set of accounts recently brought to our attention for a four-person household, where the bills in the last several months have only once exceeded $2.50, and that once in the month of September, when the demands of preserving, Exhibition visitors, and so on, ran the consumption to 270 kw.h. The cost of this current, however, works out at only $3.73, or at the rate of 1.38 cents per kw.h. If we consider that the cost of lighting alone in such a household, at the higher primary rates, would probably cost at least one dollar, we have the average cost of cooking as $1.50 per month in normal times and $2.73 under maximum requirements.

* * *

But, quite aside from its cheapness, electricity can justly demand recognition from the average housewife on the score of cleanliness, safety, general efficiency, and in conjunction with these the saving of labor. These are days when "help" is both costly and of an inferior quality, and electricity in its various forms, and especially in its use for cooking, may quite honestly be offered to the average home as a solution of the unsolvable servant problem. Don't let us overlook the point any longer that electricity is the servant of the masses. It not only serves those who, in its absence, could afford other servants, but it stands equally ready, and quite easily available, to supply comforts and luxuries to those classes who otherwise could never hope to taste of them.

Is it not just possible that electrical men are the slowest of all to recognize these facts? Years ago we dreamed about them coming true, and now that they have actually arrived they find us still of the same way of thinking. Does not the small number of electrical men who cook electrically in their own homes prove it? Or is it just the case over again of the shoemaker's children who run barefooted? In either case, is it greatly to be wondered at if the general public are a little slow to recognize the benefits of this most dependable, always available, universally applicable, and constantly lower-priced servant of servants?

Industrial Accidents Cause More Deaths than War

An extremely successful meeting of the Toronto section of the American Institute of Electrical Engineers was held on Friday, October 20, 1916. To this meeting were invited the members of the Society of Chemical Industry and engineering students of the University of Toronto. The subject for the evening was "Accident Prevention," and was presented by Mr. Charles B. Scott, of Chicago. Mr. Scott explained that some nine years ago he was claims agent for a small railway in the South, and in assisting a crew in removing a boy from under one of their cars the realization was brought home to him that this might possibly have been one of his own boys. This started Mr. Scott to thinking that the real matter behind all accidents was not how much compensation the company had to pay, but what suffering was being caused by preventable accidents by the company with which he was connected. Mr. Scott stated that the material and equipment of this company were O.K., the rules and discipline and personnel of the operating force were the best obtainable, but yet the accidents kept occurring. Accidents were only stopped after the men had been collected together and the matter laid before them and their co-operation asked as to how best to prevent accidents. Since that time employees have been meeting monthly, and a great decrease in accidents has been the result. Mr. Scott made the startling statement that industrial accidents in the United States for the year 1914 were the cause of more deaths than occurred in the British Army for the first thirteen months of the war.

The speaker explained that to prevent accidents it was absolutely necessary to educate the workman and appeal to the best that was in him. This may be carried on by buttons, banners, hurrah meetings, etc., but it is far better to realize that the humblest workman has the same father love as is felt by the highest executive. And if this workman is appealed to in the right way and the work of accident prevention presented to him so that he sees it is for his benefit and the benefit of his family and children that this work is being carried on, buttons, prizes, and hurrah meetings will be absolutely unnecessary.

Mr. Scott summed up the situation with the following quotation, written by a load despatcher of the Commonwealth Edison Company:

"And the end is that the workman shall enjoy the fruits of his labor; that his mother shall have the comfort of his arm in her age; that his wife shall not be untimely a widow; that his children shall have a father; and that cripples and helpless wrecks, who were once strong men, shall no longer be a by-product of industry."

As expressed by one of those present, the question of accident prevention as presented by Mr. Scott puts the matter in an entirely new light. He had come expecting to hear about the best method of placing danger signs all over a plant. The best evidence as to the value of the paper was the fact that everyone remained until the last, and a very interesting discussion was entered into. A very hearty vote of thanks was moved and seconded.

The next paper to be presented before the Toronto section will be on "Insulator Design," by Mr. A. O. Austin, chief engineer of the Ohio Brass Company, November 24, 1916.

Power Development on Saguenay River

A portion of the fourth report of the Quebec Streams Commission just made public deals with Lake St. John as a storage reservoir for power development on the River Saguenay, which is of particular interest on account of the proposed operations of the Quebec Development Company, whose incorporation was recently announced with the object of installing a plant for, among other things, the fixation of atmospheric nitrogen. Lake St. John, located about 100 miles north from the city of Quebec, is at the source of the River Saguenay and has a computed drainage area of about 30,000 square miles. Its elevation is about 315 feet above sea level. The river Saguenay is fairly regular on account of the natural reservoir formed by Lake St. John. The maximum discharge recorded is 220,000 second-feet. A minimum flow of 12,000 second-feet was observed on April 9 of 1915. The relation between maximum and minimum run-offs is therefore 18 to 1. This compares with 30 to 1 in the Ottawa River and 35 to 1 in the St. Maurice River.

The Quebec Development Company owns the water powers on the River Saguenay between Lake St. John and sea level, and it is proposed to use 300 out of the 315 feet of head by installing two developments. One of these would be located at Maligne Island with a head of 100 feet, and the other would be at the foot of the total fall with a head of 200 feet. The water comes off from Lake St. John by two channels separated by Alma Island. The eastern channel is called the Grande Decharge, and the western channel the Petite Decharge. Maligne Island is located in the Grande Decharge not far above the foot of Alma Island. In order to use the whole discharge of the lake, it will be necessary to dam the Petite Decharge at the head of Alma Island.

Careful readings have been taken of the height to which the water must be raised in Lake St. John to produce a certain regulation, and as readings have shown that 34,000 second-feet represents the average flow for the year, it is evident that a control of all the water must result in this amount of steady flow. This result could only be obtained, however, by storing the water in the tributaries of the lake. Proper control of the lake itself, however, would result in a flow regulation up to 28,000 second-feet.

Using both development sites mentioned above, it has been determined that with a 22,000 second-foot regulation, 600,000 theoretical horse-power could be developed; with a regulation to 25,000 second-feet, 682,000 h.p., and with 28,000 second-feet, 763,000 h.p.

Illumination and Architecture

Mr. E. N. Hyde's talk before a mixed gathering of electrical men and architects at the Electric Club of Toronto on October 6, was an able demonstration of the intimate relations that ought to exist between these two professions in order to secure the best results in illumination, both public and private. The present-day practice of the average architect in planning his buildings without due respect to their illumination has produced very unsatisfactory results, and Mr. Hyde's portrayal of the ideal in art, which demands not only that our buildings, inside and out, must be designed with the eye of the aesthete, but must further be rendered visible to the eye of the layman, appealed to his hearers as a good argument. Works of art cannot be appreciated if they are not seen, and the history of art, of which architecture is merely an important branch, is that, all through the ages, it has attained its highest conception only when properly supplemented by and combined with good lighting.

Unfortunately, the time at the disposal of the members of the Club was too limited to allow Mr. Hyde to elaborate on his topic and the address dealt only in a general way with this important subject. At some future date it is hoped the Club will have the pleasure of hearing further lectures on the practical application of good lighting to the various fields—industrial, commercial, domestic, etc., either by Mr. Hyde or someone else competent to discuss these matters.

On October 20, in the enforced absence of Sir Edmund Walker, who was occupied with Toronto's Red Cross work, Professor James Mavor, University of Toronto, addressed the Club.

The Weno Electric Company, of Weno, Alberta, have decided to abandon their gas producer plant furnishing light and power for shell and tractor industries east of Calgary, and buy power from the city of Calgary. The contract for the 12,000 transmission line has been given the Northwestern Engineering and Supply Company, of Calgary.

Analysis of Electric Cooking Conditions

Very Marked Reduction in Rates in Last Ten Years. Canada Easily in the Lead in this Respect

That electrical energy can be employed to produce heat is known for more than one hundred and fifty years, although the first public exhibit of electric cooking did not take place until 1883, when it was demonstrated at the Vienna Exposition. At that time water was boiled, once by means of a spiral of platinum wire, which was made red hot by an electric current and placed into the water, and, another time, by winding the platinum wire around the vessel, which contained the water.

Electrically heated cooking utensils, such as hot plates, tea kettles and chafing dishes, were then shown shortly after 1890 at the various electrical exhibits. In 1904 the first hotel in Europe was equipped exclusively with electric cooking apparatus, and since that time the development of the art has been going on so rapidly that today cooking with electricity offers to become a serious competitor to the general method of preparing food with heat produced from coal, gas or other fuels.

Technical Difficulties

There was one serious technical obstacle, preventing the general adoption of electric cooking, i.e., the lack of a suitable substance for the electric heater, as none of the known materials except the high-priced platinum withstood the heat to which they had been subjected. While the maximum heat for preparing food exceeds 500 degrees Fahrenheit, the electric heater itself has to be designed for considerably higher temperatures, in order to reap the benefit of quick action and radiant heat. The first substance suitable for high temperatures was discovered about 1892 in the nickel-steel alloys, which resist heats as high as 1,000 degrees Fahrenheit without injury. The material satisfied a great many demands, and considerable quantities of it are still being used today. The real solution of the problem, however, was not obtained until about 12 years ago, when the nickel-chronium alloys appeared in the market. They can be operated at temperatures as high as 1,750 degrees Fahrenheit; in some instances even as high as 2,000 degrees Fahrenheit without being affected, and fulfilling all ordinary requirements. A few other substances with similar properties have since been discovered, but so far the nickel-chromium alloys have maintained the field. In other words: The foremost technical difficulty which prevented the general use of electrical heat for cooking was successfully removed more than a decade ago.

Of course, there were other troubles which had to be taken care of, such as terminal defects and poor insulation, but as they were mostly caused by the inexperience in designing heating devices, the natural development eliminated these difficulties in the course of time, and are a matter of the past for all manufacturers of experience and repute.

Central-Station Rates

Another obstacle preventing the general adoption of electric cooking was the high cost of electrical energy. Even today the cost is not, in many cases, sufficiently low to warrant a rapid introduction of the art; nevertheless, considerable progress has been made during the last few years, and is being made every day.

With the steadily increasing capacity and efficiency of modern power plants, especially steam-operated plants, the cost of electrical energy has been cut in half within the last ten years, and all indications point towards the repetition of such a reduction within the coming decade. Naturally, the decrease in the cost of production in most cases has also reduced the rates to the consumers.

In addition thereto, central stations have just about commenced to realize the desirability of the cooking load for their systems as an "off-peak load," and in a great many cases offer now special low rates for installations with electric ranges.

The result of the conditions just named is that in those sections of the United States and Canada where either water power or modern steam plants are available enterprising central stations are in a position to offer rates which make electric cooking just as cheap and even cheaper than cooking with gas. Since this development is still going on and the lowering of the rates continues, those sections of the country in which electric cooking competes successfully are steadily increasing in number as well as in size. In fact, it is not very hard to predict that within a comparatively short time electrical energy will be offered anywhere in the United States and Canada, and, for that matter, all over the civilized world at such rates that electric cooking can be universally adopted. It may also be well to mention that the rates in our country are by far not the lowest, and, that, for instance, in quite a number of cities in England a rate equivalent to about two cents per kilowatt-hour is charged, whereas the majority of our rates range from three to six cents per kilowatt-hour.

In order to get at the facts more accurately, the rates established by a number of central stations for domestic cooking have been compiled in the accompanying Table I. Although far from complete, it nevertheless shows that the rates, compared with the customary charge of 10 cents per kilowatt-hour of 10 years ago, have been cut in two in most cities, and that rates of three cents per kilowatt-hour are not very seldom. No effort has been made to compile the rates for energy for large kitchens, such as for restaurants, hotels, clubs, hospitals and industrial enterprises, because establishments of this character, as a rule, are supplied either at wholesale power rates or generate their own energy. Besides this, there are not many large kitchens compared with the countless number of individual households, and it is for this reason that the latter have received first consideration in this article.

TABLE I.

Company.	Actual cost in cents for 100 kw.h.	200 kw.h.	500 kw.h.	1000 cu. ft. gas.
So. Cal. Edison Co., Los Angeles, Cal.	4.60	3.80	3.32	
Gr. Western Power Co., San Francisco, Cal.	3.00	3.00	3.00	75
Pacific Gas & Elec. Co., San Francisco, Cal.	2.60	2.10	1.74	75
Potomac Elec. Power Co., Washington, D.C.	3.70	3.35	3.14	80
City Elec. Light Plant, Jacksonville, Fla.	2.00	2.00	2.00	120
Commonwealth Edison, Chicago, Ill.	10.00	8.19	5.29	80
New Orleans Ry. & Light Co., New Orleans	6.00	4.92	4.07	110
Consol. Gas, Elec. Lt. & Pwr Co., Baltimore	6.75	5.87	5.35	80
Edison Elec. Ill. Co., Boston, Mass.	3.60	2.80	2.32	80
Worcester Elec. Light Co., Worcester, Mass.	4.40	3.70	3.28	75
Detroit Edison Co., Detroit, Mich.	10.35	6.97	4.95	75
Duluth Edison Co., Duluth, Minn.	2.40	2.40	2.40	85
Minneapolis Gen. Elec. Co., Minneapolis	4.55	3.46	2.81	85
St. Paul Gas Light Co., St. Paul, Minn.	6.57	6.42	3.64	100
Kansas City Elec. Light Co., Kansas City	5.80	5.15	4.70	27
Municipal Elec. Light Co., Kansas City	3.00	3.00	3.00	27
Laclede Gas Light Co., St. Louis, Mo.	4.34	3.59	3.15	80
Public Service Elec. Co., Jersey City, N.J.	10.00	8.00	6.20	100
Buffalo Gen. Elec. Co., Buffalo, N.Y.	6.00	4.50	2.26	30
New York Edison Co., New York, N.Y.	8.00	8.00	7.9	80
Cleveland Elec. Ill. Co., Cleveland, Ohio	9.50	7.25	4.90	30
Portland Ry. Light & Power Co., Portland	3.00	3.00	3.00	100
Duquesne Light Co., Pittsburgh, Pa.	5.80	5.40	5.16	27½
Narragansett Elec. Light Co., Providence	4.50	3.25	2.50	85
Milwaukee Elec. Ry. & Light Co., Milwaukee	4.88	3.44	2.52	75
Montreal Lt. Ht. & Pwr. Co., Montreal	3.00	3.00	3.00	95
Public Utilities Commission, Port Arthur, Ont.	1.64	1.50	1.41	Not listed
Toronto Elec. Light Co., Ltd., Toronto, Ont.	2.06	1.48	1.13	70
City of Winnipeg, Winnipeg, Man.	4.65	2.77	1.65	120
Winnipeg Elec. Ry. Co., Winnipeg, Man.	3.75	2.03	2.03	120

Eighty-five Reports

Twenty-six systems, or 30.6 per cent., apply a so-called room schedule, in accordance with which the price per kilowatt-hour is reduced after a certain initial quantity at a high price has been consumed. This quantity varies in accordance with the number of active rooms in the residence. In some instances the number of square feet of the floor space is substituted for the number of rooms.

Twenty-four systems, or 28.3 per cent., use a two, or multi-rate, schedule. As in the preceding rates, the price per kilowatt-hour is reduced after a certain initial quantity at a high price, approximately light rate, has been consumed. In this case, however, this initial quantity is the same for all consumers. Some systems make only one reduction in price per kilowatt-hour; others make two or more, setting for each step a fixed amount of current consumption.

Eighteen systems, or 21.2 per cent., have a plain kilowatt-hour schedule, there being one uniform price per kilowatt-hour, regardless of the quantity of current consumed and the capacity (connected load) of the installation.

Twelve systems, or 14.1 per cent., charge on the basis of maximum demand, as is customary for practically all power service.

Three systems, or 3.5 per cent., apply a plain kilowatt-hour schedule, same as the other 18 systems just mentioned, but in addition thereto make a fixed service charge per month.

Two systems, or 2.3 per cent., also apply a plain kilowatt-hour schedule, same as the other 18, and three systems, but give a discount, which increases with the current consumption.

These figures clearly show that the room and two or multi-rate schedules are the most favored methods of charging. The reason for this preference is that due to the scaling rate, a high return is received for a small initial amount of the energy delivered. This amount is usually made about equal to the monthly demand for light during the hours of the peak load. The energy consumed during the off-peak hours then represents the remaining amount delivered, and, of course, can be sold at a lower rate. Therefore, it is possible to use one meter for both light and cooking combined, without discriminating in the charges in favor of either kind. If a plain kilowatt-hour schedule is applied, naturally one rate for light and another for cooking should be made, necessitating two separate meters and an expensive installation.

The fixed, not variable minimum, payment, as can be seen, is the most preferred and probably the best for residential purposes, as it is the simplest method and sufficiently accurate to cover the fixed expenses connected with each installation.

The well-known prompt-payment discount is the leading method, and undoubtedly the simplest and best manner to eliminate a slow payment of the bills.

Fifty-seven systems, or 67 per cent., use the regular residence rates, and 28 systems, or 33 per cent., use a special rate.

As all systems with the room and the two or multi-rate schedule use the same rate for light and cooking, as pointed out before, and as there are also a few systems which do the same, although they operate on the plain kilowatt-hour schedule, it can readily be understood that fully two-thirds of all systems can successfully supply energy for domestic cooking without making a special rate. Of course, these systems were obliged to readjust their old residence light schedule to the new conditions before this was possible.

The figures show that the lowest charge for 100 kilowatt-hours is between 1.5 and 2 cents; the lowest charge for 200 and 500 kilowatt-hours is between 1 and 1.5 cents; the charge made by more than 50 per cent. of all systems lies between 3 and 6 cents per kilowatt-hour, and the highest charge for 100 kilowatt-hours iis slightly in excess of 10 cents. The highest charge for 200 kilowatt-hours lies between 9 and 10 cents, and the highest charge for 500 kilowatt-hours lies between 7 and 8 cents.

Of all the systems investigated 10.6 per cent. charge less than three cents for a monthly purchase of 100 kilowatt-hours, 65.9 per cent. less than six cents. and only 4.7 per cent. adhere to the customary charge of 10 cents of 10 years ago.

Effect of Load on System

One of the other factors affecting the electric-cooking rate, is the influence of this load on the feeder system, through which the energy is delivered to the consumer. While the maximum demand for a single range seems to be between 35 and 40 per cent. of its economical load, the maximum demand for groups of ranges does not exceed 15 per cent. of the connected load. In other words, the diversity-factor is about 1 to 7, permitting the installation of seven times as many ranges on a feeder system, as the connected load apparently would permit. In fact, it is even considered safe to figure on a ratio of 1 to 10, as the maximum demand of the domestic-cooking load does not occur at the time of the station peak.

The above information is extracted from an article by H. O. Swoboda, consulting electrical engineer, in the October 14 issue of the Electrical Review. The article is continued in the issue of October 21, from which the following additional information is gleaned.

From a table compiled, giving the energy consumption for domestic cooking in the United States and Canada in a number of cities, it works out that the average consumption per person per day is approximately 1 kw.h. Another table gives the average consumption per person in England as 1.36 kw.h. per day per person. The average monthly bills for electrical energy, based on a rate of 3c in a number of United States cities, figures out at $3.50. The article concludes with the following paragraphs:—

Temperature Control

The absolute control of the temperature, which is possible, will probably result in a gradual revolution of the methods of cooking. When using coal or gas ranges but little attention is paid to the actual degree of heat in or on the oven, because it is almost impossible to maintain it uniformly. Consequently a great deal of skill and time is required to watch the conditions of the food constantly, to stir it and to change the position of the vessel continuously, in order to obtain satisfactory results. Automatic electric ovens are now on the market, in which the temperature is accurately controlled, and the necessity for constant vigilance is removed. Therefore, once the temperature is known at which a certain food has to be prepared, an inexperienced person can hope to get uniformly good results without first passing through many failures and wasting much good material. Of course, an enormous amount of pioneer work is yet to be done before this state of conditions will be reached, as amongst other things, as Miss M. B. Van Arsdale, assistant professor of household arts at Columbia University, states, that it would be necessary for recipe books of the future not to read merely: "Bake until done in a moderate oven," or "according to judgment," but to furnish instead the "exact length of time and temperature." The first steps in this direction have already been taken, giving not only the most desirable temperatures for roasting, boiling, stewing frying, frittering and baking in general, but also a number of data about roasting beef rare, medium rare and well done at different temperatures.

Quality of Food

The superior quality of the food prepared in an electric range is the natural outcome of applying the proper temperature, in place of excessive heat, or oftentimes not sufficient heat. Roasts will be found more tender, better flavored, and, therefore, more enjoyable; other foods will be improved similarly, and, for instance, loaves of bread, baked in large bake ovens in quantity, will be absolutely uniform in quality.

Saves Labor

The saving in labor to the housewife as well as to the cook in large kitchens is material, although very often it cannot be expressed in dollars and cents. Due to the possibility of maintaining a uniform temperature as stated before, the continuous watching of the food while being cooked is unnecessary, and the time thus saved can be devoted to other matters.

Economizes Food

The saving in food on account of the proper control of the temperature is quite material. Not only is the possibility of spoiling food altogether reduced to a minimum, but there is a saving of approximately 15 per cent. in the shrinkage of meat. In other words, the purchase of meat can be reduced about 15 per cent, without reducing the weight of the meat served.

Low Temperature Rise

The low rise in temperature of the surroundings, another advantage of cooking by electricity, is due to the high efficiency of electric equipment concentrating the heat where it is required and losing but little to the surroundings. This is not only a matter of comfort, but of supreme importance in hot weather, especially in kitchens with limited space, as, for instance, in small apartments, basement kitchens and ships.

TABLE II. MISCELLANEOUS DATA

Efficiency of Electric Cooking

Comparison of Heat Units Required in Gas and Electric Cooking Equipment: Electric range.

		Gas*		Electric**		Heat Saving	
Food cooked	Time in min.	cu. ft.	Approx. B.t.u.	kw. hrs.	Approx. B.t.u.	Approx. B.t.u.	Per cent
7 lbs. of bread in oven..	45	180	12,000	2.0	6,826	5,174	43
1 leg of mutton, 1 small piece of beef, 2 Yorkshire puddings, 1 large rice pudding, 1 tin baked potatoes in oven	180						
3 apple rolls on top of range	120	78	54,600	6.5	22,185	32,415	59
2 Yorkshire puddings, 1 rice pudding, 1 tin baked potatoes in oven	180	78	54,600	5.5	18,772	35,828	64
7 lbs. of bread, 6 buns, 1 pastry	100	25	17,500	4.0	13,652	3,848	22
12 lbs. of beef in oven ...	170	76	53,200	5.9	20,000	33,200	63
Totals		437	191,900	23.9	81,435	110,465	57

* 1 cu. ft. of gas contained about 700 B. T. U.
** The current consumption was high, as a ventilator was used to carry off the excess of heat, as the current could not be regulated closely.

Other advantages of electric cooking are increased cleanliness, improved sanitary conditions and less fire risk, any of which very often give the electric the preference over fuel cooking.

Conclusions

The data collected in this paper are a clear evidence that the development of electric cooking has gained considerable during the last ten years in the United States and Canada, as well as in Europe. As the public in general gradually commences to realize the possibilities and advantages of electric cooking, and as the central stations begin to understand the benefits resulting from selling electrical energy for cooking at special low rates, it is not very difficult to predict that the immediate future will see an enormous increase in the adoption of electrical energy for cooking.

Vancouver's New Lighting System

In the very near future Vancouver citizens will be enjoying a new lighting system, in which nitrogen-filled incandescent lamps will replace the arc system in use for many years past. For economic reasons it has been deemed necessary to refit the arcs for the reception of the new lamps in place of erecting new standards. This will not interfere with the quality of the new lamps, and when good times come again the council will no doubt encourage the erection of ornamental standards on all leading residential streets.

The first shipment of the new lamps was received early in August, and up to the close of September, City Electrician Fletcher had completed twelve outlying circuits, calling for approximately 500 lights. These circuits are in Hastings Townsite, Grandview, D. L. 301, Broadway East, and part of Mount Pleasant. On car line streets 600 c.p. lights are replacing the old 1,000 nominal c.p. arcs, while on other residential streets the new lights are of 400 c.p. Despite the lower candle power of the new lamps, their illumination radius is considered by the city electrician to be fully equal to the old arc lamps. It is expected that before Christmas the new system will have been installed in all parts of the city.

B. C. Telephone Company Have Benefit Plan

An employees' benefit scheme has been worked out by the management of the British Columbia Telephone Company, which differs from most plans of the kind, inasmuch as participants are under no financial obligations to the company in connection therewith. All that is necessary is continuous service with the company, the various sick and death benefits are graded according to length of service. The sick or disability benefits under the system worked out range from 13 weeks' full pay and 39 weeks' half pay for those who have been in the company's employ for ten years or more to full pay for 4 weeks and half pay for 9 weeks in the case of those who have been employed by the company for two to five years. Death benefits, payable to the wife or husband or children of the employee, are also provided for, with a maximum of $2,000; or, if the term of service has been ten years, one year's full pay will be given as a death benefit, scaling down to six months' full pay for those who have been employed by the company from two to five years.

Power Purchase Eats into Taxes

The taking over of the electric power interests by the Government has brought out protest in reference to the loss of taxation by various municipalities. A deputation, headed by Mayor Mulholland of Port Hope, Ont., recently waited on Premier Hearst, urging that, as the loss to the municipalities would be in the neighborhood of $45,000 a year, the Government would pay the taxes for the part of 1916 they have had the plant, also for 1917, and arrange suitable compensation for the succeeding year. Sir Adam Beck has suggested that payment of a portion of the taxes be made out of Hydro earnings, though the payment might have to be spread over a considerable time. Premier Hearst has the matter under consideration and has promised to submit a proposition in the near future.

Montreal Weekly Lunch Club

The interest in the Montreal weekly electrical luncheons is well sustained. On Wednesday, Oct. 16, the attendance was 88. A number of papers has been arranged for, some of them of a general character. On Oct. 11 Mr. L. E. Hamilton of the Northern Electric, read a paper descriptive of fire alarm apparatus, and on Oct. 16 Mr. Walter J. Francis spoke on the Montreal aqueduct, particularly in relation to the proposed hydro-electric development. He gave an outline of the history of the aqueduct and also of the steps taken by members of the Canadian Society of Civil Engineers to obtain an independent report on the scheme. The speech was a temperate review of the situation, Mr. Francis taking the attitude that the capital and working costs, even on the figures supplied by the city, would be excessive.

The city of Brantford has given notice of an application to the Railway Commission for a recommendation to the Governor-in-Council sanctioning an agreement for the sale of a portion of the Grand Valley Railway to the Lake Erie and Northern Railway.

Recent Developments in the Lighting Field

Extracts from a Report of the Committee on Progress of the Illuminating Engineering Society Presented at Annual Convention (Continued from October 1)

INTERIOR ILLUMINATION.

The possibilities in the use of light properly graduated and directed to produce desired effects in interior illumination are being recognized. It has been found that an alteration in the illumination in a room may produce a change in the apparent distance of a wall as much as 10 per cent. A patent has been taken out for a system of lighting in which the light source is placed in an opening in the wall so that the rays of the lamp may shed into two or three rooms or compartments at the same time. It is expected that sufficient illlumination will be obtained to meet the requirements of bedrooms and hallways. Frosted or ribbed glass is used to protect the openings to each room, and shutters are provided to cut off the light when desired.

Office Buildings.

The lighting of the new Equitable Building in New York City, the largest office building in the world, indicates the trend of practice for this type of illuminating engineering problem. In the ground floor corridors the indirect cove lighting is supplemented by light from pendent fixtures, consisting of horizontal rings studded with radially projected frosted bulbs. Corridors and others passageways on the upper floors are illuminated by canopy-type direct-lighting fixtures. In the offices convertible fixtures are used which may be set to give either direct or semi-indirect lighting by means of a movable lower member of the fixture. In the Banker's Club, which occupies all of three floors, the fixtures are decorative, and are made to harmonize with the furniture and architecture. Table lamps and chandeliers provide direct lighting, while general illumination is furnished by cove lighting from lamps concealed in cornices around the columns and walls. In the restaurant in the basement illuminated translucent glass cornices around the columns and walls. In the restaurant in the basement illuminated translucent glass cornices around the columns furnish indirect lighting.

Stores.

A candy and catering store in the West has a number of unique features in its lighting equipment. The forward half of the store is lighted by mirror-lined trough reflectors in coves, while the showcases have specially designed reflectors, carrying low wattage lamps to avoid heating the candles. The rear half of the store is lighted by means of stereopticon lamps in shallow bowls, mounted on pedestals. A reflector cuts the direct rays of light from the side walls, throwing it upward and toward the centre of the room. The effect is that of the cove system. The average intensity is given as 2-foot candles. The banquet room is lighted by projectors of heavily plated spun brass, equipped with stereopticon lamps. The ceiling is divided into four panels, in the centre of each being a compo-plaque overlaid with a luminous foil stained in different colors. There is a curve to each plaque, so designed that when a pencil of light from the projector strikes its surface the rays are deflected and diffused at the proper angle. The inside of each reflector holder is painted in stripes of red, green, and blue, and these colors in turn are reflected to the upper edge of each projector. There is no glare, and the beams of light are invisible except when the diners are smoking. The average intensity on the floor is given as 1.6-foot candles, with a wattage about 1.2 watts per square foot.

In a Western bank a combination of cove lighting in the public lobby and fixture lighting over the teller's cages and working space has produced a very satisfactory artistic and utilitarian illumination.

Show Windows.

One result of the two "prosperity weeks" has been a marked improvement in window lighting. A new system of interchangeable show window lighting has been introduced which permits the easy installation or removal of lights to suit any particular class of merchandise displayed. The result is accomplished by means of properly insulated current-carrying strips, to which contact is made through plugs or hooks.

Factories.

The report of the English Departmental Committee on Lighting in Factories and Work Shops is discussed under the heading "Legislation," as is also the memorandum of the Health and Munition Works Committee. By installing a special night lighting system, using low wattage lamps, a considerable saving has been accomplished in a factory where an inspection showed the regular system was being used when only a few lamps were needed. An interesting test of the effect of adding artificial light to daylight was made in a shop where machine work predominates. It was found that as the natural light decreased the work fell off. On adding artificial light on a dark day the work increased, but decreased when the artificial light was added on a bright day. It was suggested that in the latter case the combination of two classes of lighting differing in color content requires an effort on the part of the eye to keep adjusted to momentarily changing conditions.

Schools and Churches.

The work of the Committee on School Lighting is beginning to bear fruit, as evidenced by the marked improvement in the methods of lighting used in some recently erected schools.

The number of new church installations described in the technical press indicates a decided awakening of those in charge to the value of good lighting. By using trough reflectors concealed between the mouldings of the arches at the points where the latter spring from the pillar capitols a church in England gets the effect of indirect lighting, although the lights are visible to those leaving the auditorium. The value of the illumination on the working plane is given as between 2½ to 3-foot candles.

Hospitals.

In connection with X-ray surgery in hospitals it has in the past been customary for the surgeon to work either in darkness or, if in the light, to depend upon an assistant who, alone in a position to see the X-ray images on the screen, guides him in his work. Owing to the disadvantages of both methods surgeons rarely attempt to operate under the guidance of the fluorescent screen and X-rays, relying almost wholly on radiographs. A new method has been worked out, involving the law of simultaneous contrast. The operating room is illuminated by an intense red light of considerable purity. Thus the active phases of an operation are executed under a red light, while the X-ray examinations of the body in the region of the operation are made in the greenish light of the fluorescent screen. The method has been used for several months, and, while the illumination obtained is not high, it has been found to be satisfactory.

Art Galleries and Museums.

An appreciation of the possibilities of applied illuminating engineering is extending even to private art galleries. Thus in one instance it was found possible to replace an old and unsatisfactory trough system by a series of stereopticon reflectors placed above the skylight. An intensity of about 6.5-foot candles was obtained, quite uniformly distributed over the wall space occupied by the pictures and the angle at which the light is received is such that there is no direct reflection from the surface of the canvas to the eye of the observer. The lighting of art galleries has occupied the attention of illuminating engineers for a number of years, but recently attention has been called to the problems involved in the proper lighting of museums, and particularly those of natural history. The colors of some birds are so evanescent that they will not stand exposure to any light. The same is true of butterflies. The coats of such animals as deer may be ruined and the color of black-skinned animals may be altered as the result of exposure to light. The problem is complicated in many existing museums owing to the expense and difficulty of installing new and up-to-date installations. The problem is further complicated by lack of data as to just what quality of light would be best to minimize the effect of fading, etc. Attention should be called to the lighting of the new Cleveland Museum of Art.

Auditoriums and Theatres.

The arena of the new auditorium at Oakland, Cal., is illuminated by a set of what are claimed to be the largest semi-indirect fixtures ever built and placed in one room. They are 10 feet in diameter and suspended 60 feet from the floor. A total of 44 kilowatts are used in the eight fixtures. The average illumination on a reading plane is 3.2-foot candles. The theatre is illuminated by a centre skylight, behind which are placed gas-filled tungsten lamps in special mirrored reflectors. The ceiling decorations are brought out by means of cove lighting. In the art gallery provision has been made for a large number of receptacles, to permit of the individual lighting of the pictures. The main illumination in this section is through the skylight. In the ballroom the illumination on the reading plane is 2.7-foot candles, produced by lamps in reflectors placed above moss-amber glass.

A new departure in stage lighting is to be found in the replacement of the old footlights by a string of lights, with suitable reflectors, placed on the stage side of a front drop curtain. This curtain can be raised or lowered to meet the requirements of different scenes.

The growth of the moving picture business is evidenced by the number and character of new theatres built for this purpose. The problem of lighting such theatres is so different from that of the ordinary playhouse that where it has been turned over to him the illuminating engineer has had an opportunity to work out many novel ideas in lighting. The intermittent coming and going of patrons in general requires continuous illumination to permit leaving and finding of seats without difficulty. In some cases the screen projection is arranged so that the pictures are distinct even with a full illumination of the auditorium, but in most cases a twilight illumination is maintained by shaded and frequently, colored lights. Such lights are apt to be distracting, and a novel manner of eliminating this difficulty has been employed in a recently fitted up photo-play house by gradually diminishing the illumination from a full daylight effect at the entrance to deep twilight at the screen. This is accomplished by lamps concealed in coves which illuminate the ceiling. The gradation was so planned that the eye adapts itself to a smaller and smaller amount of lighting without the change being noticeable. Another novelty of this installation is found in the entrance lighting, where an application has been made of a color change effect produced by using three primary colors, which pass through a cycle of varying intensities, so arranged, however, that the total flux of light remains practically constant. Each color varies from instant to instant, giving a resultant effect, which constantly changes.

Two sets of lighting units were used recently to light a boxing match, one to give photographic results and the other to correct the color effect of the mercury arcs and make the resulting light better adapted for the spectacle. For the ordinary lighting an inverted cone 9 feet in diameter and carrying 300 sign receptacles fitted with 25 and 40-watt clear bulb tungsten lamps was suspended so that its bottom was 16 feet from the floor. Five frames, each containing eight mercury-vapor lamps were used for the photographic lighting, together with 10 arc lamps to bring in the red color component. The effective area of the ring was 576 square feet, and the energy consumption for illuminating purposes was 65 kilowatts, or 110 watts per square foot. An armory has been made available for indoor tennis by installing a proper system of lighting, using high power lamps.

Railways.

An improved system of lighting has been standardized for Pullman cars, and the changes have resulted in a large increase of illumination with the same power consumption. A higher mounting, with the lamp filament completely covered, has reduced glare. There has been a big reduction in maintenance and cleaning. One hundred-watt tungsten lamps are used in 12-inch bowls, and photometric tests have given an average of 7.5 foot candles on a plane 36 inches from the floor. The problem of lighting a railway roundhouse involves many unusual features, including not only the proper spacing and distribution of the sources, but also their protection from the corroding action of gas and their proper cleaning. A system has been worked out and standardized by a Canadian railway, which uses specially designed reflectors similar to those used as headlights on interurban electric cars. A semaphore lens is employed as the front glass of the reflector, and this diffuses the light and cuts off the glare, as well as offering a surface easily kept clean. These lights are arranged in sets, one set lighting the engines, another the turntable and pit, another serving for general illumination, and another for portable use. The system has been found to have great advantages over the drop light equipment formerly used. A new system of lighting installed in the case of one of the railway lines of New England employs 10 tungsten lamps, fitted with heavy density, opal glass reflectors arranged along the centre line of the car roof. The system replaces one using 42 smaller wattage lamps mounted in flush sockets without reflectors, located under the lower decks and on each side of the car.

Houses.

An improved form of bathroom lighting consists in the use of tubular frosted lamps mounted on the sides of the mirror. When not lighted the lamps are not conspicuous, since in appearance they do not differ much from the white glass towel bars.

GLOBES, REFLECTORS, AND FIXTURES.

The fluctuations in the design of lighting fixtures seem almost as great as those in the types of automobiles. The shower and the dome of yesterday are superseded by the totally indirect fixture of to-day, and the latter may be superseded by the semi-indirect fixture of to-morrow. But there is a growing tendency on the part of manufacturers to recognize the individual requirements of specific locations, such as stores, halls, offices, living and dining-rooms, corridors, etc., and to design fixtures which shall be appropriate for each specific need. For the usual commercial and residential work the semi-indirect fixture has become the predominating type for both classes of service—gas and electricity—and efforts are being made to produce fixtures and glassware which will harmonize where the two illuminants are used in the same building.

The continued development of new sources has been followed by the design of new fixtures, but more and more there are indications of a departure from stereotyped ideas for both gas and electricity.

Table Lamps.

A modification of an idea developed some years ago in which an upturned diffusing bowl is used to hide the bulb of a table lamp involves the use of a second and larger bulb below, with arrangements for controlling separately the lamps in each bowl.

By using heat intercepting, non-conducting mica cylinders designed for ample ventilation, it has been found possible to use silk shades on gas table lamps. Mica flour is used to frost over the outer surface of the mica, thus concealing the mantle and diffusing the light.

In general there is a growing appreciation that, by the use of properly chosen cloth for shades, the lighting fixtures of a room may be made to harmonize with their surroundings.

A novel use for a table lamp is found in a combination lamp and phonograph. The base of the lamp serves to hold the disc-record, turntable, electric motor, talking box, etc. The sounds produced are led up through the pedestal and released beneath the glass shade, which throws them downward and outward.

Glassware.

Valuable data on the diffusing and absorbing properties of the materials used in lighting glassware have been worked up and reported to this society by the Committee on Glare. The delicate color treatment of decorative china duplicated in glass is one of the developments in shades. The tendency to use denser glass for semi-indirect bowls and shades has grown to a considerable extent.

In England one of the effects of the war has been to cut off supplies of glassware ordinarily obtained from the Continent. As a result the Research Committee of the Institute of Chemists of Great Britain has worked out and established the formulas of a number of important varieties of glass used in special optical and laboratory work. The question of standardizing the various kinds of glassware used for lighting purposes both as to constitution and quality has been discussed by the London Illuminating Engineering Society, with the hope of being able to establish the best types and sizes of lamp bulbs, chimneys, globes, etc., in order to support the industry by bringing about economies in manufacture. The shutting off of the German supply has led the English to undertake the production of heat-resisting glass for use with high-pressure gas and other lamps in which considerable heat is evolved.

The fact that almost nine out of ten British factories are working on munitions of war in one form or other has led to the development of globes and reflectors especially designed for such factory purposes. In Germany the change from the use of oil lamps to electric lighting necessitated by the exigencies of war has stimulated the development of equipment for converting the old burners into modern electric fixtures.

For semi-indirect fixtures a novelty in reflectors makes possible the use of any desired material, such as silk, satin, cretonne, etc., of a pattern and color to match the decorations. This is accomplished by using two glass bowls, one inside the other, with the cloth placed between. The upper piece of glass is a prismatic reflector, and thus a large part of the light is efficiently reflected to the ceiling.

By arranging plane mirror reflectors of definite dimensions and of certain angles in a conchoidal curve, with lamps about 18 inches apart at the focus of the curve, a complex system of direct and reflected light is obtained in a new fixture for show-window lighting.

A new style of lower-deck lighting fixture has been developed for railway cars. The requirements were for a fixture which, when flush mounted along each lower deck rail, would amply illuminate both the reading plane and the ceiling without glare and without the use of additional fixtures.

For use in flood-lighting a silvered mirror reflector has been brought out, in which a special heat-resisting backing is employed to protect the silver reflecting surface from tarnishing. The objectionable bright spots, both on the side walls and directly above most wall-bracket and coveliahting units, have been eliminated in a new form of shade designed to produce uniform illumination on the ceiling. The unit is placed in a wall box.

Fittings.

The soaring prices of metal fittings abroad has led to the development of semi-indirect fixtures, in which the glass bowl is supported in a holder made of wood. Very decorative effects have been obtained. A simple diffuser has been brought out, which can be snapped on to the socket, and will prevent excessive glare from a clear bulb incandescent lamp in places where a shade is not feasible. For use in hotels where it is desired to produce extra concentrated lighting as in sample rooms, a removable lamp bracket has been devised. It is made to fit into receptacles of the disappearing type. A screwless support for inverted gas burner globes has been developed in England. In the suspending lip of the globe are made three notches or free-ways, through which slip three pins on the inside supporting ring of the burner. A new type of holder for glass shades has its points of support on the inside instead of the outside of the glass. In this way threaded parts, screws, rivets, and soldered joints are avoided. In order to permit of their being easily found in the dark, switches of the pull-chain and push-button variety have been announced, which, after they have been exposed to daylight or artificial light, remain sufficiently luminous to be easily seen when the light is excluded. A phosphorescent material is used for this purpose. The great increase in the use of indirect fixtures has created a demand for a special switching arrangement which will give individual control at the fixtures without having to use key-sockets. A device of this kind has been developed for metal reflectors, the wires coming to a decorative knob at the bottom, where they may be connected to a twist or pull-chain switch.

Standards.

A special cast-iron traffic post to mark the interception of streets and serve as a guide and protection to pedestrians has been brought out. It is intended to have it surmounted either by a ruby or a white diffusing globe. To avoid the duplication of steel poles on a street in Salt Lake City occupied by a trolley line the novel expedient was adopted of enveloping the trolley poles with large size pressed steel standards, said to be the largest of this kind ever constructed. These standards carry three lamps, the height to the light source of the lower two being 26.5 feet, the third lamp being 2 feet higher. The growth in civic interest in lighting expressed in "White-Way" and boulevard lighting has brought continuous development in ornamental street lighting standards of the metal type.

The Hydro-electric Commission threatened to cut off the supply of current to Niagara Falls, Ont., if that city contracted to supply power to the Perfection Tire and Motor Company, at $10 per h.p. when the agreement between the city and the commission provides that the rate is to be $14. The city council discussed getting around the matter by making up the $4. difference out of the local rates, so that the local commission would still receive the $14, but this proposition was voted down.

The commissioner of public safety at St. John, N.B., forecasts a radical change in methods of electrical installation, declaring that at the next meeting of the council he will move for authorization to engage an electrical engineer to direct and control all electrical work in the city. Commissioner McLellan plans to have examinations for all men who wish to do electrical work of any kind.

The village of Wyoming, Ont., is now lighted by hydro power. Previous to the connection being made with Petrolea a short time ago there was no electrical service.

Minimum Charges for Electricity

Before the State Public Utilities Commission of Illinois in the matter of the proposed change of rates for electric service in Chicago there was introduced a little time ago a statement of the minimum charges in effect in the cities of the United States having a population in excess of 250,000 people. This list is as follows:

New York	per month	$ .00
Omaha	"	.50
Detroit	"	.50
New Orleans	"	.50
Kansas City	"	.50
St. Louis	"	.50
Milwaukee	"	.50
Louisville	"	.50
Pittsburgh	"	.50
Los Angeles	"	.65
Philadelphia	"	.75
San Francisco	"	.75
Cleveland	"	1.00
Brooklyn	"	1.00
Minneapolis	"	1.00
Washington	"	1.00
Newark	"	1.00
Jersey City	"	1.00
Cincinnati	"	1.00
Boston	per annum	9.00
Buffalo	"	12.00
Baltimore	"	12.00

It appears from the records of the Commission that the number of electric consumers in Chicago whose bills during the year 1915 amounted to less than 50 cents a meter a month averaged 12,446 a month. With a minimum bill of 50 cents a month applied to these consumers the revenue of the Commonwealth Edison Company would have been increased by $40,624.—N.E.L.A. Bulletin.

New Books

Principles of Alternating Current Machinery—by Ralph R. Lawrence, associate professor of electrical engineering of the Massachusetts Institute of Technology and Harvard University; McGraw-Hill Book Company, New York, publishers; price $4.50 net. This book deals with the principles underlying the construction and operation of alternating current machinery and is the result of a number of years' experience of the author in teaching the subject of alternating current machinery to senior students. No attempt has been made to treat of types of alternating current machines, only the most important being considered. Particular attention is paid to the principles of the alternator, as, in the experience of the author, students just beginning the subject more readily grasp these principles. Certain types of alternating current machinery have been developed in considerable detail where such development seems to bring out important principles, whereas other types have been considered only briefly or omitted altogether. Mathematical and analytical treatment of the subject is freely employed where such treatment appears to offer any advantage. The scope of the work may be judged from the following headings: (1) Synchronous generators, 10 chapters; (2) static transformers, 12 chapters; (3) synchronous motors, 6 chapters; (4) parallel operation of alternators, 6 chapters; (5) synchronous converters; 8 chapters; (6) polyphase induction motors, 9 chapters; (7) single phase induction motors, 6 chapters; (8) series and repulsion motors, 5 chapters. The book is illustrated frequently with geometric figures. Contains 600 pages; 5 in. x 6 in.; bound in stiff dark green cloth.

Applied Electricity for Practical Men—by Arthur J. Rowland, professor of electrical engineering, Drexel Institute, Philadelphia, Pa.; McGraw-Hill Book Company, New York, publishers; price, $2.00 net. This volume is the result of twenty years' experience in teaching applied electricity to practical electrical workers and is written wholly from the standpoint of the man who puts up and operates electric circuits and apparatus. It does not touch problems of apparatus design, and pure theory is avoided for the most part. The book is offered to the public in the hope that it may fill a need in connection with the study of applied electricity in trade and industrial schools. Well illustrated; 375 pages; 5 in. x 7½ in.; in the standard dark green binding of this publisher.

Radiodynamics—by B. F. Miessner, associate member Institute of Radio Engineers, Expert Radio Aide, U. S. Navy, D. Van Nostrand Company, New York, publishers; price $2.00 net. A compilation of the important material concerning the history, methods and apparatus of radiodynamics—the art of controlling distant mechanisms without artificial connecting means. The author has aimed at a treatment of this matter that would be intelligible to the general reader, without sacrificing the technical exactitude which makes scientific work of value to the trained engineer. Inasmuch as the chief recent developments in this art have been of a military nature, the volume is devoted for the most part to torpedo control applications of radiodynamics. This book should prove interesting to the general scientific reader, to the trained engineer and to those concerned with the purely military applications and possibilities of wirelessly controlled mechanicisms. 200 pages; well illustrated; size 5 in. x 8 in.; cloth bound.

Machine Shop Electricity—by C. E. Clewell, assistant professor of electrical engineering, University of Pennsylvania; McGraw-Hill Book Company, New York, publishers; price $3.00 net. This is specially designed as a reference book for the electrical man in the machine shop. In its preparation, the viewpoint of the practical shopman has been kept in mind and chiefly those subjects have been treated which apply one way or another to particular uses of electric power in shop operations. The entire material in the book is grouped into ten main sections and the various topics in any section are arranged in alphabetical order. The scope of the work may be gathered from the section headings, as follows: Section 1, Abbreviations, terminology and units; Section 2, Circuits; Section 3, Costs; Section 4, Communication and distant control; Section 5, Current supply, generators and transformers; Section 6, Electrochemical, soldering and welding applications; Section 7, Heating and magnetic apparatus; Section 8, Lamps and shop lighting; Section 9, Measuring instruments and measurements; Section 10, Motors and applications. 450 pages; 4 in. x 7 in.; illustrated; limp covers.

Examples in Alternating Currents—written and published by F. E. Austin, B.S., E.E., Hanover, N.H.; price $2.40. In this work the author has made a very successful attempt to help the student and operating engineer to analyze the theory underlying practical problems and work out for himself their mathematical solutions. The problems treated deal with the fundamental principles of alternating currents, worked out step by step. The book should be useful to teachers as a classroom text in electrical courses and to engineers as a reference. It contains in the appendix numerous tables and formulae designed to save time. 224 pages; 67 illustrations; flexible leather; pocket size.

The Ouiatchouan Falls Paper Company, P. Q., are putting in two new turbines, of 1,800 h.p. each, for driving grinders, and one turbine, 1,000 h.p., direct connected to a Westinghouse generator. The wheels are to be supplied by the S. Morgan Smith Company, York, Pa.

Electric Railways

Progress of High-Voltage Direct-Current Railways

Statistics, covering the progress in the art or industry measured by the extent of its use from year to year, are not only interesting and instructive, but, if favorable, help inspire confidence in the stability of the industry and to secure the participation and co-operation of capital for continued progress.

A close study of the accompanying tabulated data of high voltage direct-current railways clearly indicates that the favorable showing is the outcome of general and successful use, and is not the result of local enthusiasm or individual prejudice. The installations are widely distributed and include all varieties of service. The results accomplished have stood the critical analysis of independent engineers, and have exceeded the expectations of practical operators. In no case has the high voltage direct-current system been abandoned. On the contrary, many roads have been converted from 600 volts d-c. or single-phase to high tension direct-current, and in no case has the system failed to meet the economic success anticipated. Emphasis can especially be placed on the freedom from apparatus failures and low maintenance as contributing a large measure of the practical success.

The advent of the high voltage direct-current electric railway dates from 1907, when the first interurban line was equipped with 1,200-volt apparatus.

Up to this time electric railways had experienced a phenomenal growth not alone in city service, but also in suburban and interurban extensions.

The 600-volt system was universally accepted as the standard, and the electric apparatus comprising it had been developed to a high state of perfection. Enthusiasm in electric railway construction was at high pitch, and on every hand the city systems were being rapidly extended to the suburbs, and in many cases elaborate interurban lines were built and being planned.

It soon became apparent, however, that promoters of these interurban projects had in many cases been too optimistic in their expectations of creating traffic, and that new forms of competition, for which the automobile is chiefly responsible, were making such heavy inroads on the income that the financial outlook of the electric interurban was not a satisfactory one.

The generally increasing burdens due to new conditions and increasing demands of the public made the situation more and more acute. It became very apparent that to meet these new conditions it was imperative that some means should be evolved to lower the necessary investment and overhead charges if further extension of the electric interurban was to be made economically posisble.

The new single-phase system was put forward as a solution and was immediately seized upon rather extensively, but was not fulfilling its early promises because of a multitude of engineering difficulties and apparatus failures.

