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CANADIAN
ELECTRICAL NEWS
AND
STEAM ENGINEERING JOURNAL

OLD SERIES, VOL. XV.—No. 6.
NEW SERIES, VOL. V.—No. 1.

JANUARY, 1895

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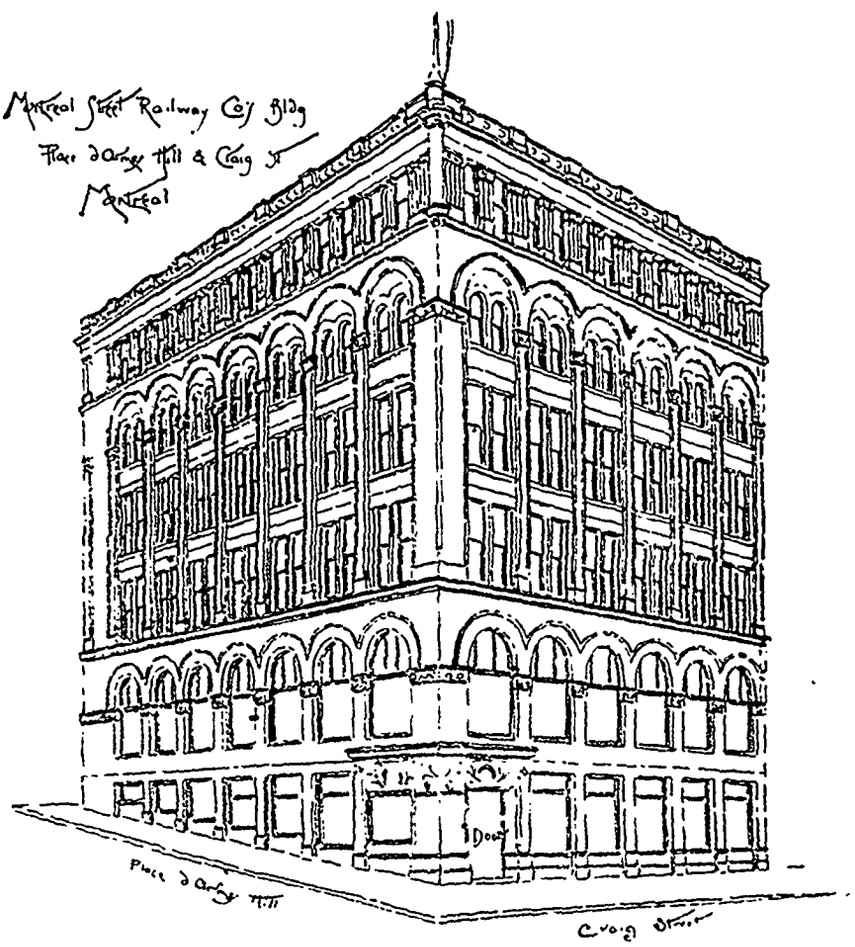
VOL. V. JANUARY, 1895 No. 1.

MONTREAL STREET RAILWAY COMPANY'S NEW BUILDING.

WE present herewith a sketch of the Montreal Street Railway Company's new building in course of construction at the corner of Place D'Armes Hill and Craig streets. It will be remembered that a few weeks ago the iron roof of this building suddenly fell in, killing several of the workmen. The coroner's jury, after a lengthy investigation, found that the accident was due to negligence on the part of the architect and superintendent of construction. These persons will accordingly be brought before the criminal courts. Meanwhile another architect has been employed, under whose direction the construction of the building is being completed.



LOSS OF POWER.

IF you happen to go into an engine room at any time and find that there is a leak past the cylinder or of the air pump, if you are using a condenser, you may be very sure that you are losing power. While the trouble may not be the cause of any danger, it shows that there has been some mistake in the setting out of the packing; that the adjustment is bad; that it has been in use for too long a time, or that the internal surface of the cylinder is cut. If the last is the case, you have no other remedy than that of re-boring the cylinder. In the other instances, the packing may be renewed or the piston may be taken out by removing the cylinder head, as in the case of locomotives. The leaking of piston packing may be detected when the exhaust is continuous instead of intermittent, although a leaky valve will also produce the same results; or it will be made to appear by opening the cylinder cocks and noting whether they blow steam on the back stroke. A twofold loss is entailed by this defect; steam is blown away uselessly and back pressure is increased, putting a greater load upon the steam that does the pushing.—Dixie.

MONTREAL JUNIOR ELECTRIC CLUB.

Nov. 27.—Mr. E. W. Sayer gave an essay on "The Difference between the Cost of Gas and Electric Light Plant."

Dec. 3rd.—Mr. W. T. Sutton read a paper on "Arc Lamps."

Dec. 10th.—Mr. Morrison read a paper entitled "Is Electricity in its Infancy?"

Dec. 17th.—Mr. W. T. Sutton gave a general review of past subjects.

The above meetings were held in the club rooms, No. 6 Richmond ave.

Dec. 20th.—A semi-public illustrated lecture on "Electricity", was delivered by the President in Welcome Hall.

MOTOR-GENERATORS FOR TELEGRAPH PURPOSES.

THE Great North Western Telegraph Company have completed arrangements for the installation of a dynamo plant in their Montreal office. It is to be of the type known as the motor-generator, and when completed will displace over four thousand cells of gravity battery.

The plant will consist of thirteen machines. The generator side will give the following voltages: 6, 20, 80, 160 and 330 volts respectively. The 6 and 20 volts are used for local work and short lines; the 80 and 160 volts for ordinary lines, and the 330 volts for quadruplex work. Each group consists of two machines of opposite potentials with a spare machine to be used as a "relief."

The adoption of dynamo currents will effect a great saving in space and materially increase the efficient working of the Company's lines.

The machines are being built by the Toronto Electric Light Company, under the direction of Supt. A. B. Smith, who so successfully installed the plant in Toronto at the head offices of the Company some two years ago.

THE INTERIOR FRICTION OF OILS.

PETROFF, who has occupied himself very extensively with the examination of lubricants, has investigated, says the Scientific American, the interior friction of oils by means of an apparatus invented by himself, and has given his results in tabular form and graphically by a series of curves. According to his results, the degree of transparency of lubricants, the refining process, viscosity, flash point and fire point, give no basis for estimating the degree of interior friction, though all are of importance.

If two oils which at the same temperature possess different interior frictions be mixed, the mixed product will yield a characteristic curve corresponding to that of an oil the qualities of which lie between those of the two opponents. Consequently the excessive friction of any thick lubricant may be reduced by mixing with it small proportions of solar oil, pyro-naptha, or kerosene, or any oil possessing low interior friction. But this addition can be useful only when the added product does not separate to any great extent.

The addition of such light oils can, of course, be easily detected through the flash point and the fire point. The addition of various resinous materials increases friction in the machinery and in the lubricant itself. These products have also an injurious chemical effect upon the metallic surfaces subjected to friction.

It was also frequently observed that samples of the same oil that were received in the factory at different times did not yield the same characteristic curve, although filling all requirements,

PROPOSED UNDERGROUND SECTIONAL ELECTRIC RAILWAY AT BELLEVILLE.

We are indebted to the Belleville Sun for the accompanying illustrations and particulars of an underground electrical railway system which is to be constructed in that city. It is known as the "E.M system, of which Mr James F. McLaughlin, of Philadelphia, is said to be the inventor The system is described as follows

The method of distribution consists of a main tube of cast iron of the same height as the rail, made in sections of fourteen feet each, which are bolted on the ties midway between the track rails. In the centre of this tube is placed the main line conductor, which is dependent upon the amount of power used This rod is continuous and carries the current. It is insulated from the iron tube by a bituminous cement.