The 1,200-volt system not only showed the necessary economic advantages, but inherited the confidence derived from the long experience with its 600-volt prototype.

It embodied no new and untried theories, and did not require the devoted nursing of over-enthusiastic patrons.

From the first it demonstrated its superior fitness and was generally adopted both for new roads and in place of other existing systems. As shown by the accompanying chart, the increase of mileage of the 1,200 and 1,500-volt roads (which may for present purposes be considered as of the same family) has been steady and continuous, even through recent years of general business depression.

To-day it is unusual to have any question raised as to the proper equipment for interurban lines. The 1,200-volt system is standard just as the 600-volt system is standard for city lines.

The history and experience with the interurban problem naturally develops faith and enthusiasm for a similar application of direct-current principles to the still more important field of railway electrification. The experience of previous years had prepared railway engineers to better appreciate the economical relation between the unit demand for power and the supply voltage and had as well fitted them to produce apparatus suited to operate at higher potentials. It was realized that the large locomotives and heavy train units required for steam railway electrification both demanded and permitted higher operating potentials.

The first installation of 2,400-volt equipment was on the Butte, Anaconda and Pacific Railway in 1912. The engineering features and designs involved some new elements and extensions of previous practice, but there was nothing fundamentally new and untried, and the engineering problem was chiefly a matter of capacity.

This installation was made not so much to demonstrate the engineering accomplishment as the economic fitness, and those most interested in the outcome were the railway officials who were formulating vast projects necessarily based on improved methods of propulsion over the most important lanes of the nation's traffic. The tremendous importance of a correct judgment required the elimination of all exaggerated enthusiasm. The decision in favor of direct-current was the result of not only the highly successful demonstration, but of the most searching enquiry and comparison with all other possible systems.

The practical results, as well as the comparative possibilities, were critically analyzed by the officials and engineers, who had the heavy responsibility for transcontinental railroad operation, and the decision must be accepted as beyond the possibility of prejudice or partisan enthusiasm.

The immediate practical success of the 2,400 and 3,000-volt apparatus resulted partly from the inherent ruggedness and flexibility of direct-current designs, as well as from the absence of radically new features of construction.

The locomotives, although larger and more powerful than any yet constructed, adhered to the simple, rugged, and thoroughly tried mechanical arrangement of motor drive and truck structure. Much study and many trials have been made in all parts of the world to find a driving connection between

By G. H. Hill, Assistant Engineer Railway and Traction Department, General Electric Company, in General Electric Review.

the motors and the driving axles that is superior to direct gearing. Preconceived limitations as to the unsuitability of simple gearing for heavy torque and a rather theoretical impression that an electric locomotive should follow steam locomotive practice led to trial construction using diagonal side rods, jackshafts, and parallel rods of various forms. It may be that some such arrangements are necessary or desirable in certain situations, but it is also very clear that direct gearing is amply able to accomplish all that can be needed for locomotives of great capacity, equal to handling the heaviest transcontinental trains. The use of twin gears, making the full strength of the gear teeth available; spring drive in the gears cushioning the hammer blow on the teeth, and equalizing the stress between the gears; and advances in the quality of the gear steel, are the chief improvements over former practice that completely determined the suitability of the direct gear arrangement to this heavy duty.

Practical service amply emphasizes the excellence of direct gearing and demonstrates its superiority to other forms of drive.

Another feature that serves to mark the adaptability of direct-current is the regenerative breaking which has been put into successful use on the Chicago, Milwaukee and St. Paul locomotives. This is a feature that previously had been considered particularly suited to polyphase alternating-current motors exclusively.

Particular attention is directed to the flexibility of this system of braking. The ability to utilize the electric brake over a wide range of speed and its ease of control make it far more useful than polyphase system of braking which is limited to a single speed.

The overhead contact system for the 3,000-volt direct-current system retains the good features of the flexible construction previously used and adds to it increased current capacity. Its appearance, effectiveness, and practical operation leave no room for criticism.

The substation apparatus corresponds closely with established practice, and is perfectly adapted to the reverse transmittal of energy incident to the regenerative braking of the trains.

It is particularly instructive to note that, in spite of many previous theoretical adverse comparisons with other systems, the direct-current system, as actually installed and in successful service, compares most favorably with concurrent installations as to the spacing of substations, the kilowatts of substations per mile of track, and the total cost of substations.

The Chicago, Milwaukee and St. Paul electrification has hardly been in operation long enough to give accurate statistics as to the economic results, but the operating officials of the railway are most optimistic, and favorable expectations are justified.

As to the probability of developing still higher voltage systems, it can only be repeated that 3,000 volts seems to be adequate for the heaviest trunk line traffic, and is likely to represent the true economic balance between cost of substations and feeder copper on the one hand and cost of locomotives on the other, and as well to present the greatest flexibility and the lowest operating charges. But 5,000 or 6,000 volts direct-current is a possibility if there arises a real field of usefulness for this further extension of the direct-current family.

Table of High-Voltage D.C. Systems

	Length of Route	Type	Voltage
Aroostook Valley Ry. Co.	32	Direct Suspension	1200
Butte, Anaconda & Pacific Ry.	30	11 Point Catenary Trolley	2400
Canadian Northern Ry., Montreal	10	Catenary Trolley	2400
Central California Traction Co.	69	Third Rail and Cat.	1200
Charles City Western Ry.	25	Direct Suspension	1200
Chicago, Milwaukee & St. Paul Ry.	440	Catenary Dble. Trolley	3000
Chicago, Milwaukee & St. Paul Ry., Great Falls Terminal	4	Catenary Trolley	1500
Davenport & Muscatine Ry.	30	Catenary Trolley	1200
Fort Dodge, Des Moines & So. Ry.	120	Direct Suspension	1200
Grand Rapids, Holland & Chicago Ry.	45	Direct Suspension	1200
Hocking-Sunday Creek Traction Co.	14.8	Direct Suspension	1200
Indianapolis & Louisville Traction Ry. Co.	41	Direct Suspension	1200
Iowa Railway & Light Co.	28	Direct Suspension	1200
Jefferson Co. Traction Co.	20	Catenary	1200
Kansas City, Clay Co. & St. Joseph Ry.	72	Catenary	1200
Lake Erie & Northern Ry.	54	Catenary Trolley	1500
London & Port Stanley Ry.	24	Catenary	1500
Maryland Electric Ry. Co.	25.3	Catenary	1200
Michigan Ry. Co., Kalamazoo-Grand Rapids Allegan-Battle Creek	92	Third Rail Over-running Catenary	2400
Michigan Ry., Flint-Bay City	46	Third Rail Over-running Direct Susp	1200
Michigan United Traction Co.	150	Overrunning Third Rail Direct Susp Trol.	1200
Milwaukee Elec. Ry. & Light Co.	135	Catenary Trolley	1200
Nashville-Gallatin Inter. Ry.	27	Direct Sus. Trolley	1200
Oakland Antioch & Eastern Ry.	118	Catenary	1200
Ogden, Logan & Idaho Ry.	97	Catenary	1500
Oregon Electric Ry.	154	Catenary	1200
Orleans & Kenner Ry.	11.6	Catenary	1200
Pacific Electric Ry.	57	Catenary	1200
Piedmont & Northern Lines	125	Catenary	1500
Pittsburgh & Butler St. Ry. Co.	33	Catenary	1200
Pittsburgh, Harmony, Butler & Newcastle Ry.	71	Direct Suspension Double Trolley	1200
Salt Lake & Utah Ry.	67	Catenary Trolley	1500
Shore Line Electric Ry. Co.	56.4	Cat. and Direct Susp.	1200
So. Cambria Ry. Co.	23	Direct Suspension Double Trolley	1200
So. Illinois Ry. & Power Co.	15	Catenary Trolley	
So. Illinois & St. Louis Ry.	60	Catenary Trolley	1200
Southern Pacific Co., Elec. Division	146	Catenary	1500
So. Pacific Railroad (Oakland, Alameda & Berkley Div.)	118	Catenary	1200
Southern Traction Co.	158	Catenary	1200
Southwestern Traction & Power Co.	14	Catenary	1200
Texas Traction Co.	76	Catenary	1200
Tidewater So. Railroad Co.	33	Catenary	1200
Toronto Suburban Ry.	49	Catenary	1500
United Rys., Portland Ore.	20	Catenary	1200
Valparaiso & Northern Ind. Ry.	46		1200
Washington, Baltimore & Annapolis Elec. R.R.	61	Catenary	1200
Waterloo, Cedar Falls & Northern	60	Catenary	1200
Willamette Valley Southern Ry.			
Foreign High Voltage D-C Rys.	30	Catenary	1200
Bethlehem Chile Iron Mines Co.	15	Catenary	2400
Imperial Railways, Japan	20	Catenary	1200
South Manchurian Ry., China	25	Catenary	1200
Victorian Rys., Melbourne, Australia	150	Catenary	1500

Partially Disabled Men as Motormen

A report has recently been issued by a committee appointed by the Home Secretary, which considers whether, having regard to the normal conditions of traffic in London, licenses should be granted to men partially disabled to operate motor cabs, motor omnibuses, or tramcars, and, if so, within what limitations. The report states that the members of the committee entered upon the enquiry with a strong and natural sympathy for the men who, having suffered some serious physical disability in the service of king and country, are liable to be thenceforward handicapped in earning their livelihood. The report goes on to state, however, that it is of paramount importance that the public should not be exposed to undue risks, and that the margin of safety, even under present conditions, is very small. The following paragraphs, taken from the report, summarize the recommendations:

Summary of Recommendations.

"We arrive at our conclusions with considerable regret. We are, however, deeply impressed by the potential risk to the public if drivers who had lost limbs were employed, and we have constantly borne in mind the responsibility which devolves by statute on the commissioner of police to satisfy himself as to the 'fitness for such situation' of each candidate for licensing whose application he approves. Were we not fully satisfied that the interest and safety of the public are at stake, we would gladly refrain from recommending that the door should be shut on this avenue of employment for men who have suffered in their country's cause and possess a moral claim on their countrymen. But, being entirely convinced, we have no option, and can only record our considered opinion that—having regard to the normal conditions of traffic in the metropolis—licenses to drive motor cabs, motor omnibuses, or tramway cars should not be granted to men who have suffered the loss of an arm, hand, leg, foot, or eye. In the case of injury to one eye, provided the other eye is sound and the injured eye retains fair vision, we think a license might be granted, each case being, of course, decided on its merits. As regards other minor disabilities, such as loss of one or more fingers, or other damage to the hands, limitation of movements of joints of the upper or lower extremities, or shortening of the lower extremities and the results of injuries to nerves of limbs, we recommend that the existing practice continue to be followed, and that each case be dealt with on its merits at the discretion of the commissioner of police, with, in doubtful cases, a power of reference to a special medical referee."

Montreal Franchise

The Montreal Tramways Company are desirous of obtaining a further franchise from the city, and an attempt to adjust the different interests has again been made. Up to the present the many plans have all failed owing to various causes, local politics playing a considerable part in the abortive negotiations. The president, counsel, and manager have recently met the controllers and publicly discussed the terms of the franchise with a view of finding a basis of agreement. The proposed clauses include those relating to poles, rails, repairs, maintenance, seating accommodation, etc. It was suggested that the wooden poles should be replaced by iron poles laid in cement, the cost of the wooden poles being $1,000 per mile while the iron poles would cost $6,000. The company have about 150 miles of streets. It was agreed that if the city ordered the company to replace the wooden poles with iron poles a certain portion of the cost would have to be paid by the city.

The question of appointing experts to advise the city as to the physical valuation of the company's property and on other points before a further franchise was granted was the subject of keen debate, the controllers being divided on the question. The names of Mr. E. L. Cousins, of Toronto, and Mr. P. St. George, of Montreal, were mentioned. The representatives of the company strongly opposed certain suggestions involving large expenditures, the president pointing out that if the controllers insisted on very onerous conditions the public would have to pay for them in the end. He also mentioned that the company were now spending between a million and a million and a half dollars in improving the supply of power.

To do away with overcrowding, passengers are not to be allowed to stand in the passageway in the interior of the car, the rear platform is to be kept clear, and riding on the steps is prohibited. The city is to control the frequency of car service, with an appeal to the Quebec Public Utilities Commission in the case of a dispute.

An Electric Express Freight Service

In August last the management of the British Columbia Electric Railway inaugurated what is proving an extremely popular innovation in connection with its express freight service to and from points on the Fraser Valley interurban line between Vancouver and Chilliwack, a distance of 76 miles. Express freight consigned from points on the Fraser Valley system is now delivered to the consignee in Vancouver without extra charge, and shipments of express parcels from New Westminster are included in this new service. Two trains a day carry express between Vancouver and the Fraser Valley, and the amount of business being done has already shown a healthy increase as a result of the concessions.

The opinion has been expressed that the day is not far distant when the company might profitably go a step further and collect express freight for the line throughout the more thickly settled portions of the valley, as is done by one or more of the British steam lines with most satisfactory results. A couple of electric lorries could be placed on certain routes to try out the service at small expense. Better and faster transportation for farm produce is the great need of the Fraser Valley rancher and fruit grower, and a service such as indicated would almost certainly build up a heavy and constant shipments to New Westminster and Vancouver dealers. Trade would also be facilitated between the grower and the consumer.

Open-Air Car Proves Popular at Vancouver

In order to ascertain the strength of the demand on the part of the Vancouver public for open-air cars during the warm weather months, the B.C.E.R. Company put into service in July one car of a type which seems to meet successfully the purposes in view. Being operated at ordinary fare on the regular route from Main and Hastings Streets to English Bay via Davie Street, it proved extremely popular with the majority of people bound for the bathing beach, and was particularly well patronized by smokers, who had the right to pre-empt the rear half of the seating accommodation. The car was withdrawn from service following the close of the holiday season and the approach of cool weather.

The car was originally a single-end prepayment car, with a seating capacity of forty, but it had been retired from service along with others which had not been fitted with gates

B. C. E. Ry. Co. makes good use of old equipment.

and other safety appliances required by the British Columbia Government. The rebuilding of the car was done at a cost of about $500, and it is likely that a number of similar open-air type of cars will be fitted up in the company's shops at New Westminster during the winter.

Particulars of Vancouver Open-air Car.

Length over bumpers	41 ft. 7¾ in.
Width over rails	8 ft. 3½ in.
Distance centre to centre of bolsters	22 ft. 2 in.
Height over trolley base	12 ft. 6 in.
Step heights	15½ in., 9½ in., 9½ in., 10¼ in.
Seating capacity	54
Weight, body and equipment	12,500 lb.
Weight, trucks and motors	22,100 lb.
	34,600 lb.

Weight, per seat—641 lb.
Trucks—Brill No. 27-G-1
Wheels—33-in. chilled iron.
Motors—Four GE-67
Air brakes—Westinghouse.
Fender—Watson automatic.
Trolley base—Sterling.
Trolley retriever—Earll.
Headlights—B.C.E. Railway

The alterations included the removal of all the body structure above the sash rails and of the end partitions. The step openings at both ends were closed and a new entrance and exit was made near the centre. Three steps were arranged to swing under the car, controlled simultaneously with the gates by levers. Wood gates with clear glass panels were installed.

The trolley base was mounted on a [illegible] steel channel arch, to the rear of which was placed a guard made of [illegible] pipe with heavy wire netting over it. The seats were rearranged on 29-in. centres, and a circular one was built against the rear dash, giving a seating capacity of 54.

Guard rails were placed along the open side and the standard wire guard panels, 18 in. high, along the devil-strip side. Eight 16-c.p. lamps were mounted on standards along the sides, and for signaling from conductor to motorman a push-button and Faraday buzzer, the latter mounted on the front dash, were provided.

Decision for Toronto and York Radial

The Privy Council have decided in favor of the appeal of the Toronto and York Radial Railway Company for permission to deviate their tracks at the corner of Yonge Street and Farnham Avenue, Toronto. The original intention of the company was to construct a spur line crossing the sidewalk on Yonge Street to an enlarged siding system and waiting room. An injunction was isued by the city of Toronto after construction work had been under way for a short time, and the matter has been pending for some months. The recent decision, however, maintains that the railway is justified in its claim by their franchise in respect to the street and adjoining lands proposd to be used. There are certain provisoes attached to the judgment, such as approval of the city engineer and consent of the Railway Board to the proposed plans, but as the case now stands the company have power to go ahead and relieve the very unsatisfactory terminal facilities existing at this point.

B. C. E. R. Technical School

Continuing the good work initiated several years ago, the course in technical education inaugurated by the management of the British Columbia Electric Railway for the benefit of its Vancouver employees has already been resumed for the season 1916-17. The opening class was held in the lecture room of Carroll Street Station early in October, J. G. Lester being lecturer in charge. Last year the company for the first time presented certificates to successful students, the number issued being 22. Mr. Geoffrey Porter, chief electrical engineer, also gave prizes for the best-kept note books, and the same policy will be followed this season. Classes are held every Wednesday night, every second one being devoted to practical work. The officers for the present season are: A. Mansfield, president; Fred Yates, secretary.

Mr. Kidd Welcomed Home

On the occasion of his recent return from a business trip to the Old Country, Mr. George Kidd, general manager of the British Columbia Electric Railway, was welcomed by the Vancouver office staff at a social arranged in his honor. Mr. W. G. Murrin, superintendent, acting as spokesman. In his reply Mr. Kidd gave a very interesting description of his trip, in which incidents connected with the war had a place. Music, dancing, and refreshments added to the pleasure of the evening.

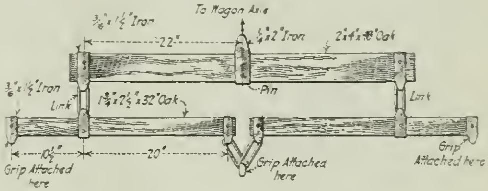
Mr. W. T. Woodruffe Killed in France

Vancouver friends learned with deep regret of the death of W. T. Woodruffe, while serving in the French trenches with the Victoria Rifles of Montreal. For many years he was associated with the British Columbia Electric Railway, in which service he won his way upward from messenger boy to the positions of electrical superintendent and also head of the mechanical department. He left the company in 1912 to become chief electrician for the city, and later accepted a similar position in Edmonton. Mr. Woodruffe married Miss Findlay, a daughter of ex-Mayor James Findlay, of Vancouver. Mrs. Woodruffe and their little daughter Margaret are living in the city at the present time.

Stretching Three Wires at One Time

An interesting method of stretching the three wires of a three-phase line at one time is described by Mr. H. H. Fenton in the Electrical World of October 14. When constructing three-phase transmission lines a great waste of time is often caused in stretching conductors by the awkwardness of the block and tackle method. To eliminate this waste of time the writer employs a scheme which enables a small force of men to stretch all three conductors of a three-phase line in one operation. In other words, the three conductors are strung, stretched and tied in with one trip over the ground and by climbing up each pole once. To facilitate stretching all three wires at once a special whiffle-tree constructed as shown in the accompanying illustration is used. This device and a crew consisting of a foreman, four climbers, a team with driver, and a helper on the wagon to watch the reels and fasten the wire grips, can handle line construction rapidly without difficulty.

The main beam of the special whiffle-tree is made of oak, 2 in. by 4 in. by 48 in. long. The single-trees are also of oak, 1¾ in. by 2½ in. by 32 in. long. A clevis, ¼ in. by 2 in. iron, fits the main beam at its centre and is held by a pin. Two other clevises are of 3/16 in. by 1½ in. iron, one placed at each end of the main beam on 22 in. centres. Six other clevises are made of the same stock and fit the ends of the single-trees. The spacing is shown in the diagram. The links used with the clevises are made of ⅜ in. round iron. This special device is attached to the ankle of the wagon by a chain so that it drags about two feet behind the rear wheels.



Special whiffle-tree for stretching three wires.

Three reels are mounted upon the wagon platform and carry the wire.

When stringing the conductors for a particular line, each conductor is dead-ended at the starting point and the team driven six spans for the first pull. Each climber takes his assigned place, one at a pole, the foreman making the fifth, and each carries the wires up the pole, the helper meanwhile at the wagon making fast the wire grips on the conductors, thus attaching the special whiffle-tree to them. The driver then starts the team and draws the wires taut. The brake is then applied on the wheels of the wagon to aid the team in holding the strain. After the four climbers have tied in the line the grips on the special whiffle-tree are released and the team driven up four spans, thus unreeling wire for another pull and the cycle of operation is repeated. Four spans have been found about the maximum pull on an upgrade that can be made with one team of horses; however, on a downgrade as high as seven spans have been stretched without any difficulty at one pull.

This method of construction makes possible a very taut line, does not produce twisting upon any pole, makes all wires hang alike, and is considerably faster than the block-and-tackle method. An average of three miles of three-phase line has been strung, stretched, and tied-in in one day.

A number of municipalities in the vicinity of Toronto will vote on January 1 on the question of hydro radials. About 100 miles is involved.

The Dealer and Contractor

The Expense of Conducting an Electrical Contracting Business and How We Can Know It

By O. G. Pack*

This is a subject which has been talked about considerably among the electrical contractors in this vicinity during the past year, and one the importance of which cannot be over-estimated. I believe some of our good members do not thoroughly understand what it costs them to do business nor just how to arrive at this cost. It will try to point out the items, and how to arrive at them, which go to make up the overhead expense of an electrical contracting business as I have learned by actual experience during the past three years.

When a man, or a group of men, contemplate entering any business, the first thing they should do is to determine how much their services are worth to themselves, not how much they can draw from the business they are contemplating entering. In other words, they should decide or learn from some source what they could sell their services for to a going concern without any financial investment on their part. Now, they or he certainly should not enter a business of their or his own where the financial returns they or he will be able to get for their or his services would not be greater than what they or he could sell their services for, plus a reasonable return on the investment made by reason of entering such business.

If, for instance, I contemplate going into the electrical contracting business and am capable of earning a salary of $150 per month as estimator for some reliable contracting firm, my contention is that it would be foolish for me to enter such business unless I am reasonably sure the business will pay me more than $150 per month. Furthermore, the man who is capable and enters the contracting business and who does not figure his services as high as $150 is making a mistake and had far better work with the tools, thereby benefiting both himself and the electrical business as a whole. Some people will say that this is placing the worth of a contractor too high. I say that this is a very reasonable amount for the smallest of electrical contractors to figure their services worth, and submit the following proof:

We have in our employ men who are not capable of conducting a contracting business and who are only workmen using the tools, and have earned from $1,200 to $1,890 per year during a period of three years. We had six men in our employ whose wages have amounted to as much as the above mentioned figures. We believe if the man who has only the knowledge and ability to perform the physical labor of making electrical installations is entitled to wages such as we have before mentioned that the electrical contractor who has the knowledge of getting and operating the business, in addition to the knowledge his employes have, is entitled to receive compensation for such knowledge and ability.

As said before, we have six men in our employ who have drawn wages as outlined, and no doubt there are other contractors in this vicinity who have men in their employ drawing equally as good wages. I do not believe there are very many electrical contractors who have been able to draw more than this amount out of their business without seriously inconveniencing their bank account. The point I am trying to make is to impress on all contractors that their services are worth at least this amout, and that this is the first item they must figure as an overhead expense in arriving at their cost of doing business.

I believe the nature of the electrical contracting business is such that one must estimate it on the yearly basis, owing to the long time it takes to complete some installations. One of the first things an electrical contractor should do, starting the fiscal year, is to make up an estimated budget of what his operating expenses are going to be during the coming year. We have found that the following items must be figured as an overhead expense and are items that most electrical contractors have, whether they figure them or not.

The following is a list of items which we include in our estimated budget:

Don't Forget Your Own Salary

Salary, management, office and stock room salaries

General Expense.—Rent, telephones, light, fuel, power, association dues, water, ice, towel service, license (occupation), license (merchants'), watchman's services, insurance (fire), insurance (liability), advertising, taxes, stationery and office supplies, interest, allowances (accounts receivable adjustments), overhead labor (that is, non-productive labor), automobile expense, miscellaneous expense sufficient to cover items not itemized based on previous experience.

You can be very accurate on this estimate of what your expense is going to be; for instance, you figure your salary based on so much per month for twelve months in the year, and you know what your other fixed charges are per month, which, listed individually and multiplied by twelve will give you the total amount of each expense item for the period of one year. You can readily take a total of all items combined, showing what your expenses will be for a period of one year.

After knowing or completing this estimate, we have found it expedient to close our books every month, charging each month with its proportion of the yearly expense. This gives us accurate knowledge every thirty days as to just how we stand and whether we are making or loosing money. We have made a chart of the following items, which we know to be expense items, which must be figured against each month's business. We do not allow our books to be closed at any time without turning to this chart and checking the following items as having been figured against gross profit for the current month:

Rent, light, fuel, phones (Home and Bell), license, insurance (fire), insurance (liability), laundry service, water service, watchman's service, ice, taxes, association dues, interest and discount, stationery and office supplies.

After completing the estimated budget of expense you will have during the year, the next step is to determine the volume of business you can get and handle without added expense. This must be based on your previous expense together with the experience of your fellow-contractor, who

* Secretary Kansas City Electrical Construction Company, in National Electrical Contractor.

has accurate knowledge of cost, then determine what percentage it will be necessary for you to figure on this volume of business to make your overhead expense.

A recent investigation conducted by the Burroughs Adding Machine Company shows that fully 75 per cent. of all the business men figure profits on a basis which gives them three to eight per cent. less gross profits than they think they are getting, often figuring themselves out of any profit. This is a vital end of the business. What is the use of contracting if profit, the whole purpose of operating a business, is lost in bad methods of operating a business, is lost in bad methods of figuring prices? All expenses are going to come out of the gross profits, whether they are put down as a part of the cost of doing business or not. If a man pays out $50 a month for rent, he will not find it to his credit in the bank at the end of the year, even if he does not charge it as expense. The same applies to every kind of expense in the business. Every one of the items mentioned in this budget is an expense, whether you charge it as such or not. I believe it is far better to err on the side of too liberal charging of expense and find an unaccounted for balance in the bank than, at the end of the year, to find a puzzling deficit caused by not charging all your expenses. The deficit may disable you just when failure to pay a big bill means bankruptcy.

I believe some of us contractors are in the same position as the grocer whom I know. This grocer thought he was clearing $100 a month, $1,200 a year over and above his expenses, but the $100 included his own salary, the interest on his investment, the salary of his wife, who spent most of her time in the store, and a number of other expense items. If the grocer had invested his capital elsewhere the interest on same would have produced $50 per month, without risk or worry. Instead of making $100 per month clear, he was not only failing to make anything, but he and his wife were both working for almost nothing. If they both had worked in some other store they might have earned $100. So, instead of making $100 they were loosing $100 a month.

The opportunity presented itself for this same man to secure a political position with the city at a salary of $1,800 per year. When he got this position he decided to sell his store, and placed same in the hands of a broker, and had an accountant go over the books and place a value on the stock to see what the business was worth. The accountant's report showed that no charge had been made for salaries. When proper allowance was made for salaries the business was found not to be paying anything on the investment. Instead of a fairly profitable business, one salable at a premium for good-will, it was found to be a business unprofitable and unsalable. Fixtures and stock were finally sold at less than actual inventory value. Nothing was received for good-will, for there was no good-will, and cannot be where is not fair return on the money invested. Only a chance to work for nothing and take the ordinary business risks is not a good selling property.

Fixing Prices to Get a Profit.

Just, for example, say your overhead expenses are going to be $2,500 this year, and you are reasonably sure that you can secure and handle a volume of $10,000 worth of business, which is 25 per cent. of selling price. You know that the percentage of this expense is figured on the gross business, but do you realize that a percentage of the gross business is more than the same percentage of the estimated cost? You should figure your cost of doing business as a percentage of your gross business, and must, of course, allow that much of your selling price for cost of doing business. When you take a contract for $100 you say a certain per cent. of that represents profit, a certain per cent. for cost of doing business, and the balance for cost of labor and material. Your profit and cost of doing business come out of the $100 you get for doing the job, not out of the $60, $70, or $80 you pay for labor and material consumed in doing the job.

Most contractors reach their contract price for doing a certain piece of work by adding what is really a percentage of the selling price to the cost price. This mixing of methods is what helps the contractor to a loss. Where the cost of doing business is 25 per cent. of the total volume of business, some contractors add 25 per cent. to their cost of labor and material, which is wrong. If you think that you are adding sufficient to cover your overhead expense on this basis you are making a big mistake. Now, if you are asked to bid on a certain piece of work and you figure the actual labor and material cost to be $60, what should you get for the job to net you your overhead of 25 per cent., plus 10 per cent. profit? We will say your selling price represents 100 per cent., and you desire a 10 per cent. profit. This makes a total of 35 per cent. deducted from your 100 per cent., which leaves your actual cost of labor and material, representing 65 per cent. of your selling price. If $60 represents 65 per cent. of your selling price you should receive $92.30 in order to make your overhead of 25 per cent., plus 10 per cent. profit for the risk you are taking. If your profit is to come out of the selling price, which it must come from, and not out of the cost price, is it not plain that the percentage of profit should be figured on the selling price?

Return on Investment

You will notice that I have said very little about what a contractor should add in the way of profit in order to secure returns on the capital investment and to pay for the risk taken, which some of us have found to be quite large.

I do not believe any contractor can afford to estimate his profit at less than 10 per cent. on jobs where the contract price is $1,000 or less, or less than 5 per cent. on installations the selling price of which is more than $1,000, because the unforeseen obstacles are so numerous and great that unless you have a 10 per cent. estimate for profit, when the job is complete you are apt to find that you have done the job for very little or no compensation, so far as your business as a contractor is concerned, and it would be far better that you be the journeyman on the job, working for a legitimate contractor or firm who would make a profit on his investment and knowledge, thereby bettering the electrical industry as a whole.

Profits from business done is what makes things move more easily and is what all invested capital wants and must have to be satisfied.

Let all of us contractors study and learn our cost of doing business, and when we know what it is let us not be backward about trying to get a price for our work that will cover it and leave a fair return on the investment.

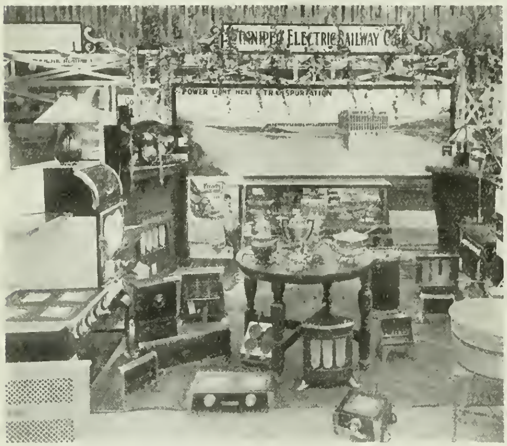
I know contractors in this vicinity now who know what their cost of doing business is, but who are forced, on account of some of our well-meaning contractors not knowing their cost of doing business, to take work for less than labor and material cost, plus overhead expense, in order to make a proportion of their expenses. This condition, we hope, is only temporary, and are anxious for the time to come when they can get their volume of business at prices which they will not be ashamed of.

The S. Morgan Smith Company, York, Pa., have been awarded a contract for the supply of a twin unit of high speed turbines, together with 80 feet of supply pipe, in connection with the new mills of the Lincoln Paper Mills, Merritton, Ont. The unit is of the horizontal type, direct connected to a generator, and will be equipped with a Lombard governor. The turbines, which will operate under a head of 21 feet, are of 455 h.p., with a speed of 250 r.p.m.

An electric boiler heater is being tried out by the fire department at Spokane, Wash., as a means of keeping the water warm in a fire engine between calls.

Winnipeg Has Successful Electric Show

The city of Winnipeg has just experienced the pleasures and advantages of a very successful electric show, the first, held in the convention hall of the Industrial Bureau, and this Bureau which, in co-operation with the Jovian Order, were responsible for the exhibit, must be congratulated on the success attending their efforts. The various displays were particularly good, and included practically all the well-known manufacturers of and dealers in electrical supplies of various kinds, operating in Western Canada, particularly those of interest to the housewife. The Winnipeg Municipal System



Part of display of Winnipeg Electric Railway Co.

and the Winnipeg Street Railway Company also lent their aid, and occupied large space at the show.

In addition to the various well-appointed booths, some idea of which may be gathered from the accompanying photographs, moving picture demonstrations of the value of electrical equipment were carried on continuously. These portrayed the woes of the usual household where gas or coal is used for cooking, heating and lighting, followed by a picture of the electric home from which all these troubles have vanished, almost as if by magic. Another interesting film was that showing the difference between farm life under the old conditions and that where electricity is used for power and light. An interesting feature of the exhibit was the illumination of the exterior of the Industrial Building during the days of the electric show.

Electrical Gifts for Christmas

Electrical dealers will surely do well to remember that to them belongs, by right, a fair share of the coming Christmas trade. They will do well, too, to remember that this trade will not come of its own accord—they must go out after it. It is not too early to be tickling the memory of their customers with a list of electrical items, reminding them that these make suitable presents, are always very much appreciated, and that the cost is within the reach of the average pocket. There is probably no single line of goods on the market to-day that fits in so well with the circumstances surrounding Christmas present-giving. These facts should be placed before the public early in the holiday campaign and before other lines of merchandise have been flaunted in the public eye.

On another page we print a page of suggestions, compiled by the Electrical Record, which we would suggest to the dealer as a good form of "bait," if he is mailing advertising matter to his customers, or it may well be used in local papers in the larger centres by a number of dealers operating in unison. The list is pretty complete, of course, and no good can be gained by advertising what the dealers do not carry in stock, unless orders are placed well beforehand.

Much has been talked and written about the value of co-operative advertising in electrical goods, and considerable success has attended it in the United States. Such a scheme ought to work well in many cities and towns in Canada at Christmas time, and we believe it would. The load need not fall too heavily on any one, in that all the electrical interests must profit—the manufacturer, jobber, dealer, contractor and central station. It follows, then, that a co-operative scheme of Christmas advertising should include all of these. With such support there seems little doubt that the "Electrical page" once a week or oftener from the middle of November up to Christmas, could be financed in hundreds of cities and towns in Canada and yield a good profit to all concerned. It is said that Canadians, in general, have a good supply of ready money, and this being the case they will spend liberally at Christmas. In the interests of "conservation," can they do better than spend it on these gifts that are so intensely practical and useful, and at the same time add immeasurably to our comfort and to the sum total of what we get out of this life. Profit aside, let us boost electrical Christmas gifts for humanity's sake.

The City's display—miniature power house and h. t. line.

General view of Winnipeg Electric Show.

Suggestions for Christmas Presents

In selecting a present the most important and often the most perplexing question to settle is whether the article would be appropriate. To help the dealer in choosing his holiday lines and his customers in deciding what they want, we offer the following suggestions, among which will be found a number of things new this season.

FOR CHILDREN

Toy aerial swing
Toy aeroplane
Toy animals, electric eyed
Toy automobile
Toy circuit breaker
Toy crane and hoist
Toy dynamo
Toy electric boat
Toy electric engine
Toy electric questioner
Toy electric range
Toy electric stove
Toy experimental laboratory
Toy fan
Toy ferris wheel
Toy "fun" motor
Toy gas engine
Toy hand driven dynamo
Toy hydro electric generator
Toy lamp post
Toy locomotive
Toy merry-go-round
Toy motor
Toy motor and countershaft
Toy motor and dynamo outfit
Toy power station
Toy railway outfit
Toy steam engine and dynamo
Toy switch engine
Toy telephone
Toy thriller magneto
Toy train
Toy transformer
Toy trolley car
Toy water power plant
Book on electricity
Electric top
Picture and post card projector
Magic lantern
Motion picture machine
Shock coil
Battery
Battery gauge
Battery lantern
Flashlight
Hand lamp
Dark room lantern
Lantern attachment (battery)
Illuminated pads and pencils
Pistol flashlight
Bicycle lamp
Bicycle lighting outfit
Canoe lamp
Electric candle
Christmas tree lighting outfit
Christmas tree lamp reflectors
Bird, fruit and nut lamps
Miniature incandescent lamps
Electric scarfpin
Battery fan
Battery motor
Chalk eraser cleaner
Corn Popper
Horseshoe magnet
Magnet charger
Telegraph instrument
Wireless telegraph set
Wireless receiving outfit
Wireless head receiver
Wireless transformer
Tool kit
Baby flatiron
Nursery light

FOR ADULTS

Alarm clock
Battery lantern
Bed lamp
Bicycle lamp
Candlestick
Chair lamp
Chimes and bells
Cigar lighter
Comb and curling iron
Curling iron
Curling iron heater
Cut glass portable
Desk companion
Desk fan
Desk lamp
Electric fountain
Electric watch charm
Electrically lighted wall mirror
Electrically lighted table clock
Flashlight cane
Flashlight umbrella
Floral decorations
Floor portable reading lamp
Flower basket
Foot warmer
Hair drier
Hair singer
Hair waver
Hand lantern
Heating pad
Illuminated pads and pencils
Illuminated table ornament
Library lamp
Lantern attachment (battery)
Massage vibrator
Mission portable
Novelty electric candle
Ornamental bird cage
Ornamental fan stand
Ornamental pendant cluster
Perfumer
Piano lamp
Plants and flowers
Reading lamp
Reed or wicker portable
Reminder clock
Shaving mirror
Shaving mug
Silk hat iron
Silk lamp shade
Talking machine motor
Traveler's iron
Traveler's companion
Traveler's stove
Traveler's lamp, cord and plug
Vest pocket flashlight
Watch case flashlight
Writing desk lamp

FOR THE HOUSEKEEPER

Bath heater
Bell ringer
Boiler
Broiler
Casserole
Cereal cooker
Chafing dish
Chafing dish and disc stove
Chocolate and cream warmer
Churn
Clothes drier
Clothes washer
Coffee mill
Coffee pot or urn
Coffee set
Combination cooker
Cook stove
Corn popper
Dish washer
Disc stove
Disinfector
Drink mixer
Egg boiler, cooker or steamer
Egg set
Egg tester
Electric cooker
Fan
Fireless cooker
Flat iron
Food carrier
Food warmer
Fruit juice extractor
Fruit and vegetable peeler
Frying pan
Fumigator
Gas lighter
Grid
Griddle
Grill
Hand lamp
Hot closet
Hot plate
Ice cream freezer
Illuminated porch number
Immersion electric heater
Ironing machine
Kitchen power unit
Lemon squeezer
Liquid heater
Meat chopper
Meat slicer
Milk warmer
Oven
Percolator
Plate warmer
Radiator
Rain alarm
Range
Refrigerator
Regulating lamp or socket
Samovar
Saute pan
Serving table
Sewing machine motor
Sewing machine portable lamp
Steam table
Stew pan
Sterilizer
Stove
Table cooking set
Table lamp
Tea ball pot, kettle or urn
Tea set
Thermometer
Toaster
Toaster-stove
Toaster-stove and griddle
Utility motor
Vacuum cleaner
Waffle iron
Water heater

FOR THE AUTOMOBILE OWNER

Automobile battery lamp
Automobile clock
Automobile foot warmer
Automobile lamp kit
Automobile license lamp
Automobile lock
Automobile primer
Automobile signal bell
Automobile signal lights
Automobile trouble lamp
Cigar and pipe lighter
Dash and trouble lamp
Dirigible searchlight
Electric horn
Electrically heated gloves
Engine and radiator heater
Garage and tire pumps
Garage portable lamp
Headlight dimmer
Hydrometer for battery testing
Inspection lamp
Limousine annunciator
Limousine cluster light
Limousine telephone
Limousine radiator
Pocket testing meter
Signal gloves
Spark plug
Spark plug intensifier
Spark plug tester
Steering wheel warmer
Storage battery
Storage battery tester
Trouble lamp and cigar lighter
Vulcanizer

FOR THE INVALID

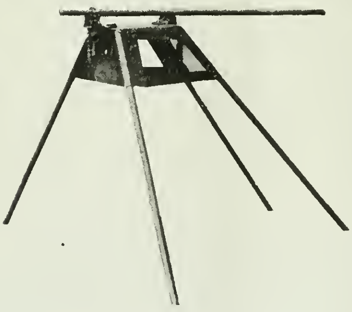
Bath cabinet
Bed lamp
Body, joint and limb bakers
Candle or night light
Deodorizer
Ceiling clock
Electrically heated blanket
Electrically heated cap
Electrically heated garment
Electrically heated pillow
Hearing device
Foot warmer
Heating pad
Mechanical exerciser
Medical battery
Medical coil
Medicator
Milk bottle or food warmer
Motor chair
Nurse signal
Obesity apparatus
Sitz bath
Sterilizer
Therapeutic lamp
Treatment apparatus
Treatment chair
Vibrator
Violet Ray Apparatus

An Improved Surface Heater Control

A United States manufacturer has recently put on the market an improved design of surface heater control switch particularly useful for installation in kitchens, pantries, laundries, etc., of the private residence or apartment. Combining, as it does, a 10 ampere, 250 volt indicating switch, a concealed receptacle, and in parallel with it, a receptacle for a pilot lamp, this is said to be the lowest priced substantial heater control on the market. By means of a standard cap which fits into the receptacle, current can be supplied for the electric iron, washing machine, and other current consuming devices. The caps for use with this outfit have two parallel blades for making connection with phosphor bronze spring contacts located in the slots well below the surface of the receptacle. Where polarized connection is desired the unique construction of the cap is the only correct manner. While the switch itself is of the indicating type, unmistakable visual evidence of the use of current is provided by the pilot lamp. This control is approved for use on concealed, cleat or molding work. When used for concealed work, it can be attached by means of four screws, to any standard two-gang box. For cleat or molding work the wires are led into base through the two holes provided in the end. The cover is reversible, so that in cleat and molding work the feed may come from either the ceiling or the floor.

A Contractor's Shop Weighing 45 lbs.

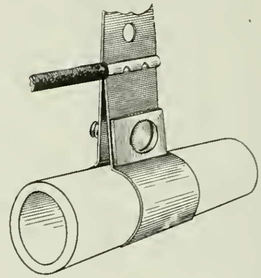
H. P. Martin & Sons, Owensboro, Ky., have devised a portable vise stand and pipe bender which should add to the efficiency of any electrical contractor. This device will bend a pipe or conduit, from 1/8 in. to 3/4 in. in diameter, without kinking. The equipment is illustrated herewith. The stand is equipped with a No. 1 Vulcan chain vise, or Reed hinged vise. When pipe is to be cut or threaded, it is fastened in the vise and the bender then acts as a guide and rest, as indicated in the illustration. The pipe is held abso-



lutely rigid and can be threaded or cut with ease. The front legs of the stand are almost perpendicular, so that short nipples can be threaded or short pieces cut without the handles of the stocks striking them. The equipment complete weighs 45 lbs, and can be folded into small space. The stand proper is made of No. 16 sheet iron, thoroughly riveted and braced with angle irons. The legs are made of 3/4 in. pipe and slip into sockets when stand is set up. The side braces make a convenient place for wrenches, cutters, etc. When the stocks are not in use they also can be placed in these braces and the oil will drain off without running down the handles. The equipment is furnished in the following combinations: Stand and bender alone; stand and bender with vise; stand and bender with legs; stand and bender with vise and legs complete. The manufacturers describe it as, "A shop that weighs only 45 lbs."

New Ground Clamp

The Devoe Electric Switch Company, 414 Notre Dame Street West, Montreal, have put on the market the Devoe adjustable ground clamp for lighting and power circuits. The clamp is made in three sizes, taking 1/2 in. to 1 in.;



1 1/4 in. to 2 in.; and 2 1/2 in. to 3 in. Special sizes are made to order. It is manufactured of soft annealed pure copper, making it easy to fit around any size and giving a perfect ground connection. The soldering lug is well tinned.

House and Switchboard Type Watthour Meters.

An entirely new line of watthour meters is now being manufactured by the Canadian General Electric Company at their Peterboro works. They are divided into type I-14, single-phase, for wall mounting; type D 6, polyphase, for wall mounting; type IS-4, single-phase, for switchboard mounting, back connected; type DS-6, polyphase, for switchboard mounting, back connected. The I-14 single phase meter is made self-contained in capacities of from 5 to 300 amperes, two wire and 5 to 150 ampere, three wire, 110, 220, 440, and 550 volts, 25 to 140 cycles. The range of capacities comprises three distinct groups consequent on the ampere capacity, i.e. (a) 5-25 amperes, (b) 50-75 amperes, and (c) 100-300 amperes. This is due principally to the fact that more room is required to accommodate the larger series windings and terminals in the higher capacities, necessitating larger base and terminal chamber. The principles involved in the design of each group are the same, however, and many of the parts are identical.

There is a radical departure in the construction of the base or supporting structure in the I-14 meter from that used almost universally in all types of induction meters. It has been the usual practice to build meters with a base or back to which is attached a frame. To this frame are mounted those parts which go to make up the meter. In the I-14 this is accomplished in a single cup-shaped iron casting. The electrical element is mounted on the inside and the moving and damping element on the outer or front side. The usual keyholed supporting lug at the top is cast integral with the base. An extension from the lower side of the base forms the terminal box. There are numerous advantages claimed for this construction of the base. In the first place, it eliminates the additional complications of a separate frame and base, simplifying the construction greatly. Second, it gives a very neat and compact meter, with all parts immediately accessible. Third, there are fewer parts to get out of order and out of proper relation with one another to result in inac-

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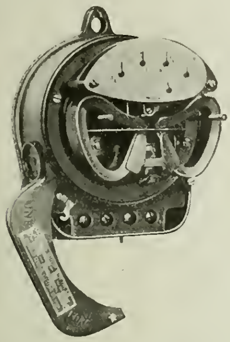
In connection with their recent extension to Granby, P.Q., the Montreal and Southern Counties Railway Company have let a contract for the construction of a car barn at Granby West. It will be of steel, brick, and concrete, and will accommodate ten cars. The barn is to be 180 feet long and from 30 to 60 feet wide. The superstructure will be of steel and brick, the foundations of concrete, and the roof of the same material.

curacies, and, fourth, the web of the iron base forms a magnetic shield between the permanent magnets and the electrical element.

A test loop is provided in the terminal compartment, which device gives ready access to the potential circuit of the meter for testing a number of meters in series, so that one does not measure the losses of the other. The simplicity and accessibility of the device, with the ease and rapidity of manipulation for testing meters in series, are features worthy of note. In three-wire meters two of these loops are supplied, one on each side.

The top bearing consists of a flexible hardened steel wire, projecting downward through a guide into a brass washer in the top of the disc shaft. A hole is drilled in the top of the shaft, and this brass washer inserted and spun into place. At the bottom of this recess in the shaft are placed several discs of billiard cloth saturated in a specially prepared grease which is extremely slow in evaporating. This provision keeps the bearing lubricated, and prevents rusting of the



Type I-14 Polyphase watthour meter with cover removed.

steel wire. This bearing gives a very low friction, the features being its flexibility and freedom from rattle. Its function is merely that of a guide bearing to keep the shaft in a vertical position. Although flexible and free to take up any sudden shock, as, for instance, that caused by short-circuits, its alignment is very definite.

The lower bearing consists of a cupped sapphire jewel. This jewel is mounted solid in a brass jewel screw. It is spun in the end of the jewel screw so that the top comes flush with the end of the screw. A brass cap fits over the end of this screw, acting as a guide to keep the pivot from jumping off the jewel. Removing this cap permits of a very close examination of the jewel. The jewel screw threads into a brass bushing, the head of the screw seating on the latter. By raising or lowering the position of the bushing the position of the jewel can be changed, thus regulating the height of the disc in the air gap. The bushing is held in position by a set screw bearing on the unthreaded portion.

Tests and experience have shown the jewel and pivot to be equal, if not superior, to the ball bearing, both in lack of friction and long life. In event of inspection or change of jewel, the jewel and pivot style is much superior, owing to the difficulty in handling and opportunity for losing the extremely small ball. The pivot and jewel construction is particularly simple and accessible in this type of meter.

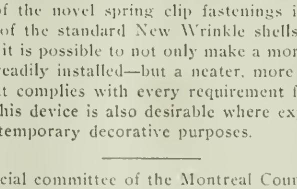
The pivot is of a standard form, consisting of a piece of high-grade hardened steel wire driven into a brass setting. It is then ground down to a taper with a rounded tip. The brass setting is threaded to screw into the end of the shaft, having a conical shoulder, which fits into a corresponding countersink in the end of the shaft, which makes the pivot concentric with the shaft. It is a very simple operation to remove and replace the pivot, it being necessary to remove only the jewel to accomplish this. This same pivot is used throughout the entire line of this company's meters.

The motor element, as in most meters, consists of a magnetic circuit of steel laminations, having mounted thereon one potential coil and two current coils. This entire motor element in the I-14 meter is assembled in a simple, rigid, and accessible manner. The whole can be removed without interfering with the other parts of the meter. The moving element, including the disc, hub, shaft, and pivot, is very light in weight (11 grams), very strong in construction, and has very high torque, thus assuring light load accuracy for long periods. The damping magnets, consisting of two "C" shaped magnets mounted on brass shoes, are astatically arranged, and provided with a micrometer adjustment for moving magnets bodily. Two clamping screws are provided for final setting. The magnets are galvanized prior to painting, thus protecting them against rust. Ample range of adjustment is provided.

The other types, viz., D-6, IS-4, and DS-6, employ practically the same element as is used in the I-14. They are arranged, however, in different cases, polyphase meters, consisting of two single-phase elements, mounted one above the other. The accuracy of these meters is exceedingly close to a straight line, with wide ranges of load, voltages frequency, waveform, temperature, and power factor. These meters are well protected against stray fields, wave-form, and short-circuits.

A New Porcelain Cleat Base.

The Bryant Electric Company have recently put upon the market a new porcelain cleat base of the receptacle character for knob and tube work and other exterior wiring. This device is particularly valuable for use where the local rules require covered connections. As will be noted from the illustration, the By base, by which name it is known, is made in two parts, one of which can be fastened directly to the ceiling beam overhead, and permits of the wiring being fastened to the terminals before the other part of the device is attached. Furthermore, as will be noted, the device is so made that it is possible to use with it practically any one of the twenty-seven New Wrinkle bodies (sockets, switches, or receptacles). A regular New Wrinkle "ring" or cap collar is permanently fastened in the opening of the base, which makes it possible to readily attach the New Wrinkle bodies



by means of the novel spring clip fastenings in the corrugated ends of the standard New Wrinkle shells. By means of this base it is possible to not only make a more convenient job—more readily installed—but a neater, more finished job, and one that complies with every requirement for this class of work. This device is also desirable where exposed wiring is used for temporary decorative purposes.

The special committee of the Montreal Council to whom was referred the report of the Controllers recommending that $45,000, be voted for preparing and supervising the plans for the proposed hydro-electric development have decided against the voting of the money. The committee are of opinion that the work should be done by the Council's engineering staff, and that outside engineers should be consulted on certain points if this be found necessary. The Council endorsed the finding of the special committee.

Trade Publications

Demand Meter—Type G demand meter is described in bulletin No. 46104-A, with illustrations, issued by the Canadian General Electric Company.

Glassware—two new catalogues by the Macbeth-Evans Glass Company; No. 87, illustrating Alba glassware, and No. 82, illustrating Thebian glassware; both splendidly illustrated.

Westinghouse—leaflet No. 3919, illustrating and describing polyphase induction feeder-voltage regulators of medium and large capacities; leaflet No. 3922, describing, with illustrations, equalizer pedestals.

Violet Ray—Charles A. Branston & Company, 359 Yonge Street, Toronto, have just issued their catalogue No. 12, describing the Branston Violet-Ray High Frequency Generator. This catalogue is well illustrated, showing a large number of physical disabilities for which the violet-ray equipment is claimed to be effective.

Decolite—a new electric light fixture consisting of a double bowl shape of hollow glass, of Holophane construction, has just been put on the market by the Canadian General Electric Company. By means of fabrics of different colors and designs inserted between these two bowls a complete change of lighting and decorative effect can be produced at any time. It is fully described and illustrated in colors in pamphlet No. 308, just issued.

Personals

Mr. W. C. Hawkins, managing director of the Dominion Power and Transmission Company, Hamilton, Ont., has been elected a director of the Southern Canada Power Company, Montreal.

Mr. A. S. Clarson of the engineering staff of the Montreal Electrical Commission has been appointed engineer of the city of Verdun, P.Q. Mr. Clarson has also held positions with English municipalities.

Mr. P. T. Davies, of Montreal, and George T. Guy, of Winnipeg, were elected members of the Jovian Congress at the closing session of the national convention of that order held recently in Indianapolis.

Mr. W. B. Harrison, of McTaggart, Sask., has been appointed superintendent of light, power and telephones for the town of Melfort, Sask.

Mr. E. H. Niebel, B.A.Sc., superintendent of light, power and telephones for the town of Melfort, Sask., has resigned to rejoin the organization of the Northern Electric Company at Regina.

British Columbia Telephone Statistics.

A sure proof of the rapid improvement in British Columbia business conditions is afforded in the steady demand for new phones. On January 1st, of this year, the number of phones in service throughout the province was 39,800, while on August 1st they totalled 41,125, as compared with 41,175 on January 1, 1915. Many services had been discontinued during the severe depression which set in coincident with the declaration of war, yet the loss of business has already been made up as a result of the improving tone in most branches of industry. On Vancouver Island the company has 11,030 subscribers, the greatest number on record for that portion of the system, the growth being from 10,925 in August, 1914. The increase noted for Vancouver and other mainland points has also been satisfactory and is being maintained.

The Provincial Hydro-electric Commission have completed arrangements for the disposal of some 80,000 pounds of aluminium for the manufacture of fuses and munitions. Copper wire is being substituted for the aluminium wire removed.

Large Bread Companies Use Electricity for Baking

Along with the growing use of electricity for general household cooking there is also being developed the "baking" load, both for private homes and with the large distributing companies. Some of the largest bakeries in our towns and cities are now using electricity exclusively. The following are a few of the reasons why electric baking is rapidly growing in favor:

The utilization of electric heat encounters no such problems and disadvantages which accompany the use of fuel, especially the problem of heat loss. These losses of heat, which occur in the combustion of fuel, are enormous.

Furthermore, electric heat does not vitiate the air, and greater quantities and more intense heat can be produced in a given spot than by any other means, every unit generated being accurately measured and absolutely controlled, both as to temperature and quantity, more readily than can any other form of heat energy.

The principal advantages of the electric oven are simplicity of operation, ease of control, perfect heat distribution, better results in baking, cleanliness and sanitation, utilization of all heat generated, and the great saving in floor space.

Simplicity of operation.—By turning the switch the desired heat is quickly obtained. No fuel to buy, store, or bother with. No ashes to be continually taken out. No keeping the fire "going" all night for early morning baking.

Ease of control.—The entire oven is under absolute control at all times through the medium of its three-heat switches. A baking temperature is reached within a very short time. Any desired temperature is quickly obtained by the proper operation of the switch. This feature helps greatly in securing satisfactory results.

Perfect heat distribution.—The heat comes from coils of resistance wire wound on asbestos tubes, which are mounted between the decks. The front part of the oven is just a little hotter than the back part, to allow for loss of heat when doors are opened. Also the elements are graduated as to heat production, the lower element being the hottest. This allows for the gradual rise of heat to the top of the oven. Thus the distribution is virtually perfect.

Better results in baking.—Because electric heat is always constant and uniform and its application in the electric oven is just where it is needed, more healthful and more evenly browned bread, cakes, and pastries, etc., are invariably the result. Moreover, the food is not contaminated by the dirt and poisonous fumes, and bread especially retains more moisture than when baked in a brick oven—therefore keeping its freshness longer.

Utilization of all heat generated.—The electricity never need be on—and burning up money—except when the oven is being used. Very little heat escapes from an electric oven, because the walls are heavily insulated. Virtually every unit of heat generated and paid for—is used!

Cleanliness and sanitation.—Electric heat gives off no poisonous gases to contaminate the food. There is no dust and dirt, which is always found in brick ovens. There are no coal nor coke boxes near; no fires to attend—all of which makes for the most sanitary conditions.

Great saving in floor space and new building costs.—The electric oven occupies approximately one-fourth to one-half as much space as the ordinary brick ovens. Furthermore, no large space in front of the oven is necessary for the manipulation of the peel. The floor space of coal and coke storage bins is also eliminated. Owing to the light weight of the electric oven, no special construction is necessary when building a new bakery.

Therefore, it is not so surprising that the electric oven has rapidly proven its superiority over fuel ovens, and that it is internationally recognized to-day as the most perfect baking chamber.

Current News and Notes

Amherst, N.S.

The Canada Electric Company, Amherst, N.S., have just entered into two contracts for the supply of power to the Canadian Car & Foundry Company, Amherst. One is for the supply of current for the ordinary business of the latter company, and the other relates to current for ammunition making.

Brandon, Man.

The Brandon Telephone Company are well advanced with their new telephone exchange building, which will cost in the neighborhood of $30,000. McDonald-Willson and Company, Winnipeg, are supplying the electrical equipment.

Cornwall, Ont.

The Bell Telephone Company, Cornwall, Ont., are making alterations and extensions to their exchange building.

Dunnville, Ont.

A by-law authorizing the expenditure of $53,000 to purchase the existing plant in Dunnville, Ont., and make necessary additions for hydro power was carried.

Fort William, Ont.

The city council is conferring with the Hydro-electric Power Commission with reference to further electric development. It is estimated that within the next year or two an additional 10,000 h.p. will be required. This development will likely be at Dog Lake Falls.

Hamilton, Ont.

The Hamilton city hospital board awarded the contract for wiring fixtures to R. M. Smith, 401 Barton Street East.

Hawkesbury, Ont.

The town council of Hawkesbury, Ont., have awarded a contract to the John McDougall Caledonian Iron Works Company, Limited, for electric pumping equipment.

Lindsay, Ont.

Fire caused $26,000 damage to the exchange building of the Canadian Machine Telephone Company, Lindsay, Ont.

Moncton, N.B.

Work has been commenced on the new telephone exchange at Moncton, N.B., which is to cost $4,000.

Montreal, P.Q.

At a meeting held in Montreal on October 16, Mr. W. C. Hawkins, Hamilton, managing director of the Dominion Power and Transmission Company, and Mr. F. W. Teele, of Boston, formerly vice-president and general manager of Porto Rico Railways Company, were elected directors of the Southern Canada Power Company.

Ottawa, Ont.

A contract for wiring the Roseman Avenue Church, Ottawa, Ont., was awarded to J. A. Ellacott, 226 Bank Street.

Port Hammond, B.C.

The B. C. Telephone Company suffered $5,000 loss in a fire which recently destroyed their store house at Port Hammond, B.C.

Prince George

The citizens of the progressive little city of Prince George are looking forward to the speedy completion of their new waterworks and electric lighting systems, which are being installed under the direction of H. K. Dutcher, of DuCane, Dutcher & Co., engineers, Vancouver. About six miles of 4-in., 6-in., and 8-in. wood pipe have been laid. Water will be taken from the Nechako River, within the corporation ilmits. The power plant for pumping and electric lighting will consist of two semi-Diesel engines of 150 h.p. each. The total cost of the two systems will be about $80,000. It is expected they will be in operation by Dec. 1st.

Raymond, Alta.

Arrangements have been completed at Raymond, Alta., for the removal of the present power plant at the Knight Sugar Factory to the Ellison mill. This will provide the town with continuous and uninterrupted service. The plant is to be completely overhauled.

Springfield, Ont.

By a vote of 82 to 2 the village of Springfield, Ont., carried a by-law authorizing an agreement with the Hydro-electric Commission.

St. Hyacinthe, Que.

The Southern Canada Power Company is completing its high tension transmission line between St. Hilaire and St. Hyacinthe, Que., which will be in operation early in November. Contracts are already assured for a large number of factories in the vicinity.

Toronto, Ont.

The Canadian National Carbon Company have awarded contracts for the construction of three new factory buildings in Toronto.

The Toronto Hydro-electric Commissioners have let practically all the contracts in connection with their Duncan street sub-station, costing about $90,000.

Winnipeg, Man.

The city council of Winnipeg, Man., have called tenders on a number of electric ranges.

The city of Winnipeg have placed an order with the Eugene F. Phillips Electrical Works, Limited, Montreal, for a large quantity of 3-conductor paper insulated lead covered cable.

Syllabus of Half-hour Talks

Before

THE ELECTRIC CLUB OF TORONTO

During the Month of November, 1916

FIRST LUNCHEON—Thursday, Nov. 2nd.
Postponed from Oct. 19 (Cause, Red Cross Work)
SIR EDMUND WALKER, C.V.O., LL.D., D.C.L., President Canadian Bank of Commerce.
SUBJECT—Financial Aspects of the War.

SECOND FRIDAY—
J. W. HUGHES, Electrical Engineer, Canadian Pacific Railway, Montreal.
SUBJECT—Electricity in Railroad Work.

THIRD FRIDAY—
R. C. HARRIS, Commissioner of Works, City of Toronto
SUBJECT—Transportation

FOURTH FRIDAY—
KENNETH J. DUNSTAN, Manager, Bell Telephone Company.
SUBJEST—The Development of the Telephone.

D. H. McDougall, Chairman. Frank T. Groome, Secretary-Treasurer

Electrical News
Generation Transmission and Application of Electricity

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ADVERTISEMENTS

Orders for advertising should reach the office of publication not later than the 5th and 20th of the month. Changes in advertisements will be made whenever desired, without cost to the advertiser.

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Vol. 25 Toronto, November 15, 1916 No. 22

What is Architecture?

It has been announced that the Dominion Government will consider the feasibility of heating the new parliament buildings at Ottawa with electricity. This in itself will cause much satisfactory comment among electrical men, for Ottawa has long been recognized as one of our biggest and most aggressive power centres, and with our most recent developments in heating devices, it is reasonable to suppose that electric heating has a good fighting chance in competition with coal at $9 to $15 a ton. The element of surprise in the announcement, however, is that the matter has been delegated to a firm of architects for a report. It is, or should be, equally a matter of surprise that any firm of architects should accept such a commission. Of course, it may almost certainly be taken for granted that the architects will immediately get into consultation with one or more electrical manufacturers of heating appliances, or that they will call in the assistance of some consulting electrical engineer who possesses the necessary technical training to make such a report, but we have no absolute guarantee of this course, except that of the architects' incompetence to make the report themselves. It is conceivable, too, that not having personal knowledge of these matters the architects may get bad advice, or advice colored by desire for personal gain. However, it seems mere waste of time in this age of specialization to advance arguments as to why one profession should not encroach upon the field of another. Calling in a lawyer to treat a case of typhoid fever would be a parallel case. Naturally the lawyer would simply turn the matter over to his medical friend. But the point is, we don't do it this way. To do so would be silly and unbusinesslike. The same is equally true when architects are asked to encroach upon the field of the electrical engineer.

One must almost hope under the circumstances that the report will be unfavorable. If it should be decided to install electric heat and, through miscalculation, it should happen that the installation did not prove a success, the cause of electric heating would be given a decided, though unmerited, setback.

The electrical industry will watch the outcome with interest, though undoubtedly with chagrin that they have no voice in a decision which their training and experience fit them, and them alone, to make.

Cooking Rates in Canada

The following letter has been received in connection with an article published in our last number on, "Analysis of Electric Cooking Conditions," and our editorial bearing on the same subject:

Winnipeg, November 3, 1916

Editor Electrical News:

I have just received the November 1st issue of the News, and while glancing over it I discovered an article on Electric Cooking and feel that I cannot pass it by without pointing out to you the fact that the City of Winnipeg Light and Power Department has not been given credit for being a pioneer in the field of low electric cooking rates or for having at the present time much the lowest rate of any city on the continent, of which we are aware. For the past four years we have been quoting a rate for electric cooking and heating of 1c per kw.h. and allowing a prompt payment discount of 10 per cent., making this a net rate of 0.9c per kw.h. For services under this "Schedule E" rate a minimum charge of 75c per month per kw. of connected load has formerly applied, but this minimum charge was reduced last August to a fixed charge of 50c per month, regardless of the size of the connected load. In addition to this we established last summer a new Schedule "K" rate, which is a combined domestic lighting and heating rate. This is a rate similar to the first twenty-six systems referred to in your article.

The initial quantity or step is charged for at the domestic lighting rate which is 3 1/3 cents per kw.h. and the value of this initial quantity varies with the floor area. The excess over this initial quantity is charged for at a rate of 1c per kw.h. We adopted this new rate in order to overcome the objection in some cases of installing an extra meter, with the entailed additional expense of wiring. There is a prompt payment discount of 10 per cent. allowed on this schedule, and each service is subject to a minimum monthly payment of 50c per meter.

On a previous occasion, about two years ago, I wrote you disputing a statement made in an article appearing in the Electrical News to the effect that the new domestic lighting rate adopted by an Ontario hydro-electric town was the lowest rate of its kind in Canada. You admitted in your editorial of the next issue that I had demonstrated the fact that this rate was not as low as our standard Schedule "B" domestic lighting rate. Since that time we have introduced our new Schedule "K" rate referred to above, which gives an even better rate than Schedule "B" to large consumers of electrical energy used for domestic purposes. It should likewise be evident to you and the writer of the above mentioned article on electric cooking that our heating and cooking rate of 0.9c net per kw.h. is considerably better than any of the rates referred to in this article, and probably better than the rate offered by any central station company in America. When you consider that we have been offering this rate for the last four years you will readily understand our desire to jealously guard our claim to the title of "The City with the Lowest Electric Rates in America."

Yours sincerely,
City Light and Power Department,
Per R. V. Slavin

We have no desire to rob Winnipeg of any lustre that may be due that city as a result of her cheap rates, but in fairness to both the article and the editorial in our November 1 issue, it must be said that no statement was made there that does not seem to be borne out by the facts even when presented in the favorable light of the above letter. Naturally we have no more interest in talking low rates for Toronto than for Winnipeg, and anything we may say below is not intended as a defense of Toronto rates, but simply an answer to certain points which Mr. Slavin has apparently overlooked and without which explanation, erroneous ideas of the comparative rates in two of our cities may get abroad.

(1) The rates which Winnipeg has charged for heating during the past three or four years must not be read without taking into consideration the condition, popularly named a "joker," of a 75c charge per kw. of connected load. Thus in the case cited in our editorial where the demand of the range is 5,600, this minimum charge is 4.20 (less 10 per cent.) This is equal to monthly consumption of 312 kw.h. in Toronto—far and away above the average. This applies to the Winnipeg rate in force up to August of this year.

(2) As indicated in the above letter, the charge of 75c per kw.h. of connected load was reduced in August of this year to a flat rate of 50c per month, irrespective of load, and if we can conceive of a customer whose load is for cooking only, then Winnipeg's rates are, we have no doubt, much the lowest in America. However, we do not think such a class of customers exists, and we do not believe the city of Winnipeg would attempt to get them on their lines if they did exist. We must then take this rate in connection with the lighting rate of 3 1/3 cents per kw.h.

Now this, of course, introduces a considerable element of uncertainty when we come to make a comparison. We have not the Winnipeg figures of consumption to guide us as to the relative consumption on the lighting and cooking circuits or as to the average consumption on either. Failing that, we shall use the most reliable data at hand and make the assumption that a house of 1,800 square feet floor area uses 160 kw.h. per month and that 40 kw.h. of this is for lighting. We believe all these estimates will be admitted as conservative and especially the 40 kw. for lighting, as this would include, for the most part, ironing, toasting, percolating, sweeping and all the household uses, except only the kitchen range. Let us compare then the charges in Winnipeg and Toronto on these suppositions:—

Winnipeg— 40 kw.h. at 3-1/3 cents	=	$1.33-1/3
120 kw.h. at 1 cent	=	1.20
		2.53-1/3
Toronto—Floor space, 18 x 3	=	.54
54 kw.h. at 2 cents	=	1.08
106 kw.h. at 1 cent	=	1.06
		2.68

This favors Winnipeg by 15 cents per month. Against this we might place the 50c service charge during the summer months when many of these customers use no current at all. Between these rates it appears to us then that you can take your choice; the only certainty being that you get your electric energy at ridiculously low cost in either case.

(3) The comparisons in (2) do not take into consideration the extra cost of installing the second service and meter, which, though not directly paid for by the customer, must ultimately come out of the pocket of the ratepayer.

We should not think of publishing this discussion if we could see how it might possibly detract one iota from the fine work which Winnipeg or Toronto has accomplished in getting the electric rates down to rock bottom. The greatest thing in the world to-day is to make electricity universally used, and, though Toronto may not be making very much money with its low rates, and though Winnipeg may not at the present time be making very big profits with these rates, yet, looking to the future, we believe the end will justify the means in the general advantages accruing from such wonderfully cheap electric current, and will offset any immediate minor inconveniences or even small deficits which one or other of these systems may temporarily experience. With a rate such as Winnipeg is giving we do not see how any sane householder can hesitate to install an electric range and enjoy the cheapness, convenience and efficiency of the only servant to which these qualities apply in this present day and generation.

Canada's Changed Financial Position

There is no more striking evidence of the changed conditions in our international financial relations than the participation by leading Canadian financial institutions in the loans of foreign governments. Until the war began it was deemed impossible to attempt any large financial operation without enlisting the aid of foreign capital. For several years preceding the war the country was buying an increasing proportion of its own issues, but it never reached the stage when a large issue would have been deemed possible of absorption by the country without outside assistance.

Canadians, however, are now finding funds not alone for large loans of their own government, but are investing in the bonds of the British, French, Italian and Russian Governments. Instead of the financial catastrophe which many pessimists predicted for Canada the country has come through a period of unparalleled stress and anxiety with its credit stronger in the markets of the world than every before.—Bradstreets' Bulletin.

Toronto Electric Lunch Club

The Electrical Lunch Club of Toronto on the last Friday in October listened to a most interesting talk by Mr. P. W. Ellis, chairman of the Toronto Hydro-electric Commission and of the Queen Victoria Niagara Falls Park Commission. Mr. Ellis briefly reviewed the history of the formation and development of Niagara Falls, touching on certain geological changes which had made their influence felt towards producing the present conditions. Incidentally he recalled to his hearers the fact that some 39,000 years ago, Lakes Erie and Ontario were at the same level and that the present difference in altitude has been caused by an intervening series of three main seismic disturbances. Mr. Ellis' talk, however, consisted chiefly of a description of the work of the Victoria Park Commission—what they are doing and have in prospect, to reclaim the wonderful beauties of Niagara glen, perpetuate them and make them available to the Canadian public. Already much has been done in the way of rendering the wonderful banks of the Niagara River available for tourists and picnic parties Paths have been made, stairways erected, supplies of pure water installed and all these, with further comforts and refinements, will be extended in the near future. Mr. Ellis further emphasized the beauties of this locality by a number of photographs which were eagerly studied by those present, who expressed general surprise that a place so full of beauty and wonder should exist so close to home without our knowledge. It is safe to say that Mr. Ellis succeeded in making every single individual hearer resolve that his next outing should be to Niagara glen.

The largest attendance in the history of the club greeted Sir Edmund Walker on Friday, November 3. Sir Edmund spoke on "Financial Aspects of the War."

Immigration and the Electrical Industry

At the Montreal Electrical Luncheon of November 8 Mr. J. M. Gibbon, general publicity agent of the C. P. R., spoke on Immigration and the Electrical Industry. Mr. Gibbon said that the connection between immigration and the electrical industry at first may seem remote, but without population your dynamos and generator and high current distributors would serve very little purpose, and the population of Canada depends, or at least depended, before the war, and will depend after the war, so much less for its increase on natural propagation than on the incoming steamers from Europe. The debt by the Canadian electrical industry to European brains was brought forcibly to my attention four years ago in Vienna, when I had the privilege of being taken over a factory in which thirteen hundred hands were engaged in the manufacture of metallic filament lamps. The ingredient which enabled the head of this establishment to make the metallic filament was tungsten, and as it happened, this tungsten was imported into Austria from Canada. As a result he began to take an interest in Canada, and discovered that owing to its extensive water powers Canada was already a great consumer of electricity, and had every prospect of using more. That being so, he argued that there should be a good market for the metallic filament lamp in Canada, with its evidently greater economy and efficiency. His argument was justified, and the export of metallic filament lamps from Vienna to Canada reached such proportions that the question now arose, Was it worth while establishing a branch factory in Canada instead of being subject to the delay and chances of breakage in transport?

Now the making of a metallic filament, according to his process, is a very delicate operation, done chiefly by women, who require five years' careful training before they can be considered first class hands. There was little use establishing a factory in Canada unless skilled labor should be available. What do you think was, prior to the war, the attitude of the Canadian Government immigration office to any skilled mechanic desiring to go to Canada? The official policy of that office was to reply to all such inquiries, "There is no demand in Canada except for farmers, farm hands, and domestic servants."

This Vienna manufacturer told me that in order to have in his Canadian factory a nucleus of hands expert in the manufacture of metallic filament from whom Canadian mechanics could learn the trade, he had to practically smuggle his first employees into Canada by two and threes, instead of sending them as he wished, in one party. The Canadian branch of this industry, I am told, has become an established success, and Mr. Shaw, chief electrical engineer for the C. P. R., informed me only last week, that had it not been for this particular invention, the C. P. R. would not have found it practicable to equip with electric light the sleeping car system of the company. Such ostrich-like policy as that of the Canadian Immigration Office, in refusing to recognize Canada as an industrial as well as an agricultural country, hampers the electrical industry perhaps more than any other, because so large a proportion of the labor in that industry is skilled labor.

One can obtain a valuable insight into the proportion of Canadian born and immigrant workers in the electrical industry from the census returns of 1911. The proportion of Canadian-born to immigrants over the whole industry is roughly 9 to 6. Here are some detailed figures.

	Canadian-born	Immigrant
Electrical Engineers		
Whole of Canada	353	294
Montreal	38	36
Winnipeg	19	22
Vancouver	24	32
Electricians		
Whole of Canada	554	323
Montreal	122	28
Winnipeg	12	57
Vancouver	26	49
Electrical Supply Makers		
Whole of Canada	1207	759
Montreal	284	69
Winnipeg	14	7
Electricity and Gas Workers (Comprising owners, managers and skilled workmen)		
Whole of Canada	4391	2932
Montreal	798	321
Winnipeg	67	99
Vancouver	115	224

In the sales end of the electrical industry the Canadian born are in a proportion of about two to one, showing that the Canadian does not have to go outside his own country to learn salesmanship, but a significant insight into the situation can be gained from the industries of telegraphs and telephones. In these industries the proportion of Canadian-born to immigrant are as 5 to 1 (10,035 to 2,259), whereas among the linesmen or skilled mechanics end of the industry, the proportion is only four to three (944 to 86). These figures are surely sufficient to show that even in 1911 the Canadian-born experts in electricity were not sufficiently numerous for the positions available. How much more so will this be the case when the immense water powers which Canada is trying hard to get developed are put into use and the industry is on a scale commensurate with our immense natural resources?

Having dealt with the immigrant as a consumer of electricity, and of electrical goods, and pointing out that England had derived enormous advantages from the admission of Hugenot and other refugees, Mr. Gibbon continued: New men from other countries bring new ideas and methods, and though these new ideas may not always be suitable for the adopted country, they prevent that country from a natural tendency to stagnation. It is a mistake in policy for Canada to bar the door against the immigrant with brains; by doing so she is postponing her own progress by at least a generation. Canada, however, has a duty to the skilled mechanic who comes as an immigrant to this country. We must see that that skill is not lost in a house to house hunt for employment. What we require in this country is a national or inter-provincial labor bureau which should card index all the opportunities for employment from the Atlantic to the Pacific. If the Dominion or Provincial Governments are too slow to take the matter up themselves, I should recommend the individual industries to organize something of the kind for the skilled mechanic labor connected with their own manufactures.

Although immigration from Europe is at present at a standstill there is very little doubt of its returning to an immense volume after the war. I have endeavored to show its bearing in the past upon your particular industry. What you have to do in your own interests is to prepare for the future, and to take measures to see that the labor necessary for the coming expansion of that industry is not hampered

Industrial Electrical Heating

By Mr. A. S. Edgar*

Definition.

Industrial electric heating includes all industrial applications of electric energy in which direct conversion into heat energy is the desired.result. It thus includes such small and such low temperature apparatus as soldering irons, and it properly includes such large and such high temperature devices as electric steel furnaces. It includes all sorts of electric welders, all sorts of electrically heated ovens and furnaces, all sorts of electrically heated driers, and all sorts of special applications, such as sherardizing and calorizing.

Development of Industrial Electric Heating.

The direct and complete conversion of electric energy into heat energy was discovered long before there was any electric industry, but little use was made of this method of obtaining heat energy for the very obvious reason that it was prohibitively expensive. As the industry developed, certain special applications for heating purposes were made, but high energy cost was generally considered to set very definite and narrow limitations to such activities.

Electrical heating in the home is largely a matter of convenience and not so much a matter of comparative cost. Electrical heating in the industries is, and must be, entirely a matter of comparative cost; the cheapest method must be the proper method when the word "cheapest" is properly interpreted.

Properly interpreted, the cheapest method is that which gives a satisfactory product at the lowest cost, when all items entering into the cost are considered.

Until very recently there has been a tendency to compare only energy costs, and when this is done the possible use of electricity for industrial heating purposes must appear very limited indeed. Under such an analysis it appears to be limited to very high temperature processes, as, for instance, steel melting and refining; to such processes as require very special localization of heat, as, for example, spot welding; and to a small number of other processes in which very special conditions must be met.

Within the past few years the problem has been studied from other angles, and it has been found that there are many industrial heating processes in which the energy cost is so small a part of the total cost as to be of comparatively little significance if other items of cost can be materially reduced. Moreover, it has been found that in many cases other items can be reduced by the application of electrical heating.

This is of great significance to the central station industry, for two reasons. First, in most industrial centres the greater number of industries are now electrified so far as the power end of the business is concerned, and further development along these lines must, therefore, depend almost entirely upon the rate of development of the industries themselves. Second, the amount of energy consumed in the form of heat in the various processes carried on in industrial establishments far exceeds the energy consumed for power purposes, so that electrification of the heating processes opens even a bigger field than that which is now so well developed.

Advantages of Electrical Heating.

The advantages of the generation of heat by direct conversion of electric energy are well known in the abstract, but it seems advisable to list them here in brief form, so that this report may be self-contained and so that they may be conveniently accessible:

1. Electrically generated heat possesses a unique characteristic—the quantity of heat energy is absolutely independent of temperature. As a result, any quantity of energy can be liberated at any desired temperature above that of the body or material receiving heat. Thus, 100 kilowatts can be dissipated from the resistor with great expanse of surface, operating at a temperature very slightly above that of the surroundings, or the same quantity can be dissipated from a resistor with very small surface, but operating at a temperature hundreds of degrees above the surroundings. In comparison, all combustion processes depend upon the bringing of the fuel to a high ignition temperature and maintaining it at or above that value as long as combustion is in progress. The products of combustion leave the combustion zone at correspondingly high temperatures, and, if these temperatures are higher than are desired, some cooling or some heat-wasting process must be used.

2. Electrically generated heat is also unique in the fact that the efficiency of the utilization of the heat may be made independent of the temperature at which a process is conducted. In combustion methods the products of combustion must leave the material being heated at a temperature at least as high as that of the work, so that the nature of the combustion process is such as to give decreasing efficiency with increasing temperature. In comparison, a wire or other resistor can be heated to any desired temperature by the passage of electric energy and the efficiency of the conversion is of necessity 100 per cent.

3. Electrically generated heat is absolutely independent of the atmosphere in which it is generated or applied. On the other hand, combustion process, as conducted in the industries, can proceed only in an oxidizing atmosphere. This independence of atmospheric composition is two-fold in the case of electrically generated heat: (a) The atmosphere need not be changed during the liberation of heat as it is by the absorption of oxygen during the combustion, and (b) heat may be liberated in a neutral, an oxidizing, or a reducing atmosphere with a certainty and nicety of control impossible with combustion processes. In fact, electric energy can be converted into heat energy in the interior of a vacuous space if desired. Combustion generated heat can, under certain conditions, be made practically independent of the atmosphere surrounding the work, as in indirect methods of heating; and control of the atmosphere is possible to a certain extent, as in open hearth steel practice; but in both cases the atmospheric control is less perfect and less certain than with electric heating. Morevoer, these methods are not so universally applicable as are electrical methods for obtaining similar results.

4. Electrically generated heat may be produced exactly where it is desired, giving wonderful adaptability and ease of application. For instance, it may be generated within a mass of metal or other material, as is done in resistance type heaters and furnaces of various sorts. This is also possible with combustion processes under certain conditions as in the blast furnace and in converters, but such applications are far more limited than in the electrical case. As another example, electrically generated heat may be localized to an almost ideal degree, as in spot-welding.

5. Electrically generated heat is susceptible of perfect and of automatic control to an extent not yet attained with any other method. This makes it possible to duplicate results in manufacturing processes to an extent which has heretofore been impossible, and also reduces the human element to a minimum.

6. Electrically generated heat is independent of combust-

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ible materials, and therefore cannot give rise to the formation of explosive mixtures emanating from the heating source.

7. Electrically generated heat is the most cleanly of all forms.

Proper Method of Utilization.

In some industries and processes the character of the change produced or of the material handled is such as to make electrical heating compulsory, irrespective of cost; in others, the convenience and safety procurable through electrical heating are so important that the matter of cost need not be given serious consideration. In a great many industries, however, the balance is so close that the advantages to be gained by electrical heating may not balance the increased energy charge unless the installation and the process are so planned as to make the best use of the energy supplied. In this connection the following points should be given attntion:

(a) Electric energy is now commonly sold on some form of maximum demand contract. If this is done the minimum cost of a unit is obtained when the demand is absolutely continuous, an ideal but almost impossible condition. The process to which electrical heating is applied should, therefore, be arranged so that the demand is as small and as continuous as possible. This may mean the entire remodelling of an industrial process, but the end will generally justify the means. Thus, if a large number of individually heated units are in use it will generally be found possible to arrange an operating schedule which will result in the shutting off of one unit or of one group, just before the next unit or group is thrown on the line. Or, as another example, many processes can be conducted as night as well as they can during the day, and in such cases a night heating load may be made to balance a day power load. In general, arrangements and schedules leading to the use of off-peak power should always be given consideration.

(b) In many industries the vessel or enclosure which serves as a container for the material which is being heated or treated is cooled after the completion of each cycle, and must be brought up to temperature again at the beginning of the next cycle. It often happens that the energy required for this purpose is comparable with or even greater than that required for producing the changes desired in the product.

It is generally possible to limit the energy requirements almost to the quantity necessary for conducting the process for supplying radiation and convection losses, and for heating the trucks, carriages, or other devices used for handling and supporting the work. This can be done by making provision for unloading and loading hot containers, or by the substitution of continuous for intermittent operation.

(c) Loss from the walls of the containers cannot be eliminated, but it can be reduced to small values by good construction, and this is more than justified on a basis of cost. Moreover, the containers should be given such shapes as will give them the maximum content per unit of wall area which is consistent with commercial considerations. Location near windows and in positions where violent air motion is the rule should be avoided.

(d) When it is possible the heating elements or resistors should consist of the material under treatment. The next best arrangement is immersion of the heating elements in the material being treated. If both of these arrangements are impossible the heating elements should be placed as near the work as conditions permit; surrounding them with the material to be heated is almost ideal.

(e) In many installations a great many pieces of work are placed in one container. It will be found in many such cases that part of the work is finished before the rest, and in some cases it may even have to be removed to prevent burning or other damage. Such results are always due to improper choice of materials forming one charge or to uneven temperature distribution. As an example of the first sort of trouble, assume the charge of a japanning even to consist partly of small stampings made of twenty-gauge metal and partly of castings with an average thickness of one inch. Unless great care is used in loading such a collection, the light weight material will be overbaked before the heavier material has been brought up to baking temperature.

The uneven distribution of temperature is one of the most common sources of trouble in oven work, and no electrically heated oven or similar device should be left as finished until an elaborate temperature survey has been made at various points within its working space. In this connection it should be noted that the great flexibility of electric heating devices makes it possible to so distribute them as to get practically uniform heating if only sufficient time will be given to the problem. All temperature surveys should be made with an oven fully charged and with normal ventilation.

(f) The industries are just beginning to recognize the advantages obtainable from what may be called flow production, or continuous travel during production. Where great numbers of duplicate parts or pieces are to be produced it is proving highly economical to carry the product on conveying or carrying apparatus of some sort, bringing it successively to each of the operators who perform one operation or a simple series of operations upon it.

This method of handling work is particularly adaptable to many electrical heating processes, the work being carried continuously through a properly constructed and properly heated oven or furnace. Such devices are becoming known as continuous ovens and furnaces, automatic ovens and furnaces, conveyor type ovens and furnaces, etc.

The continuous types of heating equipment eliminate a great amount of labor and also make possible the most perfect control and duplication of results. It will be recognized without further detail statement that these two facts makes this method ideal for quantity production.

Flow Production

Certain things must always be kept prominently in mind when planning equipment of this sort, for example:

The enclosure and the travel of the work must be so planned that a minimum external wall area encloses a maximum volume.

The volume enclosed must not be greater than is actually required for proper production of the results desired, otherwise there will be unnecessary loss of heat from the walls.

When possible, the installation should be so planned that any air circulation required will result naturally—that is will be produced by the draft created by temperature variation within the enclosure and by the arrangement of the passages within the enclosure. When this is not possible, forced ventilation must be resorted to.

Full advantage should be taken of the continuous flow by using the counterflow principle of ventilation for the conservation of heat. Work entering the oven or furnace is generally cold, while that leaving the active heating zone must, of necessity, be hot. Ventilating air will generally be drawn at normal temperature from the room or out of doors, and, after being heated by passing through the oven, would ordinarily be thrown away at the high temperature acquired.

When the quantity of ventilating air is great, measurable economies can be obtained by allowing the incoming cold air to flow over the outgoing hot work. The resultant interchange of heat has a two-fold advantage. The issuing work carries less heat to be wasted externally, and the entering air requires less heat to bring it up to oven temperature. In some cases it is possible to complete the counterflow principle by allowing the issuing air to pass over and preheat the entering work, thus saving heat that would be carried out by the air and saving heat that would be required to raise the temperature of the incoming work.

It will often be found advantageous to use a double, triple, or quadruple run of material within the enclosure—

that is, the conveyor or carrier will double back on itself once, twice, or thrice within the chamber. When this is done the heating equipment can often be advantageously hung so as to span the oven from wall to wall between the successive passes, instead of being suspended on the walls. Suspension between successive passes results in directing practically all of the heat against the work instead of directing a large part of it against the walls of the enclosure.

Present Development and Most Promising Fields.

The electric steel furnace and various special electric furnaces such as those so widely used in the neighborhood of Niagara are now well known examples of electric heating. Suffice it, therefore, to say that, despite many failures and many disheartening fiascos, these devices have now become recognized as permenent features in the industrial field. When wisely installed and operated under proper circumstances, they meet a need and supply a means of doing certain things otherwise impossible. They are not, strictly speaking, competitors of combustion methods of heating; they are rather supplementors of such methods.

As the world's knowledge of materials and demand for materials of different sorts increases these high temperature furnaces must inevitably find ever-enlarging field of effective application.

Furnaces for heating steel for forging purposes have not been developed to a commercially successful state. It is probable that certain forms now being tried will give reasonably satisfactory results and that, thereafter, development will be fairly rapid in this field.

Furnaces for the heat treatment of steel and for the annealing of metal sheets, blanks, and such have been built in large number, and a few are now operating with satisfaction to the users in several different industries.

There is at the present time a great demand for electrically heated furnaces for use in the vitreous enamelling of metals—that is, the fusion of a coating of metallic oxides and salts to form a vitrified or porcelain-like coating. Such furnaces must operate at temperatures in the neighborhood of 1,800 to 2,000 degrees Fahrenheit. At present it cannot be stated that any electrically heated device has been produced which will do work of this sort satisfactorily. However, the temperatures required are similar to those used in heat treating, and the promised early development of such devices should make it possible to enter this new field in the near future.

Perfect temperature control and perfect control of the atmosphere surrounding the work are such strong arguments in the field of vitreous enamelling that electrically-heated furnaces will find ready acceptance as soon as they are conscientiously backed by the central stations.

Furnaces for the melting and refining of metals and alloys of medium and low melting points have not yet attained the same success as the steel furnace. There are a few isolated examples of fairly successful commercial operation, and the rapidly growing fund of knowledge gives promise of commercially successful types in the near future.

The most promising fields for the development of these medium temperature furnaces at the present time are the manufacture and remelting of brass and bronze alloys, the manufacture and remelting of the various white alloys, and the reclamation of brass, aluminum, and similar scrap.

The drying, setting, or baking of varnishes, japans, paints, and similar materials has been done in electrically-heated ovens in isolated instances for a number of years past. However, it remained for the enormous production problems of the automobile industry to bring such methods prominently to the front. In such work electrically heating would seem to be at a considerable disadvantage in comparison with other methods when considering energy charges only, because of the comparatively low temperatures at which these operations are conducted. When all charges are considered the case is very different, and the decreased labor and improved quality of product, combined with safety of operation and ability to accurately duplicate results attained in periods of time heretofore believed impossibly short, are bringing this method rapidly to the front. Some of the best examples of low temperature industrial electric heating are to be found in this field. Such factories as Willys-Overland Company, Toledo; the Dodge Motor Company, Detroit, and the Ford Motor Company, of Detroit, are enameling car parts and body frames almost exclusively by heat generated electrically.

Another very promising place for the installation of electrical heating is to be found in the core rooms of foundries producing numerous duplicate parts, as in the manufacture of automobile engines; the manufacture of office and store machinery, and the manufacture of valves and fittings. The methods now in use for baking the cores are wonderfully inexact and give most variable products. Experimental work already completed shows that cores can be baked electrically in much shorter times than are now in vogue and that a much more uniform product results. Cores of small size and cores containing both thick and thin sections in the same piece offer the greatest opportunities for the application of electrical heating at the present time.

There is another very promising field for development in the baking industry. This is particularly attractive because much baking is done at night, and it would therefore give a very desirable load. Methods now in use do not give a uniform product, considering one bake in its relation to others or parts of one bake in their relation to other parts of the same bake. This is largely due to inability to accurately control temperatures and heat distribution with present methods, and should be easily overcome by the application of electrical heating.

Closely allied with the production of baked goods is the manufacture of various forms of prepared foods, such as the numerous flaked breakfast foods and the like. Many of the manufacturers of these foods have experienced difficulties arising from the combustion method of obtaining heat, and electrical heating promises a much superior product.

Miscellaneous applications are very numerous, and for the sake of brevity they are listed hereunder, giving industrial electric heating applications already in use:

Industrial Heating Applications Now Existing (Classified According to Suggested Scheme).

A. Metal industries: (a) Steel and ferro-alloy furnaces: manufacturing, melting, and refining; (b) other metal furnaces; just emerging from experimental stage; (c) special small capacity metal melting apparatus; monotype and linotype pots, solder pots; (e) heat treatment and apparatus; tempering and annealing furnaces and tempering baths; sherardizing and calorizing ovens.

B. Electric welders, both arc and spot.

D. Core baking ovens; just emerging from experimental stage.

E. Japan and varnish baking; japan baking on automobile bodies and parts, typewriter frames, and parts of similar machines, wooden handles for certain machines, etc.; varnish baking electrical machinery shells, etc.

F. Baking and cooking of food stuffs; just being introduced, excepting for special conditions, as on battleships and such.

G. Melting and heating of waxes, glues, etc., commercial waxers, oil baths, glue pots, asphaltum, pots, etc.

H. Miscellaneous applications: (a) Soldering irons; (b) commercial irons; (c) embossing units; (d) varnish and air brush units; (e) film drying; (f) vulcanizers; (g) branding irons; (h) mangles; (i) industrial disk units; (j) ink drying; (k) beer vat drying; (l) immersion heaters for various purposes; (m) stills; (n) matrix drying; (o) powder testing ovens; (p) air heaters for various industrial purposes.

Light and Power Rates Under Municipal Ownership

Paper read at the Convention of the Union of British Columbia Municipalities by H. A. Blakeborough, Vernon City Superintendent

In compiling this paper dealing with the subject of Municipal Ownership of a Public Utility, I have endeavored to make it read non-technical as far as possible, so that it may be more clearly understood by many of those present who may not be familiar with the technical phrases used in connection with a light and power system.

Much has been written upon this absorbing subject in a general manner, and much can be said both for and against the owning of public utilities by municipalities.

Vernon's System

As a rule most things are governed by local conditions, and this is no exception. It will therefore probably be of more interest to you, gentlemen, to hear the history of one plant in particular. I have therefore confined this paper principally to the experiences of the corporation of the city of Vernon in the actual operation of its light and power system.

The success or failure of any undertaking, whether private or municipally owned, naturally depends to a great extent on its management. Unfortunately it can be stated with some degree of truth that mismanagement is often the cause of a balance being shown on the wrong side of the fence in the statement of a municipality owned utility.

The fact that a new board of control may be appointed each year does not help matters, as so much has to be gone over again and again on account of the short time one board may have available to investigate the workings and management of the utility.

It repeatedly happens that by the time one board of control has grasped the situation thoroughly, it is time for another election, and as proved by past experience, the same honorable gentlemen do not always take office two years in succession. This is a very great drawback to municipal ownership. The continual changing of the management is not generally productive of the best results, especially when it is considered that in the majority of cases the new board of control may possess but little knowledge of the work they have undertaken, and it is for this reason that a very strong argument could be advanced against the present system of the whole council retiring from office each year. There is no doubt that if only a portion of the council were called upon to resign, much better results would be obtained, and the new members would then benefit by the experience of the older ones.

Probably it is owing to the many mistakes made by newly appointed boards that the commission form of government has been instituted by several of our cities in Canada. However, just so long as our system remains as it is at the present time, it would appear that something should be done in a general way to assist new councils in dealing with such problems as they are liable to encounter upon taking office.

Data Required

Something in the form of condensed data might be furnished by the Dominion or provincial governments showing how the various plants in the country or province have progressed from year to year. This might appear in some scheduled form, giving the population of each town, the number of consumers each plant serves, the number of kilowatt hours generated and how used, whether for commercial lighting, street lighting, motor power or for cooking and heating. There might also be shown the rates for the various uses, and any other information concerning local conditions which might be of general value. This could be accompanied by short articles dealing with the various subjects by experts, unbiased and not interested in a monetary way by advancing any particular theory.

It also appears to me that this data system might well be extended to the majority of subjects dealing with the usual problems which the average municipal council would be liable to encounter.

It is a somewhat difficult matter to arrive at any decided opinion in regard to the relative merits of any particular type of primary power, unless local conditions are first thoroughly investigated.

Fuel Prices

With a steam plant the price of fuel would naturally be the main factor, and where wood is used for this purpose, the question of continuous supply and to what extent the purchase of wood by the power plant would affect the price to the citizens for ordinary household use. Of course, it would hardly be expected of a private company to consider the latter effect. Nevertheless, it is worthy of consideration by municipal councils, and had not the Vernon city council taken this point into thought, our citizens in all probability would have experienced considerable trouble this coming winter in finding sufficient wood to meet their demands.

In a water power plant the big factor to be considered is the initial cost of installing, which is often found to be so high as to prohibit the use of water as a primary mover. This applies more particularly to small towns or cities, but if the first cost is not excessive, so that the plant is not saddled too heavily with overhead charges, it naturally follows that water is the cheapest power. Should the expected developments on the Shuswap River take place so that Vernon finds itself in a position to purchase current from the company who develops power from the Shuswap Falls cheaper than can be generated by our own Diesel engines, then the engines will still serve most admirably as auxiliaries in case the water power should at any time be unavailable.

Diesel Engines

There is no better auxiliary engine than the Diesel, as it can be started up and running with a load on in a very few minutes, whereas with a steam plant considerable time would be lost in getting up steam before it would be possible to bring the plant into operation.

When considering the installation of an oil plant, the two big factors to be taken into consideration are the initial cost and the cost of the transportation of the fuel oil. The cost of handling the oil after its arrival at its destination is a trifling matter, when compared to the cost of handling wood or coal, as the method is very simple—the oil being emptied by gravity from the railway tank cars into a storage tank and from there is pumped into the power house either by hand or power as required for consumption

The history of the Vernon power plant up to the year of 1911 is much the same as that of any other small city plant, the power equipment at that time being two return tubular steam boilers, a compound Corliss steam engine, and a two hundred kilowatt, three phase generator.

Cordwood was the chief fuel used and the price to the city averaged $6 per cord delivered in the power house.

The only coal available was of poor quality costing in the neighborhood of $10 per ton with the delivery uncertain.

In 1911 a twenty-four hour service was inaugurated with the object of providing power for such industries as might be attracted to the city, and also with a view to stimulating the public interest in the use of domestic heating and cooking appliances.

It was very evident that the problem of fuel supply would shortly become a serious one, as the price of wood was increasing rapidly owing to the supply in the immediate vicinity and surrounding districts becoming more depleted each year.

Early in 1912 it was also apparent that if the city maintained its rate of growth as experienced at that time the plant would not be large enough to handle the load in the coming winter. The problem then presented itself of increasing the generating system.

After the merits of the various means of power had been thoroughly investigated, Diesel engines were decided upon owing to their low fuel consumption.

A Modern Equipment

A modern building of reinforced concrete with fireproof doors and windows was erected at a cost of $15,000. The building being constructed to accommodate the two Diesel engines we have in use. The building could be easily enlarged by an addition should the requirements of the city demand it.

The first unit of two hundred horse power was installed at a cost of approximately $40,000, and was first put into use in March, 1913. So evident did the economical operation of this unit manifest itself, that the lighting rate was immediately reduced 24 per cent. and a further reduction of 16 per cent. was made within a year, bringing the lighting rate down to eight cents per kilowatt hour as charged at the present time, and a power rate varying from 4½c to 1½c according to the quantity of current used was also brought into force; the power rates also applying to heating and cooking appliances.

It was planned to further reduce the rates in 1914, but owing to the outbreak of war this was not deemed advisable, owing to the possibility of decreased revenue and the fact that probably everything used in the maintenance of the plant would advance to a considerable extent in price. However, at the beginning of the present year it was thought possible to reduce the rates in some manner, and in May a by-law was passed amending the rates for cooking and heating to 2¼c per kw. hour net, and abolishing the meter rent of 25c per month. This reducing the revenue of the light department to the extent of $2,000 per year.

The wisdom of reducing the rates just as soon as possible has always manifested itself by an appreciable increase in the current consumption, showing that the people will use the current extensively for lighting purposes if they can obtain it at a sufficiently low rate.

The revenue in 1912 was 17 per cent. in excess of 1911, notwithstanding the decreases made in the rates, and each year since there has been a big increase in consumption, due undoubtedly to the reductions made from time to time in the rates.

A Second Unit

In 1913 the second Diesel unit of 525 h.p. was installed and brought into operation at a cost of approximately $50,000. This unit entirely superseded the old steam plant which had been kept in use with the first Diesel engine to assist in handling the peak loads.

Previous to the installation of the second Diesel unit a ten-ton travelling crane was erected to facilitate the handling of the heavy parts of the engines. This completed the power house equipment and we have never had to resort to the use of the old steam plant since the second Diesel was installed, although we run a continuous service the year around. In fact the steam plant has now been dismantled.

The new power plant, which represents a total outlay of $105,000, is one which any city might justly be proud of, and certainly showed good judgment and foresight on the part of the council holding office at the time of its inception.

We will once again touch upon the all important subject of fuel costs. In 1913 $8,518 was spent by this city for fuel, when the combined steam and oil plants worked together, that is, the two hundred and sixty horse power steam plant and the two hundred horse power Diesel engine. Had the total number of kw. hours turned out during that year been generated by steam power the fuel cost would have been $12,155 at the prices then prevailing for wood and coal. If, however, the same load had been carried by Diesel engines, the fuel costs would only have been $4,135. The balance of $8,020 in favor of the Diesel over the steam plant would be sufficient to pay the interest and sinking fund charges on a twenty-year debenture issue of $90,596 at the rate of interest existing at that time of 5½ per cent., which practically means that the saving on oil fuel over wood would pay the fixed charges of interest and sinking fund on our entire new Diesel plant. In addition to this there would also be a saving of at least a thousand dollars a year in wages, as a steam plant with the capacity of our present plant would require at least two firemen outside of the three shift engineers, whereas we have all the labor we require in one man other than the engineers. The Diesel plant would also show to advantage in the matter of general maintenance, as the cost of cylinder and engine oil and other supplies would be less. In short, the Diesel engine shows up to advantage in every way over the steam power with the exception of the initial cost of installation.

Cost of Oil

In connection with the cost of fuel oil it is well to bear in mind that approximately one-third of the cost of the oil laid down here is for freight charges. So that a plant more accessible to the oil supply would have a decided advantage over our plant. The main conclusion arrived at is that a water power plant must have a very low cost of installation to compare at all favorably with such equipment as the city of Vernon now possesses on account of its low cost for fuel to operate it.

One of the greatest problems in the operation of a plant is the keeping up of the load factor as high as possible. That is, to keep all the machinery working as nearly as possible at full load. An increase in our annual load factor from twenty (which is approximately what prevails at the present time) to one of thirty per cent. (which we hope to realize) would enable us to make a further reduction in our rate per kw. hour of at least 25 per cent. That is the present rate of eight cents per kw. hour for lighting could be made six cents, and the power and heating rates could be made correspondingly less.

In every city the summer load is much smaller than the load carried in the winter.

Cooking and Heating

As the aim in all power plants is to obtain an even load factor throughout the year the city has therefore encouraged the use of any electrical appliances used principally during the summer months. The special low rates for cooking and heating now in force were adopted with this end in view.