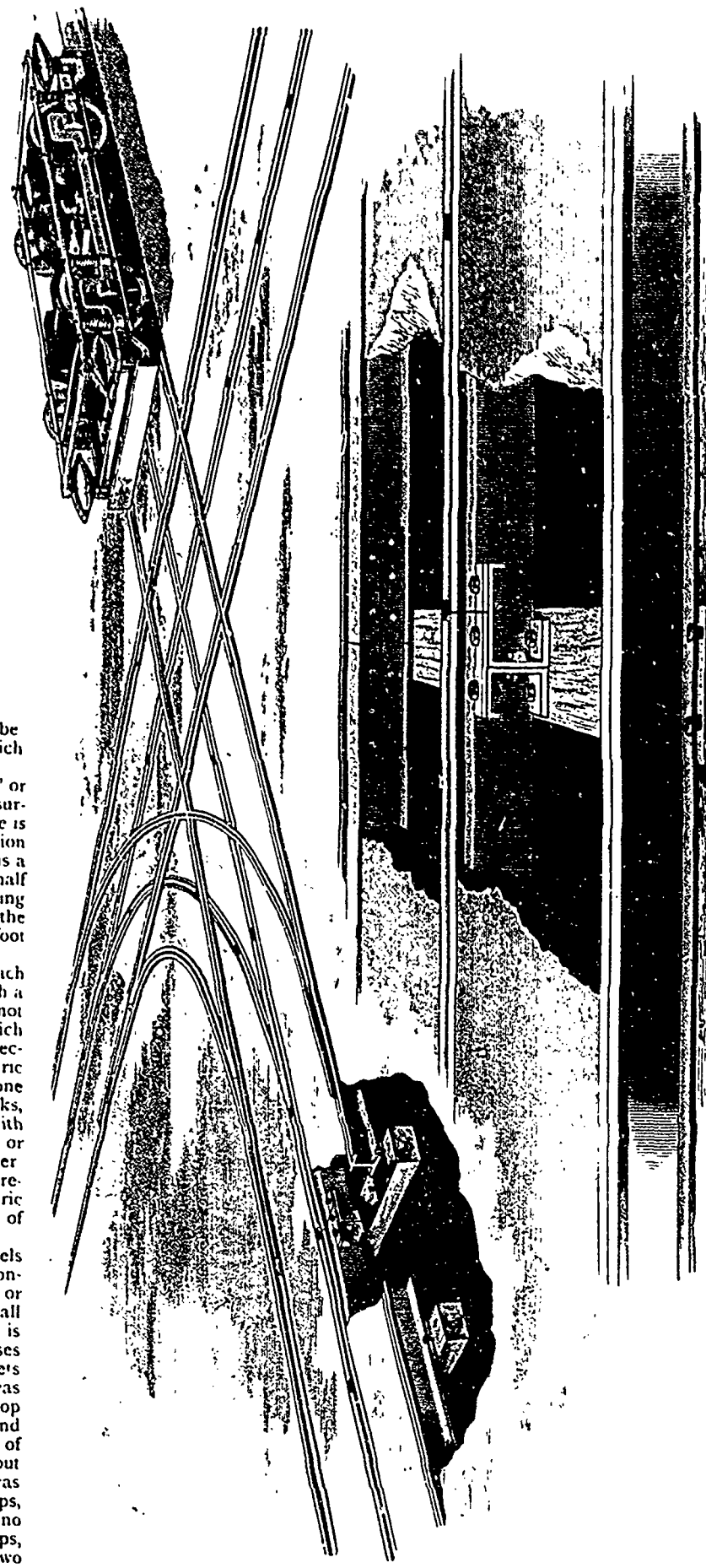
The current is distributed to the car motor by means of surface sectional conductors, in conjunction with a flexible controlling device mounted between the two car motors. The controller carries two collectors in the form of flat metal wheels, which are in constant contact with the sectional surface conductor. The electricity connection is made without the use of switches, magnets or automatic devices, the actual method as yet being kept secret, because of additional European patents which have been applied for.

There is no possibility of "grounds" or short circuits between the rails and the surface conductors, for the reason that there is no current in the conductor except the section directly under the car. This conductor is a strip of rail one inch wide and four and a half inches high. It is laid in sections of varying lengths, which are insulated one from the other by blocks of wood or asphalt a foot wide.

The electric current is supplied to each one of these sections of conductor through a switch-box, but the circuit, of course, is not completed until the trolley wheels, of which there are two on each car, pass over the section of conductor and pick up the electric current for the motor. Thus, this rail, one inch wide, which lies between the tracks, flush with the streets, is never charged with electricity so as to give a shock to a man or animal, except the one section directly underneath the car. It would be impossible, therefore, for a man or child to receive an electric shock severe or otherwise, along the line of this road.

The moment the copper trolley wheels have left a fourteen-foot section of the conductor -- or it may be an eight foot section or an eighteen foot section—that section, for all practical purposes so far as street traffic is concerned, is dead. Carriages and horses and men and women crossing the streets have nothing to fear from it. This was shown by Inventor McLaughlin at his shop when he invited the visitor to place his hand on the conductor rail and on the car rail of his model. The current was turned on, but there was no shock. Even a better test was made with a couple of incandescent lamps, attached to copper hooks. There was no electricity in the tracks to light the lamps, but when a workman struck the two sharp copper hooks underneath the car in its passage along the miniature tracks the lights burned brightly.

One of the greatest difficulties in the operation of the trolley system has been in switching, but this seems the easiest thing of all in connection with the E. M. railway system. Because of the two trolley wheels, one in front and one in the rear of the trucks, it is possible to eliminate the conductor rail for a distance of several feet where this is found necessary, at curves, crossings and switches. The two trolley wheels are so far apart that one of them is always bound to be upon the rail, even when the other finds no conductor beneath it.



THE "E. M." ELECTRIC RAILWAY SYSTEM.

Telegraph poles are now made of paper pulp in the United States. The pulp is mixed with borax, tallow, and other things, then cast in a wooden mould having a solid core, which makes the pole hollow. The cross arms are to hold the insulators and telegraph wires are attached to pieces of wood fixed in the sides of the pole. What with their lightness and durability, these poles have some advantages over wooden ones.

A new belt fastener recently patented in England, consists of a metal plate adapted to extend across the meeting edges, the plate having one straight side and at the other side a series of spurs arranged in pairs longitudinally opposite, the spurs of each pair being at equidistant points from the transverse center of the plate and arranged in advance of the proceeding in both directions, so that each pair will penetrate the belt at different points.

A B C OF ELECTRICITY.

By H. Breck, Jr.

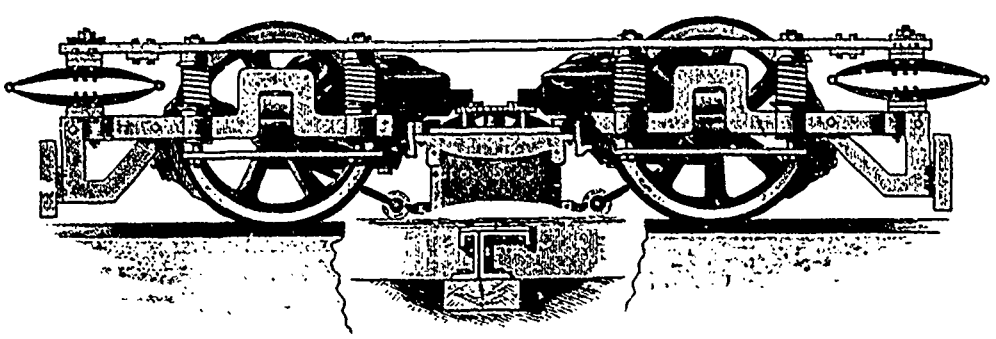
Abbreviations used E Electricity + or P Positive or N Negative

WHAT electricity is it is impossible to say, but for the present we may safely say it is a kind of invisible something which pervades all substances. At the present day, however, electricians are able to keep it under perfect control and put it to many uses. So much for the practical view of this science; but from a theoretical standpoint, supposing all substances the earth and all on it as having a certain quantity of electricity upon them, as long as everything has its proper share of electricity, no electrical manifestation is apparent; but supposing we give a body more than its usual share or take away any from it, leaving it without its proper share, then it is that we become aware of the effects of what we call electricity.