Electric ranges and water heaters are coming more extensively into use, as also are other small electrical appliances. Wood and coal are no longer in the running from an economical standpoint as a means of supplying heat for cooking. There are also many good radiators on the market which are found to be a great comfort when used during the chilly evenings of fall and spring.

The manufacturers of electric cooking ranges state that the current used for cooking purposes averages a kilowatt per person per day in an ordinary household; which at the rate of 2¼c per kw. hour now in force here would cost 70c per month per person. By actual experience we find that these figures are very near correct, and it is further claimed that the saving by less evaporation of the foods cooked by electricity will offset the cost of supplying to the household the necessary current to heat sufficient water for baths, dishwashing, etc., etc.

With wood at $6 per cord and coal at $10 there is every prospect of a considerable range load being built up in this city.

In 1912 the number of kilowatt hours generated was 335,-646. Last year the total was 698,671, over 100 per cent. increase. Four years ago our motor load was only 53 h.p. It has gradually increased until it reached a total at the end of 1915 of 240 h.p.

The revenue increased from $19,302 in 1912 to $29,796 in 1915, while the fuel bill decreased from $10,918 to $4,791 This, I believe, will be found to be a good record.

A Splendid Record

There are few plants in British Columbia that have doubled their output in four years, increased the number of consumers 33 per cent., raised the revenue 35 per cent., and at the same time reduced the rates 40 per cent. and abolished the meter rent.

This record of efficient development has been accomplished only by the constant co-operation of the council with its officials. Unless the co-operative feeling exists between public bodies and their officials the desired results cannot be expected, no matter how much organization or system may be in existence.

It would be remiss to close this paper without adding that a great deal of credit is due the Vernon City Council and its light and power committee during the last four years for their keen and untiring efforts in making this a successfully operated municipal plant.

The Winnipeg River as a Commercial Asset

By J. G. Glassco*

My object is to emphasize the commercial value of the Winnipeg River to the Province of Manitoba and in particular to the city of Winnipeg. The most expedient way of doing this is to anticipate that time when the population of this province and city shall call for the utilization of all practicable water power developments that exist on this river. It is quite true that the present demand for electricity in the province consumes not more than one-sixth of the available power on the Winnipeg River, but with the growth that is expected in the Western provinces it is not unreasonable to suppose that many of us here to-night will see the day when the Winnipeg River is fully developed for commercial purposes.

This river obtains its water from the Lake of the Woods, in the Province of Ontario. Some 35 miles from the Lake of the Woods the English River is tributary to it, and supplies approximately 40 per cent. of the water that enters Manitoba, some 100 miles from the city of Winnipeg. After a tortuous course, this river, whose flow last summer reached 75,000 cubic feet per second, finds its outlet in Lake Winnipeg, after covering a distance of 160 miles, two-thirds of which is within the Province of Manitoba. Hence it can be properly regarded as a Manitoba river, and, as far as its water power sites are concerned, it is of interest to note that only one practicable site exists outside of Manitoba—that is, the development at White Dog Rapids, some 35 miles from the Lake of the Woods. The Ontario Government have emphasized the value of this power site, which reaches 40,000 h.p., but, beyond its use for some large manufacturing industries in Kenora, it is difficult to see any market for this large block of power, which is, so to speak, isolated from any commercial market.

Table I. gives a list of the developments on the Winnipeg River, with the amount of horse power that is available at each site and the estimated cost of the development. The cost figures only go as far as the low tension bus-bars in the generating station, and do not include any transforming apparatus or transmission line, etc.

You will see from this list that there is available, roughly speaking, half a million horse power on the Winnipeg River, within an average distance of 75 miles from the city of Winnipeg. Furthermore, as I will show later, the costs for the development of these different sites are very low.

*General manager municipal system, before the Electrical Section of the Winnipeg Branch of the Canadian Society of Civil Engineers.

TABLE I.

	H.p. 24 hour power.	Cost low tension switchboard.	Cost per h.p.
Pine Falls	63,100	$4,407,000	$69.70
Du Bonnet Falls	95,500	6,551,000	68.60
McArthur Falls	30,700	2,740,000	90.00
Lower Seven Sisters	37,900	3,409,000	90.00
Upper Seven Sisters	29,600	2,724,000	92.00
Upper Pinawa	12,300	1,280,000	104.00
Winnipeg Electric Railway	26,000	3,000,000	115.40
Slave Falls	44,400	3,426,000	77.15
Point du Bois	46,000	2,800,000	60.90
Total	385,500	$30,337,000	

Now, in order to demonstrate the commercial value of the river I have made comparisons of the costs of a typical plant on the Winnipeg River, which is already developed, and its steam plant equivalent:

Comparison of City Municipal Plant and Its Steam Equivalent.

	City Present development.	Steam equivalent 30,000 kw.
Capital investment	$4,000,000.00	$2,250,000.00
Fixed charges at 7 per cent.	280,000.00	247,500.00
Operating expense	120,000.00	650,000.00
Total annual expense	400,000.00	897,500.00
Total kw. hours	60,000,000	60,000,000
Cost per kw. hour	.66	1.49
Distribution cost	.78	.78
Total cost	1.44	2.27
Yearly load factor	.41	.41

You will note that the city's hydro-electric plant, including transmission line and terminal station, has cost $4,000,000. The annual charges from this investment total $400,000, $280,000 of which are accounted for by fixed charges, such as interest, depreciation, sinking fund, and taxes; while the operating expense totals $120,000.

The total number of kw. hours delivered in Winnipeg last year was 60,000,000. Dividing these kw. hours into the total annual expense, we get a cost per kw. hour of energy delivered in Winnipeg of 2/3c; the distribution cost, which is common to either scheme, is 78c, making our total cost to the consumer $1.44 per kw. hour. I have included this distribution cost as a matter of interest, although it has no bearing on the main object of this paper.

Looking at the steam equivalent 30,000 kw. plant, we find that there is a large saving on the capital investment required. The fixed charges, however, are not altogether similar, since the depreciation item on a steam plant is appreciably higher than on a hydro-electric one, but when we compare the operating expenses we note an enormous increase in cost. The total annual expense is more than double, and the cost per kw. hour shows the same proportionate increase. The deduction to be made from these figures is that the city of Winnipeg would have to very much increase its present rates if they were selling electricity generating by steam rather than by hydraulic power. Roughly speaking, it would be necessary to practically double our present rates. Before leaving this comparison I am sure that a brief analysis of the

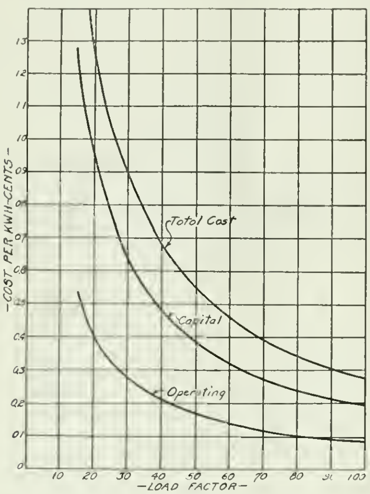


Fig. 1.

operating expense for the steam equivalent plant will interest you:

Equivalent Steam Plant.

Capital investment—30,000 kw. at $75	$2,250,000
Fixed charges at 11 per cent.	247,500
Operating:	
Coal—60,000,000 kw. h. at $6.25 per ton, allowing 3 pounds per kw. h.	562,500
Oil, waste, water, etc.	2,500
Wages at station	30,000
Station tools	8,000
Structural repairs	20,000
Steam plant repairs	20,000
Electrical plant repairs	5,000
Miscellaneous	2,000
Total operating cost	$650,000
Total charges	$897,000

The outstanding feature of this operating expense cost is the fuel, which in this case is estimated ta $562,500. In arriving at this figure I have allowed an average consumption of three pounds of coal per kw. hour, and have taken the present market price of coal, $6.25 per ton. Some modern American plants get slightly better results than three pounds of coal per kw. hour, but for the average results I consider this to be extremely favorable to steam plants in this province.

Let me now call your attention to the following sets of curves, which are of particular interest and which graphically demonstrate the importance of the load factor characteristic in its application to hydro-electric and steam plants. Fig. 1 shows the total costs on the kw. hour basis, according to load factor as applied to our present municipal plant. It will be noted at our present load factor—41 per cent.—we get a total cost per kw. hour of 2/3c. This total cost is separated into two component parts, one resulting from the fixed charges and the other from operating and maintenance expenses. It should be explained that the curve for operating expense will show a slight error, since no allowance has been made for any saving in operating in the event of an extremely low load factor. This saving, however, would not be appreciable in the case of our hydro-electric plant. The general character

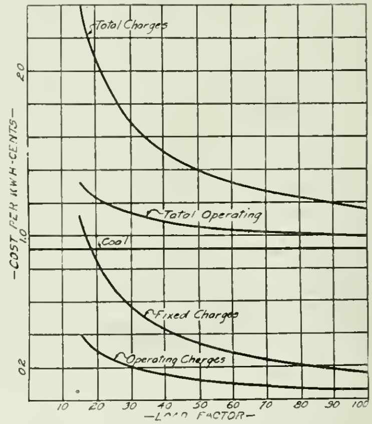


Fig. 2.

of the curves indicate an enormous increase in the cost of electric energy for very poor load factor, while it is also apparent that the cost does not decrease in anything like the same proportion for any increase in load factor above, say, 50 per cent.

In Fig. 2 the same curves are shown for an equivalent steam plant. The character of the curves here is somewhat different, and you will note that I have shown the cost of fuel as a separate constant, indicated by a straight line. This constant causes the divergence between the total operating costs and the total costs, which is not found in the hydro-electric plant.

Now, if you refer to Fig. 3 you will see a very interesting deduction, which is the result of the above comparison. The lower curve shows the total annual costs of our present city

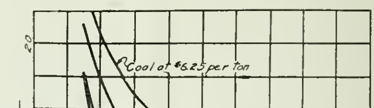


Fig. 3.

plant, while the curve above it shows the results for the same steam equivalent plant at various prices of coal.

On account of the unusually low capital charge on our present municipal plant, coal would have to be purchased in Winnipeg at less than $2 per ton to bring the cost of the steam plant to an equivalent basis. This statement smacks of the millenium. In fact, such a condition is beyond the dreams of the wildest optimist, and we breed a very fine brand of them in the West. If our plant had a very poor load-factor characteristic we would be more nearly approaching the cost of an equivalent steam plant, but as long as our load factor is above 40 per cent. there is an immeasurable gap between the cost of hydro-electric energy and steam plant energy in Winnipeg.

And now I wish to submit a general conclusion in Table II., which will bear out my first statement concerning the commercial value of the Winnipeg River:

Table II.—Comparison of Total Investments and Annual Charges of All Hydro-Electric Plants on Winnipeg River vs. Their Steam Plant Equivalents (Without Distribution Systems).

Maximum demand		375,000 kw.
	Hydro-electric.	Steam.
Capital investment	$50,000,000	$28,125,000
Capital investment per kw.	133	75
Fixed charges	5,000,000	3,093,750
Operating charges	2,250,000	16,832,500
Total annual expense	$7,250,000	$19,926,250

Saving to province annually by hydro-electric development, $12,676,250.

Table II. bears proof of the total annual saving which will accrue to the province and to this city in particular when the time comes that our population and industries will require the development of all the above-mentioned sites on the Winnipeg River. It is shown in a monetary sense by comparing the costs of hydro-electric plants and their steam equivalents. I have shown every favor to the steam plant side of the question in arriving at the above figures. The load-factor I have placed as high as 40 per cent., although a lower figure than this can be reasonably expected, in which event the hydro-electric plants would show a still greater saving than is indicated by the present figures. I have taken the same three pounds of coal per kw. hour as in my previous comparison, and have taken coal at $6.25 per ton, delivered anywhere in the province. I may add that in my conclusions I have not considered the general distribution of hydro-electric energy over the province, but have based my conclusion on the assumption that the market in the province would be developed by an industrial or manufacturing demand and not by agitation by farmers or rural communities, who would not be prepared to undertake to bear the fixed charges on a high tension distribution system.

Hence the result of my conclusion will show that the province will save annually over twelve million dollars in virtue of having the Winnipeg River within the province. If this amount were capitalized we might go still further by drawing on the imagination and estimate the value of the river at, say, two hundred and fifty million dollars, or the equivalent of the total assessment of the property in the city of Winnipeg.

Referring to Table III., you will see that the costs in different localities vary all the way from $42 to $225 per h.p. It is hard to understand how the Chicago Drainage Canal development can be profitable when it is considered that coal in that locality can be bought for $3 a ton.

Table III.—Development Costs of Various American Water Power Plants.

Name or location of plant.	Head in feet.	H.p. capacity at turbine shaft.	Cost.	Cost per h.p.
1. Chicago Drainage Canal, Lockport, Ill.	28	15,500	$3,500,000	$225.80
2. Columbus, Ga.	40	9,000	450,000	50.00
3. Catawba, S.C.	25	10,000	1,100,000	110.00
4. Tariffville, Conn.	31	2,300	....	125.00
5. Delta, Pa.	42	550	30,000	54.00
6. Lachine, Montreal	16	6,600	957,200	145.80
7. Winnipeg, Man.	40	25,600	4,000,000	156.25
8. Manchester, N.H.	30	6,000	... .	66.00
9. Lowell, Mass.	13	.....	....	110.00
10. Lowell, Mass.	18	.....	....	57.00
11. Big Cottonwood, Utah	370	.....	325,000	108.25
12. Lawrence, Mass.	..	1,000	....	67.50
13. Spier Falls, N.Y.	90	50,000	2,100,000	42.00

In Table IV. I have made a comparison of our municipal plant with three of the well known plants at Niagara Falls, on the Canadian side of the river.

My object in presenting the comparative figures in Table V. is to prove that while we suffer and will continue to suffer, in this province from an abnormally high price of coal, we will continue to benefit in a greater degree as years go on from the unusually favorable water power developments that nature has provided within our own territory. In fact, I doubt whether there is on this continent any other river that can provide half a million horse power within marketable distance of a commercial centre at such an unusually low capital cost as does the Winnipeg River.

Table IV.

Location of plant.	Horse power.	Operating expenses.	Mainten'ce and repairs.	Depreciaion.	Interest at 4 p.c.	Water rental.	Yearly charge.	Yearly cost of transf'd 24 hr. power.
Niagara plants	50,000	$57,900	$115,700	$ 86,800	$231,400	$52,000	$544,300	$10.88
" "	75,000	70,300	140,400	105,300	280,800	65,000	661,700	8.82
" "	100,000	86,300	172,600	129,500	345,200	77,500	811,100	8.11
Point du Bois	47,000	31,600	32,600	120,000	127,000	Nominal	311,200	6.62

Table V.—Development Costs of Various Foreign Water Power Plants.

Name or location of plant.	Head in feet.	Horse power capacity at turbine shaft.	Cost.	Cost per h.p.
1. Zurich, Switzerland	Very low	25,300	$4,650,000	$183.90
2. Rhinefelden, Germany	10 to 16	15,000	1,225,000	81.70
3. Paderno, Italy	90	13,000	.....	120.00
4. Champ, France	104	6,750	1,000,000	148.00
5. Department dell 'Isere, France	330	4 000	136,000	34.00
6. Department De Jura, France	6.5	300	45,000	150.00
7. Upper Savoy, France	450	11,000	182,000	165.50
8. Chedde, France	455	10,000	. ...	30.00 42.50
9. Chevres, Switzerland	14 to 27	9,600	1,044,000	109.00
10. Kubel, Switzerland	296	5,000	1,074,000	215.00
11. Schaffhausen, Germany	13.8 to 15.8 11.5 to 14.8	2,700	365,000	135.00
12. Gersthofen, Germany	32.8 to 34.4	6,000	812,500	135.00
13. Augsburg, Germany	..	9,100	1,875,000	206.00
14. Heimbach, Germany	230 to 360	16,500	2,125,000	130 00
15. Lyon, France	33 to 40	22,750	6,500,000	287.50
16. Muhlhausen, Germany	24 to 30	23,000	3,075,000	132.50

Electric Railways

Europe is Adopting Combination Petrol-Electric Type of Tramcar

A description of a novel petrol-electric tramcar, which is apparently gaining popularity on the European continent, is given at some length in a recent issue of the Tramway & Railway World. Cars equipped on this system have been at work for some time on railways in England, France, Egypt, and elsewhere. A new and important step has lately been taken by Continental manufacturers in the design and construction of Diesel-electric rail motor cars, that is, of cars whose axles are provided with electric motors that are worked by current from an electric generator driven by a direct-coupled heavy-oil internal combustion motor.

Two rail motor cars of this type were ordered before the war from the Brown Boveri Company by the management of the Saxon Railways, and the electrical part of the work on these was carried out by them, the mechanical apparatus (including the Diesel engines) being entrusted to the firm of Sulzer Brothers, of Winterthur.

On completion the cars were tested at first over the section of line between Rastatt and Gernsbach, and were afterwards but into regular work between Leipsic and Dresden, a distance of 80 miles. The final tests, which were carried out on June 8, 1915, were continued from 8.30 a.m. until 4 p.m. with intermediate stops; the speeds obtained ranged up to 44 miles per hour on long stretches; and the tests generally gave such good results that the cars were at once put into regular service on the Leipsic-Dresden section. The fuel consumption per kilometre at a speed of 70-75 kilometres per hour is said to be 0.6 kilogram, so that as the oil tank carries about 400 kilograms of fuel, the car is able to travel for 650 kilometres or 400 miles without requiring fresh supplies of fuel.

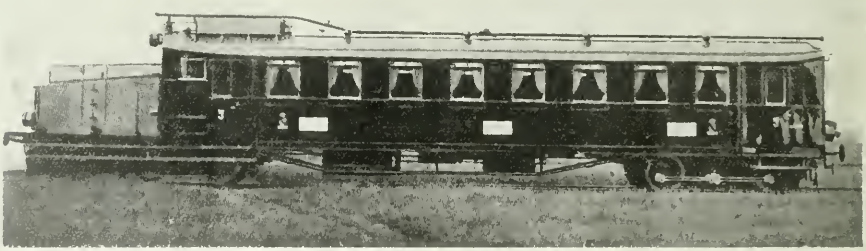
Judging from these results, it seemed reasonable to anticipate for this method of traction a useful future, and in view of the special importance that it has for lines that must be equipped and worked with the minimum of cost, the constructive details of these cars merit attention of railway managers and engineers, particularly in view of the pressing need for economy that will be felt after the war.

Each rail motor car has two trucks—the leading one with three axles, the rear truck with two. On the former is mounted a Diesel engine on special design direct-coupled to a continuous-current generator with exciter mounted on the same axle. The current from this generator at voltages varying between 200 and 380 volts is led to the traction motors mounted on the axles of the rear truck, in a manner already well known and used in the case of petrol motors, but with the great advantage of much lower cost of fuel, as well as increased safety in working, hy reason of the use of Diesel oil with a much lower flash point.

The weight of each of these cars, which are of standard gauge, is approximately 65 tons, and as already stated, they can work up to a speed of 44 miles per hour. The passenger compartments are all third class and can carry up to 100 persons, 80 seated and 20 standing. The overall length is approximately 72 feet. The Sulzer-Diesel engine, complete with flywheel, fuel, oil, and compressed air tanks, etc., weighs about 9 tons only.

On the trailing truck are mounted the two continuous-current traction motors which are provided with a single magnet frame with two armatures. They are rigidly mounted on the truck, powerful leaf springs being fitted between the axles and truck framing. Connection from the motor axles to those of the truck is made by an intermediate geared axle and side rods to the truck wheels. The two motors can develop a joint output of 360 h.p. for a short period of overload, and 160 h.p. in continual service.

Protection is given to the Sulzer-Diesel engine and elec-



Diesel-Electric Rail Motor Car

tric generator, carried on the forward truck on three axles (as in the case of ordinary motor cars), by means of a hinged sheet metal cover, which allows, however, of easy and rapid inspection. The engine is of the four-cycle Sulzer type with six cylinders, each 260 mm. diameter with stroke of 300 mm., set diagonally at an angle of 30 deg. with the perpendicular in order to reduce to a minimum the space occupied. Its output is 200 h.p. effective at 450 revolutions, but it can for a short period cope with an overload of 250 h.p. The crank axle is set parallel with the axis of the car and to the right and left under the cylinders are fixed reservoirs for compressed air. These furnish the supply for starting the engine and feeding in the fuel, and are kept filled by a compressor driven directly from the engine crank axle. The air used for starting is compressed to between 50 and 75 atmospheres.

The cylinders are cooled by water, which circulates through an air cooler after passing round the cylinder heads. On lines where car heating is desired, the cooling water can be led through radiators under the car seats, thus serving a double purpose.

The crank axle is coupled directly to the electric generator axle by means of a special elastic coupling designed by Messrs. Brown Boveri and Company with a view to eliminating the difficulty of vibration due to the irregular running of the engine. The same object is also aimed at by a special pneumatic regulation (applied from the driver's platform at either end of the car) of the fuel oil valves. This device—designed by Messrs. Sulzer—allows the engine revolutions to be reduced to 200 per minute when the car is at rest, thus giving considerable economy. The electric generator is designed for an output in steady working of 140 kw., but will run up to 190 kw. for one hour without excessive rise in temperature. The machine is entirely closed with the exception of two ventilation openings, through which cold air is drawn in through the windings and thereafter expelled.

The traction motors are started and regulated as to speed in a very economical fashion by a modification of the Leonard system. By varying resistances in the exciter armature circuit, the voltage of the generator is controlled and thereby the traction motors also.

Driven From Either End

A driver's cab is provided at each end of the rail car vehicle itself, so that it may be driven in either direction without requiring to be reversed. The cabs are, of course, fitted with all necessary apparatus for control and manoeuvre, as well as electric measuring instruments for the generator and circuits generally. The exciter is coupled direct to the generator shaft, and has an output of 7.5 kw. at an E.M.F. of 70 volts. It serves not only to excite the generator field coils, but also to drive the fan that cools the water for the engine cylinder jackets. Moreover, when the Diesel engine is running light, it can by means of the exciter be made to charge a battery of accumulators mounted under the body of the car. This battery has a capacity of 90 ampere-hours on a three-hour discharge, and serves both for lighting the vehicle and for operating train whistles or other signals. It is furthermore connected up to the field coils of the exciter, and therefore on starting up the engine the generator field can be at once fully excited.

Also worthy of note is a safety arrangement comprising an auxiliary block circuit which opens or closes the exciter main switch to generator fields, according as the said circuit itself is open or closed. This circuit is opened or shut by means of a contact connected with the controller handle, and the same action also takes place if the safety brake comes into play through a heavy overload on the two motors. Interruption of the auxiliary circuit also interrupts the exciter current, and therefore stops further supply to the traction motors. Besides this, the auxiliary circuit brings into action the compressed air brake in a few seconds after the current is interrupted.

The results obtained with this rail motor car both from tests and from actual working service have been so favorable that the makers have at present under construction three more rail motor cars and one locomotive, all employing the same type of arrangement, and they are also working out designs for locomotives and for rail motor cars both larger and smaller than those now described, to standard and to narrow gauge also. The rail motor cars are designed generally for powers of from 100 to 300 h.p.; beyond this capacity, it is preferred to employ locomotives carrying one or more Diesel engines which may develop up to as much as 2,000 h.p. This fact serves to show the great interest being taken in this new arrangement, which certainly would seem destined to have a very considerable development.

Mr. G. E. Mason, Lancashire Dynamo and Motor Co., recalled to England

Mr. G. E. Mason, president and managing director of the Lancashire Dynamo and Motor Company of Canada, sailed for England on November 7 to take a position with the parent company at Manchester. Mr. Mason came to Canada in 1909 and opened a branch office for the Lancashire Dynamo and Motor Company, Limited; two years later, when it was shown that the business was growing rapidly, a Canadian company was formed, with Mr. Mason as its president and managing director.

The bulk of the business of the Lancashire Company has been the supply, from Canadian stock, of a standard line of electric motors for factory use, as well as, of course, the supply of larger motors and generators. Mr. Mason early recognized that for a British manufacturer to sell machinery in Canada, it was necessary that he should maintain as good a service as could be rendered by local manufacturers, and this idea has dominated his policy. As a result the necessary equipment for the proper handling of a large stock and for completely repairing motors was early installed on their premises, and a complete line of all motors carried, so that customers (particularly in Toronto) were able to get immediate attention.

In the early months of the war, when the renewal of stock from England became difficult, and the possibility of conducting an import business at a profit was doubtful, the directors of the parent company considered whether the Canadian office should not temporarily be closed. Mr. Mason, however, adopted the broad policy that, inasmuch as they had supplied large numbers of factories in Canada with machinery, his company were under a moral obligation to those customers and must continue to give them all the assistance in their power. With the slowing down in imports, therefore, the company have increased their general repair business, and, having a manufacturer's ideas of repair work, this phase of their operations has developed very considerably during the past year. When the war is over it is understood to be the company's intentions to prosecute the import business vigorously along the old lines.

Fortunately, the continuity of the Canadian business will not be broken, as Mr. S. A. Gaskell, who joined the Lancashire Company in April, 1911, is taking charge of the business here. The attention to the Canadian company's business in the English factory will be part of Mr. Mason's special duties in the future, and his knowledge of conditions in this country will naturally be of great assistance to the company in meeting the special demands of the Canadian market.

The Eugene F. Phillips Electrical Works, Limited, Montreal, have received an order for the Manitoba Government telephones for 88,000 lbs. of hard drawn copper wire.

The Dealer and Contractor

Refinements in Electrical Control—Who is to Blame That Their Use is Not More General? Is the Contractor's Conscience Clear?

As one goes about from house to house in the city of Toronto—and there is little doubt that the same remark would apply to other cities—the electrical man is struck with the very noticeable absence of any except the very merest and most absolute necessities in the way of light control through the modern switch. Any idea of comfort, convenience or luxury appears to have been tabooed, and not only does one frequently find an absence of the refinements of switch control, but all too often, an absence of control of any kind beyond possibly that of a snap switch in the socket or an occasional pull chain. Such luxuries as an up-and-down-stairs control, for example, of the hall lights, generally represents the climax of efficiency of house wiring, even in our wealthiest districts.

It is useless to say that the house-holder did not ask for anything more, is satisfied with what he has, that the specifications did not call for further refinements, and so on. All of this is true enough, but is true simply because the architect and the householder have never learned that there is anything better. The fault lies with the contractor to a very considerable extent, because he does know—or ought to. Of course, we know there are a few contractors who honestly endeavor to supply their customers with a satisfactory job, but there are so many others whose chief aim is to quote a competitive price that the influence of the few is lost by the urgency of the many. It should not be a difficult matter to convince an intelligent client of the value of a few extra dollars spent in properly equipping his home or office with convenient electric light control. These are the days when time means money, when convenience means money, and when people who have little time for enjoyment of luxuries are proportionately more willing to pay for them, so that they may crowd as much enjoyment and recreation into a limited time, as possible. There is nothing in the present day that is adding so much to the enjoyment of our leisure hours as electricity in its many forms, especially electric lighting, and there is probably no single line in the electrical industry that has advanced less in the last twenty years than has the control of electric lights in the average home. We have made big advances in the lighting units themselves, big changes in the methods of installing the distributing wires, big advances in safety devices, but practically no advance in the matter of switch control.

Some little time ago an interesting article appeared in the "Electrician," by W. Perren Maycock, a member of the Institution of Electrical Engineers and a well-known authority on electrical matters. The article took the form of an imaginary dialogue between an electrical contractor and his client regarding some changes in the specifications. The client at first does not see why the contractor is not satisfied with the specifications, as they were drawn up, of course, in the regular way, but the contractor is able to point out a number of improvements, and the client, being a business man, is quick to see the advantages of the suggested conveniences. A part of this dialogue is reproduced below, and while it may contain nothing new, it may, however, suggest to our contractor readers that possibly they have not been as insistent or as diplomatic in pushing this matter of greater refinements in electrical control, with their customers, as they might have been:

Client: Good morning! Mr. Allwatt. What is it you want to see me about? I understand you have been over the premises, and I was hoping you would find the specification I sent you clear enough to quote to. Anything vague?

Contractor: The specification is clear enough, sir, as far as it goes; but I want to make a few suggestions, if you don't mind.

Client: Suggestions? Always glad to listen to any. But remember, that specification of mine was drawn up by an electrical friend; and he and I went into the matter very thoroughly, especially as regards the lamp fittings. I think we have paid every attention to what he calls "efficient illumination."

Contractor: It isn't the fittings, its the switches I wanted to see you about, sir.

Client: The switches? Why we have stated exactly what patterns we want, and have even marked the places on the walls where they are to be fixed.

Contractor: But you have marked down single-way switches everywhere; and I thought you ought to know there are others much more convenient, before sending in my price.

Client: I don't understand what you mean by single-way switches. I thought every switch was like a tap—it either turned on or turned off.

Contractor: It's rather a difficult matter to explain in a hurry, because there are so many things switches can do; but if you'll allow me to give you one or two examples, I think you'll see there is something in what I say, sir.

Client: Some new development, I suppose. Well, give me an example. Take this study, for instance. Here will be my new light, and there is the place for the switch, by the door. Now what else could I have but that?

Contractor: I should propose to fit two switches, one by the door there and another on your desk—say, about here. This switch would be connected with a piece of flex to a plug-connection on the wall, so that the desk could be moved away from the wall when necessary. They would be two-way switches, and you would then be able to turn the light on or off at either

Client: Do you mean to say that I could turn the light on at one switch and off at the other?

Contractor: Yes.

Client: That sounds very wonderful—sort of wireless. Is it quite safe?

Contractor: There is nothing dangerous and nothing complicated about it, sir. You ought to have these sort of controls—as we call them—in most of your rooms. They cost a little more, of course, but the extra cost is nothing compared with the convenience you get.

Client: Just let me get the hang of the thing again. Suppose I am sitting at the desk in the daytime, and it becomes overcast, I can turn the light on or off without getting out of my chair. Or I can turn it on or off at the door in the usual way. Or I can turn it on at one place and off at the other. Is that it?

Contractor: Exactly, sir.

Client: Well, it strikes me as most convenient. Only you first have to get used to the idea. Some new patent, I suppose?

Contractor: Years' old, sir, in fact nearly as old as myself. Only contractors won't fit these switches unless they are asked, and they seldom get asked as the customer doesn't know. That used to be the case at any rate, but things are better now.

Client: Well, I must certainly have some of these "controls"—as you call them—fitted up here. Some day I suppose we shall be able to do the same thing at three or four different switches.

Contractor: I was coming to that, sir. It can be done already, and I would suggest this arrangement in some of the large rooms, in the passages, on the staircases, and in one or two places out-of-doors.

Client: Look here. We shall have to go over the place again in a day or two, and look into this switch business closely, for I want everything to be up-to-date. Meanwhile, have you anything else up your sleeve?

Contractor: There are all sorts of things that can be done, sir; but if I were to mention them straight off they would sound complicated. The best way is to consider one case at a time—if I might suggest it.

Client: Quite so. The three or four switch idea requires a little thinking out. Now take the hall lights, do you mean to say that if we had a switch in the hall, one upstairs, one by the servants' door, and one in the front portico, we could turn the lights on and off at any switch?

Contractor: Yes. And if you wanted it, you could have a special switch to prevent the lights being turned out at the other switches, say, during the evening. A Master switch we call that.

Client: This is getting positively uncanny. Doesn't the electricity leak away, or overflow, or something?

Contractor: There is absolutely no danger at all, sir, in any of these switch arrangements!

Client: These hall-light switches will be grand. I am tired of having to go upstairs in the dark or with a candle after turning out the gas; and it's a confounded nuisance coming down in the dark for something you've forgotten.

Contractor; I'm always pointing that out to my customers; and talking about gas, sir, I often think the gas people would make the most of controls like these if only they were possible. But of course they're not, that is—not with gas.

Client: But what about the electricity people? Don't they object to anything so unusual?

Contractor: Not now, sir! They used to! That's the funny part of it. Although they have most complicated connections up at their works, their inspectors used to grumble at the simple "contraptions" (as they called them) that I fitted up on some of my jobs.

Client: Fancy electrical men objecting to electrical advantages!

Contractor: I think one reason was that they hadn't much time to spare, and it worried them to have to think out the wires.

Client:You must let me know about these things later. Now I have been thinking that two-way switch business would be the very thing for the bedrooms. One by the door, one by the bed. What!

Contractor: Just so, sir. That's where they generally are fixed. But as most people find more difficulty in understanding the uses in other places, I generally mention the other places first.

Client: Mention another besides this study.

Contractor: Your workshop down in the garden, sir. You've specified a lamp and an ordinary switch just outside the garden door, and the same outside the workshop.

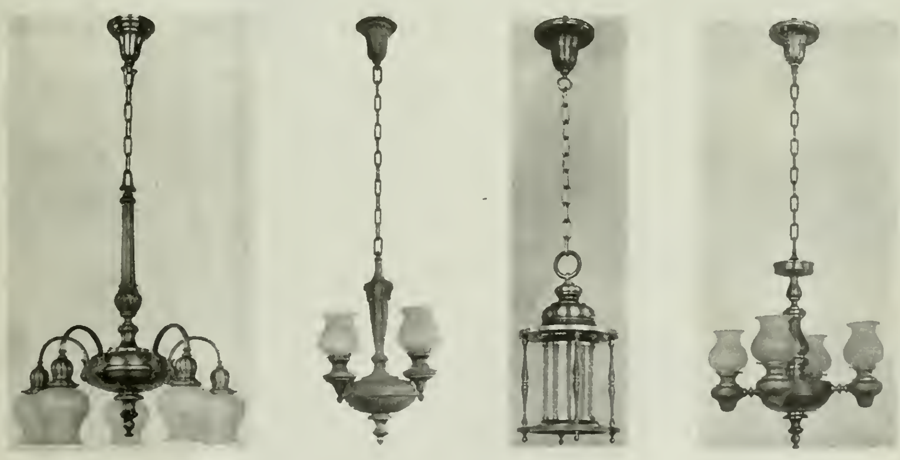
Client: Well?

Contractor: I would make the switches two-way and connect the lamps to work together. And you could have a third switch at the garden door.

Client: Good! I follow the idea. Anything else?

Contractor: I notice you have got two radiator sockets marked down for some of the small rooms as well as in the larger ones.

Client: The intention is to have two or three radiators in some of the rooms, but only one in the small rooms. But



New line of Colonial design fixtures by Tallman Brass & Metal Co., Hamilton.

in the small rooms we want to be able to plug-in the radiator at either socket, and so get rid of some of the cord. Quite O.K. Eh?

Contractor: I should fix a switch to prevent anyone using two radiators in these small rooms, to prevent waste and to save the fuse.

Client: Two sockets and one plug, Eh? Ha! Ha! What sort of a control would you term that?

Contractor: It's what we call a restrictive circuit. There are two or three kinds, and they are very useful for keeping down the consumption.

Client: I shall have to look into these. Meanwhile, let's think of the kitchen quarters. I suppose you couldn't fix up something to enable me to know if the servants had locked up and turned out the light, without my having to go and see.

Contractor: We can do most things if people like to pay for them; but these special switching arrangements are not at all costly when all's said and done.

Client: It just struck me that when you have two or three switches turning lamps on and off, you can't alter the amount of light.

Contractor: Yes we can, sir.

Client: Marvellous!

Contractor: Quite so, sir. Ha! Ha!

Client: Well, it's very clear I shall have to get the specification amended, and now my time's up. Will let you know when to call again, Mr. Allwatt. Good day. Half a minute, though. Supposing I wanted a switch to turn on all the lights in the house, say, when there was an alarm of burglars. You couldn't do that, I'm sure.

Contractor: That could be done sir; and it's not a bad idea to fix special lights outside for burglar scare purposes, in a lonely place like this.

Client: You astound me! Well, it's quite clear we shall have to go into the whole matter very thoroughly; as the earwigs said when they got on the apple. Good day, once more.

Lowering the Cost of Distribution

The illustrations accompanying this article picture a new line of wall brackets designed to reduce the cost of service connections without impairing safety or service. They have been thoroughly tested in practice and are now in successful use on a large scale, giving perfect satisfaction and saving money.

These brackets have some remarkably fine points and are making a strong appeal to central station managers and superintendents of distribution. Figs. 1, 2 and 3 show one, two and three point brackets respectively. Each bracket consists of a sherardized stamped steel base plate on which are mounted high grade porcelain insulators of unique design. The insulators are secured to the base plates by means of sherardized U bolts and nuts as shown in the phantom view of the one point bracket, Fig. 4. The round transverse holes, shown in the insulators, are for the purpose of securing the wires; the U bolts pass completely around these holes. In other words, the insulators are "iron bound," the construction being very similar to that of strain insulators. The peculiarity of this design results in a bracket having not only great tensile strength, but also a bracket which can be installed with great ease and rapidity. For example, the necessity of using tie-wires has been entirely eliminated. On the other hand, the design of the insulators is such that the wires may be secured with tie-wires, in the regular way, if so desired.

Fig. 1

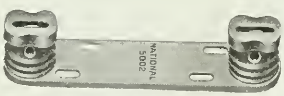


Fig. 2

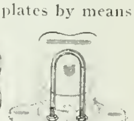


Fig. 4

Fig. 3

Fig. 5

Figs. 8 and 9 show two typical installations; Fig. 6 is a photograph of an actual installation on a frame dwelling. From the latter, it will be noted that the service wires, leading from the pole, are merely threaded through the holes in the upper bracket and dead-ended, by lopping, at the lower bracket. The weight of the wires, between the pole and the building, always keeps the short vertical spans, between the upper and lower brackets, taut; this feature eliminates complaints on account of "noisy wires." It will further be noted, by reference to Fig. 9, that, by removal of the centre insulator, a three point bracket may be used in making a right angle turn with two wires and the wires kept parallel; insulators on the two point brackets are on 9-inch centres and on the three point brackets on 6-inch centres.

The design of these brackets is such that their use is practically universal, as they may be installed in either a vertical or horizontal position, or at any angle. This is an especially important feature, as the necessity of carrying stocks of a large variety of brackets for different types of service connections is eliminated. With the one, two and three point brackets, and the corner chairs, almost any type of connection may be made. As the brackets are shipped complete with insulators, it is not necessary to handle separate shipments of brackets and insulators; a considerable economy results from this fact. Fig. 5 shows a corner chair, designed to secure the brackets at corners, as shown in Fig. 9.

Fig. 6

Fig. 7

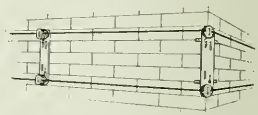


Fig. 8

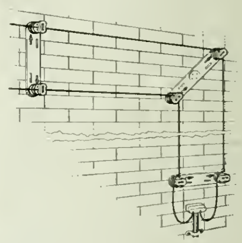
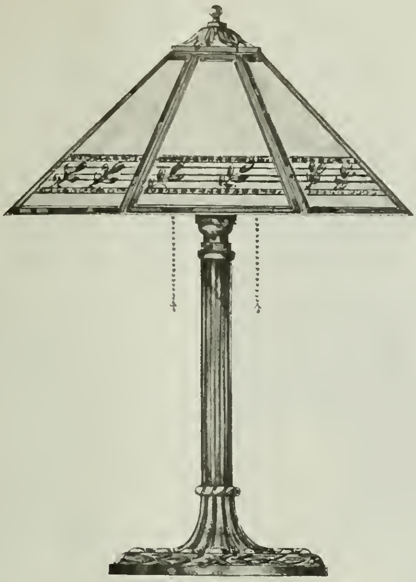


Fig. 9

A comparison of Figs. 6 and 7, both photographs of actual installations, and in the same proportion, will show the improved appearance of service connections made with this new type of bracket over those made with wood brackets. Costs, installed, will compare favorably, it is said, with those where wood brackets are used. It will be noted further that the stress from the weight of the wires leading from the pole is almost directly from the point of support, practically no leverage obtains as is the case where either wood or steel "pin" type brackets are used.

These brackets will also be found to be admirably adapted for supporting open feeders in industrial plants, mills, warehouses, etc., and can readily be attached to steel girders. The line is being manufactured and marketed by the National Metal Molding Company, Fulton Building, Pittsburgh, Pa.



light electric portable oxidized, brass finish, with 16 in. art glass shade overlaid with metal—McDonald & Willson Limited, Toronto

1 light electric reading lamp, equipped with 12 in. scenic hand decorated shade—McDonald & Willson, Limited, Toronto

Biennial Meeting of the Electrical Committee

The biennial meeting of the Electrical Committee of the National Fire Protection Association will be held in March, 1917, in New York City, the day and place of the meeting to be announced later. As usual, the provisions of the National Electrical Code as they now exist will be considered, together with reports of all sub-committees. Suggestions for amendments to the Code, in order to be included in the Bulletin, must be specific and where a change is desired in a rule or section of a rule definite wording of such change must be given, together with the reason why the change is recommended, and these suggestions, together with all committee reports must be in the hands of the Secretary not later than January 15th, 1917. As heretofore, the meeting will be open to all interested and such persons will not only be welcome but are urged to be present and give the committee the advantage of their experience and advice. The Secretary is Mr. Ralph Sweetland, 144 Milk Street, Boston.

The Canadian September bank statement showed increases in savings deposits of approximately $10,000,000. This is in the face of an extra outlay of about twenty millions in initial payment for the new war bonds. Plainly Canada thrives on such mere incidents as $100,000,000 loans.

Electrical Contractors forming Club

The Electrical Contractors' and Dealers' Association early in the month of November sent out notices calling together members of the electrical industry—that is, contractors, dealers, jobbers, manufacturers, power supply companies, and so on—to meet on November 10 and consider the organization of an electrical club. The meeting was held on the evening of Friday, November 10, at 177½ Yonge Street, Toronto.

Canadians in Jovian Offices

At the annual convention of the Jovian Order, recently held in Indianapolis, the following Canadians were elected to office: Members of congress for fourteenth district, P. T. Davies, Montreal; George L. Guy, Winnipeg; statesmen: Alberta, Norman S. Richards, Calgary; British Columbia, Roy S. Davis, Vancouver; Manitoba, J. H. Schumacher, Winnipeg; Quebec, E. N. Hyde, Montreal.

Safety First

The Ontario Safety League are distributing a pamphlet describing the workings of the Safety Patrol. This is a plan to safeguard the pupils of our schools, particularly the younger children. The league supplies each member with safety reports which they are asked to fill in, giving the date of the accident, the location, the cause, as definite a description as possible of the accident, and suggestions as to the prevention of similar accidents in the future.

Personal

Mr. C. H. Withers has been appointed manager of Messrs. Escher Wyss & Company's head office for Canada in Montreal.

Mr. Macaulay Pope, late manager appliance department, Toronto Hydro-electric System, has severed his connection with that system and has accepted a position with the Imperial Oil Company of Canada.

Mr. P. A. McFarlane, former district superintendent of the Bell Telephone Company, Toronto, has been transferred to Montreal with the title of commercial engineer, a new position created by the company.

Instrument Transformers

For measuring the voltage, current and power in a transmission system, instrument transformers are usually necessary. Potential transformers for stepping the voltage down to a safe value for the meter, usually 110 volts, and current or series transformers for stepping the current down, usually to 5 amperes, and also for insulating the meter from the transmission line. They may be either the oil insulated type or dry type, depending upon the line voltage. For three-phase work where two potential and two series transformers are used, they may be mounted in the same case,

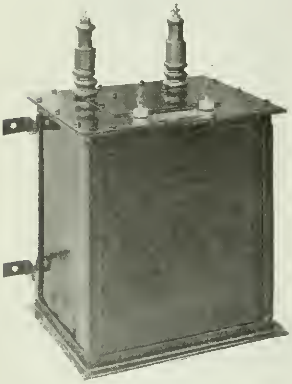


Fig. 1.

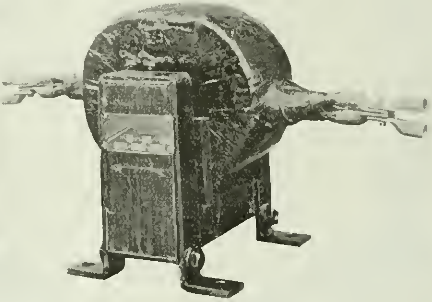


Fig. 2.

thus making a more compact and cheaper metering outfit. For accurate meter readings it is very essential that the transformers shall be accurate at all loads, not only for ratio but also for phase angle.

Fig. 1 shows a potential transformer and Fig. 2 a series transformer, both for 13,200 volt, 25 cycle lines. These were made by the Packard Electric Company, Limited, of St. Catharines, Ont., and illustrate only one each of a complete line developed by the above company. In the development work particular attention was given to both the ratio and phase angle.

Canada Sales Co. Have Taken Lionel Agency

The Canada Sales Company, 165 Church Street, Toronto, announce that they have taken the Canadian agency for the Lionel Manufacturing Company of New York City, manufacturers of Lionel electric toys. This company is said to be the largest manufacturer of electric toys in the world.

Hand Signal Lamp for Drivers

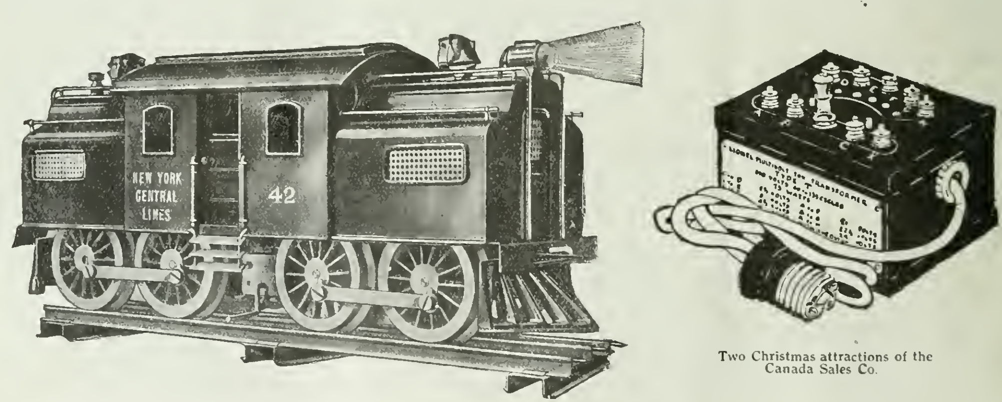
An electric hand lamp to make the extended hand of the driver an effective signal at night has been designed by the Pittsburgh Electric Specialties Company. It is called the "Safety First" hand signal, and is worn the same as a wrist watch, only the elastic which holds it in place fits around the hand instead of the wrist. It gets current from the socket in the dashboard through a very fine silk cord. So little current is required that it can be burned all the time. Since every driver instinctively, as a result of habit, extends his hand to indicate his intention to stop, slow down, or turn a corner, this lamp on the hand is a signal that nobody can fail to understand and heed. The lamp is two-candle power. It is enclosed in a polished nickel case, three inches in diameter

and one inch thick. It is provided with a ruby bull's-eye one inch in diameter, and throws a strong red light to signal to approaching cars the intention to turn. The bull's-eye is surrounded by the words "Safety First" cut out in white. Besides being effective as a signal to traffic, it enables the driver to get the immediate attention of the corner-man. The device is very light in weight, and its presence on the back of the hand is scarcely noticeable.

Electric reflectors have been provided in a St. Louis park by which a rare collection of water lilies is illuminated at night.

The Underwriters' Laboratories have issued a booklet under date October, 1916, being a supplement to their list of inspected electrical appliances published last April.

The town council of Roland, Man., are considering the advisability of installing an electric light and power plant.



Two Christmas attractions of the Canada Sales Co.

New Violet Ray Equipment

The two illustrations accompanying this article show new types of equipment being placed on the market by the Charles A. Branston Company, Toronto. Fig. 1 is known as model 5 B, which, though not giving as strong a current as model 7, is recommended as ideal for home treatment. It is very compact, room being provided in the cover for three large electrodes. Fig. 2 shows a model that combines both high frequency and sinusoidal currents. Complete, it includes a set of Dr. Snow's electrodes, cords for high frequency and sinusoidal, two felt discs No. 101, two metal handles, a massage roller, electric brush, sinusoidal chart and complete directions for use. This latter is known as model 27.

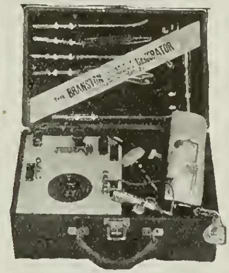
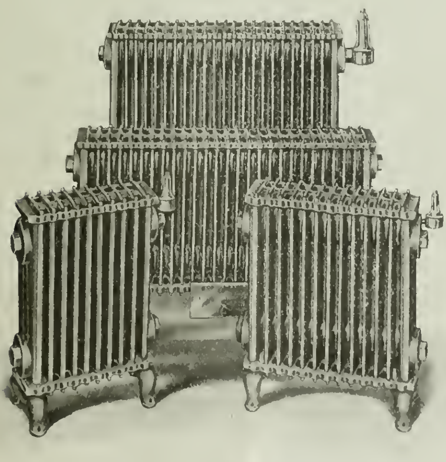


Fig. 1, above
Fig. 2, to the right.

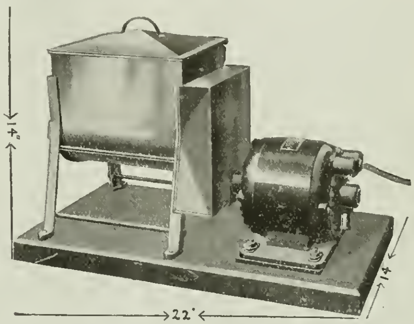
Electrically Heated Radiators

Hydro-electric Radiation, Limited, 21 Richmond St. West, Toronto, are now turning out in commercial quantities their new radiators as illustrated herewith. This is a steel radiator of very light construction, but of proven quality, and is available in sizes from 6 square feet of radiation up to 48 square feet of radiation, with, of course, any multiples of these. When considered desirable, a thermostatic control is installed either in connection with each individual radiator or to govern a group of radiators. This is a steam radiator, only a small quantity of water being used, which entirely surrounds the element. While no greater electrical efficiency can be claimed for this radiator than for those of the hot coil type so common on the market, the manufacturers do claim that the greater diffusing surface of this unit, which means that the heat is given out at a much lower temperature (below the boiling point of water, in fact, as atmospheric pressure is maintained in the radiator), produces a more comfortable and sanitary condition in the atmosphere. One Toronto home is already installing these units as the only source of heat, and the results will be watched with considerable interest.



Electrically Operated Cream Whipper

The equipment illustrated herewith is manufactured by the White-Stokes Company, Chicago, for whipping the "Mallo" Topping manufactured by this company. It is also suitable for whipping cream and other material. The outfit consists of a one-gallon hopper which is equipped with a rotating beater or dasher. This dasher is gear connected to a one-eighth horse-power motor made by the Robbins & Myers Company. The gears and bearing of the whipper are made of bronze and no oiling is necessary. By removing a pin from the axle, the dasher can be lifted out for cleaning, and easy access is given to the interior of the hopper. The motor is supplied with 10 feet of cord and plug for connecting to any lamp socket. The base of the outfit is 14 inches by 22 inches and it can be operated in the window as a window display.