When a body has more than its proper share of electricity, it is said to be in the state of positive electrification; conversely, if it has less than its usual share, it is said to be in the negative state of electrification.

I may here explain the term "potential." When a body is in the + state of electrification, its potential is said to be higher than that of the earth, so, if a body is in the − state, 's potential is lower than the earth, whose potential is reckoned as zero.

To make this clearer, for illustration let us take a number of men. So long as each of them has an equal amount of wealth, there is no thought of poverty amongst them. Suppose one man was to get more than his usual share, he would be considered rich as compared with the rest of them, when each body has



THE "E. M." SYSTEM—METHOD OF MOUNTING CONTROLLER ON CAR TRACK.

its proper share of electricity, the presence is not noticed, but let one body get more than its share, and then its potential is raised.

Suppose one man to lose some of his wealth, then he is considered as poor amongst his fellows; so if a body loses some of its share of electricity, then its potential is lowered as compared to the earth whose potential is reckoned as zero. The reason the earth's potential is reckoned as zero is for the same reason that we measure the heights of mountains or the depths of mines from the level of the sea.

When a body has a potential higher than that of the earth, it is said to be at a + potential; conversely, when its potential is lower than the earth's, its potential is −. Although, bear in mind, two bodies may be at a + potential, it is very clear that they may be at different potentials to one another.

Whenever two bodies are at different potentials, the current tends to "flow" from the one at a higher potential to that of a lower potential; or if a body be at a higher or lower potential than the earth, electricity tends to "flow" between the two until the potentials are equalized. If the difference of potential be very large, electricity will "flow" through anything, even air, as is the case with the lightning flash. With electricity at a low potential, some substances offer a comparatively high resistance to the current. The difference between a conductor and insulator is of one degree only, for whether a body will or will not allow the current to pass depends merely on the difference of potentials of the bodies between which the current tends to pass. There are three principal properties of a current, namely, heating, magnetic and chemical.

Heating.—If we pass a strong current through a fine wire, the wire will become heated in proportion to the strength of current passed.

Magnetic.—When electricity passes along a wire, it sets up invisible circular lines of force round the wire, and if the current is strong enough the wire will pick up iron filings.

Chemical.—If a current of electricity be passed through certain chemical solutions, these will be split up into their component parts.

Let me now divert from electricity and turn your attention for a while to magnetism. What magnetism is it is impossible to say, but we may speak of every particle of iron or steel as being a perfect magnet with a north and south pole.

The earliest form of magnet known to the ancients was lodestone, or "leading stone," as they termed it, as they used it in early times for a compass. It is a brownish colored stone, dug up from the earth, and from which iron may be extracted, and naturally possesses the magnetic power of attracting iron.

A magnet may be easily told by dipping the piece of iron or steel into iron filings; if these adhere the iron or steel is a magnet. The poles of a magnet may be discovered by suspending the magnet by a fine thread, and the end which points toward the north is termed the north pole of the magnet, the other the south pole.

There are two kinds of magnets—permanent and electro-magnets. A permanent magnet is one that when once magnetised will retain that power. An electro-magnet is one that will only retain its power while a current of electricity is passed through a coil of wire (insulated of course) wound around it.

The air space surrounding a magnet is filled with invisible lines of space, and is called the magnetic field. You cannot have a magnet with but one pole. If a magnet be broken, each end will form a pole of a magnet. If a magnetic piece of iron or steel be placed in a magnetic field, it will turn so that its own lines of force are parallel with and in the same direction as the lines of force of the magnetic field. From this we have the law of "lines of force," viz., that neighboring lines of force tend to turn themselves so that they be parallel with one another and in the same direction.

The molecular theory of magnetism may be spoken of as follows:—Suppose we mix a lot of small magnets together, what would be the effect? Simply this. each north pole would unite itself with the south pole of a neighboring magnet, and vice-versa, on account of the first magnetic law, that like magnetic poles *repel* (north and north), unlike magnetic poles *attract* or unite (north and south). When these poles attract one another there is very little free magnetism. The molecules of a piece of unmagnetised iron or steel may be looked upon as in this state, each magnetised molecule completing its magnetic circuit through the neighboring molecules; the iron or steel as a whole exhibits, therefore, no free magnetism.

Suppose we magnetise the iron or steel, we then arrange its already magnetised molecules so as to give free magnetism by causing their lines of force to act according to the law stated previously. This causes, as you know, the molecules to set themselves in straight lines so that their own internal lines are in the same direction as the lines of force passing through them. So, excepting at the ends of the bar, all the north poles come opposite the south poles, and no free magnetism is apparent, but at one end of the bar we have a row of north poles and a row of south poles; at the other end, consequently, we have free magnetism.

As to the use of *electro-magnets*, I need not say much, excepting that if any person has occasion to study the practical application of electricity, he will find that this form of magnet is by far the most useful electrical device, as every form (or very nearly every form) of electrical instrument or machine depends for its action on some form of an electro-magnet.

In this paper I hope I have made the description of magnets and the theory of magnetism clearly understood; but, however, if any reader fails to understand any part, I will be glad to hear from him, either through the columns of this paper or by letter. My address can be had from the editor, who will furnish it to those who desire it.

THE ONLOOKER.

JUST how rapidly history is made in the present day is best realized when one has occasion to examine into some special subject. The Onlooker thought of this when, in conversation with Mr. Rutherford, chief engineer of the Canadian General Electric Co., he learned of the growth of electric light for domestic purposes. "There are many towns throughout the country now," said Mr. Rutherford, "where electric light takes the place altogether of gas, coal oil or the old tallow candle. Just at the present time we are completing a plant for the town of Mattawa, the capacity of which is 1000 lights. The order was at first for a 500 light plant, but the change was made almost immediately to double the size. When we remember that Mattawa has a population of only 1700, and is a lumbering town, where the large majority of buildings are not the most pretentious, we can see that almost everyone in the place will have his home, no matter how humble it may be, lighted by electricity. In towns where gas is used, the electric light is gradually supplanting it, and where there is no gas it has largely the control." The advance from the tallow candle to the electric light has been made within the memory of the younger men on the stage of life today. The Onlooker is not going to give his age away, but it seems only as yesterday since the old home was lighted with the tallow candle, and he can remember when a boy and occasion made it necessary to take a visit to the eastern section of Toronto, that he would go a long step out of his way to escape the delightful odor that came from a tallow candle factory located then in what was known as east Toronto, though to-day one must travel much further east to reach the section so described in the municipal map. To-day the tallow candle—can the bright boys of the public schools tell anything about it? And yet it was to those of a quarter of a century ago what the rude torches prepared by dipping sticks of papyrus or rushes into pitch, and coating them with wax, was to the ancient Greeks and Romans of centuries past. It seemed but a short step from the tallow candle to the kerosene lamp. This method of lighting, however, had little more than fairly become a fixture in the home, and the fears of the good housewife from a kerosene explosion had been overcome, before gas, in the larger towns and cities at least, had become the more common method of domestic lighting. It is hardly to be anticipated that either gas or electricity can drive out kerosene and petroleum. They occupy a wide field in mechanics and arts. But as a method of giving brilliancy to the home after nightfall, their doom would seem to be sealed. Now gas has to fight for its place as an illuminator of towns and cities, and the odds are entirely in favor of its rival, electricity.

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On another page of this issue of the ELECTRICAL NEWS is to be found some account of the several railroad undertakings in the construction of which Mr. William T. Jennings, the well-known engineer, has taken a prominent and practical part. The two great railways of Canada, the Grand Trunk and Canadian Pacific, now cover the Dominion so completely from Atlantic to Pacific, that it is hardly to be expected, that in the time of the present generation, at least, there can be any further extensive railroad building. "The trend of railroad construction to-day," said Mr. Jennings, "is in the direction of covering the interior of the country, especially in Ontario, with a network of short and light electric roads that will enable the farmer and small manufacturer to get the products of their industry to the leading markets and shipping centres with less difficulty and cost than is necessary in driving, or the occasional train from one of the regular roads that may, perchance, be passing these points. I look for a large development in the next few years in this direction. Illustration is found of this in the Galt and Preston road, and which is likely to be soon extended to Hespeler. Also in Hamilton and Grimsby, and not only for pleasure-seeking, but likewise as a convenience to that portion of country, the Niagara Falls Park and River Railway, now so well known to everyone." It has occurred to the Onlooker that an intelligent development along these lines will have a healthy bearing on the general progress of the Province. A lamentable lesson from the recent census was the phenomenal growth of a number of the leading cities of Ontario at the expense of the smaller towns and rural sections. This condition is common to all progressive countries, though none the less regrettable, and carrying with it obvious evils. Manufacturers, who have been the life and heart of moderate-sized towns, have been pulling up sticks and locating in the cities, because of the increased shipping facilities there offered. Now if the development that Mr. Jennings hints at, and which is already taking practical shape, can be made the means of holding manufacturers in the smaller towns, who will say that a great good will not have been accomplished for the country as a whole? Those who, like the Onlooker, have their interests centered in the cities, feel a natural pride in the growth of these places, and selfishly congratulate themselves on these conditions, but it is to be remembered that if the big cities owe their growth simply to a sapping of the life blood of the smaller communities, that growth will be of an unhealthy character, and the time will come when a severe reaction will set in. Toronto, Hamilton, London, Peterboro' and Kingston cannot live within themselves. They are going to prosper only as the large and beautiful country that constitutes the province of Ontario prospers. Not the least of the blessings that electricity has brought to the present age will be that of serving to give to the smaller communities the opportunity, not alone of holding their own in the world of commerce and agriculture, but to put on increased strength in these particulars.

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It is no easy matter for any one concern in this age of progress to hold for any length of time a particular advantage in mechanical equipment over another The Onlooker, last month, in describing the new engine of the Toronto Street Railway Co., quoted Mr. Ross, engineer, as saying that this was the only engine in Canada not belted and with a water jacket. Mr. Ross, of course, was speaking out of his own experience, as mechanical superintendent of the Laurie Bros., and which has been far from limited. He had not known then that in the main station of the Incandescent Light Co., of Toronto, according to its superintendent, Mr. Milne, there has been in use for the past fifteen months a compound vertical 750 H.P. engine with generator direct-driven and also bearings water jacketed. No one will be more pleased than Mr. Ross and the Onlooker to make this further remark as to completeness of equipment in engineering progress in Canada.

HARTFORD v. THE BELL TELEPHONE CO., THE TORONTO ELECTRIC LIGHT CO. AND THE HOLMES PROTECTION CO.

READERS of the ELECTRICAL NEWS will doubtless remember the particulars of this case. Suit was brought against the above named companies by a Mrs. Hartford, who claimed $25,000 damages for injuries received as the result of coming in contact with a live wire, dangling in the street. Mr. Justice Rose, before whom the case was heard, gave immediate judgment in favor of the Bell Telephone Co., but reserved his decision as regards the other defendants. A few days ago he gave judgment in favor of these defendants also, in the following terms:—

At the trial I gave judgment for the defendants the Bell Telephone Company and Wheeler, reserving for further consideration the question of the liability of the remaining defendants or of either of them.

The Electric Light Co. had a right to have its wires where they were and if there has been a reasonable use of the powers of the Company, if there has been no negligence, then there is no liability see the National Telephone Company v Baker, L. R. Q Ch. Div 193 P. 168; Howard vs. St. Thomas, 19 O. R. 719.

The negligence charged is that putting up its wires under a crossing wire, it did not adopt sufficient safeguards against the wires coming into contact. The suggested safeguards were: separating the wires by a greater intervening space, placing a guard wire above the electric light wires, a better composition for insulating such wires. The evidence would not justify a finding that there was any defect in the material or composition used to insulate the wires but the weight of evidence was much the other way.

The remaining grounds must be considered in the light of the facts. What was the cause of the accident? Undoubtedly on the evidence the falling of the branch or branches from the tree upon the crossing wires put up by the Holmes Co., the branches having been cut by boys whether as trespassers or not, did not appear.

Admitting for the sake of argument, that the workmen of the Electric Light Company, knew or should have known that the wire passed among the branches of the tree and that they should have reasonably anticipated that in the course of nature, some natural force such as the wind, or as the result of decay, the branch might fall upon the wire, that the result would naturally be that having regard to the span of such crossing wire and its fastenings and the smallness of the space between the electric light wire and the crossing wire, it, the crossing wire, would sag so that the wires would

come into contact and that against such a not improbable occurrence it was the duty of the company to provide either by having a greater space between the wires or a guard above the electric light wire, it is sufficient to say that the accident here was not due to any such a state of facts.

The question in my opinion narrows itself down to this should the act of the boys in cutting the branches of the tree have been contemplated and guarded against by the Electric Light Company as something likely to occur and reasonably to be anticipated.

After much consideration, which the peculiarly sad condition of the plaintiff in a high degree demands, I am not able to answer such a question in the affirmative, even on the admissions or assumptions above made.

This particular danger was caused by the act of another without the defendants' knowledge or consent, that other was a "responsible third party." As I look at it, there was no neglect of duty on this defendants' part, for there was no duty to guard against such an act. It is not a case of negligence on a defendants part which was "insulated by the act of an intervening third party—see Howard v. St. Thomas- but it is a case of a wire in apparently a safe and secure position, where it would not, so far as we know, have become dangerous but for the act of another over whom the defendants had no control.

A duty may have existed to guard against other possible causes of danger, but such duty, if it existed, was not this duty, and so here there was no neglect of duty and hence no negligence.

This in effect also disposes of the question of the liability of the Holmes Company. Something was made of the fact that the crossing wire was a disused wire, but I cannot see how that makes any difference. I must on this question assume that the Holmes Company had a right to erect the wire, that it was allowed to remain in position although not in actual use, did not make it more but rather less a source of danger. The duty to watch such wire and prevent its becoming loose and dangerous no doubt remained, but on the evidence it was in as safe and secure a position and condition at the time of the accident as when in use. Mr. Cameron cited United Electric Ry. Co. v. Skelton, 14 S. W. Rpter. 863, in support of his argument on this point, but beyond establishing continued responsibility for a disused wire, it does not, as I think, help the plaintiff. The elements of knowledge of the facts, except on which the judgment there is founded, is lacking here.

But there seems to me to be another difficulty in the plaintiff's way. Assuming that the managers of both the Electric Light and the Holmes Protection Co. knew the position of the crossing wire, and how it was fastened, and that it passed along the branches of the tree in question, I do not see how it could be fairly found as a fact that it should have been reasonably anticipated that a blow on the wire at the tree would cause the sagging which here happened. It may be that such a result should reasonably have been anticipated and therefore guarded against, but I do not think on the evidence I could so find the fact.

On the whole I think the action must be dismissed with costs.

The following additional authorities may be referred to: Viners Abridged "Actions B" p. 215, Box v. Jubb, L. R. 4 Ex Div p. p. 789, Beven on Negligence p. 1000, Ahern v. Oregon Telephone & Telegraph Co. 33 Pac Rep. 463. Ward v. Atlantic & Pac. Tel. Co. Am. El. Cases Vol. 1, p. 259.

Had I found for the plaintiff, and had the husband here joined, I should have assessed the damages at $8,000. For the assistance of the Court, if my opinion should hereafter be held to be erroneous, I asess the damages for the wife at $6,000.

FIRE HAZARDS FROM TROLLEY WIRES.

THE Inspector for the Board of Underwriters, in Toronto, having represented to the Board the danger of allowing the use of current from trolley wires in buildings insured by the Association, it was suggested that the opinion of well known experts be asked. Accordingly the following letter was forwarded by Secretary McLean to Mr. J. J. Wright, of the Toronto Electric Light Company, Mr. F. A. Badger, City Electrician, Montreal, Mr. W. E. Davis, Toronto Street Railway, and their own inspectors.

The replies as printed below will be interesting, as showing how the matter is viewed from the different standpoints:—

TORONTO, November 12th, 1894.