Monthly Meeting of A.I.E.E.

The next meeting of the Toronto section of the American Institute of Electrical Engineers will be held on November 24, when Mr. A. O. Austin, chief engineer of the Ohio Brass Company, will give an address on "Insulator Design."

Trade Publications

Transformers—Catalogue No. 166, by the Moloney Electric Company, describing, with illustrations, a large number of installations of Moloney transformers at various points in Canada and the United States.

C. G. E. Bulletins—G-E Type M-3 synchronism indicator for switchboard service; G-E polyphase watthour meters for switchboard service, type DS-6; G-E polyphase watthour meters, house pattern, type D-6; G-E single-phase watthour meters for switchboard service, type IS-4; G-E type M-3 synchronism indicator for switchboard service; type P demand meters, (printometers); the lighting of indoor recreations by Edison Mazda lamps.

Wiring Devices—Catalogue No. 24 by Pass & Seymour, Inc., Solvay, N.Y. This catalogue contains 80 pages of well-illustrated information on Handy Electric Wiring Devices. Particular attention is called to a comprehensive charting of the interchangeable parts, which is the most complete chart attempted, as we believe, by any manufacturer. This chart covers pages 4-11 of the catalogue.

The village of Westport is now receiving electric light service for the first time since January last, when the plant was destroyed by fire.

Current News and Notes

Granby, Que.

The Montreal & Southern Counties Railway Company have begun work on the erection of their car barns at Granby. The general contractors are the Nicholson Construction Company, Montreal.

Hamilton, Ont.

A vote will be taken on January 1st on an extension to the Trolley Street sub-station.

It is estimated that Hydro profits for the year will amount to over $40,000. The number of consumers supplied is 14,042.

Melancthon, Ont.

The Backline Telephone Company, Limited, Melancthon, have obtained a charter.

Montreal, Que.

The Empire Electric Company, Limited, Montreal, have been granted letters patent. They will carry on a general electrical business. The chief members of the firm are George Jarry, Albert Vaillancourt and Albert Belanger.

Moose Jaw, Sask.

Plans have been completed by a local company at Moose Jaw, Sask., for the installation of individual lighting systems in districts at present isolated from central plants.

Ottawa, Ont.

The committee in charge of re-construction of Parliament Buildings are considering the feasibility of heating by electricity.

Owen Sound, Ont.

The Utilities Commission of Owen Sound have decided to reduce the light and power rates of the Hydro-electric system 10 per cent. This is the first reduction since the Eugenia power lines were connected to the Owen Sound system.

Port Hope, Ont.

The Hydro-electric Commission of Ontario are said to have under consideration substantial rate reductions in the Trent district which will take place in January.

Stratford, Ont.

Tenders were called to November 9 for the erection of hydro-electric sub-station at York Street, to cost some $25,000.

Tavistock, Ont.

In anticipation of the Hydro-electric power supply, arrangements for which are practically complete, many buildings and houses are being wired in Tavistock, Ont. In connection with the local system there will be installed about 80 street lights.

Thorold, Ont.

Work is well advanced on the transforming station at this point, of the Ontario Power Company. It is understood that approximately 10,000 kw. capacity in transformers will be installed at once.

Toronto, Ont.

It is expected that the Hydro-electric Power Commission will be ready to start work shortly on the erection of transmission lines through the township of Scarboro.

The Toronto Hydro-electric System will erect a new three-storey brick sub-station on Jefferson Avenue, at a cost of $20,000.

Guglielmo Marconi predicts immediate developments in wireless equipment that will not only make wireless communication much more efficient, but will also make it more difficult for messages to be intercepted. Those improvements will apply more particularly to instruments on aeroplanes and airships.

Vancouver, B.C.

Mayor Gray, Vancouver, B.C., has been negotiating with the B. C. E. R. in the attempt to get a cheaper day load rate so that the city may supply electric current for cooking.

The B. C. Electric Company, Vancouver, B. C., have announced their intention of returning deposits to consumers who have paid their accounts regularly for twelve months and established their credit to the satisfaction of the company. About 20,000 customers are involved.

Walkerville, Ont.

Plans have been approved by the Bell Telephone Company for a new exchange building at Walkerville, Ont., though it is not expected construction will begin for some time.

Wainwright, Alta.

A by-law was passed on November 2 authorizing an agreement between the town of Wainwright, Alta., and Mr. B. L. Perry, Edmonton. Under the terms of the by-law Mr. Perry is given a ten-year franchise to operate an electric lighting plant in Wainwright. The plant is to be installed and in operation within six months. A maximum charge of 17 cents per kw. hour may be made, with reductions to 16 cents and 15 cents if 500 kw. h. hours or 1,000 kw. h. are used respectively. These rates are subject to a discount of 10 per cent.

Windsor Mills, Que.

The Corporation of Windsor Mills, P.Q., have made a contract with the Canada Paper Company by which the former will obtain a supply of power from the Shawinigan Water and Power Company. The Corporation have hitherto operated a small hydro-electric development for lighting purposes only, but under the new arrangement sufficient current will be available for lighting and also for industrial purposes. The change has involved the installation of some new equipment, including transformers, and it is likely that further equipment will be required. Mr. M. A. Sammett, of Montreal, is the consulting engineer.

The Department of Commerce, Bureau of Standards, Washington, are distributing Circular No. 60, entitled "Electric Units and Standards." This publication gives comprehensive and up-to-date information regarding the units and standards in terms of which electric and magnetic measurements are made. It includes the history of the units and the evolution of the definitions upon which the laws on electrical standards are based. The laws of this and other countries are given. These laws are in substantial agreement, and the various national bureaus of standards co-operate in maintaining the fundamental standards. The circular gives conversion factors, by means of which measurements may be expressed in any desired unit. The information on electric units and standards had not previously been available in a single publication. This paper is now ready for distribution and those interested in the subject may obtain a copy free by addressing a request to this Bureau.

The Bureau has also issued pamphlet No. 292 on "International System of Electric and Magnetic Units.'

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Saving a Life

Electrical and medical authorities who have made a study of resuscitation methods following electric shock are practically unanimous in their decision that the work of resuscitation should be carried on without the slightest intermission for anywhere from an hour and a half to two hours, or until there is unmistakable sign of "rigor mortis." It is unexplainable then, why, following a recent accident in Toronto, and the removal of the victim to a hospital, no effort was made towards resuscitation and, six minutes after the accident occurred, the man was declared dead by the attendant physician.

In these days good men are surely scarce enough that we cannot afford to ignore the very slightest chance of saving a life. Quite aside from the humanitarian side of the question, too, it is unscientific, to say the least, and would seem to indicate that the medical profession are as yet working too much along the old grooves. We make this statement deliberately, for it is inconceivable that this particular man can plead any other excuse for the course he followed than ignorance. Assuredly he was not in touch with the work that has been done in recent years along the line of resuscitation after electric shock, or some effort would have been made to save this man's life, using such simple methods as are now well tried and approved by medical men and engineers who have made a special study of the subject.

We do not know what action the Medical Council will take in this matter, but presumably, and naturally, it will be along the lines of preventing a recurrence of such an unfortunate omission. We must not, of course, expect of the medical profession, any more than of any other body of human beings, that they should never make mistakes, but surely we have a right to expect of these trained men, to whom we entrust our lives, that every individual so entrusted should be schooled in all the latest methods of life-saving and should exercise every precaution and all reasonable patience and perseverance in applying them.

Heavy Power Demands in Quebec

The power situation in the province of Quebec, and particularly in the Montreal district, can be gauged from a statement made by Mr. J. E. Aldred, president of the Shawinigan Water and Power Company. The demands on that company and also on the other power companies are very urgent, and the Shawinigan have made arrangements to take an additional 15,000 horsepower from the Laurentide, thus anticipating by more than six months the contract which called for this amount of power on July 1st next. "Immediately," said Mr. Aldred, "we are taxed to the limit, and now things are still coming. It is the natural result of the bringing together of cheap power and other natural resources of the wide range covered in this province. I see no halt in development along these lines." The Shawinigan Company have recently spent about $1,500,000 on new enterprises connected with the electrical industry, and these will entail a very large demand for power next year. A new chemical plant and one for the manufacture of electrodes are among the enterprises, while the contracts made with the St. Maurice Paper Company for their new mills, the Weedon Mining Company, and the Donnacona Paper Company, will mean further demands. The industrial development at Shawinigan has necessitated the company building one hundred houses for the working people. Mr. Aldred stated that the result of the extension of the company to Quebec had been very satisfactory.

The large amount of power required by ammunition factories is an important factor in the increased requirements of power, but other industries are also larger buyers of current. In Sherbrooke, for example, the demand is very large, in fact it cannot for the moment be hardly met, while the Southern Canada Power Company have been obliged to obtain additional power from the Shawinigan Company.

Many New Plants in the West

In spite of the stringency of money due to the war and the not altogether too bountiful crop of this year, Alberta is slowly forging ahead and erecting electric light plants. If unforeseen events do not prevent the carrying out of the plans, Central Alberta will enjoy two new plants before the first of January, 1917. Wainwright on the second of this month voted ten to one in favor of granting a ten-year franchise to the Bert L. Perry, Ltd., of Edmonton, to construct and operate a light plant in the town. Construction has already started, and efforts will be made to have the electric light ready for the first of January, 1917. Judging by the results at the polls, the people of Wainwright are fully alive to the great convenience of having electric light in the town. It might be said that the town is progressive in every respect; with electricity it will make it one of the fine residential towns in Alberta.

At Hardisty the vote was taken in September, and carried with a large majority. The franchise was granted to the Hardisty Electric Light Company, of which Mr. T. A. Weeks is president and general manager. This company is already on the ground and making good headway, and will likely start service some time in December, of this year.

Electric Club of Toronto—December Programme

On account of the holiday season the Electric Club of Toronto will meet on only the first three Fridays of the month of December. On December 1, Mr. C. C. Bothwell will describe, by the aid of moving pictures, the manufacture, from A to Z, of tungsten lamps. The second meeting, Friday, December 8, will be addressed by Mr. C. N. Candee, Jr., on some phases of the work of experimental chemistry and its relation to the armies in Europe. The third, and last luncheon will be held on December 15. All information regarding the programme at this luncheon has been held up by the censor, but we have the secretary's assurance that it will be a fitting climax to a most successful year. The programme then stands as follows:

Syllabus of Half-Hour Talks

Before

THE ELECTRIC CLUB OF TORONTO

During the Month of December, 1916

FIRST FRIDAY—December 1.
MR. C. C. BOTHWELL, Laco Phillips Co.
SUBJECT—Moving Pictures of the Manufacture of Nitro Lamps, etc.

SECOND FRIDAY—December 8.
C. NEWTON CANDEE.
SUBJECT—Chemical Discoveries of Private Benefit in the War.

THIRD FRIDAY—December 15.
? ? ? ? ? ?

H. G. Nicholls, Chairman. Frank T. Groome, Secretary-Treasurer.

Montreal Electric Lunch Club

Mr. Alan Sullivan, secretary of the Canadian Electrical Association, was the speaker at the Montreal electrical luncheon on November 15. The address was mainly a consideration of the development of the industry and its effect, moral and physical, upon future generations. Mr. Sullivan quoted from conversations with and letters received from Professor Elihu Thomson, Mr. Frank Sprague, Mr. Ward Leonard, Mr. Thomas Edison, and Professor Alexander Graham Bell bearing on possible developments. The first named, he said, did not expect anything revolutionary except as to wireless telephony, the general tendency being in the direction of revising and perfecting, while Professor Bell was quoted as saying that the application of electrical energy was only in its infancy, and that they might look shortly for its application in a way which had not yet been dreamed of. Mr. Edison was of opinion that the future development would be of a chemical rather than a mechanical character. Mr. Sullivan then pictured the condition of the world a hundred years hence, when electricity was adapted to many uses not yet realized. It lies with those who carry the burden of the electrical industry to make a tremendous mark on the future, even greater than that made on the present day. If nothing but riches resulted from the industry then it had failed of its true purpose. Mr. Sullivan concluded by a reference to the enormous possibilities of electrical science in making the world brighter and happier for those who will succeed the present generation. The address was lightened by several humorous touches and stories.

Testing Transformer Oil

A recent issue of the Electrical News contained an enquiry from one of our subscribers as to the best method of determining when transformer oil contained moisture. In general, tests of this nature require fairly elaborate and expensive equipment, but the following suggestion, taken from the Electric Railway Journal, is passed along for what it is worth:

"While the only thorough test for suitability of oil for transformers and oil switches can be made with high-tension testing apparatus, very good indications of the presence of moisture have been obtained by J. K. Mackie, superintendent of the Connecticut Power Company, as follows: A sample of the oil to be tested is drawn from the bottom of the transformer, oil switch, or storage tank. (Samples from the upper parts of the tank are not considered as suitable for the test, as water is heavier than oil, and usually collects at the bottom.) In the sample thus taken is placed powdered anhydrous copper sulphate. If moisture is present the copper sulphate will be dissolved, producing a blue color that will diffuse through the oil if moisture is in suspension. Since enough copper sulphate is added to ensure a saturated solution, the intensity of the blue tint will be a measure of the amount of moisture present. As small percentages of moisture have a very deleterious effect on the dielectric strength of oil, however, the lightest shade of blue is sufficient indication that the oil should be dried by filtering. It may be pointed out that other substances giving a deeper tint than copper sulphate may be used, the only requirement being that they dissolve quickly in water but not in oil."

Memorandum on the Use of Block Type Storage Batteries in Substitution for Dry Batteries on Rural Telephones

By H. E. Brockwell*

Some recent experiments have been conducted for the purpose of ascertaining the efficiency of the block type storage battery when used in the magneto telephone. The general practice has been to use three dry-cell batteries in the transmitter circuit of the telephone, the life of these batteries averaging about one year. It is also customary to change them at least once a year.

The type of storage battery selected was the Fuller block type accumulator, single element, having a normal charging rate of three amperes. These batteries, when first made, were encased in celluloid, but it was found that the celluloid was affected by acid when spilled on the casing. Experiments were tried with rubber cases, and finally a lead case was decided upon, the battery being sealed with compound in the same manner as the dry battery, with the exception that a small vent hole is left for the gasses to escape.

A comparative test was made over a period of 55 consecutive days, the conditions being three cells of dry battery placed in series with induction coil and transmitter, thus continuously completing the normal circuit of a telephone instrument during the test period.

These tests showed that the storage battery would outlast five sets of three dry cells, each set of dry cells lasting practically ten days and having a voltage at the beginning of the test of 4.4 and ending at 1.6. The storage battery had a voltage at the beginning of the test of 2.3, and maintained its voltage until the thirty-eighth day above two volts, finally ending on the fifty-fifth day at 1.7 volts. The dry cells have an ampere hour capacity of approximately 20.6 and the storage battery of 70 ampere hours.

During this test transmission during the first day on the dry cells was superior to that of the storage battery, but on the third or fourth day the transmission with the storage cell was superior, and the storage cell maintained normal trans-

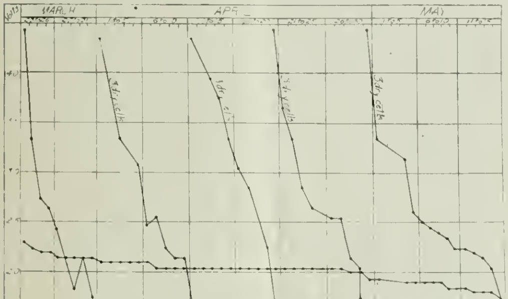
* Chief Engineer Manitoba Government Telephones before C.S.C.E.

mission throughout the period, whereas with the dry cells transmission would be nil on the tenth day.

The cost of the five sets of dry cells is approximately \$3.75, and the cost of the storage cell, substituted in place thereof, is approximately \$2.10. At the end of the period the storage battery is just as good as new, and can be electrically re-charged at a cost of about 12c.

From these tests it would seem that a storage cell of this type would last out on a telephone instrument an extreme life of three years without re-charging, under normal conditions, and at the same time be maintaining its voltage above two volts. During that period the transmission would be uniform, and thus materially improved.

The storage batteries used in this way have some peculiarities. It has been found necessary to take special measures



Tests on block type accumulators Ampere-hour capacity (average): Dry cells, 20.6; storage cells, 70.0.

to prevent creeping of the acids at the positive pole in the battery. To overcome this defect, a pocket of vaseline surrounds the positive pole, just below the terminal, and is enclosed in a small piece of fibre tubing.

It has been found that these batteries are practically foolproof, inasmuch as they may be short-circuited without harm to the blocks, and, even if the charge is reversed in them, no permanent defect results, as they can be restored to their normal condition by re-charging in the proper direction.

These batteries have been tried out in actual practice, and many of them have now been in use more than one year, under actual conditions of service, and are still maintaining their voltage above two volts.

This memo. may be found of interest to those using dry batteries on telephone lines associated with the transmission power lines.

Water Diversions for Power Development Purposes from St. Croix River, New Brunswick

In 1915, the Commission of Conservation had brought to its attention an unauthorized diversion of boundary waters on the St. Croix River, which forms part of the international boundary between New Brunswick and Maine.

Briefly stated, the facts are as follows: United States financial interests, controlling the St. Croix Paper Company of the State of Maine, and operating through two allied companies—St. Croix Water Power Company, chartered in 1899 by the Legislature of Maine, and the Sprague's Falls Manufacturing Company, Limited, chartered in 1902 by the Parliament of Canada—secured control of the two most valuable sites on the St. Croix River—one at Sprague Falls, the other at Grand Falls. The electric energy capable of development aggregates some 25,000 horsepower, and is to be used entirely on the United States side for the operation of pulp and paper mills located at Woodland, Me., where a thriving community, with a population of 1,500 to 2,000, has, as a result of this power development, already been built up.

At Sprague Falls, the capacity of the power plant is about 12,000 to 14,000 horsepower. Another plant, situated near Grand Falls, about ten miles above Woodland, has recently been completed, with an additional rating of 12,000 to 14,000 horsepower, which is transmitted to Woodland to increase the capacity of the Sprague Falls plant. The property of the St. Croix Paper Company, exclusive of its extensive timber holdings, represents an investment of over \$3,500,000, and the average net earnings are stated to be over \$300,000 per annum.

To develop this power at Grand Falls, the company constructed a large canal, lying and extending for nearly a mile, entirely within the State of Maine. By means of a dam erected across the international boundary at Grand Falls, an artificial lake has been created so as to enable the water of the St. Croix River to be diverted, by the canal, into the United States for the development of power at the Grand Falls power house. At its lower stages, the total flow of the St. Croix River—an international boundary stream—is diverted into the United States.

Commission of Conservation Takes Action

The Commission of Conservation being requested to report upon this diversion, the Assistant to Chairman, Mr. James White, appeared before the International Joint Commission and presented, on behalf of the Commission of Conservation, a memorandum objecting to the diversion; also requesting that the use of Canada's share of the waters of the St. Croix River be only permitted on such terms, including time limit, as would ensure that the Province of New Brunswick, or the Dominion of Canada, would receive reasonable compensation for the use of Canada's waters; and, further, that Canada's equity in the waters, per se, be inalienably preserved.

On November 9, 1915, the International Joint Commission granted the application, provided:

(a) That the applicant companies obtain from Canada and the United States, authority for the maintenance of the dam and the obstruction, diversion and use of the waters of the St. Croix.

(b) If the waters so diverted cease to be used for generating power for the St. Croix Company's pulp and paper mill, the order of approval shall thereupon cease to be operative unless the International Joint Commission continue it.

Other clauses forbid undue lowering or raising of the level of the water.

The time will come when Canada will require her share of all such water-powers. One element of danger which the Commission emphasized in connection with the diversion of waters like those of the St. Croix River into the United States, was that, while the International Boundary Waters Treaty contemplates the possibility of certain "temporary" diversions, yet, unless the terms and conditions of such temporary diversions are explicitly understood and specified, and means taken to render the diversion only a "temporary" one with respect to time, interested parties may, later, claim that the diversion has resulted in the establishment of vested interests, and should "now" be regarded as of a more or less permanent, rather than of a temporary character.

* From a paper by Mr. A. V. White, in the Seventh Report of the Commission of Conservation.

In the interests of better street lighting and power supply for Trail, B. C., representatives of the Consolidated Mining and Smelting Company, from whom power is now purchased, conferred with the city council recently. The Consolidated Company propose to spend \$30,000 on improvements to their plant if a suitable long-time contract can be arranged with the city.

Electric Light and Power Problems at Steam Railway Terminals and Division Points

By Mr. J. W. Hughes*

The writer has been requested to furnish a short description of problems of an electrical nature which present themselves to the electrical man in the ordinary course of events about railroad divisional points. It might be well before proceeding further to outline briefly just what constitutes a railroad divisional point in railroad organization, which will illustrate the vast difference between the manufacturing concern, which, however extensive, is concentrated in one location, and the railroad strung out over thousands of miles of main line, each terminal point dovetailing with the other to obtain what is recognized as the greatest detailed system and organization known. It is plainly seen that electrical appliances form no small part in steam railroading, and the continuous electrical improvements have found ready adaptation in the modern railroad terminal, and the result is but one of the many examples of time's progress.

Consider a railroad operating from the Atlantic to the Pacific. This road is divided into two major parts, called Eastern and Western Lines. One of these portions is again divided into four parts called districts, and each district again subdivided into from three to five parts called divisions. Each division has three to five principal points known as divisional points, and each presents problems of its own.

There is the central division point, located at a more or less important town or city, the isolated division point, and the steamship terminal. At each point there will be found a station, roundhouse, machine shop, power house, coaling plant, pumping plant, bunk house and stores.

Up to a few years ago the standard source of motive power was steam, which was used to operate electric generator of three-wire direct current type, air compressor, machine shop engine, boiler feed, pumps, etc.

The transmission of hydro power and general reduction in power rates during recent years has made it possible to replace much steam-driven apparatus with electric motor drive.

Converting Steam Plants to Electric

A big factor in minimizing failures in mechanical plants which directly affects traffic consists in the standardization of electrical apparatus. This will keep down the investment by obviating the carrying of spare apparatus at each point. The difficulty arising from operating on such a widespread area is the impossibility of obtaining power of the same characteristics from the different power companies. One town, for instance, finds it most suitable for its purpose to install a three phase, 60 cycle equipment, and another town in the same district will only furnish 25 cycle current. The importance of a delay, in a busy section, to a water service or coaling plant can readily be seen, and this is guarded against by carrying at a district point one or two motors where necessary, which can be loaded in the baggage car of a passenger train at short notice and installed in place of disabled motor. Of course, all precautions in the manner of proper fuse protection, fool-proof control apparatus, etc., are made, and regular inspection is made particularly at points where automatic starting and stopping is depended on, to insure upkeep of bearings, etc. Special difficulty was experienced in overcoming burnouts due to three phase motors with automatic operation attempting to start on single phase, but trouble of this nature has been practically overcome with the use of protective relays.

* Electrical Engineer C. P. Ry. Co., before Electric Club of Toronto.

In the conversion of a steam plant described above, from steam to electric, it must be borne in mind that boilers cannot be shut down during the entire year, due to heating in winter, but this is taken care of with low pressure steam, and except in large plants the watchman at night and handy man in day takes care of firing, permitting saving for entire year of salary of two men. In most cases the air compressor can be converted to electric drive, obviating the purchasing of a new machine, and compressor has usually sufficient margin of capacity to accomplish blowing up of locomotive engines which formerly was done with steam.

The expenditure necessary and resultant saving in operating cost obtained in conversion of an average plant of this type is as follows:

Apparatus involved: air compressor, machine shop engine, steam-driven water service pump.

Investment

Cost of converting air compressor to electric drive (cast iron pulley, belt tightener, etc.)	$225.00
One 50-h.p. induction motor to operate compressor	650.00
One 10-h.p. induction motor for machine shop, replacing steam engine	260.00
One 10-h.p. induction motor and triplex power pump for water service	875.00
Electric wiring for three motors	250.00
	$2,260.00
Contingencies	240.00
Total investment	$2,500.00

Operating Cost per Annum with Steam Power

Pumping Plant—		
Wages	$960.00	
Coal	575.00	
Oil	14.50	
Repairs	32.00	
		$1,581.50
Air compressor and machine shop engine—		
Coal	$3,010.00	
Oil	22.00	
Repairs	40.00	
		$3,072.00
		$4,653.50
Plus interest and depreciation		146.50
Total operating cost per annum		$4,800.00

Operating Cost per Annum with Electric Power

Engine and compressor indicated, and average electrical horsepower determined.

Estimating on basis of—

Pumping plant operating	8 hrs. per day, av. h.p.	7.0
Machine shop engine	10 hrs. per day, av. h.p.	6.0
Air compressor	12 hrs. per day, av. h.p.	35.0

Average kw. hours per day	402
Average kw. hours per year	120,600
Cost 120,600 kw. hours at 3 cents	$3,618.00
Oil, waste, etc.	20.00
Repairs	50.00
	$3,688.00
Interest and depreciation, 12 per cent. of $2,500	300.00
	$3,988.00

Saving per annum in favor of electrical operation $812, or 32.5 per cent. return on investment.

Apart from actual saving in operating cost considered above there is also the elimination of losses from leaks, condensation and radiation from steam lines.

Electricity in Railroad Shops

(1) The replacement of the steam engine drive in large machine shops with its belts and countershafting is something that has been dwelt on very often, and there are few of these drives now to be converted. I will mention a few of the main items to receive consideration in shop design, and will be glad to give further details in discussion.

The type of current is always the first factor to be determined, and as railway shops are bound to be spread over a large area, it is safe to say that a combination of alternating current for constant speed motors and direct current for variable speed motors is preferable. This would prove a valuable arrangement if a.c. steam generating plant with motor-generator for direct current were shut down later to give way to purchased power when same became available. The use of direct current cannot be denied the railroad shop, for overhead cranes, wheel lathes, boring mills, etc., where a satisfactory variation of speed over a wide range is necessary to obtain the maximum output and revenue on investment. The electrical man is too often neglected in the layout of shop motors, and in stipulating a motor well on the right side the resultant power-factor trouble is not reckoned with. This requires, later, considerable readjustment, although the situation in a plant such as I describe is often taken care of by driving the direct current generator with a synchronous motor.

(2) Replacement of pneumatic portable tools with electric type and air and gasoline turntable motors with electric type is being made in many cases. The class of work and manner of handling it determines the change, the electric tool having the advantage of greater efficiency and ease in handling, against the more rugged abuse-standing power of the pneumatic tool. In severe weather in this part of the country it is difficult to prevent freezing up of air lines, which is the principal cause of delays caused in moving power due to turntable being out of commission.

(3) Electric arc welding and cutting is proving a big item in railway repair work and in handling scrap. It has proved cheaper than its rival the oxy-acetylene and performs better work. It is more easily handled from panels fed from the same machine against the necessity of moving the portly acetylene equipments from job to job. In welding and building up broken and worn parts of locomotive engines and boilers its use is very general and, although the smaller repair shops and roundhouses have not been equipped on this railroad to date, this is gradually being done by some of the American railroads.

(4) General uses.—You will find electric power in use throughout the office buildings of the railroad—cancelled railway tickets are mutilated with electric cutter, electric time stamps, clock system, elevators, vacuum cleaners, grills and typewriters.

(5) Electric baggage and freight trucks.—Due to the scarcity of labor this type of truck is becoming more popular than ever. Their use has been extended to shops, stores, baggage handling and general freight handling at freight sheds and steamship terminals. Trucks for shop and warehouse use are equipped with the elevating platform and are great time savers where material from machines or bins can be piled directly to rack which is ready to be picked up by truck without extra handling.

For handling baggage at stations the straight frame truck is used and may be operated from either end. The carrying capacity is 4,000 lbs. and speed under load from 5 to 5½ m.p.h.; with empty truck speed of 6½ to 7 m.p.h. can be attained. Twenty-one A-6 Edison batteries are used, which are set in a metal battery box in three tiers on trays; charging receptacle is mounted on box and whole box can readily be removed for replacement with spare set of batteries. Length over body is 12 ft. 4¾ inches and width 3 ft. 9 ins.; turning radius of outside wheels is 12 feet; weight of truck with Edison battery, 2,800 lbs. Motor is series wound enclosed type; controller drum type with three forward and three reverse speeds; brake is released automatically when operator stands on portion of split platform controlling brake.

Freight trucks are used to advantage at freight sheds and steamship terminals, replacing hand propelled trucks. At one point 25 trucks are used unloading Great Lake steamers and placing contents in freight sheds. Considerable flour is handled in this way and one complete sling of flour is brought from deck to shed and thence to box car. The system of handling this flour would be considerably simpler if it were not that flour of different grades is mixed in shipment. The truck used for this purpose has similar carrying capacity and will develop same speed as truck already described. Drive is spur gear. The length over body is 6 ft. 11⅝ ins. and width 44 ins. The turning radius is 7 ft. and truck is very handy for carrying load to interior of box car. These trucks are operated from one end only.

The saving of electric over hand truck figures from 40 per cent. to 60 per cent. The extent of success with electric trucks we have found to vary widely with the quality of labor employed in operating and maintaining them, the length of regular run with load, condition of floor and class of material handled. They are generally much imposed upon by being asked to climb heavy grades, run over tracks and frozen streets, between sheds. Headwork on the part of the foreman, regarding charging hours, and boosting battery during meal hours, will materially increase output with trucks.

First Cost	Electric	Hand
Truck	$1,550.00	$50.00
Battery	540.00	
Tires	110.00	
1/10 cost switchboard	100.00	
	$2,300.00	$50.00
Fixed Charges		
Interest, insurance, taxes, 8 per cent.	164.00	8.00
Depreciation:		
Trucks 10 per cent.	155.00	10.00
Batteries 30 per cent.	16.20	
Tires 40 per cent.	44.00	
Switchboard 5 per cent.	5.00	
Inspection, repairs, etc.		
1/20 one man's time at $75 per month	45.00	
Material	60.00	20.00
Operation:		
Labor $2 per day	730.00	2,920.00
Power 5 kw.h. for 365 days at 2c	37.00	
	1,256.00	2,958.00
		1,256.00
Saving by electric		$1,702.00

Lighting Problems

No less than motor problems are the lighting problems. The question is first cost of wiring installation against its life. Most study has probably been made of roundhouse wiring. There is a peculiarity about roundhouse wiring, brought about by the presence of sulphuric acid resulting from the combination of gases and condensation. Conditions in the old days were aggravated by inferior type of roundhouse and smoke jack. It was evident immediately that open wiring with conduit or on porcelain knobs was very unsatisfactory, a few months being sufficient to corrode the conduit and render the insulation of ordinary rubber covered wire useless. In the case of knob or cleat work, the iron or brass screws which were resorted to soon allowed wires to drop. Wire with slow burning insulation was resorted to without success. The first really successful roundhouse wiring was accomplished by strapping iron saddles to concrete roof supports and fitting standard cross-arms into saddles, held with bolts and nuts. The cross-arms were bored to take double the number of top-pins used with pole work and porcelain insulators were used instead of the standard glass type which would not stand the temperature variation brought about by opening house doors in severe weather. The cross-arm down each stall was made on two wire galvanized iron brackets with porcelain insulators. The reflectors, of which there were two per stall with three 60-watt lamps each and enclosing globe, were suspended from the ceiling. It was necessary to make use of a certain amount of conduit for runs from distributing panel, (one of which was installed for every six stalls) and from ceiling on two posts per stall, to a point five feet from ground for receptacle for portable extensions. This conduit, as well as panel boards and other metal parts and joints in wiring, was given a coat of heavy insulating compound. Wire used was of "Higrade" or "Kerite" type. With this type of wiring a life of from five to seven years is obtained and the cost per stall for a standard 25-stall roundhouse would average to-day \$77 per stall, or a total of \$1,925 for the entire house, distributed as follows:—Wiremen's material 62 per cent., labor 19 per cent., living expenses 11 per cent., supervision 2 per cent., overhead charges 6 per cent.

Passenger Yard Lighting

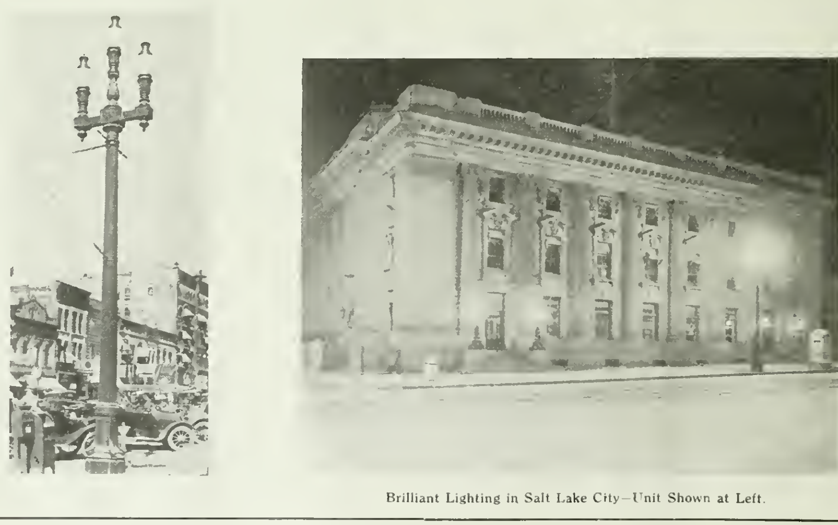
These yards are equipped with wood platforms, the placing of poles on which would interfere with trucking, etc., and the most satisfactory method of lighting platforms was found to be by supporting reflector and 400-watt nitrogen lamp on messenger wire between poles placed between tracks. This messenger wire is made sufficiently strong to support weight of man with ladder when renewing lamps or cleaning reflectors. However, to avoid difficulty of mounting ladder on iced platform and in view of "safety first," lighting units are mounted on carriage with pulley and counterweight at pole, by which lamps can be hauled close to pole, which are spiked, and furnished with pole seats. Lamps are staggered over platforms and spaced 150 to 200 feet apart.

Advance in Street Illumination

The accompanying illustrations indicate a considerable advance in street illumination, which has been developed in the western United States. These particular photographs represent a street in Salt Lake City. There are seven standards to the block on each side of the street, approximately one hundred feet apart. Each standard carries three 6.6 ampere, inverted type General Electric luminous arc lamps. The standard fits over the regular trolley pole and completely conceals it. It has an ornamental cast-iron base and a pressed-steel column in two sections with the three-armed cast-iron fixture carrying the lamp mounted on top, the lamps being 29 feet above the sidewalk level. The lamps are equipped with special diffusing glassware. Each lamp is rated at 1,500 candle-power and the absorption in the glassware is approximately 30 per cent. The lamps are connected on two circuits, one circuit supplying 190 lamps, which operates until midnight, the remaining 20 lamps burning all night.

The total cost of installation of the system was \$28,220. The cost to the property owners was \$25,535, and the city bore the balance of the expense. The installation charge against the property owners amounted to \$4.12 per front foot. The total cost of operation for the three-year period of the contract is \$28,138, of which amount the city pays approximately \$4,000. The cost of operation to the property owners is approximately \$1.30 per front foot per year. The Utah Power & Light Company spent approximately \$12,000 for rectifiers and other station equipment necessary to supply the installation. About 36,000 feet of steel-armored cable was used for the complete equipment of the new system.

The city issued to the Utah Power & Light Company in payment for the cost of installation and for the cost of operation for the period of three years, over which the contract runs, lighting improvement district bonds, which bonds are secured by a mortgage that is a first lien on the property included within the lighting improvement district. The company had no difficulty in disposing of these bonds at par. The property owners have the option to pay the cost of installation and operation in full or to pay it in three annual installments.



Brilliant Lighting in Salt Lake City—Unit Shown at Left.

Construction of High Tension Transmission Lines and Steel Towers

By Mr. Lesslie R. Thomson*

The truest economy in transmission line design may only be attained by a close co-operation between the electrical and structural engineers after a careful weighing of all the various conditions that affect the whole project. The following few notes are prepared from the point of view of the structural engineer who may be called into consultation when a transmission line is under consideration:

General Characteristics.

When electrical power is to be developed and then carried over any considerable distance, the necessary transmission line becomes one of the most important items in the estimated cost of the whole installation. It will be admitted that the aim should be not to so design the line that the original investment is a minimum, but rather to so lay out the whole scheme that, consistent with satisfactory operation, the annual outlay is reduced to the smallest possible dimensions. Before going further it would be well to note at this point that the term "satisfactory operation" is a very difficult one to either define or equate to a definite financial basis, but an attempt will be made, however, to reduce it to tangible terms.

Annual Cost.

The annual cost of a line may be assumed to divide itself roughly under the following heads:

I. Interest on the original capital investment.

II. Depreciation.

III. Operating costs, e.g., engineering services, repairs, patrolling and (a) any premiums on accident or interruption, liability insurance, or (b) the annual equivalent of any monetary damages due to interruptions to service (unless covered by policies under III.-a).

I., II., and III. are not isolated or independent channels of expenditure, but are related one to the other, and will, consequently, overlap to a certain extent. It is desirable to touch briefly on this interdependence. In the past it was often considered that if the capital investment was reduced to a minimum the line would then be the most economical one possible. This is now felt to be only partly true, for a cheaply-constructed line, with frequent interruptions and accidents, with perhaps heavy damages, may prove in the long run to be far more costly than a well-designed line involving a larger capital outlay. The problem thus resolves itself into preparing a design on which the sum of I., II., and III. is a minimum.

I. Capital Charges.

It will be readily seen that items I. and II. will contribute a fairly important part of the total annual cost, and, consequently, any attempt to reduce the capital investment will result in the reduction of both the interest and depreciation charges. The following list comprises the various heads under which the capital expenditure is distributed: (a) Wires and splices; (b) towers or poles; (c) insulators; (d) guy wires; (e) right of way complete, or (f) land for towers, with right of passage for overhead wires; (g) foundations; (h) erection, including the delivery of the towers; (j) engineering services.

The cost of all the foregoing will vary, of course, with every change in the layout of the line. The minimum clearance of wires from the earth, all the electrical characteristics, such as voltage, number of circuits, number of phases, power per circuit, sizes and types of insulators, etc., and the average span length, will all affect the total capital cost. But for purposes of discussion, from the point of view of this paper, it may be assumed that all electrical features have been fixed, together with the minimum clearance of wires from ground. This leaves span length as a remaining variable whose changes will affect the capital cost.

The effect of span length on capital cost is a little difficult to predict with any certainty, but various characteristics undoubtedly influence it, and these characteristics will be examined. Reverting now to the list of headings under which capital expenditure may be distributed, it will be noticed that the cost of certain of them will be practically unaffected by any change in span length. These items are (a), (d), and (j). The cost of wires and splices may be assumed to be independent of span length, for most transmission cables are strong enough in any event to carry their loads over comparatively long spans, while the increase in cable length—due to larger sags—may be neglected. Similarly the cost of guy wires (d) and of engineering services may be regarded as being independent of span length.

The items now remaining are those whose costs vary with the changes in the span length. If short spans are to be used there will be a large number of light towers, or perhaps poles, with consequently heavy costs for insulators and possibly for erection. On the other hand, the right of way will be less expensive than were longer spans desired. This will be easily appreciated when one considers the fact that long spans necessitate increased distances centre to centre of conductors at cross-arms, and also large sags in the cables, which, in heavy winds, must have wide arcs of swing. These facts naturally require for the line wider limits, and, consequently, a more expensive right of way, in order that the cables shall at all times and under all circumstances remain within the limits of the property or passage right acquired. As the spans increase in length the towers become, of course, heavier, but there are naturally fewer of them to the mile, and it must be borne in mind that the cost of insulators varies directly with the number of towers. Pole lines usually have spans of 150 feet to 300 feet long, while tower lines have spans of from 300 feet to 2,500 feet, depending on the judgment of the engineer. In flat country a succession of equal spans with as few horizontal angles as possible will give the most economical arrangement. In mountainous country the high points along the line should be selected for the tower sites, and very little effort should be made to keep all spans of equal length. For sake of repairs, shipping, storage of spare parts, etc., all towers should be made alike unless some exceptional circumstances should demand a few special towers. By selecting high points for the towers in rough country a considerable saving may often be effected, owing to the fact that the conductors will, in general, be above the trees, and consequently the necessity for a large amount of expensive clearing on the right of way is obviated. Also tower sites in mountainous country should not be placed in the path of possible snow or land-slides, while towers placed near rivers that are liable to overflow their banks should be protected by cribs or piling. The cost of foundations will naturally increase as the number of towers increases, and will, in general, be cheapest per mile when long spans are selected. The cost of erection will, within certain limits, vary directly as the number of towers. The question of lightning also enters into the discussion to a small extent. It has been found to be particularly true that lightning most frequently discharges through one of the pin insulators to the tower rather than travels along the line to a

* Before Canadian Society of Civil Engineers, Montreal, Nov. 16th, 1916

lightning arrester provided for the purpose. Consequently the fewer towers and insulators, with, however, the same number of lightning arresters per mile, the less likelihood of damage by lightning.

Structural steel poles are the more economical for short spans, and, without further comment, will be assumed to be used. The advantages of short spans with poles are as follows: Short cross-arms and small bases permit narrow rights of way; frequent supports for conductors, by reducing sags and hence swings, enable lines to have a narrow right of way; steel in poles is likely to be economically used; and riveting on poles is done in the shop, which is superior to the field-bolting necessary for towers. The disadvantages are higher costs for steel supports and insulators per mile. It will have been recognized by this time that great emphasis has been laid upon the cost of right of way and the saving that may be effected by reducing its width. The importance of this can hardly be overestimated, especially in regions where land is expensive. It will generally be found that in modern transmission lines entering cities or towns the saving in cost of right of way more than compensates for any increased cost of insulators or poles.

II. Depreciation.

The depreciation in the towers depends on the type of protection afforded, severity of climate, presence of chemicals in either the air or ground, and on the amount of original "stability" provided. By the term "stability" is meant that excess thickness demanded by the structural engineer for sake of rigidity. For example, it may be often found that when a $2\frac{1}{2} \times 2\frac{1}{2} \times \frac{1}{8}$ angle might perhaps figure, the engineer will insist on $2\frac{1}{2} \times 2\frac{1}{2} \times \frac{1}{4}$, because of his distrust of thin legs, or because of specification requirements on minimum thickness.

The protection usually given to towers and foundations is either galvanizing or paint. If it be desired to paint over the galvanizing, though this is usually regarded as quite unnecessary, a special paint must be secured.

III. Operating Costs.

Operating costs are capable of being fairly closely estimated before the line is built, but the discussion of them lies outside the scope of this paper. It will be remembered, however, that they must be estimated when "satisfactory operation" is being furnished. As mentioned above, this is difficult to define, but some idea may, however, be formed of its financial equivalent. Most engineers agree that a large amount of power is entitled to more insurance than a small amount, whether this insurance be paid directly in the form of premiums or whether it be paid in the form of increased interest charges on a larger capital investment. Again, certain services, from the very nature of the case, must be continuous. For example, a city engineer whose low tension bus bars supply power for lighting, street railway, and general office service, would probably consider one shut-down a year of even ten minutes' duration as very unsatisfactory, for there would be investigations without number enquiring why citizens were stalled in the streets, caught in elevators between floors, etc., etc. On the other hand, power delivered to electric pumping stations in a small locality would be satisfactory if they had power for 75 per cent. of the day.

Having reduced the question of "satisfactory operation" for different types of service to a definite basis, the engineer should use his own judgment as to the amount of insurance the service needs, and thus the financial equivalents for various types of service may be approximated. It is interesting to note in this connection that many engineers feel that it is impossible to provide absolutely continuous service over one circuit. If two circuits are provided, they may be either on the same tower or on separate towers, with the same or independent rights of way. It is on questions of these kinds that the judgment of the engineer must be exercised to obtain the most economical solution.

Loads.

The loads on a transmission line tower are of three classes, each system at right angles to the other two. They may be described as the (a) dead, (b) transverse, (c) longitudinal and will be discussed in order:

(a) The total dead load is obtained by taking the sum of (1) tower itself; (2) weight of all wires supported by the structure; (3) the weight of the snow or ice coating. It is on this point that climate enters into the question. In the south ½ inch of ice coating is sufficient, but in northern countries like Canada more allowance must be made. The Montreal Light, Heat, and Power Company assumes ¾ in. on each side, making the diameter of the cable 1½ in., plus its own thickness. (From information supplied to the writer by Mr. R. M. Wilson, chief electrical engineer of the M. L., H., and P. Co.)

(b) The transverse loads arise from the action of the wind on the towers and cables. It is usual to neglect the wind pressures on cross-arms and insulators. The most frequently assumed wind pressures in England and the United States are 56 pounds and 30 pounds per square feet of exposed normal surface. A cylindrical surface is usually considered to present 0.6 of its projected area as an effective normal surface. In America it is readily recognized that wind pressures up to 50 pounds per square foot are quite possible, but only over small areas. For any considerable surface 30 pounds is felt to be a liberal estimate. It is a matter of observation that wind pressures decrease as one approaches the ground. For the foregoing reasons it seems adequate to take the following pressures, and they are recommended: (1) On structure itself (on two series of faces), 30 pounds per square foot; (2) on bare wires, 15 pounds per square foot; (3) on projected area of ice-covered wires up to ½ in. of ice, 10 pounds per square foot; (4) on projected area of ice-covered wires with more than ½ in. ice, 8 pounds per square foot.

The only question about which any doubt may be raised in the foregoing is the allowance of heavy wind on coated cables. Many engineers feel that these never occur simultaneously, and some are dubious as to whether sleet ever forms in a conductor carrying an appreciable amount of electrical power. But the majority will admit that ice and wind do occur together, and hence the necessity of providing for it.

(c) The longitudinal loads are obtained by assuming one or more conductors to break, and thus place on the cross-arms an unbalanced load—tending to produce torsional effects in the towers. Certain specifications insist that provision shall be made for all wires on one side of the longitudinal centre line of tower, breaking together with the ground wire, while others only require one conductor and ground wire per circuit.

Angles.

When turning longitudinal angles the usual practice is to put in standard line towers unless this angle exceeds 10 degrees. In the latter event either a standard tower with wire guys or a special tower designed to carry the actual loads is placed in position, bisecting the angle of the line. The use of a special tower is the better practice, as the transverse guys introduce more or less indeterminate stresses.

Tests.

During the last decade or so purchasers have been insisting on actual mechanical tests of a certain number of towers before acceptance for delivery of any of them. The test loads usually specified for each type of loading are double the actual values (calculated). It is customary for the specifications in use to read "the tower shall not fail," and this is usually interpreted to mean that no member or part shall fail by buckling or parting. In a well-known international transmission line the tests were of two sorts (a) and (b). For tests (a) the towers were set on rigid foundations, in the manufacturer's plant, and all calculated loads were doubled and applied. In tests (b) the towers were set up on special field foundations and 90 per cent. of loads used in tests (a) were applied.

This specification is indicative of a growing conviction among engineers that the effect on the towers themselves of non-rigid foundations may no longer be neglected. It is evident that if the foundations of a four-legged tower are somewhat elastic with irregular settlement there will be an entirely new stress distribution within the structure. This point will be touched upon more fully under the head of "Foundations."

It is well to realize that these test factors bear a close relation to the unit stresses specified; and they will be discussed later under unit stresses.

Unit Stresses.

Working stresses for the towers of a transmission line are to be used with loads that may actually occur at not infrequent intervals, there being no impact whatever. On the other hand, their maximum values are capable of being actually determined. Hence it is a little difficult to relate them intelligently to bridge stresses. Certain engineers feel that conservative unit stresses for towers are somewhat in the nature of an insurance or guarantee, and that for lines not so important as trunk lines higher stresses may justifiably be used. In this connection R. Fleming divides proposed towers into three classes—A, B, and C—and allots unit stresses for each class, depending on their importance, thus:

Class A.—Towers for a line whose purchaser insists upon uninterrupted service, with heavy penalty clauses. Cases where failure of tower would mean probable loss of life, as in thickly populated regions.

Class B.—Towers for a line where certain interruptions are not inadmissible. Towers for a line through sparsely settled country.

Class C.—Towers that must be put up as cheaply as possible, independent of all other considerations.

He then gives the following unit stresses for open hearth structural steel: Class A, 22,500 pounds per square inch; class B, 27,000 pounds per square inch; class C, no definite figure given, but the inference is that certain engineers assume that wind and ice-covered cables are not considered as occurring simultaneously, and the resulting loads are figured at 30,000 pounds per square inch. He condemns this high figure as being too near the elastic limit, and does not commit himself as to the assumption. Before this question of the unit stresses to be used can be finally settled their relation to the test safety factor must be discussed briefly.

It was noted in the preceding paragraph that many purchasers insist on test loads of double the actual calculated load. If, for example, the tower under test belonged to class B of Mr. Fleming's list, and the material were closely designed, the resulting stress in certain of the members would be 54,000 pounds per square inch. This is much beyond the elastic limit, and the tower would probably fail. If, however, instead of an arbitrary test factor of 2, the purchaser would insist upon a test safety factor having for its magnitude the ratio between extreme elastic limit and unit stress desired (which should be conservative), and would at the same time stipulate that the maximum combination of loads must be used, the resulting towers would be in no danger of being weak or badly detailed, and rigid tests to elastic limit would be not only possible, but would be welcomed by the manufacturer.

Conductors and Wires.

(a) Conductors.—These are, in general, of three different kinds—(1) copper, (2) aluminum, (3) steel reinforced aluminum. The latter two are the ones frequently used in transmission lines to-day owing to the high price of copper. A cable often used by the Montreal Light, Heat, and Power Company for high tension service consists of a steel stranded core of 78,500 c.m. and a stranded aluminum sheath of 336,420 c.m., with a total diameter of about 0.74. As mentioned above, this paper does not intend to do more than touch upon these purely electrical features that may need, however, to be mentioned in passing.

(b) Ground Wires.—These wires may be of either stranded or solid steel, and are about ½ in. in diameter. Those engineers who place reliance in the capacity of these ground cables to save the lines from lightning usually assume that they protect all conductors underneath and within 45 degree lines.

(c) Stresses and Sags.—The stresses and sags in any of these conductors may be found from the well-known equations which are presented in very clear form in an article entitled "Mechanical Stresses in Transmission Lines," by A. Guell, Bulletin No. 54, the University of Illinois, Eng. Exp. Station.

(d) Swings.—As the swing of wires between supports often affects the width of right of way, the following vertical swing angles will be of service in allowing for this characteristic: Copper conductors, 45 degrees; steel aluminum, 50 degrees; aluminum, 55 degrees.

(e) Insulators.—Insulators are of two main types—the pin and the suspended. The former are used almost universally up to voltages of 60 or 70 kilowatts, while for higher voltages the suspended insulators are preferred, the number of units being dependent on the amount of the voltages. Pin insulators for h.t. service are always of the petticoat type, and are manufactured in a great variety of designs. The modern practice is to use wrought iron or steel pins, and care should be taken that the insulators are strong against electrostatic puncture to the pin. The ratio of the resistances to puncture and to flash over should be about 1.6.