DEAR SIR —I have been instructed by the Toronto Board to ask for your opinion as to the danger of an electric ground circuit when high pressure and a ground return are used for power or light. Does this danger exist when the current is taken from the trolley wires? Your reply will much oblige.

Yours truly,

ROBT. MCLEAN, Sec'y.

[COPY.]

TORONTO ELECTRIC LIGHT CO.

TORONTO, Nov. 16th, 1894.

ROBT. MCLEAN, Secretary Board of Underwriters.

DEAR SIR —In answer to yours of the 13th, re grounded electric wires, I may say that from the very inception of the electric lighting business, the danger of a grounded circuit has been recognized and its use discountenanced. Electrically, it can be worked all right, but the opposition to its use has always come from the insurance fraternity and other parties interested in the security of property from danger of fire. From our standpoint, we shall be very glad indeed if the insurance companies can see their way to relax their rules on this subject. We have spent many thousands of dollars in copper wire for return circuits, where we could easily have used the ground for a return. The moment the companies allow a ground return we shall at once ground all our power circuits and thus double the capacity of our distributing plant. At the same time, I am free to say, that the risk will be greater. Where there is the slightest dampness, the current will have a tendency to leave the wire and seek the ground, and anything that *will burn that lies in its path will be set on fire. This tendency to leave* the wire does not exist in the same degree on a metallic circuit. There is also a much greater danger of ignition from lightning with a grounded circuit. The network of wires all over the city form a huge lightning rod The lightning always seeks the nearest passage to the earth, so that wires grounded through motors or lights are just a picnic for a flash of atmospheric electricity - they form a lightning conductor of the best quality. On the other hand, a metallic circuit *insulated from the ground* offers no inducement for the lightning to travel on it at all, and consequently it rarely does so. I wrote your Inspector some time ago, when I found that the Railway Co. were putting in grounded wires, and claimed the same right. That letter has not yet been answered. I did not press for an answer as I understood the Association took the stand that is universally taken in England and the States, that it could not be permitted. I want the Association to understand, however, that while we shall continue to observe their regulations in the future as we have done in the past, we shall claim the same privileges that are extended to others, and that if the other companies are allowed to use *grounded wires, that we shall do the same. In reply to your query, does* the danger of grounded circuits exist when current is taken from trolley wires? I answer emphatically, "yes," and always will as long as the ground is used for the return circuits. There is absolutely no difference between "trolley" or any other electrical current, as far as grounded circuits are concerned

Yours very truly,

(Sgd.) J. J. WRIGHT.

[COPY.]

OFFICE OF CITY ELECTRICIAN.

MONTREAL, Nov. 15th, 1894.

ROBT. MCLEAN, ESQ., Secretary Toronto Board of F. U.

DEAR SIR —Replying to yours of the 13th inst., regarding the use of trolley circuit for light and power, I will say that while it may be possible in a given case (every precaution being taken to guard against accident,) yet I do not believe that in general practice such precautions would be fully attended to, and we would not sanction nor assume any responsibility for the use of such currents for the purposes mentioned.

Yours, etc.,

(Sgd.) F. A. BADGER.

[COPY.]

THE TORONTO RAILWAY COMPANY.

TORONTO, Nov. 13th, 1894.

ROBT. MCLEAN, ESQ., Secretary Underwriters Association.

DEAR SIR .—Yours re danger from high voltage and grounded circuit to hand. There is no greater danger from high volt system than low—*provided* the proportion of care taken in installation is *equal to the increase in pressure*. More fires occur throughout the country from low volt—heavy ampere systems—than others.

The pressure from the trolley wire is 500 volts—not by any means high voltage. All extensive electric light and power systems are more or less grounded—the more dangerous owing to the fact that it is often a partial ground only, and that the locality of same is unknown. A partial ground is liable to overheat the wire and cause combustion, whereas a dead or actual ground would instantly melt the fuses provided, of course, the other wire was at some point also grounded.

The only danger from current to installations from trolley wire, in my opinion, is from lightning. This I consider small, inasmuch as, when lightning strikes the trolley wire it invariably comes to the power house, taking the path of least resistance, blowing circuit breakers and passing to earth through lightning arresters. We have besides about 60 lightning arresters on the line throughout the city and one on every car. We have experienced over 40 thunderstorms and have never had any damage whatever, either in cars or buildings, otherwise than blowing fuses and the melting of lightning arresters.

We admit that there is danger from such circuit when not properly protected Where such protection is ample, I believe there is no more danger than from the ordinary overhead circuit. Our experience in Toronto will bear out the above statement.

Respectfully yours,

(Sgd.) W. E. DAVIS.

TORONTO, Nov. 15th, 1894.

ROBT. MCLEAN, ESQ., Secretary, Toronto.

DEAR SIR —In reply to your letter of the 12th inst., I can only repeat what I have stated before, namely, that the use of a ground return for electric lighting and power has been universally prohibited by all Boards of Underwriters, ever since the earliest days of electric lighting. There is today more than ever good and substantial reasons for a strict enforcement of this rule.

That there is a decidedly increased hazard by the introduction of such systems for commercial purposes, is beyond dispute.

At the convention of electrical inspectors held in Chicago in August of '93, the rule bearing on this subject was amended to make it as emphatic as possible, and reads as follows: "Lighting and power from railway wires must not be permitted *under any pretence* in the same circuit with trolley wires with a ground return, nor shall the same dynamo be used for both purposes except in street railway cars, electric car houses, and their power stations."

I might say the rules of the International Underwriters' Association have been universally adopted in the United States and Canada.

Yours,

A. B. SMITH.

CANADIAN ELECTRICAL NEWS
STEAM AND ENGINEERING JOURNAL

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VOL. V.

THE present number of THE ELECTRICAL NEWS marks the commencement of the fifth yearly volume. During the coming year each number of the journal will consist of 28 pages instead of 24, as hitherto, and we shall be glad to further increase its size from time to time to keep pace with the future development of the important industry which it strives to represent. We recognize also that quality is of greater importance than quantity, and shall aim to make THE ELECTRICAL NEWS, especially from a Canadian standpoint, of the greatest possible interest and value. Every reader is invited to assist, by forwarding information which would tend to make the journal increasingly useful. We are indebted to the friends who have sent us contributions from various parts of the Dominion, and trust that during the coming year their example will be largely followed by others. The editor doesn't profess to know it all, and will at all times welcome information and suggestions.

The year 1894 was marked by great electrical development in Canada, especially in electric railway construction, notwithstanding the severe commercial depression which prevailed in this and all countries. Towards the close of the year there was observable in business circles a feeling of greater hopefulness, which bespeaks more encouraging and satisfactory conditions during 1895. In the hope that such will prove to be the outcome, we extend to every reader of THE ELECTRICAL NEWS our best wishes for a happy and prosperous new year.

FEBRUARY 19th and 21st are the dates chosen for the next annual meeting of the National Electric Light Association, to be held at Cleveland, Ohio.

THE latest application for membership in the Canadian Electrical Association comes from Mr. W. A. Foster, Electrical Engineer to H. H. the Sultan of Johore, India. Having read in the technical press a report of the proceedings of the convention in Montreal, Mr. Foster writes the Secretary of the Association from Singapore, as follows: "Having for several years been connected with the telegraph service of the Canadian Pacific in various parts of Canada, and a Canadian by birth, I should be glad to become a member of your Association. Since leaving the Canadian Pacific Telegraph Service, I have for the past five years been actively employed in electrical engineering, having installed several large lighting plants in this and other districts."

THE boiler explosion at Essery's saw mill near Orangeville, Ont., referred to in our last issue, is but one of many that have resulted from the same cause. The boiler was a second-hand one, about thirty years old, and should have found its place in the scrap heap long ago. The engineer of the Orangeville waterworks, who made an examination of the boiler at Essery's request, said it should not be run at more than 40 or 50 pounds pressure. Mr. Edkins, boiler inspector, from an examination of the boiler subsequent to the accident, came to the conclusion that 20 pounds was the safe limit of pressure at which it could be operated immediately prior to the explosion. To what extent the boiler was properly handled is apparent from the testimony of one of the employees, that twenty minutes before the accident he noticed that the steam gauge indicated a pressure of between 110 and 115 pounds.