If possible, pin insulators should be used on account of their many superior characteristics, chief among which should be mentioned their rigidity. The advantage of a rigid support for the conductor is manifest should there be any tendency of the wire to "whip" under the following conditions: Suppose, for example, there is a heavy coating of sleet on a conductor with a warm sun and wind. The sleet will, in general, be melted off in large blocks rather than gradually. These long blocks of heavy ice, suddenly released, impart to the wire a whipping effect in a vertical plane, which is transmitted along the wire by a wave-like motion. If the point of support is rigid the whipping is arrested, but if not it may jump high enough to touch part of the tower or even meet another conductor. For this reason conductors on suspended insulators are seldom, if ever, in modern design, placed vertically over one another. Often each conductor is suspended by two strings of insulators, each set at a good angle to the other in order to secure greater rigidity.

Suspended insulators are of two or three main types, each unit being a duplicate of every other one. The bell or petticoat units are familiar to all.

With whatever type of insulator a h.t. line be equipped, it is to be borne in mind that the first two or three years will be in the nature of test years, for electric storms will in that time be pretty sure to have discovered the weak insulators, and, irrespective of any lightning protection, a marked improvement in the annual insulator cost should be apparent by the end of the third year.

(f) Ties.—The design of the tie is always dependent on its required function. Certain ties are designed to be rigid, and to hold the wire not only from vertical displacement but from longitudinal movement as well. Such ties would be placed on any dead end or anchor tower. Sometimes it is desired that in the event of a cable breaking the entire longitudinal pull shall not be given to only one tower, but rather distributed over two or more. In this latter event the tie is designed to allow a certain amount of slip. In certain instances it or the pin is designed to break absolutely should the load become more than nominal (e.g., ties to a so-called "flexible" tower). Whatever type of tie to pin insulators be adopted, there are two points that should not be overlooked—

first, protection must be given the conductor against arcing from it to the grounded pin; second, protection must be given the cable against confined arc occasioned by a puncture of the insulator. The first is usually afforded by a large amount of serving in the cable by the tie wire and the second is accomplished by extra parcelling around the cable with either soft copper or aluminum plate.

Poles.

The two following sections touch respectively on the design of poles and towers. The distinction between these may be clearly drawn in a few words: A pole is a steel or iron structure whose ratio of base width at ground level to height is small. This ratio is usually in the neighborhood of 1.10 or smaller. A secondary distinction may be drawn from the base support, which is nearly always monolithic, and consequently acts as a unit in supporting the load.

By a tower is meant a light fabricated steel structure, in which the distance at ground level between main upright supports in any one direction is large compared with the height of the structure. A usual value for this ratio is ¼.

The design of steel transmission poles has crystallized into a three or four-latticed angle type, with a triangular or square base respectively, back to back angles about 1/12 of the height to the first of the conductors. These are set on pin insulators vertically over one another at about 6 feet centres for 66 kilovolts, and a ground wire is located at the same distance above the uppermost conductor. Frequently the sides of the pole are slightly tapered toward the top, where the distance back to back of angles is about 1/24 the height from ground to first conductor. Horizontal bracing is usually placed in these poles at about 1/3 points to aid in resisting torsional loading. The pole is set into a concrete foundation for about 6 or 7 feet, while the enclosed space between the main leg angles above the foundation is frequently filled with concrete for a height of about 5 or 6 feet. By selecting comparatively short spans the sag may be reduced to very small quantities and hence the height from ground to first conductor may be kept down.

Towers.

(a) General Hints on Design.—Designs for towers have not absolutely crystallized as yet, but for rigid towers two main types are emerging from the mass of all sorts of odd designs that have from time to time appeared. For the want of better terms they may be described as the braced A frame and the windmill type. The latter are the more frequent, especially for the longer spans which necessitate higher towers.

In designing a tower the spans should first be approximately determined and the classification of the tower selected on the type of service required. The various loads are then figured—dead, ice, wind, and breaking. The grouping of the wires is usually determined from electrical considerations, and, with a knowledge of maximum sag for a span, the heights of each wire may be determined from ground elevation. The outline of the tower and cross-arms may be then sketched in as a trial. Every effort should be made to have the stress lines as direct as possible. It will be noted that any load, in any direction whatever, imparted to the tower at the insulator supports is conveyed to the ground in tension and compression by the four main legs, and in tension by some of the main diagonals. The great directness of the straight line stress route is very desirable. It obviates the customary crossing back and forward by alternate diagonals and struts, which inevitably tends toward loose joints in a light, bolted structure like a transmission tower. Another result is to reduce the detail weight in connections, etc., because main stresses are not being carried into the strut bracing.

In addition to usual vertical bracing designed to withstand longitudinal or transverse displacement of the top or to stiffen the main legs, when subject to such stresses, bracing in a horizontal plane should be put in to resist warping from torsional loading.

"Flexible" towers, first suggested by the Italian engineer, Smenza, are constructed to be rigid in a direction transverse to the line, and, of course, against vertical loads. These, then, become very effective supports for the line against the vertical dead load of conductors, ice, snow, etc., and also against wind. But by their design they are quite flexible in a longitudinal direction. A distinct saving is thus effected in the weight of these towers by the absence of any longitudinal bracing. As mentioned elsewhere, the tie fastening the conductors to these flexible towers is usually designed to give way under even a comparatively small longitudinal pull, and this obviates the chance of complete destruction of the tower by broken cables. In designing a transmission line with flexible towers the engineer uses one or more of them consecutively—the number depending on span length selected, configuration of the ground, etc., and then one dead-end tower, where all conductors are firmly anchored.

One of the best-known examples of flexible towers in Canada is to be found in the municipal transmission line between Winnipeg and Point du Bois, Man. In this case the engineers—Smith, Kerry, and Chace—have placed rigid and flexible towers alternately at about 600 feet cts. The tie to each insulator on these towers is only good for 80 to 100 pounds before it fails.

It is generally admitted, however, that flexible towers are not quite so reliable as the braced, and it is just a question as to how far their increased economy offsets their decreased reliability.

(b) Cross-arms.—The cross-arms for pin insulators must be very carefully designed owing to the heavy torsional stresses developed in them by the height of the insulator pins. Cross-arms for suspended insulators, on the other hand, have these loads applied almost directly on the arm. Cross-arms should always be designed for about 1,200 pounds suspended at each extremity, for one or two repair men at any time may have to be at the very end of the arm.

(c) Ladders.—A step bolt ladder should always be provided ascending one leg of the tower. It is frequently required that, after passing the first cross-arm, ladders shall be provided on two legs to the top in order to allow use of either corner as a route from lowest cross-arm to top of tower.

(d) Foundations.—The foundations of the towers are, in the main, of two kinds: (1) Steel, with anchor or bearing piece; and (2) concrete. The simplest steel foundation is the single stub angle, in which each leg of the tower is supported by a small angle let into the ground.

(1) The stubs consist of comparatively short pieces of angle, with holes punched in each leg at the tops. These holes match the holes punched in the bottom of the main tower legs. On the other end of the stub angles there are riveted or bolted bearing devices of one kind or another. These usually consist of a piece of 8 in. or 10 in. about 2 ft. or 2 ft. 6 in. long, two angles about the same length or old pieces of I-beams, etc. In practice these foundations are set as follows: Four holes are dug at the proper centres and to the desired depth. Each stub angle, with its bearing piece, is set into the proper hole, care being taken that it rests on undisturbed earth. The foundations are then bolted to a large, full-size template built to duplicate a standard tower. When bolted up in this way the earth and gravel are then backfilled and tamped into position. This style of foundation is fairly satisfactory, except on hard rock, where some type of fox or wedge bolts should be grouted in with either cement or sulphur. The tops should be forged to fit the tower legs, which are then bolted directly to them. Stub angle foundations are not suitable for marsh or swampy lands. Steel foundations may also be of the steel tripod stub type, where each leg of the tower is supported by a complete tripod, to apex of

which is fastened the main angle. The base of the tripod is made up of some simple bearing device in plates, angles, or channels. The uplift capacity of the tripod type is about 50 per cent. greater than that of the single stub.

(2) Concrete foundations are becoming more used in recent years for the large towers supporting long spans. Their supremacy and solidity also recommend them highly for the foundations of special dead-end and angle towers. These foundations are of several types—mushroom without forms, mushroom with steel or wooden forms, truncated pyramid type to forms.

The mushroom type is usually constructed by digging postholes about 16 in. in diameter and about 6 ft. deep. The bottom section is then undercut for a depth of about two feet and to a diameter of about 5 ft., leaving in the upper part a parallel-sided posthole for about 4 ft. Sometimes the spread of the bottom portion is made by dynamite instead of digging. In either case the stub angle or other type of steel foundation is set to template and the concrete is poured. Forms are often hard to set and hold in place owing to their tendency to lift when concrete is being placed. Concrete foundations of type (b) are difficult and somewhat expensive because of the difficulty in setting the forms. This type is satisfactory in service, however, for swampy locations, owing to the large spread that may be given to the base. The anchor bolts are usually set to template before the concrete is poured. The tower legs for these foundations have, of course, small angle shoes to rest on the concrete, and the anchor bolts pass through them. With all concrete foundations care must be taken to effectively ground the tower electrically by some standard device.

The whole question of tower foundations is one that bears a very important relation to the strength of four-legged towers, and it is highly probable that in the past many structures have failed owing to some small uplift of one foundation rather than to any inherent weakness in the structure itself. Every care should, therefore, be taken to ensure rigidity against either upilft or sinking of any one of the foundations. Spread footings in concrete, either of the mushroom type or of the truncated pyramid type, would seem to be the foundation of the future, and the writer would recommend them for class A towers.

The method by which the main horizontal shear is transferred from tower to ground is one that has only recently been investigated. The usual way in the past has been to connect the lower diagonal to the main leg about six inches or one foot above the connection to the foundation. With this device all shear must be taken up by stub angles in both direct shear and bending. This introduces, of course, into the main legs entirely new stresses, with their consequent danger.

Erection.

The field splices should be designed to afford easy shipment for the tower sections. Very often erections must take place in localities remote from the railway, and sometimes there is not even a wagon road to the tower sites. Consequently the pieces have to be transported by pack horse or mule. Under circumstances any thought given to the layout of field splices and weight of shipping bundles is amply justified. Bundles of main material should not weigh more than 200 to 250 pounds. All bolts, nuts, and washers should be boxed by themselves and carefully marked. In the field all pieces are assembled and bolted together on the ground and the tower raised as a unit by some simple tackle, e.g., a gin pole.

Preservatives.

As mentioned under "Depreciation," two main methods of preserving towers are (1) galvanizing, (2) painting. The cost of the former is quite high, and, though it is assumed nominally that no upkeep is required, the danger from unforseen deterioration is very real. If, however, the towers are to be subject to rigid inspection from time to time and provision is made in foundations for either permanency or ability to frequently renew them, there is no reasonable doubt that a heavily galvanized skin is a substantial and almost permanent preservative. The galvanizing should be done on all material except bolts, nuts, etc., after all shop work is completed. All bolts and nuts should be sherardized after the threads are cut. Paint is very much cheaper than galvanizing, but has the objection that it must be frequently renewed. But this can, of course, be done in the field, while galvanizing is always a shop process.

The writer would recommend the adoption of paint as the better preservative for all transmission poles and towers, with the possible exception of those located in regions of difficult access, such as mountainous country.

Hughes Electric Moves to Larger Quarters

The Hughes Electric Heating Company, manufacturers of electric ranges and ovens, have moved from 591 Yonge Street to 364 Richmond Street West, Toronto. In their new building they will occupy over 10,000 square feet of floor space, which is about three times the space of their former premises. A tremendous increase in sales during the past year has made it necessary for this company to take up larger quarters and to install more modern machinery and increase

New home of Hughes Electric.

their facilities, in anticipation of a larger business during the coming year, to which end they have made adequate preparation for the continued scarcity of materials and labor. The Hughes Electric Heating Company contemplate putting on the Canadian market many new electrical specialties; they have also made many improvements on their electric ranges. The accompanying illustration shows their new place of business.

The Slocan Star mines at Sandon, B.C., have installed one 250 kw. 3-phase 60-cycle 2,200-volt 360 r.p.m. Westinghouse generator, direct connected to Pelton-Doble tangential water wheel, with Pelton governor. Standard switchboard panel, belted exciter, 75 h.p. motor and transformers have also been supplied by the Canadian Westinghouse Company, Ltd., Vancouver.

The Dealer and Contractor

Standard Electrical Specifications—Prepared for a California Contractors' Association but Applicable, with Minor Changes, to Canadian Requirements

By H. Conger Bowers

The work to be done consists in providing all materials, appliances, equipments, tools, labor, etc., unless otherwise stipulated, and the installation of certain electrical systems for power, heating, lighting, telephones, and bells in the owner's premises, comprising three buildings, connecting pergolas, garage and yard, situate at............... all to be as herein described and in accordance with the contract documents.

All wires, except as may be hereinafter specified, shall be run in approved rigid galvanized or sherardized conduits.

Circuits of different systems must not be run in same conduits, but, with the exception of service wires, two or more circuits of the same system may be pulled in the same conduit, provided the fuses of the largest wire or any circuit will protect the smallest wire as specified in Code Rule No. 18.

The contractor shall furnish and have built in all necessary supports for conduits and boxes.

All conduits, junction boxes, outlet boxes, etc., must be properly concealed while the building is in the course of construction, as no cutting will be allowed except by permission of the architect.

Power System.

The system of wiring for power shall be for 220-volt, 3-wire, 3-phase, and shall consist of a separate and complete system of conduits, boxes, wires, and appliances from the main switchboard to each and every power, or control outlet shown on plans or herein specified, inclusive of all equipment and appliances herein provided for.

Service to be as hereinafter specified.

Feeders to be as hereinafter specified.

Conductors in power circuits shall be of such size that the drop in potential will not exceed 1 per cent. with full connected load.

Heating System.

The system of wiring for heating will be for 110-220-volt, 3-wire for feeders and sub-feeders, and 110-volt, 2-wire distributing circuits, unless otherwise specified, and shall consist of a separate and complete system of conduits, boxes, wires, and appliances from the main switchboard to each and every outlet shown on plans or hereinafter specified, inclusive of all equipment and appliances herein provided for.

Service to be as hereinafter specified.

Feeders to be as hereinafter specified.

Heating circuits shall be of such size that the drop in potential will not exceed 1 per cent. with the full connected load.

Lighting System.

The system of wiring for lighting will be for 110-220-volt, 3-wire for feeders and sub-feeders, and 110-volt, 2 wire distributing circuit, and shall consist of a separate and complete system of conduits, boxes, wires, and appliances, from the main switchboard to each and every light, receptacle, or switch outlet shown on plans or herein specified, inclusive of all equipment and appliances herein provided for.

Service to be as hereinafter specified.

Feeders to be as hereinafter specified.

Lamp or distributing circuits shall be of such size that the drop in potential will not exceed 1 per cent with the full connected load.

All lamp circuits shall be so arranged that not more than 16 sockets or receptacles requiring not more than 660 watts shall be dependent on any one cutout.

Telephone System.

The wiring for telephone shall consist of a separate and complete system of conduits, cables, wires, and appliances connecting each and every telephone outlet shown on plans or herein specified, inclusive of all instruments, appliances, and equipment shown or herein provided for.

Size of conduits cables, and wires shall be as herein specified.

Bell System.

The wiring for bells shall consist of a separate and complete system of conduits, boxes, wires, and appliances, connecting the source of electric supply to each and every outlet shown on plans or hereinafter specified, inclusive of all battery equipment, and appliances herein provided for.

Underground Work.

All exterior work shall be run underground in approved galvanized rigid conduit, as hereinbefore specified, at least 18 inches below the finished surface.

Conduits shall be installed with leaded joints, shall terminate in the proper condulets or outlet fittings, which shall be closed to prevent the entrance of moisture of any foreign substance.

The conduit shall be given a coat of asphaltum paint or tar, applied hot.

Conductors for power, lighting, or heating circuits shall be a standard 600-volt cambric insulated lead covered cable.

Telephone conductors shall be a standard double silk and cotton insulated braided and lead covered switchboard cable, having the required number of conductors and at least two extra pair.

The conductors shall be of the size hereinafter specified, and shall be continuous from outlet to outlet, as no joints or splices will be permitted in the conduit.

The ends of cables must be impregnated with compound, to prevent the absorption of moisture; must be properly served with rubber and cotton tape, and well painted.

Telephone or bell wires must not be run in the same conduit with lighting or power wires.

Symbols and Location of Outlets.

The various outlets are indicated on plans by N. E. C. A. symbols, and indicate the approximate location of outlets only.

Figures in power outlet symbols indicate the number of horse power for which the outlet is to be wired.

Figures in heating outlet symbols indicate the wattage for which the outlet is to be wired.

Figures in lighting outlet symbols indicate the number of 40 watt lamps.

Light outlets not marked, unless otherwise specified, shall be wired for 120 watts.

The contractor shall obtain from the architect the exact location of all outlets and exact height of all brackets, receptacles, and switch outlets.

Service.

From the cross-arm on lighting company's pole to the main switchboard this contractor shall run underground, in the manner herein described, a four-wire service.

This service to be a standard 600-volt, 4-conductor cambric insulated and lead covered cable, having a 3/32 x 3/32 varnished insulation and 3/32 lead sheath.

Conductors in this cable to be No. —— B. & S. stranded.

Cable shall terminate at either end in a standard 600-volt open-air terminal.

This contractor shall figure on a distance of 100 feet from the exterior wall of building to base of pole, as measured along the ditch, and he shall state in his bid the amount per lineal foot installed, to be added or deducted, should this distance be over or under 100 feet, the exact location of pole to be obtained before cable is ordered.

Main Switchboard.

The main switchboard to be furnished and erected in engine room by this contractor shall consist of a blue Vermont marble panel of ample size to accommodate the switches and equipment hereinafter specified.

Marble to be of good quality, free from mineral veins, not less than 1½ inches thick, with ⅜ inch bevel edges and polished face, bevel, and edges.

Frame for this panel shall be built of 1¼ inch angle iron, of rigid construction, supported by ornamental iron legs securely fastened to floor, and shall be braced to wall with 1 inch standard pipe braces.

Supporting bolts to be provided with polished copper heads and ⅛ inch rubber washers inserted between marble and frame.

Frame, legs, and braces to receive two coats of asphaltum varnish.

Provide and mount the following switches and equipment on face of panel:

One—	Amp.	3	P.S.T.	fused	knife	switch	Main	lighting.
"	"	3	"	"	"	"	"	power.
".	"	3	"	"	"	"	"	heating.
"	"	3	"	"	"	"	"	lighting feeder, main bldg.
"	"	3	"	"	"	"	"	lighting feeder, west wing.
"	"	3	"	"	"	"	"	lighting feeder, east wing.
"	"	3	"	"	"	"	"	lighting feeder, garage.
"	"	3	"	"	"	"	"	heating feeder, main bldg.
"	"	3	"	"	"	"	"	heating feeder, west bldg.
"	"	3	"	"	"	"	"	heating feeder, east wing.

On back of panel the bus bars, supports, lugs, etc., necessary to make board complete.

All metal parts on face of board to be highly polished and lacquered.

Bus bars to be built up of flat copper, figured on a basis of 1,000 amperes per square inch carrying capacity, and so designed and of sufficient width to provide one square inch of contact for each 75 amps. They shall be neatly arranged and secured and rigidly supported in place.

Provide on face of panel under each switch a neat black fibre name plate, showing feeder controlled. Letters on these plates to be not less than ¾ inch high, distinctly recessed and filled with white enamel.

Above the marble panel provide and securely bolt to frame and braces an angle iron frame properly designed and drilled to receive three meters. Run the necessary meter loops for lighting company's connection.

This contractor shall submit to the architect a scale drawing in duplicate showing both front and rear of board, and must obtain his approval before work is started.

Feeders.

From the above described main switchboard to the various panel boards hereinafter specified run the following feeders:

(1)—3-wire No. .... B.S.G. in....Conduit to power panel.
(2)—3 " No. .... " "....Conduit to heating section.—Main building.
(3) 3 " No. .... " "....Conduit to heating section.—West wing.
(4)—3 " No. .... " "....Conduit to heating section. East wing.
(5)—3 " No. .... " "....Conduit to lighting section.—Main building.
(6)—3 " No. .... " "....Conduit to lighting section.—West wing.
(7) 3 " No. .... " "....Conduit to lighting section.—East wing.
(8)—3 " No. .... " "....Conduit to lighting panel.

Feeder conduits to run open across basement ceiling and up raceway provided and shown on plans.

Panel Boards and Cabinets.

Furnish and install where shown on plans the following panel boards:

Panels "A," "B," and "C," in main building.

Panels "D," "E," and "F," in west wing.

Panels "G," "H," and "I," in east wing.

Panels "J," in garage.

Panels "K," for power in main building.

Panel boards shall be of polished Alaska marble, of good quality, free from mineral veins and of ample size to accommodate the equipment specified to be mounted thereon. These panels, except the garage and power panel, to be arranged in two sections, the upper part for lighting and to be fed from the lighting feeder, the lower for heating and to be fed from the heating feeder.

Provide on face of board a 30 amp. panel type fused knife switch for each circuit. Switches for lighting circuits to be double pole and either double or triple pole, as required, for the heating circuits.

Switches on power panel to be 220-volt, 3-pole fused.

All switches and fuses to be properly bussed to connecting lugs. bus bars to be of flat copper on face of board, and all to be highly polished and lacquered.

Each circuit shall be numbered on bus bar opposite switch, and a neat schedule provided showing circuits controlled.

Provide a lining around edge of board, of the same material as board, polished, and of sufficient depth to fill space between face of board and inside of door.

These panel boards to be enclosed in metal cabinet large enough to provide a gutter of at least two inches on all four sides of board and of ample depth to allow door to close when switches are open.

Cabinets to be built of No. 14 U. S. G. galvanized iron, securely riveted to angle iron frame.

Cabinet doors and trim will be furnished and hung by the owner.

Conduits.

All conduit used in connection with this work shall be either ....
rigid galvanized or sherardized with the maker's name and trade mark clearly stamped on each length.

All conduits must be continuous and extend from outlet to outlet, ends reamed smooth and carefully butted in couplings.

Where conduits terminate in boxes they shall be securely fastened and provided with approved bushing. At all other points, as at switchboard, motors, etc., conduits must terminate in proper condulets or taplets.

Conduit sizes to be according to the "Standard List of

Conduit Sizes," as published by the National Electrical Contractors' Association, and shall be installed in accordance with Section 28, 1915 Code, except that plates will not be permitted.

Wire.

All wire used in connection with this work shall be either

....

double braid unless otherwise stipulated in 1915 Code, rubber covered, and shall be delivered on the work in original packages, with manufacturer's tag on each coil.

For the power, heating, and lighting work no smaller wire than No. 14 B. & S. shall be used; all wire larger than No. 8 B. & S. must be stranded, and in wires or cables having more than one conductor the conductors must be parallel, and each conductor shall be insulated and braided, or taped, separately with an outer braid over all. Concentric wires will not be permitted or accepted.

For the telephone and bell work, wire to be rubber covered, braided and twisted inside wire or double silk and single cotton insulated and braided switchboard cable, twisted in pairs and having a distinct color scheme. In underground work this cable to be encased in a 3/32 inch lead sheath.

Wire in conduit must be continuous from outlet to outlet, as no splices will be permitted in the conduit, and shall not be pulled in until after the plaster is on and dry.

Boxes.

At every outlet provide an approved galvanized or sherardized outlet box.

All boxes used in connection with this work to be listed and approved by ....

Boxes must be securely fastened in place, by suitable hanger or support, independently of the conduit piping. Locknuts on conduits will not be considered as filling this requirement.

Outer edge of face of box to be flush with surface of wall or ceiling, and must be so installed as to leave no open space or gap around the edge or sides. When the surface at any outlet is broken it must be repaired so as to leave no holes or open spaces at outlets.

Light outlet boxes shall be a standard 4-inch box, fitted with plaster ring, and must be provided with an approved stem or stud threaded for ⅜-inch standard pipe. This stem must be securely fastened to box by at least four bolts, and should enter box from back.

Should the contractor use a box larger than the standard 4-inch round box, it must be provided with a cover, and this cover must be provided with lugs taped for screw threads.

Flush Switches.

Furnish and install, where shown on drawings, or hereinafter specified, ...
flush button type switches, of the best grade of their respective make (competition switches will not be accepted), to control lights as indicated on plans. Plates must be of brass, finished to match hardware, and not less than 60 mils in thickness.

Where more than one switch comes in the same location they shall be provided with gang plates, and plate must be engraved to show lights controlled. All switches and plates must be set flush and true with wall and trim.

Receptacles.

Furnish and install where shown on lighting plans or herein specified, ...
flush receptacles. All lighting receptacles, unless otherwise shown, to be wired for 120 watts each.

At each heating outlet shown or herein specified provide a 25 amp. flush receptacle, either double pole or triple pole, as indicated, and each wired on a separate circuit of not smaller than No. 8 B. & S. wire.

Receptacles for iron, where indicated, to be of the indicating type, indicator to burn only when plug is inserted, and each to be wired on a circuit of not smaller than No. 12 B. & S. wire.

All receptacles to be provided with brass plates, not less than 60 mils in thickness and finished to match hardware. Receptacles and plates must be set flush and true with wall and trim.

Knife Switches.

All knife switches called for herein to be of the best grade, polished, and only such switches may be used as are listed and approved by the ....

Fuses.

Provide one complete set of fuses.

Fuses on panel board to be of the plug type, and on switchboard to be of enclosed type, as provided in Code Rule 68-F.

Only such fuses may be used as are listed and approved by the ....

Motor Circuits.

From the power panel board to the various locations shown on plans this contractor shall run 220-volt, 3-wire, 3-phase motor circuit to the following motors:

One 1 h.p. for boiler.

One 5 h.p. for vacuum cleaner.

Two 3 h.p. in laundry.

At each of these motors, except vacuum cleaner, this contractor shall install one enclosed type 3-pole, fused knife switch for motor control. From this knife switch this contractor shall install conduits and wires and make motor connections.

Vacuum Cleaner Motor and Control.

Provide at location of vacuum cleaner motor in basement a .... remote control switch, and operate from combination momentary contact switch and bull's-eye receptacles placed at each cleaner outlet marked "V. C." on plans.

Do all wiring and furnish all electrical material in connection with the vacuum cleaner motor and above switches, using the same grade of material as specified above and taking motor circuit from power panel board.

Telephones.

Provide all material and equipment and install an intercommunicating telephone system, consisting of seven selective ringing, selective talking, automatic, non-interfering telephone sets, each to be fully equipped and wired, each set to be provided with a retardation coil of high impedence and of at least 100 ohms resistance, and the bells, transmitters, and receivers to be of the high-resistance type.

Telephone circuits to be full metallic, and number of conductors to be as required.

Telephones to be located where shown on plans and type of set to be as indicated.

All conductors must be continuous from outlet to outlet, as no splices or joints of any description will be allowed, except in outlet or terminal boxes.

All connections in the cables or between rubber-covered wire and cable shall be made by means of soldered terminal strips enclosed in proper size boxes. The wires leading to the terminals must be properly formed and taped or laced, and ends of cables thoroughly saturated with compound to prevent the absorption of moisture.

Conduit sizes to be in accordance with the N. E. C. A. conduit chart.

Boxes shall be provided at all outlets, and must be large enough to prevent crowding of wires and cables.

Provide and properly connect the necessary dry cell battery to operate the system in a satisfactory manner. Battery to be enclosed in a neat battery box and located in basement where shown.

This contractor will provide all materials and equipment, and install a complete call bell system, consisting of a 10-drop flush wall type automatic reset annunciator and the buzzers and push buttons shown on plans or herein specified.

System to be fully wired and annunciator drops connected to operate from push buttons shown.

Provide in each dining-room a floor push, located as directed, and connected to operate buzzers in kitchen.

Push button at all exterior doors to match in design, finish, and workmanship door hardware. Interior push buttons to be of cast brass or bronze, design and finish to be selected by the architect.

Bells or buzzers in the same general location must be of decidedly different tone, and all bells and buzzers must be of the best grade and equipped with spiral spring and screw adjustment.

Annunciator to be metal front flush type, finish as selected, and to be of an approved make.

Provide and place in telephone battery box sufficient dry cell battery to operate system in satisfactory manner.

B. C. Contractors Hold Successful Dinner

Thursday evening, the 26th of October, marked a great event in the history of the young and active British Columbia Association of Electrical Contractors and Dealers. On that evening an electrical dinner was held, attended by representatives from every branch of the electrical industry in Vancouver, Victoria and New Westminster; there were in addition to the numerous members of the association and allied chapters, representatives from the British Columbia Electric Railway Company, the Western Canada Power Company, the Canadian General Electric Company, the Canadian Westinghouse Company, and the Northern Electric Company, the whole family from the wholesale house of Cope & Son, while the remaining wholesale house of Horsman & Son regretfully had to be absent owing to a previous engagement.

To the number of seventy-two, which was considered remarkable for so recent an organization, the gathering sat down to dinner at the Castle Hotel, Vancouver, at 8 p.m., after the usual round of table introductions had been made. Dinner having been completed, the toast of the King was given by President C. H. E. Williams, who afterwards called on Mr. Emson to give the first item on the musical programme.

If you are in any branch of the electrical industry in British Columbia you should join the B. C. Association of Electrical Contractors and Dealers, an organization which has for its object the welfare of its members—a real live organization.

During the evening three most interesting addresses were given, the first by Mr. Hayward, President of the Victoria Chapter, B. C. Association Electrical Contractors and Dealers, who gave a good straight talk to the members on Overhead Cost and Profit. Mr. Hayward was followed by Mr. W. McNeill, assistant general manager Western Canada Power Company, on "Co-operation in the Electrical Industry." He dealt with the co-operation that should exist between every branch of the great industry in which his hearers were engaged; he emphasized the fact that co-operation should come first from the great central stations, should be taken up enthusiastically by the manufacturers, and finally that the great brotherhood of contractors and dealers should work hand in hand with the branches above mentioned; Mr. McNeill introduced many witty remarks into his address which caused much amusement to the members.

Mr. McNeill was followed by Mr. George Kidd, general manager B. C. Electric Railway Company. Mr. Kidd (after expressing himself strongly in favor of co-operation with the various branches of the industry in British Columbia, drew a picture of the great progress that was being made by electricity, especially by the electrically-operated railways. He concluded his remarks amidst loud applause by forecasting a still greater future for electrical men. Mr. Kidd's address, though brief, was much to the point and was much appreciated by all present.

Numerous musical items, splendidly rendered, added greatly to a highly successful evening, which was planned out by J. R. Read (Chairman of Dinner Committee), district manager Canadian Westinghouse Company; vice-president Jarvis, Jarvis Electric Company, and secretary-treasurer E. Brettell, Electric Supply Company.

CODE OF ETHICS

Adopted for the General Guidance of the Members of the

B. C. Association Electrical Contractors and Dealers

Section 1. Members of the Association shall regard themselves as being engaged in a business in which there is a well defined duty and obligation toward the public and themselves. The business demands that members use every honorable means to uphold the dignity and honor of this vocation, to exalt its standards and to extend its spirit of usefulness.

Section 2. Every member of this Association should be mindful of the public welfare and should participate in those movements for public betterment in which his special training and experience qualify him to act. He should not, even under his client's instruction, engage in or encourage any practices contrary to the Rules and Regulations Safeguarding Life and Property, for he is not obliged to accept a given piece of work; he cannot, by urging that he has followed his client's instruction, escape the condemnation attaching to his act. Every member of this Association should support all public officials and others who have charge of enforcing safe regulations in the rightful performance of their duty. He should carefully comply with all the laws and regulations touching his vocation, and if any such appear to him unwise or unfair, he should endeavor to have them altered.

Section 3. It is unbusinesslike for a member of this Association to assist unqualified persons to evade or to lend himself in the evasion of any of the recognized rules and regulations governing electrical work.

Section 4. Members of this Association should expose, without fear or favor, corrupt or dishonest conduct and practices of the members of this business, and it is their duty to bring to the attention of the proper authorities the existence of electrical conditions which are unsafe to life and property.

Section 5. Members of this Association owe a duty to the business of refusing to furnish estimates to general contractors who do not regard bids as final and binding upon which they are awarded general contracts.

Section 6. Members of this Association shall not falsely or maliciously injure, directly or indirectly, the business reputation, prospects, or business of a fellow member of this Association.

Section 7. Members of this Association shall not attempt to supplant a fellow member after definite steps have been taken toward his employment or toward the letting of a contract to him. Nor should they offer any interference in the carrying out of said contract or commission to the end that loss or damage may result to the fellow member.

Section 8. Whenever disputes or differences arise between members, it should be the duty of the parties to the controversy to submit the trouble to an arbitration of two disinterested members of this Association, and in the event of a failure to arrive at a satisfactory settlement, then, upon request, the President of the Association shall appoint a third member of the Commission and the decision of the majority of said commission shall be final and binding.

Toronto Contractors Reorganize in Force

Following the meeting of electrical contractors held on Friday, November 10, as mentioned in our last issue, a get-together dinner for contractors, jobbers and manufacturers was held on Wednesday, the 22nd, in the Board of Trade rooms, at which the matter of re-organization was more thoroughly discussed. Brief, but enthusiastic addresses were delivered by Mr. E. C. Weed, for the manufacturers, and Mr. C. A. McLean, for the jobbers, expressing the viewpoint of the man "on the outside" and urging on the contractors the value of a closer association and organization. It was finally decided to appoint a committee who would meet the members at a later date to perfect the organization. The date arranged was Wednesday, November 29, and, on motion of Mr. Davenport, seconded by Mr. Woods, a committee, composed of Messrs. Kenneth A. McIntyre, Harry Hicks and W. H. Douglas was appointed.

The enthusiasm with which the idea of re-organization had taken hold was evidenced by the large attendance of representative contractors, who also further pledged themselves to attend the next meeting on November 29. These included the following well-known individual and company contractors:

Canadian Electrical Fixture & Contracting Co., Ltd., 134 Bay Street; Windeler Electric, 603 Yonge Street; D. Robson, 62 Millicent Street; R. E. Holditch, 223 Pacific Avenue; Martin Nealon, 15 Harbord Street; James Devonshire, Limited, 701 Yonge Street; Thos. Jackson, 11 Sorauren Avenue; J. Harris, 204 Dovercourt Road; J. E. Myers, 4 Gould Street; Dolson & Palmer, 275 Waverley Road; E. A. Drury, 45 Moutray Avenue; John A. Neal, 402 Pape Avenue; Wales Electric Company, 1753 Dufferin Street; D. Balment, Dupont Street; P. C. Taylor, 79 Balsam Avenue; Rooks Electric Company, 238 Adelaide Street West; A. E. Richardson, 435 Kingston Road; Parsons Electric Company, 135 Essex Avenue; Chas. Moore, 12 Stonehouse Crescent; Wm. Bennett, 664 Gladstone Avenue; C. Fraser, 35 Harvey Avenue; Earle Electric, 72 Nelson Street; Keith's Limited, Campbell Avenue; Geo. J. Beattie, 72 Victoria Street; R. H. Hughes, 430 Church Street; Harry Hicks Company, 203 Church Street; W. Henry Lodge, Bain Avenue; Electrical Maintenance & Repairs Co., Ltd., 162 Adelaide Street West; Harry Alexander, Inc., 6 King Street West; Leslie Electric Company, 147 Front Street West; Douglas Electric Company, 2525 Yonge Street; A. T. Brookes, 66 Frizzell; Kenneth A. McIntyre, 410 Kent building; Canada Electric Company, 165 Church Street; Sam Woods, 16 Woodycrest Avenue; V. K. Moritz, Yonge Street; G. E. Davenport, 70 Melbourne Avenue.

The successful launching of this new movement is entirely due to the enthusiasm of Mr. Frank T. Groome, who has shown in this, as on other well-known occasions, a special genius for getting men to work together—and keep working. Mr. Groome has backed this genius by a tremendous driving force of human energy, and the contractors of Toronto owe him much. He looks at the whole matter largely from the human side—good fellowship first, personal gain second—and the opinion was quite apparently unanimous that on such a basis a strong and useful contractors' organization can be built up in Toronto.

The new committee made an auspicious start by insisting that they meet every electrical contractor present, and Mr. McIntyre, who has consented to act as president of the re-organized association, introduced himself in a brief address, thanking the contractors for their expressed confidence in him and promising for himself and his committee a close study of the situation during the coming week, so that on November 29 a definite organization may be established.

A splendid musical programme added greatly to the success and enjoyment of the evening, which broke up with cheers for the contractors, for Mr. Groome and for the chairman, Mr. H. H. Couzens. An unusual interest attaches to the clever menu card, which is reproduced below:

The Menu

Relishes
"Loricated" "Rubber Covered"

Soup
"Juice a la Hydro"

Fish
"Waterproof Fittings" with "Soldering Paste"

Roast
"Tensile Strength 30,000 lbs.
with
"Telco" d.c. Service

Vegetables
"Grounded Terminals"
"No Rights"—"No Lefts"

Dessert
"Finish—Rich Gold Lacquer"
"Free from Grounds"

Smokes
"Weatherproof" "Flaming Arcs"

Electrolier Push Button Switch

Efforts have been made during the last few years to develop an electrolier type of switch with a standard push button movement, and a switch that is said to conform closely to the standard push switch and at the same time is an adjustable electrolier switch has just been put on the market by the Arrow Electric Company. This switch has the appearance and action of an ordinary single-pole push button switch. Pushing the pearl button connects the circuits; pushing the black button disconnects them. The black button, however, has an additional function—it can be rotated whether the circuits are closed or open to four different positions, giving four combinations of lights. This button is so shaped at the end that it offers a gripping surface and also indicates by sight or touch the circuit on which the switch is set.

It is not necessary to operate this switch, as in the old flush type or as in other electrolier push switches, through the various combinations to get to the "off" position, or to make two or three useless turns or pushes to get the desired circuit. Neither is it necessary for the lights in the room to be turned off even momentarily to get another circuit or a different combination of lights. The black button, by its rotating movement can be set at whatever circuit desired, and the switch then operated as a single-pole switch on that circuit.

In most electrolier combinations there is usually one circuit or set of lights, which is generally used. The other circuits, or lights, are only used occasionally. With this switch the black button can be set on the circuit most generally used, and the switch can then be operated as an ordinary push button switch on that circuit, entirely disregarding the other circuits. These, however, can be brought into service at any time by simply rotating the black button.

Winnipeg's Electrical Show Committee

The photograph herewith represents the chairman and committee of the first annual electrical show held in Winnipeg at the Industrial Bureau, on October 10-14, 1916. Reading from left to right in the top row are Messrs. J. M. Leamy, Manitoba Government Electrical Engineering Department; F. A. Cambridge, City Electrician, Winnipeg; W. J. Osborne, Winnipeg Electric Railway Company; and F. E. Filer, 302

Donalda Building, Winnipeg. Bottom row, from left to right are Messrs. G. E. Carpenter, Secretary Canadian Manufacturers' Association, Winnipeg; E. A. Smith, Canadian Westinghouse Company; W. R. Ingram (Chairman), Swift Canadian Company; C. W. Webster, Commissioner of Industrial Bureau; R. A. Sara, City Light and Power Department; E. V. Caton, City Light and Power Department, and W. H. Reynolds, Eugene F. Phillips Electrical Works, Limited.

Allen Commutator Lubricant

The Allen commutator lubricant is especially prepared for use on commutators using either carbon or copper brushes. It is made from the purest of chemicals, put up in stick form, and is guaranteed to contain positively no acid or other ingredients of a destructive nature. It is extensively used and recommended for dynamos generating high potentials and is equally adapted for commutators of low voltage. Only a very light pressure of this lubricant to the surface of the revolving commutator is necessary. There is claimed to be no danger of cross-circuiting between the bars, thus eliminating burn-outs in the corresponding armature sections, which frequently take place when oil, grease, or tallow is used. Where this lubricant is used the manufacturers say that practically no wear takes place on brushes or commutator, no sandpaper is required, and they keep "smooth as silk."

McDonald & Willson, Limited, 12 Queen Street East, Toronto, have issued a very attractive folder illustrating a choice selection from their newest designs in electric portable lamps. Nothing is more suitable for a Christmas present than a handsome electric lamp.

Trade Publications

Motor Generators—Bulletin No. 129, by the Robbins & Myers Company, Springfield, Ohio, describing type B battery charging motor generators; illustrated.

C. G. E. Bulletins—No. 48108, direct current crane and hoist motors; No. 49300, Armored Cables; No. 46101-A, type P demand meters (printometers); No. 46103-A, type M demand meters; No. 46104-A, type G demand meter; No. 43408, the lighting of office buildings and drafting rooms by Edison Mazda C lamps; No. 43406, the lighting of indoor recreations by Edison Mazda lamps; No. 43606, focusing types of Edison Mazda lamps; No. 34309, modern lighting as applied to places of assembly.

Induction Motors—The Lincoln Electric Company of Canada, Limited, Toronto, are distributing their latest catalogue of Lincoln induction motors for two or three-phase alternating current. This is a very complete and comprehensive work of 50 pages, profusely illustrated. Special attention is given to the field of the induction motor and its adaptability for special purposes. Reproductions are shown of the dissembled parts of the motor and photographs of actual installations in chemical and paint factories, woodworking plants, bakeries, provision and packing plants, ice plants, foundries, mills, and so on. Mention is also made of the Lincoln arc welder and the Lincoln storage battery charger.

The Menominee Electric Manufacturing Company, Menominee, Michigan, announce that they are now carrying in Winnipeg a full stock of fractional h.p. motors, buffing and grinding motors, stationary and oscillating fans, telegraph instruments, spark coils, etc. They are represented in Winnipeg by the Federal Agencies, 56 Albert Street, of which Mr. A. L. Woolf is manager.

The Eugene F. Phillips Electrical Works, Limited, Montreal, have secured a contract from the Toronto Hydro-Electric System for eight miles of 250,000 c.m. 3-conductor paper insulated plain lead covered cable, for a working pressure of 13,200 volts. The same company will supply the Saskatchewan Government with 200,000 pounds of hard drawn copper wire.

The Adams-Bagnall Electric Company of Cleveland, Ohio, are now completing an addition to their factory, with the installation of a complete vitreous or porcelain enameling plant. The object of this addition is to improve the quality and service of the Abolite line of porcelain enamelled reflectors.

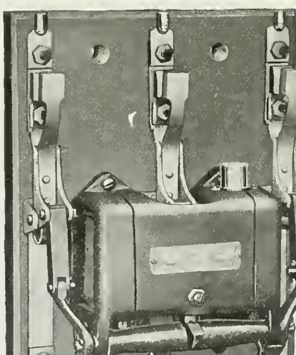
Heating the home by portable electric steam radiators.

What is New in Electrical Equipment

New Electrically Operated Remote Control Switch

The type R, form C, electrically operated remote control switch, shown herewith, for central control of lighting circuits, motors not subject to heavy overloads, and other electrical apparatus located at a distance from the controlling button or buttons, has been placed on the market by the Canadian General Electric Company. This switch is advantageous for use in moving picture and other theatres, halls, stores, libraries, and like places where centralized control, for light work, is desirable. At the same time this particular switch takes care of loads too heavy for the ordinary snap-switch. Control may be centered in one special push-button switch or in different locations by the use of a number of these push buttons, wired in multiple. This special control button operates at finger pressure, and sends current through the two solenoid coils on the switch only at the moment of opening or closing. It is a single-pole, double-throw, specially-designed push button, and is normally in the open position. It remains closed only when held by the operator. One such switch, with escutcheon plate ready for the wall mounting, is furnished as part of full equipment, and must be used, as the solenoid coils are not intended to carry current continuously. Little current is used for operation. One coil opens the switch and the other closes it. This approximates on direct current 1.6 amperes at 110 volts and 0.81 amperes at 220 volts, and on alternating current of 60 cycles, 10 amperes, at 110 volts and 6 amperes at 220 volts. The device is made specially for use on currents of the above voltages. There is also an insulated handle on the switch for manual operation.

The switch itself is a self-contained unit, with two sets of contacts. The main set has the special G-E laminated copper brushes that make an "end-on" contact with the switch blade with no tendency to force the laminations apart. The cross-



Electrically operated remote control switch.

section of the brushes is correct for the current it is designed to carry, and its arrangement permits a firm, strong, closing contact. The contact surfaces are kept bright, and a good contact is assured by the wiping effect given the contacts every time the switch is closed. The secondary set of contacts take the arc on breaking the current. They are of blocks of selected carbon, fastened without screws or bolts to flat phosphor bronze strips, shaped into holders at their upper ends. Thus the switch is protected and great durability attained. The spring tendency of the bronze strips, which are under considerable pressure when the switch is closed, assist to make a quick, clear break when it opens. It is single-throw, single, double, or triple-pole. Simple, durable, and reliable, there is nothing to get out of order.

Repairing Chipped Rolls by Arc Welding

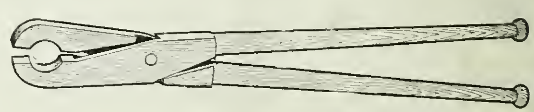
The field for the application of electric arc welding is an extremely broad one. Practically every industry making use of iron and steel can utilize the electric arc welding process to distinct advantage. In foundries and machine shops many applications for arc welding can be found. Steel mills also use this method with great success. The accompanying picture shows a roll used for turning out special shapes of sheet piling. It has been repaired by electric arc welding. The extent of the weld is indicated by the arrows, the points of which touch the periphery of the weld. Rolls occasionally chip out. Instead of scrapping the roll or turning it down, one of the large steel companies

Roll repaired by arc welding.

has found that very great economies can be effected by repairing the defective spot by means of the electric arc. The chipped portion is first filled in and welded, after which it is ground or filled to the proper shape. After the work has been completed it is practically impossible to detect the point at which the weld has been made except by very close examination. The repairs are apparently permanent and will wear as long as any other part of the roll. The steel company in question is making all its repairs of this nature by means of the electric arc, employing electric arc welding sets made by the Westinghouse Electric & Manufacturing Company, of East Pittsburgh, Pa. The company is also securing very successful results in repairing worn wobblers, and rebuilding broken teeth in gears and pinions, in the same manner.

Safety Fuse Tongs

Wooden tongs for inserting and removing fuse plugs have recently been put on the market by a United States manufacturer. These tongs are composed of rock elm, treated by a special process that makes them both shock and moisture

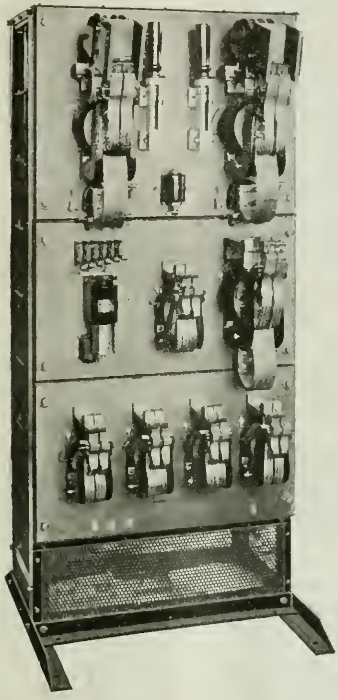


Wooden tongs for replacing fuses.

proof. They come in four sizes—16 in. long, ⅜ to 1¼ in. diameter; 16 in. long, ¾ to 2¼ in. diameter; 20 in. long, ¾ to 3 in. diameter; 28 in. long, ¾ to 5 in. diameter.

Large Automatic Controller

The controller illustrated herewith is a recent development of the Industrial Controller Company, and intended for use in connection with large d.c. motors. This controller is novel in its operation as it combines both current limit and time limit acceleration, thereby not only securing protection to the motor by means of the current limit acceleration, but preventing too rapid acceleration of the motor under light loads. The controller consists of a number of large magnetic contactors, the first of which is equipped with a powerful blowout and arcing shields, and the acceleration is accomplished by means of a master solenoid at the left of the panel, which when closing energizes the coil of

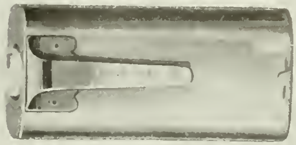


the large magnetic contactors successively, thereby closing the switches and bringing the motor up to speed. The acceleration of the master solenoid is retarded by means of an air dash pot, and in addition by a braking magnet, which in turn is controlled by a current limit relay at the centre of the panel. When the current in the motor exceeds a predetermined amount, the master solenoid is prevented from operating until the current is reduced to the proper amount for which it is set. On the controller illustrated, magnetic switches with blowouts are provided for both sides of the line and each are equipped with overload relays, thus giving protection to the motor. These controllers are particularly adapted for use with large rolls and similar machinery.

The New York Section of the American Society of Mechanical Engineers held a "Preparedness" meeting on November 11. Members and friends of the society were given opportunity to inspect the plant of the Electric Boat Company and to witness a special exhibition of submerging and attacking a vessel by a fleet of U. S. submarines. An illustrated lecture was also presented on "Submarines," by Charles H. Bedell, electrical engineer, Electric Boat Co.

"Cliplite" Vest Pocket Flashlight

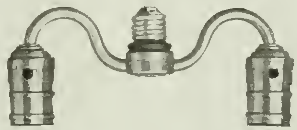
The "Cliplite" vest pocket flashlight shown below is being sold by the Import Sales Company. When clipped to the pocket it is ready for use. The safety clip prevents the battery from short-circuiting and also prevents the flashlight from being lighted in the pocket unknowingly. It is simple



to reload, having two contacts inside the case. The battery can be slipped in either way; the short brass part on the battery can be to the right or to the left. There is no adjustment of the battery necessary. This new clip contact adds considerable value and efficiency to the popular sized nickel-plated case, and has all the advantages of the fountain pen flashlight, with the additional advantage that it is large enough to hold an efficient battery.

Two-arm Extension Bracket

The two-arm extension bracket shown here is designed for use wherever a double connection is desired. For instance, when this two-arm extension bracket is employed electrical energy may be used to supply power for an electric



iron or sewing machine motor and light at the same time. This appliance has been recently brought out and is manufactured by the Waterbury-Wallace Company, Inc. The fixtures are made in brass, bronze, and nickel, and are provided with push buttons.

Personals

Mr. C. Robertson, of Hamilton, Ont., has been appointed assistant engineer of the local electric plant at Orillia, Ont.

Mr. J. B. Woodyatt, formerly superintendent of the Southern Canada Power Company, Montreal, has been appointed manager of the company—a new position.

Mr. J. W. Dorsey on November 8 read a paper on "A cut-out system on party telephone lines," before the Electrical Section of the Manitoba Branch of the Canadian Society of Civil Engineers.