ON another page will be found illustrations and a description, both copied from the Belleville Sun, of a street railway system to be introduced in Belleville. It is spoken of as the E. M. system, and the inventor's name is McLaughlin. It is a sectional contact railway, and the description quoted is simply a description of sectional contact railways in general. It states incidentally that the collector wheels are maintained in constant contact with the sectional surface conductor, and current is supplied to the latter from the main conductor through the switch board; also that a "secret" controller does it all. Now the durable construction of the switches, and reliable methods of operating them, and insuring constant contact of collectors, are the only points in a sectional contact railway that any inventor can claim. They are what constitute a "system." Any so-called system which does not explain the methods of dealing with these essentials is no more a subject for serious criticism than is a patent medicine advertisement. It is an impertinence for an inventor to obtrude his "secrets" on public attention. And the offence is aggravated by column after column of trash about the "deadly trolley," "the death dealing fluid," extravagant claims of economy, personal descriptions of the inventor, his career, and the number and sexes of his children. This kind of newspaper article is out of date, long out of date. It belongs to the earliest and worst days of electrical development, when it was almost a slur on a man's character to call him an electrician. Electrical engineering now-a-days is business, and to merit confidence should be treated in a business-like manner.

ONE of the signs of a revival of business from the depression of the last two years, is the number of electric railway schemes which are now being mooted. Some are appearing for the first time, and some reappearing after an enforced retirement. If there is a quick return of prosperity, there is danger of a boom, with its accompanying construction of unprofitable lines, whose inevitable failure will bring loss to the shareholders and undeserved discredit on electric railways in general. It is of course plain to all that such lines mean a waste of capital. But there is another method of wasting capital which is not so plain. In many parts of Canada, particularly in western Ontario, there are steam railways in abundance connecting all the smaller towns through branches and junctions. But unless on some main lines, these towns are poorly served. The cost of running a train is too great to permit a frequent service, and the inconvenience to traffic of being forced to accommodate itself to a few opportunities at long intervals tends to minimize the development of travel. The inhabitants grumble at the railway which cannot give them any better steam service except at a loss, and readily welcome an electric railway which promises them relief. Since an electric railway is most economically run when its total traffic is uniformly diffused in small lots throughout the whole running time, it will probably take the bulk of the passenger and small parcel traffic from the parallel competing steam road. It will also in many cases build up and increase traffic which the steam road could not obtain, and it is quite probable that the electric railway may pay handsomely. But it is none the less true that a large portion of the investment in it is wasted capital, so far as the community at large is concerned. The steam railroad with its existing tracks, buildings and organization, might have served the town just as well or better, by *undertaking the local electric service, with merely the additional* investment required for power, cars and trolley wire. The public benefits by competition—but only up to a certain point. When the business competed for is not enough to pay the expenses of competition, the loss, directly or indirectly, falls on the community. Where a projected electric parallels an existing steam road, it means in general that it is to do work which the steam road could do at less cost. And if the steam road for any cause will not undertake it, the communities to be served, the investing public, and electrical interest in general, would probably all be better off if the electric company simply leased running rights over the steam road, instead of sinking capital in a new and parallel permanent way of its own. Of course operating, or leasing operating rights, by the steam roads, presupposes that the latter are alive to their own interests, and are prepared to deal in a spirit of fairness with the communities they serve, whose interests are interdependent with their own. Unfortunately the record of Canadian railways does not tend to inspire much confidence in their judgment in such matters, and if they cannot or will not see their opportunity, a parallel road is the only solution; but it is none the less, to the extent of the invested capital, a tax on the resources of the country in general, and a source of justifiable alarm to foreign investors.

THE well known saying of the French general who witnessed the charge of the Light Brigade at Balaklava was, "*it is magnificent, but it is not war.*" On looking at some of the large central stations in America, and seeing a large part of the plant lying idle for twenty-two hours out of the twenty-four, in readiness to tide over a brief heavy local period, European engineers must frequently be tempted to parody the phrase and say, or at least think, "it is magnificent, but it is not business." With more abundant and cheaper capital, generally greater competition and national habits of permanent construction, the fundamental conditions in Europe are not strictly parallel to those on this side of the Atlantic; and such a criticism, though natural in one imbued with European methods, may in many cases be too sweeping when worked down to details. But it must be confessed that there are some grounds for such a criticism which might profitably receive more consideration. The tendency of American engineering practice is to run in grooves. This is a natural result of the system of machine manufacturing, whose developments is so distinctively American, and justly considered one of the triumphs of American mechanics. Added to this is the national habit of rapid business expansion designed to skim the cream off the opportunities for making money which are so lavishly afforded by the growth of a naturally rich and diversified country. The wonderful development in any one branch due to such enterprise, is dazzling, but it tends to unwise self-satisfaction and to blind the observer to the merits of the steadier advances which are being continually made by the less wholesale methods pursued in Europe—advances to which the American engineer is glad to turn for lessons, when the inevitable time comes that something more than the cream of the business must be worked to maintain profits. The American engineer owes the large direct connected dynamo to the labors of his European confreres, and at least two of the largest central stations in the United States are now availing themselves of European experience in the use of storage batteries as an adjunct to central station plants. In a station load curve there will always be one summit much higher than the others—generally about 6 p. m. The first object of every central station is to add customers till the height of this summit equals the full capacity of the plant. But during most of the running time the load is much

less than the maximum, and at these times the surplus power may charge an auxiliary storage plant. This plant may be used to carry an increased maximum load, beyond the capacity of the dynamos and steam plant. In this case the investment, depreciation and expense of storage plant required would be compared with the same items for additional generating plant to do the same work. Or the storage plant may be used to carry the whole load of the station during the light load period, allowing the generating plant to be shut down altogether, saving wages and fuel, &c. For such a use as this last the interest and depreciation on battery plant investment would be compared with the running expenses saved. In the case of smaller stations which run only at night, a day load might be carried by an auxiliary battery plant, which could be charged between midnight and morning. Such uses of the storage battery have been common European practice for years, but it is only recently that they have been applied to central stations in America. The largest plant of the kind in the United States is that put in last spring by the Edison Illuminating Co., of Boston, and it is now reported that a large increase of this plant has been ordered.

It is a noticeable characteristic of our neighbors in the United States that they suffer themselves to be inconvenienced or imposed upon in their collective capacity, by any individual or corporation of sufficient impudence to profit by their national weakness in resisting organized extortion. We say weakness advisably, for although their forbearance is no doubt partly due to their equally noticeable national good naturedness and sense of humour, it has its roots in the eclipse of that sturdy civic virtue which resists any oppression on principle, even though resistance involves greater temporary individual inconvenience than would submission. A good nature which finds sufficient general relief from continual imposition by making a joke of it, is not so estimable as it appears if the imposition is no joke to the humble or weaker members of the community, whose unheard blessings would fall upon any "crank" or "kicker" who would refuse to see the joke. Amongst our near relations across the Atlantic, this sturdy civic virtue shines with possibly too undimmed radiance. We in Canada are, in this respect, certainly more like our neighbors than our relations, but we have from the latter a wholesome leaven which causes us to rise more quickly than the former. The leaven has been working in Montreal recently, where an unregarded civic ordinance against over crowding the street cars was invoked by a public-spirited individual, and the Street Railway Co. was fined $1.00 and costs in two cases. This drew forth a plaintive protest from the company that they really could not help it. People would crowd on in "a most discourteous fashion." Their conductors could not be expected to "beat them off with a club, or take them by the collar and jerk them off into the street." People in Montreal are so unruly and so bent on making themselves uncomfortable that if the ordinance is to be enforced, the company "will have to engage and train sluggers and bullies" to keep the people from crowding. This sort of nonsense is simply adding insult to injury. People are not such fools as either to do or believe such things. In the whole letter there is only one semblance of an argument. It says, "extra cars do not meet the requirements, as everybody wishes to get on the first car and will not wait for the next, which is only half filled." Of course they will not, when they have no assurance that the next car will not be just as bad as the first. Let people know that they must wait until they can get the seat they pay for, and they will wait. If there are not enough cars to handle the business, people will walk off with their fares in their own pocket, instead of in the company's, and then kick till a proper number of cars are put on. This is the true reason of the wail from which we have quoted. In England the licensed number of passengers is posted in the car, and when that number is complete, the car stops only to let people off. Do the same thing here and fine the company for every extra passenger carried, and there will be no more tears over the gentle feebleness of the conductors and the untamable fierceness of the passengers. Perhaps, even, in time, the passengers will learn that when they pay their fare they pay for the right to get and keep a seat, and not for the privilege of exercising their politeness by giving up a seat to a lady, who herself ought not to be subjected to the crowding and jostling from which even a seat will not shield her. There are emergencies, times of extraordinary traffic, or unavoidably irregular cars. At such times it may be in the public interest to permit overcrowding. Let the police magistrates have power to dismiss charges of overcrowding when they think it excusable. This would avoid all hardships to the railways from a cast iron rule, and the public will be content to leave its interests to the magistrates, instead of as at present in the hands of the other interested party, the street railway itself. If the corporation whose attitude towards the public meets with condemnation, cannot find ground upon which it can defend its position and policy, it had better attempt no defence.