Lieut. Edwin Baker, B.Sc., who lost his sight on the battlefields of Flanders after several months' service, has been retained by the Hydro-electric Commission of Ontario in an advisory capacity. Lieut. Baker is a graduate of Queen's and a specialist in electrical work. He was awarded the Military Cross for gallantry in action.

Mr. H. C. Haskell, secretary-treasurer of the Southern Canada Power Company, Montreal, and Mr. W. H. McIntyre, assistant superintendent of the Ottawa Electric Company, have been appointed members of the committee on Education of Salesmen, commercial section, of the National Electric Light Association. Mr. Haskell looks after Quebec and the Maritime Provinces, and Mr. McIntyre Ontario and the West. The courses in commercial engineering and practical electricity are conducted by the correspondence method supplemented by class discussions.

Current News and Notes

Chilliwack, B.C.

At the annual meeting of the Chilliwack Telephone Company, Limited, Chilliwack, B.C., on November 14, a dividend of eight per cent. was declared. The financial statement for the year ending September 30 showed gross earnings of $15,308 against operating expenses of $7,254.

Grand Coulee, Sask.

The power station at Grand Coulee, Sask., was recently destroyed by fire.

Hepworth Ont.

A by-law was submitted on November 27th to the electors of Hepworth, Ont., authorizing the Hepworth Light, Heat and Power Company to erect a plant to supply electric light, heat and power to the village.

Kilsyth, Ont.

The Ontario Hydro Commission are contemplating the erection of a sub-station at Kilsyth, Ont. This will entail the extension of the transmission line from Tara, Ont.

Kenora, Ont.

The utilities department of the town of Kenora, Ont., have arranged to hold a two days' electrical show in the Oddfellows' Block on December 14-15.

Kingston, Ont.

The Hydro-electric Commission of Ontario have offered to supply 1,000 horsepower at $29 per h.p. to the Kingston, Ont., public utilities commission. When the consumption is increased to 1,125 h.p. the rate would be reduced to $28.

Lake Megantic, Que.

The plant of the Lake Megantic Electric Company, Lake Megantic, Que., was recently totally destroyed by fire. They will rebuild immediately, using steam power, and will require turbines, dynamos, switchboards and transformers.

London, Ont.

Plans are under way for a new telephone exchange in London, Ont., to cost $60,000. New switchboard and equipment is to be installed.

Tenders are being called by the Utilities Board, Mr. E. V. Buchanan, manager, London, Ont., for the erection of a four-storey building to be used for the local hydro offices.

Norwood, Ont.

The electric power plant owned and operated by W. C. Harrison at Norwood, Ont., was considerably damaged by fire recently. The loss is partly covered by insurance. Work of re-construction is being initiated at once.

The Pas, Man.

The town of The Pas, Man., have awarded to Houston and Tallman, Limited, Regina, Sask., a contract for the installation of a $12,000 telephone system.

Pickering, Ont.

Residents of Pickering, Ont., and vicinity, recently met to discuss negotiating for a supply of Hydro-electric light and power. Petitions are being prepared.

Renfrew, Ont.

Following a conference with the Ontario Hydro-electric Commission, the town council of Renfrew, Ont., have accepted the offer of Thos. A. Low to sell the business and plant of the Renfrew Electric Light Company for the sum of $6,500.

Sarnia, Ont.

Motor power will be used at Sarnia, Ont., by the Central Stone Company of Canada, in their new plant for cutting the stone to be supplied for the Union Station, Toronto.

Saskatoon, Sask.

In his annual report, Commissioner Yorath, of Saskatoon, Sask., recommends the abolition of tungsten cluster lights and in their stead the use of single nitrogen units of 350 watts each.

Stratford, Ont.

Mr. Charles Wagner has taken over the electrical fixture and supply business of Rank & Ferrier, Stratford, Ont.

Strathroy, Ont.

The town council, Strathroy, Ont., have authorized the extension of the street lighting system on McKellar Street.

Vancouver, B.C.

The B. C. Telephone Company, Vancouver, B.C., have under consideration the construction of a telephone exchange at Port Moody, B.C., and are receiving tenders for the work.

Wingham, Ont.

The town council, Wingham, Ont., will secure data regarding power producing possibilities at the town dam.

Mr. A. M. Stevens, formerly with McDonald and Willson, Limited, of Toronto, has become associated with the Canadian Carbon Company, 98 King Street West, Toronto, in the capacity of sales manager.

Electrical News

Generation Transmission and Application of Electricity

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The Sphere of the Engineer

A truly remarkable state of affairs in Montreal has been exposed by the "Committee of Ratepaying Engineers," on the expenditures necessary to carry out a power development in conjunction with the Montreal water supply system. It had been originally estimated that there would be available some 10,000 h.p., but the report shows this figure to be much too large, and places the maximum at 7,000 h.p.

The startling feature of the report, however, is the statement that, "the minimum cost of the project as designed will be \$10,600,000." This cost is exclusive of the filtration works or any pumping plant or steam auxiliary or any allowance for parking or the usual allowances for contingencies. The minimum capital cost, based on the maximum safe capacity of the plant, would amount, therefore, to \$1,515 per horse power.

Now, the city of Montreal is the centre of one of the most abundant power areas on the North American Continent, and as such can obtain by purchase such power as it needs at very reasonable rates. The report in question states that 24-hour power can readily be purchased for from \$20 to \$25, so that, taking the higher figure, the 7,000 h.p. would not cost more than \$175,000 per annum. As against this, the engineers' report calculates the carrying charges, if the proposed development is carried through, at \$757,000, estimating interest at five per cent., sinking fund at one per cent., and the usual depreciation rates. The latter scheme, therefore, would cost the city annually close to \$600,000 over and above the cost of the purchase of power.

That the estimate of the Board of Ratepaying Engineers is reliable is perhaps best evidenced by the personnel of the Board, which includes only well-known members of the Canadian Society of Civil Engineers. If further proof were necessary, one has only to compare the estimated cost of this installation of \$1,515 per horse power with other hydro-electric installations in Montreal, or for that matter anywhere in the world. Take for example the plant of the Cedars Rapids Mfg. & Power Company, recently completed in Montreal. The last annual report gives the bonded issue of this company at approximately \$10,500,000, and the development at about 100,000 h.p. This is a cost per h.p. of \$105. Doubtless, too, there are many plants on this continent installed around this figure. The Niagara plants, for example, are probably little in excess of this amount, and possibly one of them less. Indeed, from the Atlantic to the Pacific, it is safe to say there is not a modern installation developing hydro-electric power that has cost more than \$200 per horse power in capital charges.

When one considers these cases one realizes more forcibly the enormity of the mistake the city of Montreal has been persisting in. Much money has already been spent on the scheme, but that is no reason for continuing the work. Even if another five or six millions were to be spent on it and the installation completed, it would still probably pay the city handsomely to allow the plant to stand idle and purchase from one of the companies operating in that city.

Incidentally it may be recalled that this report was furnished by the engineers "gratis"—a refreshing and encouraging contrast to the schemes of profiteering that one sees around him in every direction these days. We hope the whole situation is an omen that engineers and engineering methods and ideals will in future have more to say in the management of affairs of national importance which, in the past, have been so much mis-managed by our (sometimes) well-meaning, but too often incompetent "politicians."

Important Factors in Insulator Selection

A meeting of the Toronto Section of the American Institute of Electrical Engineers, was held in the Engineers' Club, Toronto, on November 24th. Mr. A. O. Austin, chief engineer of the Ohio Insulator Company, gave a very interesting talk on the question of "Important factors that should be considered in the selection of an insulator." Mr. Austin outlined the trend of design of insulators at the present time, showing that the work was tending to bring up more the quality of the insulation, rather than the quantity of insulation. He also showed how the designer of insulators had to follow very carefully the work of the operating engineer in connection with transmission line work. He showed that it was essential for the designer of insulators to be familiar with the troubles that arose in carrying out the work of transmission of power.

Taking up the manufacture of insulators, the speaker showed that great care was taken in every step in the manufacture. A lantern slide was shown giving the different test records, such as pyrometer records and fusible cones. He also showed the great care that was taken in testing insulators, showing that a single test was practically useless in selecting the insulator; he rather suggested the use of routine testing and making a record of failures during this type of test.

At the close of the meeting the chairman announced that the next meeting would be held on December 15th, the speaker for the evening being Mr. G. H. Hill, Assistant Engineer of Railway and Traction Department of the General Electric Company, the subject being "Railroad Electrification."

Phase Changing by Means of Auto Transformers

By Mr. Frank T. Wyman*

Due to changing conditions and for economic reasons, it is often desirable to transform from two phase to three phase or vice versa. For instance: if the generating and transmission system is two phase, twenty-five per cent. of the line copper may be saved by changing at the station and transmitting three phase, that is, the fourth wire may be taken down and used for other purposes and just as much power transmitted as before, or by investing in fifty per cent. more copper the amount of power transmitted could be doubled.

Other reasons may be that a town, village or manufacturing plant is wired for two phase, and changing conditions may make it necessary or economical to use three phase power, but to immediately change all the wiring and motors would be impossible, consequently, a phase changing device must be used while the installations are gradually being changed, as conditions will permit.

In fact, there are a great many special cases, large and small, such as cited above, and for laboratories, special tests, furnaces, welding, etc., that phase changing is necessary.

For the above purposes two methods are in common use, one by using a Scott connected auto-transformer and one by using a delta connected auto-transformer.

The material necessary in such a phase changer compared to a double wound transformer is as follows:—For the Scott method as shown in Fig. 1: Let $I_2 = 2$ phase current; $I_3 = 3$ phase current. If $I_2 = 1$ and $I_3 = 1.155$, then the current in b.o. $= 1.155 - 1 = .155$; the current in d.o. $= 1$, and the current in a.c. $= .5775$; and the material used in the different parts of the windings compared to a double wound transformer will be:—

in b.o. $(43.3\% \times .155)/2 = 3.35\%$
d.o. $(6.7\% \times 1.\ )/2 = 3.35\%$
a.c. $(50\% \times .5775)/2 = 14.4\%$

or the total material is 21.1%.

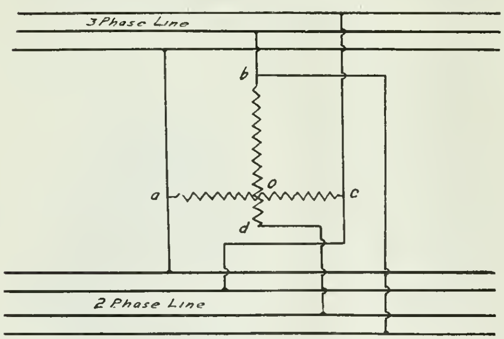


Fig 1

For the delta method refer to Fig. 2.

As before let $I_2 = 1$; $I_3 = 1.155$.

Then the current in a.b.c. $= (1.115 - 1)/2 = .0775$
the current in a.d.c. $= .5775$.

And, as in the Scott method, the material used in the different parts of the winding compared to a double wound transformer will be:—

in a.b.c. $66.66\% \ (.0775/.578)/2 = 4.48\%$
in a.d.c. $(33.33\% + 15.33\%) \ (.5775/.578)/2 = 24.33\%$

or the total material required is 28.78 %.

That is, an auto-transformer for transforming a given amount of power from two to three phase or vice versa, will cost in active material less than 30 per cent. of that which a double wound transformer would cost for transforming the same amount of power. This, of course, providing the incoming and outgoing voltage is the same.

The delta auto-transformer may also be used, at the same time, as a booster, if transforming from two phase to three phase, by simply dropping the leads at a.c. towards x.y., Fig. 2. In this way any percentage of boost up to 15.3% may be obtained, and as may be noticed from examining the diagram, Fig. 2, as the boost increases the active material decreases, until at the maximum the material is as follows:—

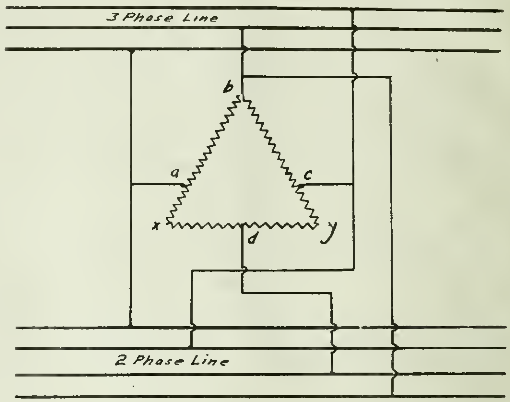


Fig 2

in x.b.y. $76.76\% \ (.0775/.578)/2 = 5.15\%$
in x.d.y. $38.43\% \ (.5775/.578)/2 = 19.2\%$

or the total material required is 24.35 per cent.

The above also shows that the Scott auto-transformer is somewhat cheaper in active material, but, on the other hand, the housing is more expensive, and its regulation and phase balance will not be quite as good as in the delta.

* Chief Engineer, Packard Electric Co.

Report of Winnipeg Jovian Order Nominating Committee

The following members were nominated for positions of Executive and Chairmanship of the different committees of the Jovian League and Jovian Order for the incoming year, at a recent meeting of the Jovian League at Winnipeg:

Executive Committee:—President, E. H. Smith; Vice-President, G. L. Guy· Secretary-Treasurer, W. M. Houston.

Ex. Committee:—J. S. Henry, J. A. Coyle, A. H. Steventon, R. G. Taylor.

Chairman Development Committee:—R. H. Long.
Chairman Public Affairs:—H. W. Billing.
Chairman Visiting and Relief:—H. F. Allan.
Chairman Reception Committee:—W. G. Vogan.
Chairman Publicity Committee:—F. E. Filer.
Chairman Entertainment Committee:—J. M. Leamy.
Chairman Membership Committee:—A. E. Esling.

It was thought advisable to only suggest the chairmen for the different committees and have each of these chairmen select his own committee.

The Romance of the Telephone

History of its Development Inseparably Associated with the great name of Alexander Graham Bell—Holds a Prominent Place in Modern Civilization and Development

By Mr. K. J. Dunstan*

In 1875 a tall young man—a professor of elocution—a teacher of vocal physiology at $500 per year, who for about three years had worked consistently at a problem which constantly baffled—was busy in a small machine shop in Boston on a hot June day absorbed in making a sort of crude harmonica with clock spring reed, a magnet and wire, when he heard an almost inaudible sound—a faint twang. It was the sound long waited for, and in intense excitement he ran to his young assistant, Watson, and said "Snap that reed again." This was the tiny cry of the new-born infant—a milestone in the invention of the telephone.

The word "telephone" comes from the Greek word meaning "far off" and "sound or voice." In 1861 Reiss, a German, produced an instrument by which he transmitted musical sounds, but he failed to reproduce the peculiar quality of a tone or note. He used an interrupted current. Bell subsequently found this to be a mistake and used an undulating current; that is, one which is never broken, but only varies in strength. Sound has three qualities—pitch, volume and individuality. Pitch is obtained by the number of vibrations within a given time, volume by the amplitude of the vibrations or waves and the individual quality by the peculiar shape or character of the waves. Reiss obtained pitch alone, while Bell reproduced with perfect accuracy but with diminished volume.

Bell was a master of the laws of speech, as were his father, his two brothers, his uncle and his grandfather. For three generations the Bells had been professors of the science of speech. One had invented a system of correcting stammering, another was the Dean of British elocutionists—the author of many text books and also of an ingenious system of visible speech. Thus the inventor of the telephone came honestly by his peculiar fitness for the task. He, himself, while yet a boy, had constructed an artificial scull of gutta percha, which, by the aid of air from bellows would pronounce words.

He was 28 years of age when he heard the first baby cry of an invention which has revolutionized the social and business world. Educated in Edinburgh and London, thrown in contact with scientists, he became convinced that speech could be transmitted by electricity over wires. Consumption had carried off two brothers. His own health was threatened. The doctors ordered a change of climate. His parents brought him to Brantford, Ont., where he struggled and won the fight. He taught visible speech to Mohawk Indians. Tall, supple, pale, large nose, full lips, jet-black hair and eyes, of Bohemian temperament and artistic tastes; a man of enthusiasm but without business ability. He was so deeply interested in his work of teaching deaf-mutes that he even hesitated between this love and the desire to perfect a musical telegraph. Receiving an offer from the Boston Board of Education, he accepted and from that time he has lived in the United States, at first spending his holidays with his parents in Brantford.

Professor Bell has stated that the years 1874 to 1877 marked the incipiency of the telephone, that from 1873 until the beginning of 1876 he was a resident of Salem, Mass., going to Boston daily for his professional work. So these places—Salem, Boston and Brantford—are concerned with the early days of the telephone. He says, "Brantford was my thinking place." There he reviewed the work done in Boston and planned for the future. There, when discussing the problem with his father in the summer of 1874, the thought of the membrane telephone was elaborated. So he says, "the conception originated in Brantford." In the summer of 1876, when he was again in Brantford, he borrowed a line from the Dominion Telegraph and placed instruments in Brantford and Paris—eight miles distant—but as the battery was in Toronto the total circuit was sixty or seventy miles. Professor Bell states that this was the first transmission over a circuit of any length, but it was onesided, not reciprocal.

On April 4th, 1877, was opened the first telephone line specially built for telephone purposes. In October, 1877, Mr. Hugh C. Baker, of Hamilton, leased the first instruments placed on the market for commercial purposes in Canada, and from that day I have been connected with the industry. I have seen it develop from a scientific toy into a necessity of life; have seen it become a blessing to humanity, making the world small, blotting out distance and annihilating space. The once faint voice is now heard in commercial use between the Atlantic and the Pacific. There are 62,000 sets in Toronto producing about 600,000 originating messages, 300,000 of which pass through more than one office. Think of traffic removed from streets, the reduction in shop and office area, the economy of time, the saving of lives and property—to say nothing of the added pleasure in life through being able to speak with those we love, but from whom distance separates.

The First Company

The District Telegraph Company was incorporated March 1, 1878, and obtained the exclusive rights for Wentworth, Halton and Haldimand. The Hamilton Telephone Company took over the business in September, 1878. The exchange was the first in Canada, and within two or three months of the first in the world.

Reverting to Professor Bell. He had among his pupils in Boston Mabel Hubbard, aged 15, whose hearing had been destroyed by scarlet fever when a baby, and was mute in consequence. Bell lost his heart, and in time they became engaged. This led to her father, Gardiner G. Hubbard, supporting Bell financially. But even he was sceptical, and said such a thing never could be more than a scientific toy. He wanted Bell to go on with his musical telegraph, in which he had great faith, and not waste time on visionary schemes. Bell said that if he could make a deaf-mute speak why could he not make iron talk, so he persevered, though ofttimes discouraged, and always hampered by lack of money.

"In the early part of 1874," says Bell, in telling the story, "I had the good fortune to consult Dr. Clarence J. Blake, in relation to the mechanism of the human ear. I told him I wanted to get a phonautograph (an instrument for recording the vibrations of sound) modelled after the ear, and he quite startled me with the suggestion, "Why not take an ear from a dead man and get tracings from the little bones of the ear?" Well, that struck my fancy. I said, "Where will I get the human ear?" Dr. Blake was equal to the occasion, and, in a short time, I had an ear prepared very nicely. That was in 1874. It so happened that it was about summer vacation time, and so I carried this ear up with me to my father's house in Brantford, and there I commenced to make experiments. I moistened the ear with glycerine to make it flexible, and attached to it a small piece of hair,

* Before the Electric Club of Toronto.

and when I spoke into the dead man's ear I saw this hair vibrate. Then I got a piece of smoked glass and put it under the hair and commenced to study the vibrations characteristic of the different elements of speech. Many of these tracings are of the greatest interest and value.

"Now, while I was experimenting with this human ear, it struck me that the bones of the ear were very massive indeed, as compared with the delicate thin membranes that operated them, and the thought occurred that if a membrane so delicate can move bones relatively so massive, why should not a thicker and stouter membrane move a piece of steel.

"At that moment the telephone was conceived. That was the thought which led to it. The conception of the telephone originated during that visit to my father's residence in Brantford, in the summer of 1874, and the apparatus was just as it was subsequently made, a one-membrane telephone."

So the first telephone was just a piece of gold-beater's skin stretched over a drumhead with a small piece of metal glued to its centre.

Bell Got Little Encouragement

But his friends were of little faith. Hubbard told him to stop wasting his time if he wanted to marry his daughter. He was frightfully poor; had given up his school, retaining only two pupils, of whom Mabel Hubbard was one. The respective fathers threatened to cut off all supplies. He was summoned to Washington by his patent solicitor, and had to borrow the railway fare, and stay with a friend to save hotel bill. This visit, however, was the turning point, for there he consulted Prof. Henry, then 78 years of age, who told him he had the germ of a great invention, and when Bell said he lacked electrical knowledge, he told him to get it. Bell then moved his workshop from a cellar in Salem to a room rented from Charles Williams, a maker of electrical supplies. Thomas Watson was Bell's practical assistant, and both lived in two cheap bedrooms. The rent of shop, bedrooms and Watson's salary amounted to $9.00 per week, and was paid by Hubbard and Sanders.

When on that memorable day in June, 1875, he heard the twang he won over Hubbard, Sanders and Watson, and all became enthusiastic. Remembering that Morse, once a painter, had mastered electrical difficulties, Bell grappled with the problems.

The telephone was born but it had not yet spoken a word. Its voice was lamentably weak. Much remained. Discs were tried from boiler plate to thinnest iron. For months they worked incessantly. About July 1st, 1875, it talked. It said, "Mr. Watson, come here, I want you," answered by a mad shout, "I can hear you, I can hear the words."

On his 29th birthday Bell received his patent, the application having been filed February 14th, 1876, and granted on March 7th, 1876. Prof. Bell came to Toronto and consulted with Hon. Geo. Brown and Gordon Brown, who were to take out patents in England, and perhaps other countries, on condition that Bell would refrain from filing the American patent, so that it would not interfere abroad. As a result the American patent dragged for months, and Mr. Hubbard becoming impatient told the solicitor not to wait longer, and so the patent was filed without Bell's knowledge or consent. It was the most valuable single patent ever issued.

Had Grasped the Idea

That Bell clearly realized the underlying principles is shown by the description of August 14th, 1875, when he said that this invention "involved a great principle consisting in the creation and employment of electrical undulations similar in form to sound waves, and insisted that whatever sound could be transmitted by air, including spoken utterances, could be transmitted by these undulations, and he believed his apparatus was sufficient to accomplish it."

His patent covered "the method of and apparatus for, transmitting vocal or other sounds, telegraphically as herein described by causing electrical undulations similar in form to the vibrations of the air accompanying the said vocal or other sounds substantially as set forth."

This was the broad and fundamental patent that weathered the most expensive patent litigation known.

The Centennial was opened a few months later. Hubbard was a Commissioner. The invention was exhibited. Bell had no intention of going. He was poor, and besides, he had a school of vocal physiology, and was in the midst of examinations, but on going to the station to see his sweetheart off he could not resist her tears, and jumped aboard as the train was moving.

The exhibit had attracted no interest, but when Bell arrived on a Sunday afternoon, Mr. Hubbard with difficulty persuaded the judges to view the instrument. They were hot and tired, and their remarks were not encouraging, but Don Pedro, Emperor of Brazil, and the Empress, entered the room, and with outstretched hand told Bell that they were delighted to see him. It seems that Bell had shown the Emperor his work in making deaf-mutes speak when in Boston. "Come along," said the Emperor, and where an Emperor leads judges follow. All at once became keenly interested. A wire had been strung from one end of the room to the other. Bell spoke and the Emperor listened, and with a look of amazement exclaimed, "My God, it talks."

Sir Wm. Thompson—afterwards Lord Kelvin—the engineer of the first Atlantic cable, then listened. He said it was the most wonderful thing he had seen in America, and so the judges gave a certificate of merit.

I have heard Mr. Watson say that in 1877 the four who composed the telephone business at the time, viz., Hubbard, Sanders, Bell and himself (only a boy of 20) had become bitterly disappointed because the Western Union Telegraph had refused their offer to sell all the Bell patents for $100,000. They were much depressed. Bell wanted money more than ever. He was in a hurry to get married. Some of the ladies interested insisted that telephones be made and sold, as many and as quickly as possible, that the ceremony be not delayed. This would have meant flooding the country with very imperfect instruments, and would have blocked the plan of leasing which has resulted in the exchange principle to the great gain of all concerned. A course of lectures was substituted, and it is amusing to hear Mr. Watson recount his experiences. Bell lectured and Watson illustrated by playing a cornet or other instrument, shouting and singing. Once Bell spoke in New York and Watson was in Boston. His laboratory was on the upper floor of a cheap boarding house. Neither he nor Bell, for obvious reasons, were on the best of terms with their landlady. Watson was afraid to disturb the boarders, and though it was intensely hot he took all the bedclothes from both beds, arranged a sort of tent over the big telephone, crawled under and for two mortal hours shouted, played and perspired. In answer to a timid enquiry the next morning the landlady said she had not heard a word.

Bell's Marriage

The lectures created a tremendous interest and shortly Bell married, presenting his wife on their wedding day with a certificate for all his stock in the newly-formed company, saying that but for her the telephone would never have been invented. He gave the Canadian patent to his father.

Bell's work was over; henceforth others were to develop and carry on while he retired to his laboratory. That he foresaw the future is shown by extracts from his addresses about that date, among others, one delivered at the first annual meeting of the Electric Telephone Company at Kensington, England, in 1878, in which he suggested methods for introducing the telephone to the public, in offices, factories and homes. He predicted a network of telephone communication analogous to gas and water systems, the establishment of "central offices," the replacing of speaking tubes, and confidently expressed the belief that "a man in one part of the country may communicate, by word of mouth, with another in a distant place." It would be used, he said, as a means of communication between bankers, merchants, manufacturers, wholesale and retail dealers, in police and fire stations, hospitals and hotels, railway offices and mines.

You know how fully his predictions have been realized. Everything has come true. Cables of wires have been suspended overhead or laid underground. Central exchanges have been established the world over. Long distance lines connect village, town and city. Even speaking tubes have been displaced. Hotels provide a telephone in every room, and there are as many as 32 in one private house in Toronto. Bell saw, as in a vision, the extent to which shopping would be done by telephone. In one thing and one thing only was he wrong, and that is when he said each company would employ a man for the purpose of connecting the wires as directed. Girls may not be infallible, but a man or a boy is an impossibility. Yet I remember when the president of the American company discussed in Hamilton the question as to whether girls were suitable. He said he understood they were employed somewhere, but did not know where, and thought perhaps they would be all right. We engaged the first girl operator in Canada and she now lives in Toronto. The Toronto operating staff now numbers about 1,600.

On the wires of the transcontinental line, sound travels 56,000 miles per second. It takes a sound wave 1/15 of a second to be transmitted 3,400 miles. Sound unaided by the telephone travels only 1,160 feet per second. Perhaps this modern miracle cannot be better illustrated than by a reference to the annual dinner of the International Geographic Society held at the New Willard, Washington, on March 7th last, to celebrate the fortieth anniversary of the award of the patent to Alexander Graham Bell. After the dinner Mr. Carty, chief engineer of the A. T. & T., called the Washington office, and a little lamp burned on a specially prepared map of the proposed voice travel. Then followed Pittsburg, Chicago, Omaha, Denver, Salt Lake City, Pocatello, Boise, Wala Wala, Portland and Seattle—when eleven twinkling lamps glowed. The human voice was speeding from ocean to ocean. Then the Postmaster-General and Sir Robert Borden came in with greetings from Canada. Then jumping from north to south General Pershing joined the voice party at El Paso. Then Jacksonville, Florida, and finally San Francisco, when lights representing 21 places in 17 States and Canada were shown on the map. You will admit that this was a marvellous trip across a great continent on the wings of the electric wires. In their passage across the continent 2,100 sound waves per second—tiny and of varying shapes, irregular and different as the waves of the sea—must not jostle or tumble against each other, but must arrive at the Pacific Coast as they left the Atlantic, unchanged and undisturbed.

On October 21st, 1915, wireless telephone messages were sent by Bell engineers from the wireless station at Arlington (Virginia) near Washington, and were received on the Eiffel Tower, Paris.

The following figures will serve to illustrate the enormous development in the Bell System in America in less than 25 years:—

In 1892 there were 100,000 stations; in 1902, 1,100,000; in 1906, 2,500,000; in 1908, 3,800,000; in 1910, 5,100,000; in 1913, 7,500,000; in 1914, 8,100,000. There are now over 9,500,000.

In telephone investment per capita, the United States takes first place, and Canada second place, among the countries of the world. The United States, with a population of 33 to the square mile, has 9.7 telephones per hundred population; Canada, with a population of only 2 to the square mile, has 6.5 telephones per hundred population. Europe, with 121 persons to the square mile, has only .08 telephones per hundred. More detailed figures are given below. The city of Toronto has a population of approximately 465,000; with 52,500 telephones in use, this means 13.3 per hundred persons, or 1 to every 7.5; the number of miles of wire in the city of Toronto is in the neighborhood of 225,000, of which 75 per cent. is underground; there is approximately 3,000,000 feet of telephone duct. The number of Toronto exchanges now is 10, with a staff of over 2,000.

Telephones Per Hundred of Population

Austria-Hungary, .5; Denmark, 4.2; France, .7; German Empire, 1.9; Great Britain (March, 1913), 1.6; Norway, 3.1; Italy, .2; Netherlands, 1.3; Sweden, 3.9; Switzerland, 2.3; Ontario and Quebec (March 31, 1914), 7.4; Ontario alone (March 31, 1914), 9.21.

Switzerland.—96 per cent of the exchanges close at 9 p.m.; 46 per cent. open from 7 a.m. to noon, then close for two hours for lunch, opening again at 6, close for two hours for tea, then open from 8 to 8.30.

Sweden.—Only 75 out of 2,064 central offices give continuous service.

Belgium.—(Before the War)—Of the 23 larger exchanges, comprising what is called the Brussels group, only two are open day and night.

There are similar restrictions in Germany, France, Italy and other European countries.

Such in forty years has been the development of an industry based upon an invention not brought about through greed for gold nor desire for fame, but as an indirect result of an ardent wish to benefit that unfortunate class known as deaf-mutes.

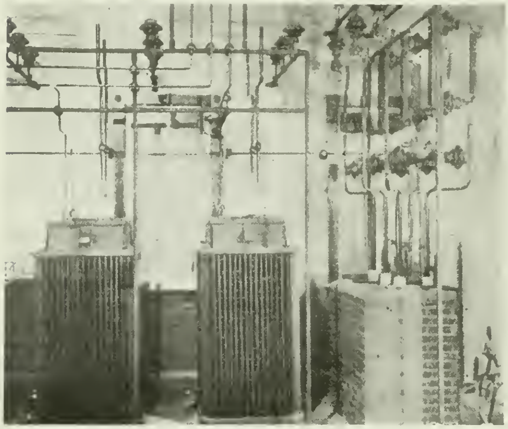
The Listowel Hydro-Electric Station

By Mr. Norman J. Lake

This article comprises a description of the distributing station installed for the Hydro-Electric Power Commission of Ontario at Listowel, Ont. Listowel is a town of about 2,500 population, situated in the northern part of western Ontario. It is essentially a farming community in the surrounding district, but the town contains a number of industries of moderate size, and is a very progressive municipality, possessing water supply, gas, sewer and electric lighting systems. The railway connections are the G. T. R. and C. P. R. The town is prosperous and in a very good position to develop into an important industrial centre. The town has been supplied with electricity for the past six years by a steam plant, owned and operated by the municipality itself. The affairs were administered by a commission appointed by the council every year, and it had proved a very good system.

The power house building was constructed of red brick on a stone foundation, equipped with cement floor throughout and divided into four divisions, consisting of an engine and generator room, pump room with office attached for the chief engineer, a boiler room and an adjoining coal house. The building was well laid out from an efficiency point of view.

The contract for the equipment of the distributing station was awarded to the Canadian Westinghouse Company, exclusive of the lightning arresters, which was let to the Canadian General Electric Company. The contract, in brief, called for three transformers, each of 100 kw., giving a total capacity of 300 kw.; one 26,400 volt oil switch; and a one-panel low-tension distributing board with the necessary connecting apparatus. The advisability of retaining the original steam plant as an auxiliary set, in case of line trouble, was considered, but the idea was discarded, as the old system was 60 cycles, and the new line was 25 cycles. It was decided to dispose of the original plant and install the above equipment.



High tension equipment—Listowel sub station.

The engine room was utilized for a transformer room, and provided ample space. The transformers, choke coils, and oil switch were placed across one end; the lightning arresters, next to the wall in middle of room, and the distributing panel at the other end. Thus a large amount of space was left in the middle of the room for any additions to the apparatus. Only one line was erected to tap the main line at first, but a future line was planned to assure continued service and offset breakdowns. This applied to the town line also, only one system leading out of the distributing panel to the transformers around town, but provision was made for an additional line, and space was provided on the panel for this. The company installed the apparatus in their contract according to the plans prepared by the commission. The transmission line from the main line to the station was erected by the commission. It was a three-wire line, 5 aluminium strands on a steel core being the wire used.

High Tension Switching

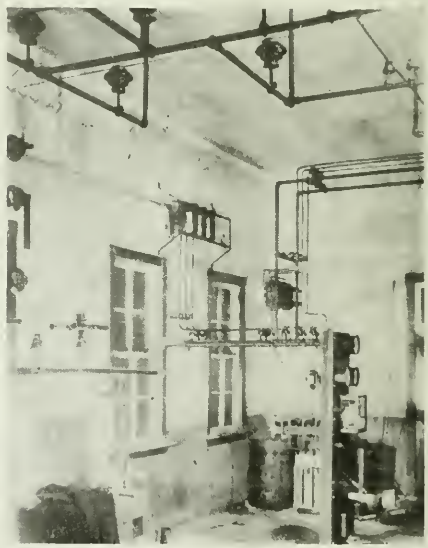
(1) The three wires were brought into the building through insulators placed in the wall and each wire led directly to a 100 amp., 26,400 volt, disconnecting switch on a ceiling mounting, the switch being operated from below by a long pole. All wire used on the high tension end was bare hard-drawn copper wire, .365 inch in diameter. The high tension insulators used were 26,400 volt, brown porcelain, three petticoat type, mounted on an iron stand with a U-bolt fastening for 1¼-inch iron pipe. This size pipe was used for mounting all the equipment, and was standard throughout. The pipes were supported by face plates, having two holes on each side of the pipe through which bolts were used for fastening to the ceiling. In the case of the walls, which were of brick, and the floor, which was concrete, expansion shields and lags were used, size 5 inch by 2½ inch. The specifications called for a clearance of 24 inches between all bare high tension wire.

From the disconnecting switches, the wires lead to three 100 amp., 26,400 volt disconnecting switches, double blade, mounted on the wall directly above the lightning arresters. Between the two sets of disconnecting switches, "T" connections were made and the wires lead vertically downward to the three choke coils. These consisted of a number of turns of aluminium wire and were air cooled, designed for 100 amps. From the choke coils 26,400 volt half-inch cambric covered insulated wire of .325 in. diameter lead the current downwards to the oil switch. The oil switch consisted of three circuit breakers, operating on a common lever and designed for 26,400 volt service, each breaker having a capacity of 100 amperes. They were mounted on brick foundation with each tank in a separate brick compartment.

The switch was operated from a control panel placed at one end and could be tripped either by hand or by the relay circuit. Three relays were mounted between the oil switch and the transformers. They were series trip, 26,400 volts, relays with 10 amp. coils and were operated from the 110-volt potential bus on switchboard. They tripped the oil switch in case of any overload or line trouble and could be adjusted for various values. From the oil switch, insulated wire led to the relay coils, and from the relays, bare wire was put over the top of the transformers on insulators on pipe supports, so that connections could be made to the transformers.

Transformers

(2) The transformer set consisted of three 100 kv.a., single phase, c.i.s.c. transformers with a ratio of 26,400 volts on the high tension side, to 4000/2300 volts on the low tension side. The transformers were of the standard type. They were cooled by oil circulating around the coils. Each transformer weighed about three tons. In shipping, just enough oil was put in to cover the coils and keep them dry, as, if the coils were left uncovered, they absorb moisture, and it is a great inconvenience and loss of time to dry them out by a fire. The rest of the oil was added after the transformers were in place.



Switchboard—Listowel sub-station.

The high tension side was wired in delta. Connections were made to the overhead bus by "T" connectors. All connections were soldered. On the low tension side, one terminal of each transformer was connected to a common ground wire which ran along the wall and terminated in a ground plate of tinned copper, buried outside the building, in damp ground to a depth of 7 feet. Size of plate was 2 ft. x 3 ft. x ⅛ in. The other terminal was connected by .325 in. cambric insulated wire for 4000 volt service. This gave 2300 volts on each of the three wires, or 4000 volts between them. These wires passed, by means of insulators mounted on pipes, to the 4,000 volt bus on top of the switchboard.

Low Tension and Switching

(3) The switchboard consisted of two panels of slate, one mounted above the other. The lower one was 25 in. x 24 in. x 2 in. in size and the upper one 65 in. x 24 in. x 2 in. They were mounted on an iron frame, which was fastened to the floor by a "U" beam across the bottom, filled with concrete, and at the top by two horizontal pipe braces, one on each side of board. These braces also supported the 4000 volt bus. The three potential transformers were mounted on a bracket above the bus, together with their fuse blocks in a convenient place to tap the mains, which was done by "T" connectors. These transformers supplied the 110 volt current to operate the relay switches and other small apparatus.

From the bus three wires led down to the oil switch, the two outside wires having a series transformer on each of them to trip the switch in case of overload or trouble. The middle wire had two of the same mounted on it. The secondary leads from these went directly to the two series relay trip coils mounted on the bottom panel, and to the instruments on top panel.

The oil switch was a type "B" three phase, 300 amp., 4000 volt automatic oil circuit breaker. This switch was operated from the front of the board either by hand, or by the series relay trip in case of trouble. From the other side of the switchboard three feeder wires went up the board and across to the wall to the three type "S" lightning arresters which were mounted on an iron bracket, the bracket providing space for three more of the same when a future feeder line is added.

Mounted on the feeder panel is one a.c. ammeter, 100 amp., 25 cycle, with space alongside for another ammeter in case of a future line being installed. There is also a phase plug and three phase receptacles, so that the current on any phase can be read at any time. This removes the necessity of using three ammeters, one for each phase, and hence is much more economical; there is also one voltmeter with a range of 0-3000 volts, together with an 8 pt. receptacle and 4 pt. plug to read voltage on any phase; one power-factor, polyphase, indicating meter; one graphic recording polyphase wattmeter for 25 cycle. All meter connections were made from a small slate panel mounted at the back of the board and were provided with test links so that a convenient test could be made at any time.

Economical Construction of Rural Lines

By A. S. Hall

The subject of electricity in rural districts is one which is attracting more attention every year. The central stations of the Pacific Northwest have practically secured all of the business which is to come to them unsolicited. It is true that some business does come voluntarily, but upon investigation it is generally found that advertising or soliciting in some form is the basis of the customer's decision.

The purposes for which electricity can be used to the greatest profit to both customer and company have segregated themselves, and have been cared for by the central stations, up to a point where the activity of central station is the factor which is to produce the new business of the future. The business which we are to secure in the future divides itself into three classes: First, the competitive class; second, the development class; and, third, the rural class.

The competitive class is that portion which is now using wood, coal, or petroleum products, and to secure this is solicitor's work.

The development class is that portion of the lighting and power business which the engineer and promoter will obtain by inducing factories and mills to locate and enlarge and use power, with the attendant commercial and resident load.

The third, or rural class, is not necessarily the third from standpoint of size, and may eventually become a very large proportion of our total business. Up to this time this rural business has not been sought to any great extent by organized methods, for the reason, unfortunately, we have not realized the possibilities in it, and for the further reason that we have up to this time devoted our attention to the business which is nearer home and apparently more remunerative.

The extent of the available rural business may be realized when we know that practically every town in the Pacific Northwest is surrounded by an agricultural community, and in many cases the surrounding community has a population nearly as large as the city itself.

In Hood River County 37 per cent. of the population served is outside the city limits of Hood River. Only 30 per cent. of the population of the county is inside of the city limits, and I believe that eventually 50 per cent. of the population served will be outside of the city. This 37 per cent. of the population served furnishes 38 per cent. of our gross revenues; therefore it is a safe assumption that when 50 per cent. of the population served is outside the city limits, over 50 per cent. of our gross revenue will come from this rural business. It is a proven fact that rural customers use in their homes more kilowatt-hours and apply electricity to more different purposes than do the city customers.

Water Systems in Country Homes.

It may be well to mention some of the uses to which electricity is applied in our case. Over 50 per cent. of our customers use apple graders run by electricity. These are driven by small motors, which are operated on the lighting circuit at lighting rates. About 20 per cent. of them have water in their homes under pressure, using electric-driven pumps. Their barns and apple houses are all lighted. Some of them have small street lighting systems in and around their property. The average farm circuit contains about 35 outlets, in some cases running as high as 100 outlets.

Nor can you say that Hood River, an apple raising district, uses more electricity than would be used by the average other rural community. By analysis we find that year after after year the stock raiser, the dairyman, and the diversified farmer have a much more uniform income, and a larger income in proportion to their investment, than does the apple grower. Not only this, but there is less labor which can be performed by electricity, in the apple industry, than there is in either of the three lines of agriculture mentioned. Nor does this rural business follow proportionally to population.

Paper read before Portland, Ore. section of N.E.L.A. and A.I.E.E.

It follows rather proportionally to acreage; for instance, a farmer recently stated to me voluntarily that he has nine pieces of farm machinery which he operates by electricity from a 15 h.p. motor. These include a woodsaw, threshing outfit, cream separator, churn, cider mill, and hay-handling apparatus. He stated that he guaranteed the electric company $35 a month, and his bill frequently runs to $75 per month. He further said that the installation saves him $150 per month the year around, over what he has to pay to the electric company.

When we look at the other phase of our rural business, however, we find a somewhat different result. This 37 per cent. of gross business, furnishing 38 per cent. of gross revenue, uses 51 per cent. of our operating expense. The principal reason for the high cost of operation of rural business is in the distances which have to be covered by the commercial and trouble department, with the consequent loss of time and cost of transportation. These difficulties are being overcome to a certain extent by gasoline for transportation, but a portion of this expense will always remain as a handicap. Our rural business requiring 51 per cent. of the operating expenses furnishes only 10 per cent. of our net revenue from operation and about one-third of 1 per cent. of our net operating income.

These figures are developed from actual operating expenses and appraised property values as determined by the Oregon Commission in the Hood River rate case. They make no attempt to favor either class of business. Each class is made to stand its own depreciation, operating expense, production expense, and taxes, but, as a matter of fact, were it not for the 37 per cent. of rural business the city business would show a less net revenue than it now does, and the rates on the city business would have to be increased materially. The commission realized this when it decreased the rural rates and increased the city rate. It made this decrease in the rural rates notwithstanding that the analysis showed that the just rural rate should be 18.89 cents per kw.-hour as against 12.53 cents which we are receiving. In making this reduction it established a precedent which will enable us to handle much rural business that could not otherwise be accepted.

Rural Business Justified.

If the theory on which it made this reduction is a sound business principle, and it is so recognized in railroad rates and is becoming recognized in electric rates, we then are justified in going after this rural business, even at an apparent loss. Of course, we are limited by the quantity of rural business which a given city business can support. It is evident that this principle cannot be carried beyond the point where the city rate begins to be burdened by having a rural business attached. In other words, we may take on all the low-priced business we can handle without actually increasing the rate on the original business, but to take on more than that amount of low-priced business would be an unjust discrimination against the city customer. Our analysis shows that in our rural business 38 per cent. of the gross revenue uses 47 per cent. of the total investment, or, in other words, 9 per cent. more than its normal share. This 9 per cent. of the investment, of course, carries taxes, interest, and depreciation, so that the excess reacts doubly against the net profits from the business.

The greatest problom now confronting us in the rural field is how to overcome this handicap. It is obvious that it cannot be done by the present methods of standard construction; we are using these in a modified form to-day. We are not justified in admitting that it cannot be overcome, because the central stations demand this revenue, and the development of the county demands the service. The solution, therefore, lies along the lines of new standards of construction, and on analysis it is obvious that this business will permit—in fact, lends itself particularly to—different standards of construction from that which we have developed for the city business.

Many Unsolved Problems.

Some pioneering has been done in rural construction, but only enough to bring us in touch with the unsolved problems, rather than to work out a solution of them. They will not be solved in a day, because we are loath to part from established practices; but this we must do to the extent that eventually we will have one set of standards for rural work recognized as such, and entirely different from those specified for city work.

I might mention some of the methods which have been tried out, and others which should be tried out, for the reduction of first cost. The distance between supports has been increased to where we have distributing lines of solid copper operating with perfect satisfaction in spans of 250 feet. How much farther we may extend is yet to be determined, but above 250 feet it is apparent that local atmospheric conditions must be taken into consideration. Possibly copper-clad steel or other combination of metals may increase that span at a lower cost per mile.

The steel and the reinforced poles which are receiving consideration for transmission and city distribution may eventually be the solution of the support problem, for the reason that the maintenance of poles is great where the poles form a large proportion of the investment.

The insulated copper which has in the past been regarded as proper for city uses is entirely out of place in rural construction. It shortens the span, thereby increasing support cost, and the insulation does not add any great factor of safety in the rural districts.

Standard of Voltage.

It has not yet been established what voltage is best adapted as a standard for rural work, nor which scheme of transformer connections is the best to adopt as a standard. In our case we use 110 volts for all single-phase circuits and 220 volts for most polyphase purposes. I do not believe that this can be improved upon, as it offers the most flexibility of any scheme of secondary voltages. In the primary side we use delta connected 3-wire, 6,600-volt and 2,200 volt systems. There is much to be said in favor of 4,000 volt or 11,000-volt star connected, grounded neutral primary circuit for rural work. It has the advantage of fewer necessary grounds, thereby lower grounding cost, and a further advantage of cutting out the circuit entirely by an automatic switch in case any of the three wires should be grounded, whereas the delta-connected three-wire primary will sometimes operate with one wire down, at a great danger to pedestrians and traffic. It has the additional advantage of placing the ground on the high voltage side, which is the voltage we are grounding against, and by grounding the secondary also the customer is rendered doubly safe. It gives us an increase in voltage, hence lower copper cost, using the same transformers. A single wire can be run to handle single-phase distribution transformers, using the earth as a ground return. This has in some cases proven satisfactory. A plan which has saved us considerable first cost has been the banking of transformers in multiple on both primary and secondary side. This is not good practice in the city, but the objections are not so apparent in rural work and there is a decided saving in both transformers and copper on account of being able to use larger transformer units and consequently take advantage of the diversity factor of grouped customers.

Low Cost Transformers.

One of the greatest problems, and one which must be solved by the manufacturers, is the securing of a low cost transformer. At present strictly domestic rural business is practically prohibited by transformer cost. The transformers which have been designed and standardized for city work must be redesigned to meet rural conditions. Efficiency must be sacrificed in favor of first cost, and beauty of design and portability can also be sacrificed. It is possible that a transformer without oil, and with a tank made of sheet metal with ventilating outlets, can be designed to hang from a crossarm with the leads brought out at the bottom without bushings, which will meet these requirements at half the present cost.

Up to this time the regulatory bodies have prescribed the same voltage variations for rural as for city business, and central stations have worked to these standards, but it is obvious that a greater range of variation will give a corresponding decrease in first cost, and this decrease will enable many customers to secure service which we cannot afford to take on now.

The combination of electric light and telephone on the same poles is another possible solution of part of this first cost item. We have consistently educated ourselves to separate electricity and telephone, and where the business will justify separation this is advisable, and in most cases necessary; but beyond the reach of either telephone or electric light singly, are large numbers of customers who could be profitably reached and served with both telephonee and light by properly constructed joint pole lines. By this I do not mean a cheap line, as usually built, but a line carefully designed, with due regard to safety and the other detrimental factors, and I maintain that such a line can be built for less money than the average cheap rural lines and unsafe crossings which we see in many of the rural districts to-day.

Electrically Operated Farm Machinery.

The application of electricity to farm machinery is a field by itself, and a field which has barely been touched. In the orchards of our principal fruit sections are thousands of spray machines driven by gasoline engines. Not one has yet been superseded by electric power. Anyone going through a modern dairy farm will find a dozen uses for electricity. But this field will be developed rapidly when the power is made available.

The systems of rates developed for city business have up to this time been applied to rural business, but the attempt to modify these to suit rural conditions has emphasized the need of revised methods of selling rural electricity. No doubt the eventual system for rural work will be flat rates based on maximum demand or demand control, but before this can be brought about to any great extent further investigation must be made into the business already developed.

As the engineer has devoted his energy to the problems of the classes of business already secured and standardized his results, so must he apply his energy to the problems of rural distribution before any great portion of the enormous revenue available can be secured.

The demand for electricity in the rural districts will be greater from year to year, and the means of distribution must be standardized, and we should profit by past experience and standardize before we secure the business, rather than doing it after much money has been spent in working along lines which are not permanent; and on the standards so adapted depend almost entirely the amount of business which a rural district will furnish.

Advances in Street Illumination

The photograph herewith illustrates what is known as "The Path of Gold" of San Francisco. The installation, consisting of a total of 439 lamps, takes in fifteen business blocks on the north side of the street and thirteen blocks on the south side, a distance of approximately 7,500 feet, and including the Ferry Building Plaza, 1.5 miles. General Electric luminous arc lamps have been adopted. They operate at 6.6 amperes, but the appearance is greatly enhanced by the addition of the new sectional globe and special glassware. There is a yellowish tint to the glass that is visible in daytime, but not at night, when it prevents any glare. These lamps are mounted in the form of a triangle with the plane of the lights at right angles to the direction of the street, and have a combined candle power of 4,500. The poles average 110 feet apart and are 32 feet high, including the ornamental triangular tops. Decorative trolley poles carry the lamps, which have bronzed surfaces tinted green to simulate a weathered effect.

The "Path of Gold." Note perfect illumination of roadway and sidewalk. Unit shown at left.

Electric Railways

The Street Railway and the Jitney as an Economic Factor in the Community.*

The Council has asked my company to send a representative to this meeting, at which, I understand, various matters in connection with jitney traffic are to be considered, and I am glad of an opportunity to put the views of my company before your Council on this matter.

We have not until this time adopted any public attitude antagonistic to the jitney.

This was not because we did not realize that the condition of affairs which converted the whole operation of the city system into an unsound and insolvent undertaking must in a very short time necessitate drastic changes affecting the efficiency of our city system as a whole, but because we believed that the Council and the business people generally would realize in their own good time just how unfair the competition was and would take steps to put the matter on a fair and equitable basis.

The older and more settled communities in the East have already expressed themselves on this question, and where a capable and impartial body has directed its attention to this question there has been little doubt as to the result of the deliberations.

The Public Service Commission of New York State made a very complete report on this subject, and I just quote one or two sentences:

"The time is not yet ripe to abandon the electric street railway as the standard means of urban transportation.

"The operation of jitneys in direct competition would so impair electric street railway revenues and progress as to result in defective service and the eventual death of the older means of transportation.