THE BELL TELEPHONE COMPANY'S NEW EXCHANGE AT OTTAWA.

In the December number of The Electrical News some particulars were published concerning the Bell Telephone Company's new exchange at Ottawa. The following additional facts in connection therewith have since come to hand:

The new Ottawa building is 80 feet deep, has a frontage of 32 feet and is 3½ stories high. The basement and first story have a brown stone front; the upper stories are brick with brown stone trimmings; the woodwork inside is of clear pine with natural wood finish.

The rear of the basement is used for the linemen's quarters, store room for line material, also hot water heating apparatus; the front part and all of the first floor is rented for offices.

On the second floor are the manager's office, general office, and long distance tool office, operators' cloak room, battery room and instrument store room. The top floor is one large room the full size of the building, and is used entirely for the switchboard and distributing rack.

The switchboard consists of 14 sections of improved 100-point metallic standard switches. These switches are set in the middle of the room to allow a multiple switch being put in when necessary, without having to move the present board. The distributing rack is made of iron, and is known as the Ford or "number four" rack, having sneak and carbon arresters attached, which are known as the "number seven" arrester.

All the lines enter the building through an underground system. The lead cables are spliced in the basement to Akonite cables, which extend to the top floor where the cables are formed up and connected to the arrester; this method does away with the iron terminal generally used, and saves considerable valuable floor space.

There are over 4,000 lineal feet of conduit in the underground systems, having a capacity for over 1,800 miles of wire. There are at present about 575 miles of wire in use underground, and 200 miles of wire in aerial cables; the latter cables are spliced to the underground cables in the nearest manhole to the lead they are on.

The ultimate capacity of the exchange and underground system is 3,000 subscribers; there are about 1,100 at present.

The return ground system is used on the pole routes; the rest of the system is metallic. The return wires of all the pairs in the cables are connected in the return ground at the cable poles, which makes the entire system nearly as good as straight metallic circuits.

The change from the old to the new system was successfully made on the evening of November 7th, in about three minutes.

The City Council of Halifax have threatened to ask the Legislature to cancel the charter of the Halifax street railway on the ground of inefficient service. The solicitors of the company state that representatives of the various interests concerned in the road are conferring together with the expected result that the disputes and litigation between them will be amicably settled and the electric substituted for the present unsatisfactory service in Halifax. The Council have deferred action awaiting the outcome of the present negotiations.

The New Westminster and Burrard Inlet Telephone Co. has purchased the Postal Telegraph Co.'s line between Vancouver and Seattle, W.T., which has been converted into a telephone line. The line, which is 160 miles in length, is now in first-class working order for telephonic purposes. Besides Seattle, Tacoma and other Sound cities will shortly be connected, while public offices have been established at the following places: Westminster, Clover Valley, Blaine, West Ferndale, Whatcom, Fairhaven, Samish, Brownsville, Wash., Mount Vernon, Stanwood, Walker's, Maryville, Everett, Snohomish and Botholl.

CHARACTER SKETCH.

WM. T. JENNINGS, C.E.

"Because I have neglected nothing." Nicholas Poussin.

It does appear, if one takes a broad view of the world's history, either from the standpoint of the philanthropist or that of the man of business, that greater credit for the world's progress cannot be given to any class of men, than to those whose vocations have led them to open out uninhabitable sections of country and by an iron band to belt continents and connect far distant districts with each other.

So far as the Dominion of Canada is concerned, one of the men, who has played an active part in the construction of its public works, is Mr. Wm. T. Jennings, who was born in Toronto, May 19th, 1846. Mr. Jennings was educated at the Model Grammar School and Upper Canada College in his native city, and commenced his professional career as an engineer in 1869. He was then under Mr. Molesworth, and his first work was to survey the swamp lands of Grey and Bruce for drainage improvements. From 1870 till 1875 he was on the engineering staff of the Great Western Railway, which he left to enter the service of the Dominion Government. From that time forward Mr. Jennings' chief work, perhaps, has been in the line of railroad construction. Several important surveys and construction works in the Northwest, British Columbia and other parts of the Canadian Pacific Railway were made by him while in the service of the Government, the Construction Co., and the C.P.R. Co. From 1886 to 1890 he had charge of the surveys and constructions for the C.P.R. in Ontario, and early in 1890 was appointed Engineer for the City of Toronto.

WM. T. JENNINGS, C.E.

What his activities amounted to during his years of railroad construction find illustration, in a measure, in the Canadian Pacific and the success that has attended this railway in opening out the extensive and fertile northwest territories, and proving the medium of spanning the Dominion out to the Pacific coast.

Whatever work Mr. Jennings has undertaken has been marked with thoroughness and complete mastery of his profession. Nowhere was this more apparent than during the two years he occupied the position of City Engineer in Toronto. The basis of the present arrangement between the city and the Street Railway Co. had its origin with Mr. Jennings, and not only the excellent character of the road, but also the revenue the city receives from it in the shape of percentages and mileage tax was the thought of the late City Engineer. Toronto is proud of its splendidly paved streets, and this work was planned by Mr. Jennings during his occupancy of the office of City Engineer. It was a special study with him to give to Toronto a system of pavements that should not alone be attractive as public thoroughfares, but that would possess endurance and lasting qualities. Negotiations between the city and Bell Telephone Co. which resulted satisfactorily for Toronto, were also undertaken while Mr. Jennings was in the service of the city. He had planned a system of underground wires in connection with the electric light and telephone contracts, and had he remained in office would likely have brought these plans to completion. During these two years the esplanade matter came up for consideration, and Mr. Jennings had to fight with his known determination the strong railroad corporations.

His official connection with the city did not cover as great a length of time as citizens, desirous of the well-being of Toronto, would have liked. The fact is that Mr. Jennings was too independent and fearless an officer to suit many who at that time occupied the position of aldermen. They quickly learned that he was a man who was master of his business and could not be dictated to, or used by those who had their own little schemes to carry out. His wide experience, outside of that hemmed in by the bounds of a single municipality, had given him a thorough knowledge of human nature, and contractors, as well as aldermen, understood that they were dealing with a man who would permit of no injustice, much less anything approaching crookedness. Of his own free will, and to the regret of the better elements in the council, after occupying the position for about two years, he resigned, owing to the aldermanic body breaking faith with him by changing the by-law under which he took office.