"Dependable Transportation."

"And since arrested development in the case of any business enterprises usually means slow death, such a decision could only be taken to mean that in our opinion the traffic needs of the city would best be served by a gradual replacement of the old by the new method of transportation.

"Now, as a matter of fact, the commission believes nothing of the sort. On the contrary, we are of the opinion that the electric railway must for many years be regarded as the backbone of any dependable transportation system in such a city.

"To arrest the development of electric railways would be to injure greatly the city's growth and future prospects, and the situation seems to us to be in no wise changed by the fact that the competition comes from individuals, and perhaps in some cases irresponsible owners of autos, instead of from a single well-managed company.

"In either case the competition would certainly be large enough to interfere seriously with any further growth of the electric railway system, and in our opinion no dependable form of transportation, good alike in winter and summer, has yet been devised to take the place of what the city would lose if further development of its electric railways was to be discouraged and interfered with by the state.

"Protection is being extended to it now because we feel that on the whole the existing street railway system, viewed not as a money-making machine operated for the benefit of its stockholders, but as a public agency, is distinctly worth saving in the interests of the people of the city."

The Rough With the Smooth.

Some years ago my company entered into an agreement to provide a transportation system for the city, and on the strength of the franchise obtained borrowed money in increasing amounts as the city developed.

There can be no question that at the time the franchise was given there was no idea of any competition or duplicating, at least over those lines where the company had its tracks, otherwise no money could have been obtained for such an undertaking.

We might reasonably contend that according to the spirit of our franchise we had the right to cater for the whole travel on certain routes on which our tracks are laid, providing we are complying with the conditions of the franchise and travel on those routes.

Public opinion has demanded a fixed fare, and we in our agreement undertook to follow in line with public opinion in this matter and to provide transportation anywhere in the city of Vancouver for a fixed fare.

With increasing length of lines, increasing demand with regard to the quality of travel and of rolling stock, increasing rates of wages, increasing cost of materials, the fixed fare has been a serious burden to all street railway companies, and has only been possible while the question could be considered as a whole.

Many of our lines are operated at a very great loss, and the whole basis on which the fixed fare and transfer system is based is that the rough shall be taken with the smooth and an average result obtained.

The advent of the jitney in its unregulated form was a permission to draw revenue from the smooth without the obligation to take any of the rough. This is our first cause of complaint.

Council Demanded Facilities.

You may say that there is nothing in the franchise giving the company the privilege of catering for the transportation of this city as a whole, but the company has taken upon itself the obligation of dealing with the whole system of transportation, and, as I will show, this obligation has been recognized by the city, and we might fairly claim the privileges which would follow that obligation.

Some years ago, when Vancouver was growing very rapidly, the Council was insistent in its demands for the extension of lines. These demands were complied with long before the roads provided by the Council were fit for travel, and at these times the tramway was the only means of transportation.

In the years 1910, 1911, and 1912 the Council repeatedly and emphatically pointed to the necessity of the company purchasing more cars. We did. We purchased the cars as

* Address of Mr. W. G. Murrin, Assistant General Manager of the B.C. Electric Railway Company, before the Vancouver City Council, November 20th, 1916.

quickly as they could be obtained, and eventually, at the insistent demand of the Council, the last order was placed, amounting to $400,000.

If the Council did not consider that we had any obligation to deal with the whole travel of the community why did they so insist and press their demand that we should provide additional cars?

That obligation was met by the company, and to-day, in addition to having cars we do not need, we have twenty cars which are paid for and not yet delivered. Is there no obligation on the Council in connection with this matter?

They have asked the company to increase its plant to cater for the increasing population. Have we not a right to ask the Council to give us the privilege of handling the additional population at least during such time as we have an opportunity of using the plant purchased at their request?

What security has any investor in undertakings under municipal supervision if the Council would not consider that it had an obligation under these conditions?

Obligations Placed on Company Under Franchise Should Be Placed on Other Modes of Transportation.

When our franchise was granted, certain obligations were imposed on the company, and I ask the Council, in all fairness, to do the least they can reasonably be expected to do in this matter, viz:

To attach to any permission to cater for transportation in the city the same or equal obligations that they ask of my company.

There are very few business men in the city of Vancouver to-day who do not realize that my company is having a very raw deal, and I will attempt to show why this is.

It is because at a time when the company was endeavoring, with some difficulty, to meet its obligations to the city and comply with all the conditions of the franchise the city permitted competitors to operate in such a way as to interfere seriously with the company's business, and at the same time has not subjected those competitors to the obligations which have been exacted from the company.

Assuming, therefore, it is fair to ask the Council to impose the same conditions on the jitney as it does on the company, how is this state of affairs to be brought about?

Imagine instead of a series of individuals applying for the right to operate on city streets that a responsible corporation asked the Council for the privilege of operating this type of vehicle in competition with the street railway company. What might the Council fairly ask in return for this privilege given?

The Long and the Short Haul.

The first thing that is asked of the street railway is that it shall for a fixed fare carry people from any one point in the city to any other point in the city, whether it likes to or not. That is to say, that in return for the privilege of carrying a short rider it must carry the long rider at the same fare.

Would it not be essential for the Council to ask any responsible corporation competing with the street railway to comply with this arrangement?

Now, instead of one responsible corporation you have a number of corporations. Each individual is a corporation responsible in himself to the Council, and for whom no one else can be responsible. You cannot ask him to give a transfer to any other car, but this does not relieve him of the obligation of providing for long as well as short riders.

To insure this the Council must fix the routes on which the individual has to run, and must insist that the individual runs regularly on these routes from end to end. This is a poor substitute for the transfer system the company has to operate, but is the least that can be done in fairness.

We are not allowed to do just as we please, neither should our competitors be, and in this connection I contend that while transfers cannot be issued, the routes should be so fixed that the obligation to carry the long rider exists with the privilege to carry the short rider.

Instead of the routes being fixed from the centre of the town to the extremities, the routes should be fixed through town from end to end, and this is the only way the Council can impose any obligation in return for the privilege of carrying the short rider.

Company Pays City Percentage on Its Earnings, Bridge Rentals, and Heavy Tax Bills—Other Obligations.

The next point wherein my company is unfairly discriminated against, as compared with its competitor, is in connection with the amount which the city demands from it for the privilege of running.

We pay a percentage of our receipts to the city, and this percentage is on a sliding scale, rising to 8 per cent., and averages somewhere in the neighborhood of 5 and 6 per cent., whereas the only charge made by the city on the jitney for the privilege of running is the $25 license fee, with the $2 individual driver's license, which amounts to something less than 1 per cent. of the revenue earned.

Surely I am not making an unjust claim when I ask that the jitney driver should be asked to pay the same percentage of his revenue to the city treasury that my company has to pay!

In 1913 we paid to the city $85,000. In 1915 this was reduced, by jitney competition largely and other causes in part, to $35,000.

The difference between the amount we pay to the city and the amount we should pay, if there were no jitney competion, is a direct loss to the city as the result of the operation of jitneys, and as heavy taxpayers we have to bear part of the burden of this loss. Every dollar taken from the revenue of the street railway company is removed at the highest percentage, and affects the city exchequer to a much greater extent.

I say the company may fairly ask the city to fix an amount to be paid by the jitney for the privilege of running at least equal to the percentage now paid by my company, and I will indicate one or two reasons why we mightly fairly ask that the amount should be more than this.

Company Provides Own Tracks.

In the first place, my company provides its own roadbed, and the maintenance of this roadbed costs us $40,000 per annum, this sum not including the cost of renewals when tracks are worn out.

The jitney does not provide its own roadbed, but by virtue of its running adds largely to the maintenance of the roads. This I believe to be a very serious item, and we as taxpayers contribute a part of this increased cost.

We pay the sum of $9,000 per annum for the privilege of running over the city bridges.

The jitney does not pay anything for the privilege of running over the city roads across the bridges, and I might say, as an offset to the $25 received as a jitney license, the city has had to incur additional expense in the way of additional point men, license inspector, etc., which considerably reduces the amount annually received from the jitney.

Free Transportation City Officials.

One of the conditions of our franchise is that we shall provide free transportation for city officials; that we shall carry policemen and firemen at all times within the city limits when in uniform.

Still on this argument that we are entitled to ask for equal conditions for the jitney and equal obligations to be imposed on them, what has been asked of the jitney in this connection?

We have issued this year 166 passes to aldermen and officials who are entitled to free transportation, in addition to carrying policemen and firemen free. At a very moderate estimate, the total value of this transportation is at least $20,000 per annum.

Have the jitneys been asked to make any such arrangements for the privilege of running on the city streets?

Should they not fairly be compelled to accept an obligation equivalent to this, if my company is compelled to accept this obligation?

Design of Cars.

We have been compelled to design our cars so as to make them suitable vehicles for public transportation, and the regulations passed in 1912 imposed on my company the obligation to make certain alterations to equip cars with gates and make other changes which cost us $250,000, practically the whole of which was unremunerative expenditure.

There was no question raised as to our ability to afford this amount. The only point considered was whether the vehicle provided by us was as suitable as it could be for public transportation.

I think the jitney has been allowed to go practically free on this score, and to use a vehicle designed for an entirely different purpose, for the purpose of private travel, even though it must be admitted that in many ways it is quite unsuitable for public transportation with mixed sexes.

Congestion.

In 1913 the population of Vancouver was larger than it is to-day, and the number of people travelling as a whole much larger than it is to-day, but the congestion of city streets was in no way to be compared with the congestion as it exists to-day since the jitney started.

Not only are the main thoroughfares almost blocked to ordinary traffic, but the dangers to the large numbers of passengers who use our street cars have been increased very greatly.

Our own accidents have increased as a result of the presence of the jitney, and a large number of boarding and alighting accidents have been entirely due to breaches of regulations by the jitney.

We are in receipt of numerous complaints from time to time from passengers calling our attention to this danger, pointing out the difficulty they have in boarding and alighting from street cars.

I know the Council recognizes this state of affairs, and I am merely drawing this matter to your attention as one of the direct phases of the jitney situation.

Rights of Pedestrians.

My company has financially and in every other way to stand behind any accident which occurs to passengers on our cars, to pedestrians in the streets, to the users and owners of other vehicles.

There has never been a complaint as to the way in which we have carried out our obligations in this connection.

In entering the field of public transportation the owner of a jitney has placed himself in a position in which he may be responsible for heavy damage to his own passengers, heavy damage to pedestrians, and other vehicles.

To some extent the inability of the jitney driver to be adequately responsible for his misdoings or accidents has been recognized by the existence of a bond to cover the cost of any such damage.

Now I maintain that the present bond is absolutely inadequate, and does not place the jitney driver on anything like the same plane that my company stands on. The liability for an individual accident is $1,000.

Only last week we have paid out $2,000 in one claim, and have paid out as much as $16,000 on a single claim. The accident that occurred to the Ladner jitney could reasonably have cost approximately $100,000.

Of what use is a $5,000 liability to cover accidents of this kind? I would say nothing about the liability to make good accidents done to other vehicles.

For the jitney driver to be adequately responsible for the damage liable to be incurred by him and make good his claim the amount of this bond should be very largely increased.

I have endeavored, gentlemen, to bring to your attention a few points out of many wherein my company is not getting a fair deal—that is to say, because we are asked to fulfil certain obligations in payment of our privilege to operate, which our competitors are not asked to fulfil.

Remove Company's Obligations.

I have heard it argued that the earnings of the jitney driver are not sufficient to enable him to bear his fair share of the obligations entailed by being permitted to run on city streetes.

If the financial returns of the business of carrying city passengers are not considered in connection with the obligations imposed on those who are catering for this travel, then I here and now ask you to remove some of the obligations imposed on us.

I can prove to you beyond question that my company is operating its city system to-day at a considerable loss, and the earnings per car mile on our street railway system are less than our operating costs.

We cannot financially justify the obligations that we are called upon to bear. Therefore, I say either put the jitney on the same basis that we operate on or adjust our obligations so that we are on an equal basis with the jitney. Is this an unfair request?

We believe that Vancouver is only at the beginning of its real development, and that the question relating to the treatment of capital by the city, at a time when capital is required by almost every industry, is of supreme importance to the welfare and eventual growth of this city.

Many Company Employees.

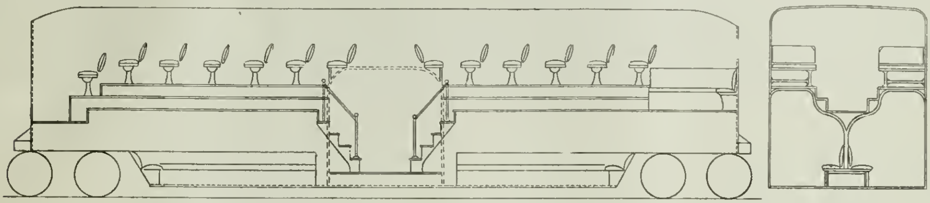
We believe that the growth of the city will be assisted largely by the healthy development of a street railway system operating under conditions which we can reasonably be expected to operate under, and I ask your Council to treat this matter broadly, without regard to individual interests either in the Council or outside it, and I have every faith that the Council will in its wisdom so deal with this matter that a fair and equitable arrangement will be arrived at, doing equal justice to all concerned.

If you are considering personalities, then I ask you to bear in mind that my company is one of the largest employers of labor in this district; that its employees depend on the company's ability to run its cars, and that the number of men affected by the failure of the Council to act equitably as between ourselves and the jitney is greater in our case than in the case of the jitneys.

The majority of our employees are taxpayers, and they have a direct interest in this matter, and, as I have said, if personal interests are to be considered, their individual interest surely calls for the same attention on your part as the individual interest of any particular jitney driver.

Design for Increasing Car Capacity.

Patents recently issued to Fred Steffens, master mechanic St. Joseph Railway, Light, and Power Company, covering a new type of car for electric railway service, are described in the Electric Railway Journal. The prominent feature is the great increase in capacity which it attained by making use of a modified form of double-deck arrangement, although the design provides for galleries rather than an upper deck for the support of the elevated tier of seats. This arrangement is practically a reversal of the scheme adopted in the New York and Pittsburg double-deck cars of three years ago, the seats on the lower deck being longitudinal and located along the centre line of the car, while the upper tier of seats makes use of cross-seats located along the car sides. Access to the upper tier is attained by longitudinal steps along a central passageway, this passageway being reached by a stairway with five steps rising from a slightly elevated platform at the centre portion of the lower deck.

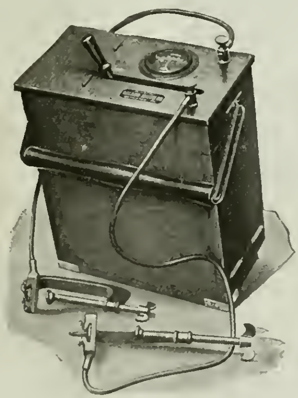


Design for car of large capacity.

The design calls for a length of 45 feet over all, and the total seating capacity is estimated to be 98, 40 seats being provided on the lower deck, while the galleries seat 58, the estimated weight per seated passenger being 400 pounds. The height from top of rail to top of entrance floor is 12 inches, and the height from rail to the top of the trolley board is 12 feet 10 inches, this over-all vertical dimension giving a clear height above the lower deck aisles of 6 feet 4 inches, and a clear height of 6 feet 8 inches above the floor of the gallery aisle.

Portable Battery for Bond Testing

The Roller-Smith Company have recently issued a bulletin describing a portable storage battery equipment for use with their bond tester. The particular application of this apparatus is to provide an external source of current for testing rail bonds with the Roller-Smith bond tester, as it sometimes happens that the current normally flowing in the rail is insufficient, or current may not be present at all—as during construction. The equipment comprises a carrying case in which there is mounted an Edison A-5 storage battery of 187.5 ampere hours capacity, as the source of current; an ammeter, range 60-0-60 amp., to show rate of battery charge or discharge; a rheostat whose first step is an open circuit step and whose succeeding steps are used for establishing and bringing to correct value the rail current; and a knife blade switch for interruption of circuit during transportation. There is also a compartment for carrying the cables and clamps. The illustration herewith shows this new battery equipment.



Personals

Mr. F. W. Teele, formerly vice-president and general manager of the Porto Rico Railways, has been elected vice-president of the Southern Canada Power Company, Montreal.

Mr. Howard Murray, vice-president and treasurer of the Shawinigan Water and Power Company, having joined the staff of the Imperial Munitions Board,—the directors have given him a year's leave of absence—Mr. Julian C. Smith, chief engineer and general superintendent, has been appointed gneral manager of the company.

Mr. E. Hanson, A.A.I.E.E., M. Inst. Mun. E., has been appointed secretary of the Institute of Municipal Engineers (London, Eng.), for Western Canada. It is the intention to inaugurate a campaign for members amongst municipal engineers in the West, with a view to securing closer co-operation amongst municipal engineers of all classes, and furthering the cause of municipal engineering throughout Western Canada.

Mr. F. A. Chisholm, former superintendent of the St. John, P. Q., division of the Southern Canada Power Company, has been appointed superintendent of power of the Sherbrooke Railway and Power Company, vice Mr. J. T. Kemp, resigned. Mr. A. P. Broadhead, superintendent of the Drummondville division of the Southern Canada Power Company, succeeds Mr. Chisholm at St. Johns, while Mr. H. P. Fisk takes the place of Mr. Broadhead at Drummondville. Mr. Geo. Atchison has been appointed to take charge of the merchandising department of the same company in Montreal. He was formerly in the Montreal office of the C. G. E.

Mr. G. R. G. Conway, of the Mexican Light and Power Company, has been nominated as one of the vice-presidents of the Canadian Society of Civil Engineers for next year. Other gentlemen connected with the electrical industry nominated as members of the Council are: District No. 1, Messrs. R. A. Ross, consulting engineer, Montreal, and Julian C. Smith, general manager Shawinigan Water & Power Company, Montreal. District No. 4, Mr. John Murphy, electrical engineer, Department of Railways and Canals, Ottawa. District No. 7, Mr. R. F. Hayward, chief engineer, Western Canada Power Company, Vancouver.

The two lighting and power companies in Montreal made special efforts to interest the public during the electrical week, December 2-9. The Montreal Light, Heat & Power Company announced a reduction of 10 per cent. on all electrical appliances, and the Montreal Public Service Corporation used large newspaper space for the purpose of calling the attention of householders and merchants and manufacturers to the advantages of electricity for lighting, household, and power purposes.

The Provincial Hydro Commission are calling tenders shortly for a 13,000/2,200 volt distributing station to supply Mimico, New Toronto, the Mimico Hospital for the Insane, and numerous brick yards and other industries. About 4,000 h.p. capacity will be installed initially.

to say that my criticism was not made without careful consideration of the problem involved.

It would appear that the above problem may be divided under two headings, namely, (1) question of the replacing of the neutral fuse in districts which at one time were not grounded, but which have been subsequently grounded, and (2) fitting up by contractors of existing three wire cutouts now in dealers' stocks, for new installations in order to conform to Rule 23.

As to the first of these I have not heard what central stations intend to do in this matter; probably by reason of your extensive connections you may have knowledge of some scheme being worked out in reference to replacement of the neutral fuse, but in actual practice I really believe that a neutral fuse installed in conformity with the rules existing at the time of its installation will remain until it burns out and that except in the case of central stations who have highly developed trouble departments, these fuses may be expected to be replaced by other fuses.

As to the other division of this subject, namely, the adaptation of existing new material to be installed, it would appear that either in the case of the plug form of cutout or the cartridge type that it would be better to instruct the contractors through the medium of the inspection departments as to the methods of adaptation that would be approved. In my own particular territory we have approved of a strip of copper placed across the bases that formerly held the clips for a cartridge fuse and we have taken these clips off entirely. In the case of a plug cutout we unscrew the centre contact, take out the mica washers and replace these with a copper washer and then screw the central contact down again. Each of these alterations can be carried out at very slight expense by the contractor and they will form a reliable contact.

One of my objections to the Bryant No Fuse Plug, is that I have met with considerable trouble in plug cutouts in certain classes of buildings in the way of loosening of the plug due to vibration. This especially is the case of the neutral plug has proved a serious matter in the way of lamp breakage, and I question whether the crimping of the outer edge of the screw shell over the edge of the Bryant Plug would be satisfactory, but at any rate it would not look a workmanlike job, and soldering would also have to be carefully done to be effective.

I think, as far as the manufacturers are concerned, they can readily change over their existing lines of cutouts in a manner similar to that outlined above at very little expense, and failing this, contractors could readily do so, so that to my mind the only problem remaining is the requirement of existing neutral fuses, lawfully installed at the time of installation; and as to this the Code does not give any direction, to my mind, so that it is left to either the central station authorities or local inspectors concerned, and as before stated, chances are that the only neutral fuses that will be changed over will be those that blow, which will amount to an exceedingly small percentage of the neutral fuses installed on a central station system.

Another of my objections is that once this device is placed on the market and recognized as being an approved device, the temptation to use it in an unlawful manner should not be lost sight of. We know only too well the trouble that people will take to bridge existing fuses, and if this device, which is of such simple application that the merest novice can install it, is allowed to be sold, possibilities of serious trouble are not very far off. Further, the Bryant Company would not be the only parties who could manufacture such a device, and the consequence would be that large numbers of these would be on the market, the inevitable conclusion being that they would find their way into the hands of the public and be used in an improper manner.

It is greatly to be regretted that the whole matter has been insufficiently considered by the Code Committee, as it is evident that the wording of several of the paragraphs will require to be changed; no provision being made, for instance, of the omission of the fuse on the grounded side of a two-wire service, and, owing to the ambiguity of the Code, manufacturers have naturally hesitated to provide for any changes in their design. As illustrating this I have had the matter of the enclosed service entrance cabinet under consideration, and find this very difficulty exists in dealing with the manufacturers.

I trust that the whole situation will be clarified at the forthcoming Code Revision Committee meetings, so that the manufacturers may be able to ascertain what really is intended to be called for, when, no doubt, they will be prepared to supply the demand.

Yours truly,

(Signed) F. A. Cambridge,

City Electrician.

Electrically Heated Ovens

One of the most important problems with which industrial plants have to cope, in a great variety of productive work, is that of securing the most efficient and economical application of heat. This is readily accomplished with electrically heated ovens which permit of close temperature control and insure uniform production and high quality of finish.

The air heaters shown in Figs. 1 and 2 have been developed by the Canadian General Electric Company, for heating core baking ovens, small bread baking ovens, such as the reel type, ovens for drying paints, varnish, ink, lumber, leather, for baking cereals, etc., and for other similar applications. These heaters are made up by mounting on a metal frame a number of units shown in Figs. 3 and 4. Each unit consists of a thin metal strip on the edges of which insulating blocks are carried. These blocks are made of a compound which will retain its insulating qualities at the temperature to which they are subjected, and at the same time are strong and will not crack. Notches on the edges of the blocks make a winding form for the flat resistance ribbon and the blocks serve to insulate the ribbon from the metal supporter. These units are assembled in an iron frame, and are insulated therefrom by blocks of the same compound.

The frames are provided with feet for mounting in the oven and are made in standard forms for mounting on either wall or floor. These heaters are available in capacities from 1.3 kw. to 12.3 kw. and are standard for voltages up to 480. The temperature range for which they are suitable extends as high as 900 degrees F. in the oven. A few practical applications to industrial purposes are illustrated here.

Core Baking Oven

An electric oven is now available for baking foundry cores. This type of oven was formerly heated by gas, with which it was difficult to get a uniform temperature or to regulate the temperature. The oven has four shelves, each 30 inches wide and 30 inches deep, with an opening of 5 inches. The shelves are hinged at the right so that they can be swung open. When in the open position, a baffle at the back of the shelf closes the opening so that while the cores are being changed or examined the heat losses are reduced to a minimum. Electric heaters totalling 16 kilowatts are installed in the bottom and sides of the oven.

Enamelling Oven

An oven used for baking enamel, with which wooden switch handles and similar articles are coated, is now also made by this company. The baking is done at a low temperature—180 degs. F.—in order to prevent the possibility of

The Dealer and Contractor

Some Interesting Correspondence, for Contractors, between Winnipeg's City Electrician and Underwriters' Laboratories, Concerning a Short Circuiting Device to Replace Neutral Line Fuse Plugs

The following letters which recently passed between the Underwriters' Laboratories and Mr. F. A. Cambridge, city electrician of Winnipeg, in reference to the question of a screw plug device to take the place of the neutral fuse on lighting systems, are interesting. This question is causing considerable discussion, though in a general way it may be said that Canadian electrical men are not in favor of such a device. Probably the two main objections are: (1) that it may be easily removed, thus breaking the ground connection, and (2) that it may be used either by mistake or intentionally to replace fuses on the other lines.

Winnipeg, Nov. 13, 1916.

The Underwriters' Laboratories,
Chicago, Ill.

Gentlemen:—

I have received from the Bryant Electric Company a device which they are placing on the market which is intended to take the place of the neutral fuse in an Edison type of cutout.

Inspection departments are already sufficiently worried over the common abuse of fusing without the elaboration of a device such as this, which it would appear would only place a premium on crime.

I trust that you will be able to in some way actively discourage the use of such a device, if not to prevail upon the manufacturers to withdraw the same from sale.

Yours truly,
(Signed) F. A. Cambridge,
City Electrician.

* * *

Underwriters' Laboratories,
New York Office,

Electrical Department, November 18th, 1916.
City of Winnipeg,

Gentlemen:—Your letter of November 13th, in reference to short-circuiting plug made by the Bryant Electric Company, and addressed to our Chicago office, has been referred to us for reply.

This device was developed by the manufacturer in order that cutout bases either after installation or while held in stock by supply dealers or contractors could be made to conform to the requirements of Rule 23 of the National Electrical Code, which states that fuses must not be placed in any permanently grounded wire, except under certain specified conditions.

This device was submitted to us in April, 1916, and after a considerable amount of thought was reported on to our Council on May 2, 1916, with the recommendation that it be listed for use only in grounded sides of plug fuse cutout bases, and only where fuses are prohibited, it being further stated that the removal of the plug should be prevented either by soldering it to the screw shell of the cutout base, or by crimping the outer edge of the screw shell of the cutout base over the edge of the plug. The device naturally brought out some discussion from some of our Council members, but a considerable majority being in favor of the device, the card recommended was issued.

While we appreciate the comments in your letter, we believe that looked at from a somewhat different angle there is a real practical need for a simple, positive fitting for bridging the fuse receptacles in neutral wires. You are probably aware of the fact that although the Bureau of Standards and the Electrical Committee have gone on record as favoring the omission of fuses in grounded neutral wires, at least at services, that nevertheless the omission of such fuses is by no means general as yet. It will undoubtedly take a very considerable period of time to educate users, contractors, manufacturers and even inspection departments to this practice. Meanwhile, manufacturers are loathe to change over all of their extensive lines of switches, cutouts and the like to comply with the new rule. There should, however, be some way of adapting the present fittings, either installed or in stock, without calling upon wiremen to make jumper connections with wires, or to use plug fuses which have been intentionally filled up and bridged. So long as it is possible, and it probably always will be possible, to fill or bridge a fuse by any one of a dozen familiar methods, we do not feel that the argument against this particular device, the use of which is obvious, which is easily recognized, and which can with no difficulty be reliably fastened into place where it belongs, has particular force.

It is perhaps natural to object to fittings on the ground that someone may use them in a way not intended and improper, but we are inclined to the opinion that such arguments seldom constitute a very real and proper objection. It is certainly true that if the argument is carried to its logical conclusion or generally applied, we should either have to get revolutionary changes in fittings as they have always been made or refuse approval to a great variety of fittings which are undoubtedly occasionally misused, but which are in general proper and necessary.

If, after further consideration of the above matters, you desire to comment further on this subject, we should be pleased to hear from you.

Yours very truly,
Underwriters' Laboratories, Inc.,
(Signed) Edgar P. Slack,
Assistant Electrical Engineer.

* * *

Winnipeg, Nov. 24th, 1916.

The Underwriters' Laboratories,

Gentlemen:—I am very much interested in reading over your favor of the 18th inst, and have duly noted the points you make in reference to the Bryant No Fuse Plug. I wish

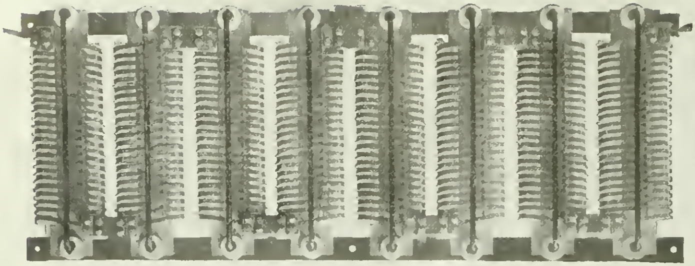


Fig. 1 220-240 volt form A air heater.

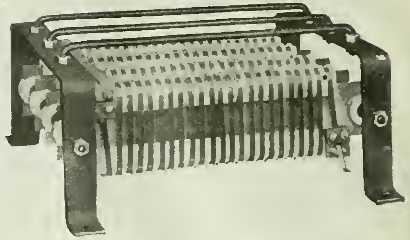


Fig. 2 220-240 volt form C air heater.

carbonizing the wood. The inside dimensions of a typical oven are 78 inches wide, 78 inches high and 38 inches deep, and it is equipped with six shelves with 8-inch spacing between shelves. The electric units are placed in a compartment in the bottom of the oven. This oven has a maximum input of 7.5 kw. and the heaters are grouped so that varying heats may be obtained to carry on the baking at any speed desired. When this oven was equipped with electric heaters, it was found that the temperature could be controlled closely and a greatly improved finish on switch handles was obtained.

Revolving Oven for Baking Japan

A japanning oven which is used for baking a great variety of metal parts ranging from small punchings to large castings, is so arranged that one-half of the oven can be charged with fresh material while the material in the other half is baking. This is accomplished by having the oven fitted with a revolving drum, which is divided into two compartments

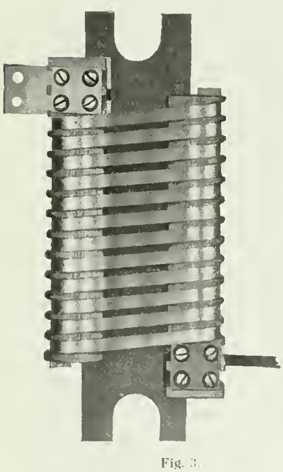


Fig. 3.

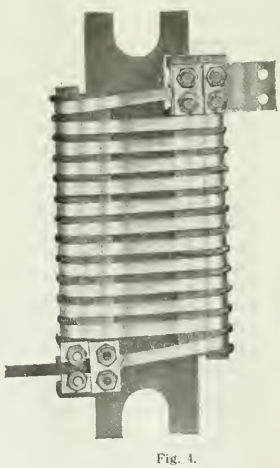
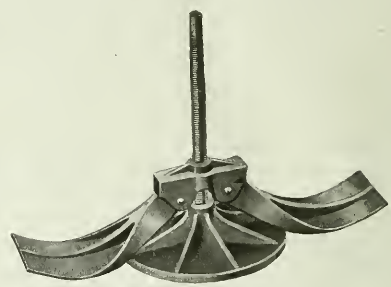


Fig. 4.

by an insulated partition through the centre. The drum is revolved by motor driven mechanism. The dimensions of this oven are as follows: height 6 ft. 6 in.; diameter of drum 8 ft. Each compartment is 5 ft. $3\frac{1}{4}$ ins. wide, 2 ft. ins. deep and 6 ft. 6 ins. high. The current input is 67 kw. maximum which will raise the temperature of the oven to 500 degs. F. in one hour and thirty-five minutes with a current consumption of 105 kw.hr. To maintain this temperature requires an input of 34.5 kw. The oven is provided with a blower ventilating system for carrying off the gases.

Pole Guy Anchors

The accompanying illustration shows a type of pole guy anchor marketed by the Faultless Anchor Company. These anchors rely almost entirely upon undisturbed earth for strain resistance. This is a distinct advantage, as they can be quickly installed and reclaimed by one inexperienced man and can also be installed as close to the pole, building or fence as is desired. The blades are made of malleable iron and are of such design that when opened, their strength is sufficient to withstand, without bending, any strain which can be placed upon them within the tensile strength of the jackscrew used to expand them and upon which is also formed the



"Faultless" pole guy anchor.

eye for attaching the guys. The jackscrew is an arrangement for forcing the blades out into the virgin soil. It is so powerful that no difficulty is experienced in expanding the anchor in any kind of soil. The ribbed base has a dual purpose and is of ample strength to withstand the weight of the displaced soil and to form a backing for the blades when spread.

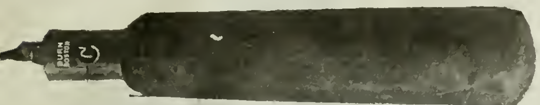
Faultless anchors are made in four sizes as follows: Nos. 1 and 2 (two-blade types) are intended for light and heavy storm guying or farm work, such as guying silos and fences. No. 3 (three blade) and No. 4 (four blade) types are designed for heavy strains, encountered in dead-end cables and all classes of work where firm anchorage is a necessity.

Interstate Electric Novelty Co. Expanding

The Interstate Electric Novelty Company of Canada, Limited, 220 King Street West, Toronto, have taken on an additional five thousand square feet of floor space at their present address, occupying another entire floor of the building. This, the company state, was necessitated owing to the increased demand for their flashlights and batteries. The increased facilities will permit them to more than double their output for next year. They report an exceptionally heavy demand for batteries during the present year, which up to date has resulted in a 300 per cent. increase over 1915.

Carbon Grounding Device

The device illustrated below has recently been put on the market by Hickey & Schneider, New York. The makers claim that it is the only permanent grounding device, because it is non-metallic, non-inductive, and non-electrolytic. It consists of a solid carbon electrode 1½ inches in diameter and 23 inches long surrounded by a carbonaceous mix which is porous and moisture absorbing. This mix is closely packed around the solid carbon electrode, resulting in a conductor having a resistance of only 0.05 ohm. The ground is in the shape of a long upright cone, so that the pressure of the



tamped earth will compact closely against it. At the top of the solid carbon electrode is a copper lug connection, this connection being sealed in with a waterproof compound, leaving a tinned copper lug exposed ready for connection to a No. 4 line wire. The wire should preferably be rubber insulated and stranded. In designing this ground cone the manufacturers have assumed that it is fundamentally wrong to use any metal in contact with carbon and moist earth; or any metal in contact with moist earth only, the idea being to prevent electrolysis. In preventing electrolysis in this device, the manufacturers claim to have developed a ground cone for electric circuits that is virtually indestructible.

Sockets for Outdoor Work

The general adoption of porcelain sockets for all work of a nature requiring a unit capable of resisting the ravages of exposure and chemical action has encouraged the expansion of this class to meet special requirements. A line of pull, key and keyless sockets of this character having an aluminum cap, the bushing of which is tapped with a ½-inch thread inside and a ¾-inch thread outside has just been placed on the market by the Harvey Hubbell Company. These are designed primarily for use as a part of outdoor

No. 3444
⅜ actual size

fixtures. The fixture canopy may be dropped over the socket cap, leaving the threaded bushing protruding through, and to this bushing a lock nut may be threaded to hold the canopy rigidly in place. The unit can then be screwed to either a hollow goose-neck or bracket through which the wires pass. The illustration shows the keyless type ⅜ actual size.

The Automatic Reclosing Circuit Breaker Company, of Columbus, Ohio, have issued a bulletin describing why automatic reclosing circuit breakers should be used; another bulletin describing the theory and operation of these breakers; three bulletins describing types A, C and D, automatic reclosing circuit breakers; and a bulletin entitled "Important considerations in the protection of individual motor circuits," The same company are also distributing a smaller bulletin, No. 8, entitled, "Relays for use with automatic reclosing circuit breakers on direct current circuits."

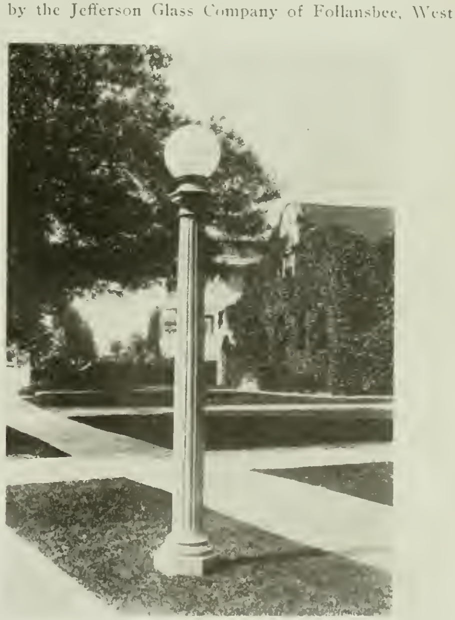
Toronto Contractors Hold Another Successful Dinner

The electrical contractors of Toronto held another very successful get-together at the Carls-Rite Hotel on Wednesday evening, November 29. Following a 7.30 o'clock dinner the members were addressed by Mr. Alan Sullivan, secretary of the Canadian Electrical Association and of the Electrical Employers' Association. Mr. Sullivan gave the members some fine ideas to carry away on the value of co-operation and on the necessity for every member of the contracting profession setting himself a high standard, not only in his work, but equally in his treatment of, and relationship with, his fellow-contractors. He assured the members present of any assistance that the associations he represented may have it in their power to render.

Enthusiastic three-minute speeches were afterwards delivered by Mr. George J. Beattie, Mr. Gordon D. Earle, and Mr. Harry Rohleder, all of whom expressed their satisfaction that the Toronto contractors were now getting better acquainted and finding out that, underneath the crust, they were "good fellows all." The next meeting will be held in the same room, Carls-Rite, Wednesday, Dec. 13, at 7.30 p.m.

Porcelain Standards with Moonstone Glassware

Single lamp standards of the type illustrated are having a great vogue in Los Angeles and other communities in the Southwest, and constitute striking evidence of the growth of the artistic spirit in street lighting. The standards are of marbelite, made by the American Cement Products Company of America. The light is enclosed in a moonstone plain ball, made by the Jefferson Glass Company of Follansbee, West



A handsome street standard.

Virginia. The balls were selected by President Landwehr of the Cement Products Company, and will be used on an extensive installation of this type on Wilshire Boulevard, in Los Angeles, said to be one of the most attractive streets in the world. These standards and balls have proved to be a most efficient lighting unit, and this fact, coupled with their artistic merit, promises a widespread popularity for this type of street illumination.

A Household Refrigerator

Mr. Geo. J. Beattie, Toronto, has taken the Canadian agency for the "Isko" refrigerating machine, illustrated herewith. This is an apparatus designed for household use and is motor-operated, the cooling medium being sulphur di

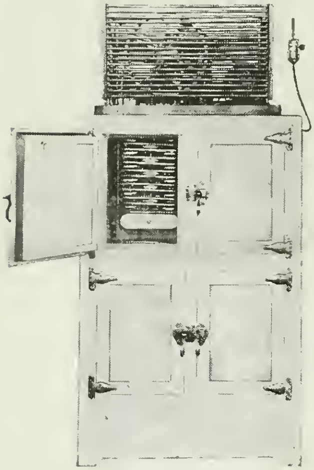
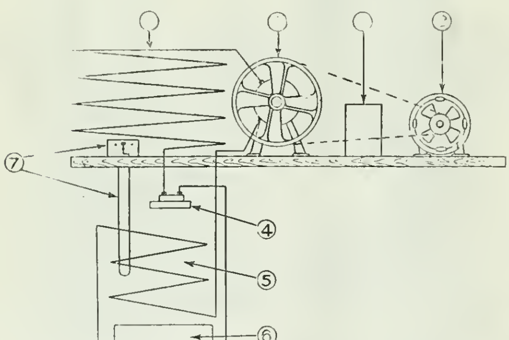


Illustration of "Isco" refrigerator installed for household use.

oxide. This becomes liquified in the motor-operated condenser and passes down through copper coils into the refrigerator, where it gradually vaporizes. As the vaporizing temperature of liquid sulphur dioxide is about 14 degs. F., this maintains the contents of the refrigerator well below the freezing point of water. Thermostatic control operates



1, condenser coil; 2, motor; 3, circuit breaker; 4, expansion valve; 5, expansion coil; 6, ice making chamber; 7, thermostat; 8, compressor.

the motor intermittently so that a minimum of electric current is required. It is calculated that in the average household about 1 kw. hour would be consumed daily. Not only is this equipment valuable for maintaining a low temperature within the refrigerator, but it is so arranged that blocks of artificial ice may be manufactured for use in the kitchen, dining room or elsewhere.

The Turbine Equipment Company, Limited, Toronto, have been awarded a contract by the town of Mimico to supply and install their sewage pumping machinery. Two pumps will be direct connected to Canadian Westinghouse motors and a third unit to a 40 h.p. gasoline engine.

Canada Sales Co. in New Quarters

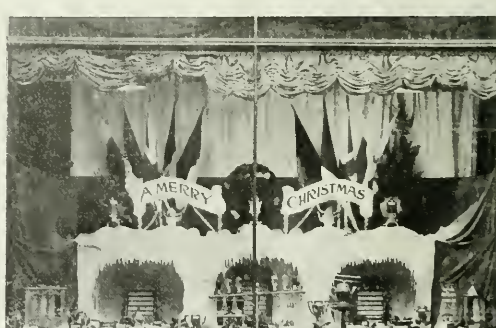
The Canada Sales Company have moved from 165 Church Street, to 183 Church Street, Toronto, where they will have large, bright showrooms and about double their former space. This company has also opened an office at 122 Board of

Trade Building, Montreal. The accompanying illustration shows the industrial reflector made in 14, 18 and 20 in. sizes by the Burr Manufacturing Company, for which the Canada Sales Company are agents.

A Novelty in Percolators

The accompanying illustration shows an electric percolator somewhat out of the ordinary, in that it is of brown earthenware, and thus gets away from the stereotyped nickel finish. It is white lined and hand decorated in silver. The

capacity is five large cups. Cold water starts percolating within 30 seconds after current is connected, and coffee is ready in 15 minutes. The "built-in" heating element comes in direct contact with the water, thus adding to its efficiency. Consumption is 450 watts. This unit is manufactured by the Rochester Stamping Company.



Don't forget your windows at Christmas time. They are the magnets of trade. A Toronto Hydro window.

Evolution in Public Utilities

What I have in mind, in referring to the evolution of public utilities is merely this: We have been passing through experiences for twenty-five or thirty years past that have been more or less interesting and exciting and trying. As a result of these experiences I believe public utilities are on a better basis to-day, and still more promising for the immediate future, than they have ever been before.

There are perhaps three or four distinct eras in this evolution of the utilities. The first may be but briefly mentioned—the era of invention and of initial promoter or developer. Following that came the era of exploitation, of utilities generally, and this is the era with which so many of our friends among the public find so much fault: where attempts were made without restriction of any kind whatever as to the issue of securities or as to the payment of earnings to capitalize the privilege of serving the public, and to utilize that privilege for the mere purpose of extorting from the public all that could possibly be secured and paying out to the promoters the spoils. That seems to have been the conception of the average individual with regard to this era of exploitation of public utilities.

We must confess, of course, that there was no restriction imposed by law upon the issue of securities, and that what happened was very largely the result of the capacity and the ingenuity of the promoter and the operator in each individual case.

Then came the era of regulation on the part of the public and the attempt to do away with all of the abuses of the past, protecting both the investor and the consumer as to rates and to service; and, while the theory of regulation is absolutely sound, and is for the interest of the investor no less than for the interest of the public, I am forced to the conclusion from my own experience that what was in the public's mind generally, in imposing regulation upon utilities, was not the protection of the investor, but was to reduce the charges for service. It was because the general belief in the public mind was that rates were high and service was poor; that the people were being bled by public service corporations generally, and that these things would stop when regulation was imposed, that there was such a unanimous sentiment for the regulation of public utilities.

We have had regulation for a good many years, longer in some states than in others, and operators will tell you that they had experience in connection with regulations that have been interesting, and have been at times annoying, and unfortuate.

It is not the most pleasant thing in the world to have the power of life and death over your properties placed in the hands of men, however intelligent they may be, and sincere, who are absolutely unequipped from the standpoint of experience to undertake the duties suddenly imposed upon them, and operators will tell you, if they are frank, of repeated experiences where they had been told by those well-meaning people that theories which they themselves perhaps entertained years ago, but found to be fallacies, must be introduced in the operation of their properties.

However, we have struggled through, assuming the good intent of the public with regard to regulation. The principal point I wish to particularly emphasize is that regulation in general, eliminating certain individual cases, has failed to produce the result that it was intended to produce, so far as the general conception of the public was concerned; and regulation has served to-day more for the investor, in proportion to what was expected and intended than it has for the consumer, for the public.

As a first step in reducing rates, through regulation, the question of the valuation of properties was raised. Valuations became popular and numerous in various parts of the country. Then came the discussion of the rate of return to which a company was entitled, and attempts were made to devise certain standards as to certain rates applicable generally. The fact is, that the valuation of properties, the application of the theories of regulation to the average properties throughout the country, has not served to reduce rates or to produce the results that were generally expected and intended. Now, the reason must be this, that, notwithstanding certain abuses that may have existed, notwithstanding the absence of restrictions, there were automatic restrictions to the financing and operating of these properties, which gave the public the protection of which they were not aware, and which they sought to change through regulation.

The rates for service of public utility companies have been more or less standard in all parts of the country, varying occasionally in localities, but these standards, which were accepted, perhaps without a full appreciation of what they involved, and the necessity for rendering good service, have served, without the knowledge of the public, in giving them the full measure of protection to which they were entitled, and giving them as much protection as they have secured by their more modern methods.

Following this era of regulation, I believe that we are rapidly approaching finally one which I may perhaps call the era of recognition. I believe a new policy with respect to public utilities is forming in the public mind. I believe that policy can be accepted freely by the utilities and accepted by the public. The first admission in connection with that policy should be that the only excuse for a public utility in any community is the necessity for a public service; that without that necessity the organization of the public utility is not justified; that it is the primary function to serve the public, and not to make any particular sum of money; that standard of service gives the utility the dignity in the community, as a real necessary public servant, and to the extent to which it fulfils that function it is entitled to the credit of the community for being a faithful public servant. Also coupled with that duty of the utility to the community there is an equally strong duty on the part of the community to permit the utility a fair and reasonable return for the service which it renders, and the measure of what is a fair and reasonable return is not any definite percentage on the capital, but is over and beyond the necessary expenditure for first-class service, the sum which will enable the company to obtain readily all the capital which it needs to give to the community the very highest grade of service. That may be one rate of 1 per cent. in one community and another rate of 1 per cent. in another community.

I find that most reasonable people will agree to that basis, and by the elimination of a discussion of capitalization, elimination of the discussion of a definite rate of return, and the comparison of figures with other figures from all parts of the country that have no possible application, the basis of understanding seems practicable, which readily leads to amicable relations and satisfactory conditions.

I believe that the future of our public utilities, based on past conditions, based on what the public has found as a result of their method of protection, based on present conditions, the future prospects—I believe that we have before us an opportunity as the operators of public utilities which serve the public faithfully to receive a just return for that service, and, through you, as the purveyors of these securities, an opportunity to conserve the investors as well.

*Extracts from a paper by W. W. Freeman at Investment Bankers' Convention in Cincinnati.

The Quebec Government have been asked to appoint, through the Lieut. Governor-in-Council, a commission to deal with the question of a new franchise for the Montreal Tramways Company. Representatives of the Company and the Montreal Board of Control have for several weeks been in conference over the terms of a new franchise, but the progress has been very slow, and on several points there seems little chance of an agreement.

Current News and Notes

Agincourt, Ont.

The Scarboro council, Agincourt, Ont., recently passed a by-law authorizing the signing of a contract with the Ontario Hydro-electric Commission for a supply of light and power. The line will be run along Danforth Road to Scarboro Junction and then to Agincourt.

Chatham, Ont.

The city council of Chatham, Ont., have passed a resolution to request the Ontario Hydro-electric Commission to consider taking over the electrical department of the Chatham Gas Company, to be operated in conjunction with the Chatham Hydro-electric System.

The ratepayers of Chatham, Ont., will be asked at the January election to endorse debentures to the extent of $45,000 to provide for extensions that have been made and are being planned to the local Hydro system.

Cobden, Ont.

Hydro-electric power was recently turned on in the village of Cobden, Ont.

Fergus, Ont.

A by-law will be submitted to the ratepayers of Fergus, Ont., on New Year's Day, authorizing an agreement with the Hydro-electric Power Commission.

Galt, Ont.

A by-law has been passed by the Galt, Ont., city council authorizing the submission to the ratepayers at the January elections of the question whether the municipality shall develop or acquire through the Hydro-electric Power Commission such power as is needed in addition to that already obtained under the contract with the Commission.

Hepworth, Ont.

A by-law was passed by the voters of Hepworth, Ont., authorizing the Hepworth Heat, Light and Power Company to erect poles and wires for a supply of electric current.

Rainy River, Ont.

The Rainy River Electric Light and Power Company, Rainy River, Ont., have changed their system from 133 cycle to 60 cycle, in addition to other improvements.

Sarnia, Ont.

Work on the hydro-electric street lighting system in Sarnia, Ont., is progressing rapidly, and it is anticipated that light will be supplied by January 1.

St. Andrews, N.B.

Connors Brothers, Black's Harbor, N.B., are installing an electric plant for the supply of light and power for their factories.

St. Catharines, Ont.

Workmen employed by the Hydro-electric Commission, St. Catharines, Ont., recently went on strike for an increase of from 32 cents an hour to 34 cents.

Stratford, Ont.

The Ontario Hydro-electric Commission will prepare an estimate on the cost of completing and rebuilding the Ontario West Shore Railway. The municipalities of Ashfield, Huron and Kincardine are principally interested.

Toronto, Ont.

A new system of street lighting is being tried out on University Avenue, Toronto. Thirty-eight units are to be installed, consisting of goose-neck brackets with pear-shaped globes. Lamps will be 250 watt gas-filled, replacing the former 100 watt lights which were inadequate on account of the width of the street.

At a meeting of the board of control, Toronto, Ont., and the Toronto Hydro-electric Commission, it was decided to recommend the purchase of the assets of the Interurban Electric Company for $75,000. There are four existing franchises, in the townships of Toronto, York, Etobicoke and West Toronto.

Waterloo, Ont.

The city council of Waterloo, Ont., authorized the submission of two by-laws to the ratepayers on New Year's Day; one providing for the purchase of the Snider dam and land surrounding it, and the other providing for an agreement with the Hydro-electric Commission.

Walkerville, Ont.

The ratepayers of Walkerville, Ont., will vote on a by-law authorizing the Ontario Hydro-electric Commission to develop 200,000 additional h.p. at Chippewa Creek at a cost of $9,000,000.

Weston, Ont.

A by law will be submitted to the ratepayers of Weston, Ont., on January 1, authorizing an agreement with the Hydro-electric Commission in connection with the Chippewa Hydro-electric power proposition.