The past two years of Mr. Jennings professional career have been employed, to a large extent, in the construction of various short lines of railway throughout the province. He has come actively to the front as the engineer of several electric roads recently completed, and that are likely to be the forerunner of many others. He points with natural pride to the Niagara Falls Park and River Railway, in the construction of which he was chief engineer. He served the new Hamilton and Grimsby Electric Railway as consulting engineer, and the line extending from Galt to Preston was built under his superintendence. During the past twenty years the various undertakings with which Mr. Jennings has been connected, represent a total of not less than $35,000,000. On another page of the ELECTRICAL NEWS is discussed the question of short line electric roads suggested by Mr. Jennings' experience and observations on this phase of railroad building.

Personally Mr. Jennings is popular with all who have his acquaintance or friendship. He is ever ready, out of his wide knowledge of public affairs, to impart information to those honestly wanting information; at the same time he is too busy to rest comfortably under the intrusion of those who hold to a person in his position much the same relationship that the editorial bore does to the journalist in his sanctum. His career furnishes a capital illustration of the saying of Owen Feltham: "That man is but of the lower part of the world that is not brought up to business and affairs."

Mr. Jennings is a member of the Canadian Society of Civil Engineers, the Institution of Civil Engineers, the American Society of Civil Engineers and the American Association for the Advancement of Science. In religion he is a Presbyterian, being a son of the late Rev. John Jennings, D. D., for many years pastor of the Bay St. United Presbyterian Church, in his time one of the best known and ablest clergymen of Toronto.

PUBLICATIONS.

"The President and Directors of the Canadian General Electric Company wish you a Happy and Prosperous New Year" is the kindly inscription borne by a card addressed by the Canadian General Electric Company to their friends. The ELECTRICAL NEWS heartily reciprocates the cheery sentiment.

An attractively gotten up card reached us the other day, on which was printed the following. "All comparisons are odious, yet we must say that, among our customers, ONE only has first place in our esteem We have (at great expense) secured a portrait (in colors) of our honored friend WE PRESENT IT TO YOU AS A MODEL. Study the features, see in this genial face how CANDOR, JOY, MIRTH and BEAUTY are tempered by WISDOM, JUSTICE AND PEACE. Merit demands recognition. What we say of the original of this apotheosis of art is only justice. Our New Year's wish is, may pleasant relations long continue between our esteemed friend and yours truly." This is followed by the name of the American Electrical Works, Providence, R. I., and its various branches, including the Eugene F. Phillips Electrical Works, Montreal. The reader wonders what it is all about, and is prompted by curiosity to unfasten the little envelope attached to the center of the card, when his own face reflected in a tiny mirror reveals to him the secret. This is decidedly the most original New Year souvenir that has come under our notice.

The Seaforth Electric Light Co. are considering the advisability of extending their lighting system to Egmondville.

It is said to be the intention of Mr. J. Ashley, to establish at Gananoque, Ont., works for the manufacture of electrical machinery.

The citizens of Stratford will vote on a by-law on the 7th inst., to authorize the council to expend the sum of $16,000 on a municipal lighting plant.

It is reported that Mr. S. R. Break, Manager of the London, Ont., Street Railway Co., has been appointed Assistant Secretary of the Detroit Street Railway Co. Mr. Break enjoys the well-deserved respect of the citizens of London, and his removal from that city will be much regretted.

CENTRAL STATION TYPES.

By Geo White-Fraser.

NO. 2.—SMALL MUNICIPAL PLANT, ORILLIA.

MUNICIPAL versus Private Ownership of Electric Lighting Plants is a question which undoubtedly has two sides, both of which have had a good deal of consideration; and a quantity of statistics on the subject have been collected, chiefly by the champions of private ownership. The writer has followed the discussion throughout, and has had the pleasure of hearing Mr. Francisco speak on it personally, and cannot help being struck by the fact that all the arguments against the economy and expediency of municipal ownership seem to be founded on the *possibility* of aldermanic corruption; the *possibility* of political partizanship influencing appointments; and the *possibility* of the same undue influence being excited to keep *in office incompetent* persons to the detriment of economical management. Mr. Francisco and other writers draw attention to the reports from several municipal plants in the States, in which electric lighting is said to have cost nothing, or some absurdly small figure; and in refutation of the implied argument in favor of municipal economy, states that in all these cases the salaries of the engineers, the cost of the coal, &c., have been put down to the waterworks or some other municipal department, so as to show a good *economy for the electric lighting account.*

This expose is by many taken as a proof that, for the towns cited, municipal lighting is a failure as regards economy, but while it certainly throws light on the eccentricities of municipal book-keeping, in the absence of any definite data, it still leaves open the question of the economy of municipal lighting, because expensive lighting is not a necessary consequence of poor accounting. In fact if the waterworks account is thereby not so greatly increased as to rouse an outcry, it is obvious that the two municipal departments work together more efficiently than either of them singly. For in all large towns, the engineering staff that is required for the pumping machinery can equally well attend to the electric light engines; one thoroughly competent chief engineer is sufficient for both plants; one accounting department controls the finances of both. The mere fact of the waterworks department being able to shoulder the electric lighting expenses, itself might be cited as one illustration of the practical advantages of municipal control. It seems to the writer that the question of corporate management of electric lighting should not be regarded simply *per se.* Whether a city arc lamp costs a little more or less than a private one is no doubt of great interest, but of itself it proves nothing except that the City Superintendent is or is not fully competent to handle electricity. The question is: "How do the various departments affect each other as regards *efficiency* and *general* economy?" Is the whole level of efficiency raised or lowered by the addition of an electric department? Obviously it is raised. The whole engineering and business staff must benefit by the accession of another official who, as Lord Kelvin timely says, must by profession be as much of a mechanical as of an electrical engineer. It is impossible to draw a clear line between civil, mechanical and electrical engineering, as these branches of the profession overlap in many places, so it may well be that in municipal affairs, as in others, three heads are better than one. To follow the same line of argument a little further: It needs not much demonstration to prove that the book-keeping as well as the engineering staff will be working at higher efficiency, and therefore relatively more economically. Then as to the possibility of "boodle." It stands to reason that any unnecessary expenditure on behalf of "boodle account," must be in the first cost of the plant, and therefore can only increase the yearly operating expenses by the interest on the money so expended. This interest, divided by the number of lamps, is not going to very appreciably raise the yearly cost per lamp, because the amount of boodle that a plant can stand is limited, and bears a certain loose proportion to its capacity. There is no really valid reason why political partizanship should not influence civic appointments, so that the whole argument seems to reduce itself to a weighing of facts on the one side and possibilities on the other. The writer is not extenuating bribery and corruption, but merely taking things as they seem to be and considering their practical bearing. The question, however, should not be regarded as a whole and so attacked. If carefully considered, it seems to divide up naturally into portions which have their own peculiar features. The general efficiency of a plant increases, as a rule, with its size and the nature of its service; so that in a large city electric lighting in connection with an electric railway may quite possibly be more cheaply done by a private plant than as a civic enterprise. And in towns of any size, where a reasonable sum has been paid, or considerable responsibilities undertaken by a private company in return for a franchise, it seems almost a breach of faith for the civic authorities to undertake their own lighting, unless of course the sum charged by such private company be exorbitant.

As communities become smaller, the arguments against their undertaking their own lighting seem to have less and less practical application, and a limit is soon reached when the question becomes one, not of expediency, but almost of necessity. The operating expenses of an electric station can be placed under two heads: fixed and variable. The latter—coal, carbons, repairs, &c. decrease directly in proportion to the size of the plant; the former—salaries of electrician, engineers, clerks, linemen, &c.—decrease to a certain extent in the same proportion, but eventually arrive at a point where further reductions can only be made at the cost of imperilling the life of the plant. I assume, of course, that the fallacy that electrical machines and good engines require no experienced care, is quite exploded. Statistics show that in all successful stations the fixed expenses are to the variable, in the proportion of, roughly, 2 to 1. It is therefore quite evident that a private plant that has to pay dividends as well as operating expenses, requires a certain minimum amount of business for its support, and small towns therefore seem to have no alternative but to do their own lighting, or go without. Between these alternatives they of course will choose for themselves, but as the very large majority of towns in Canada are below the "business limit," it will be interesting to watch what results are worked out in one or two typical cases.

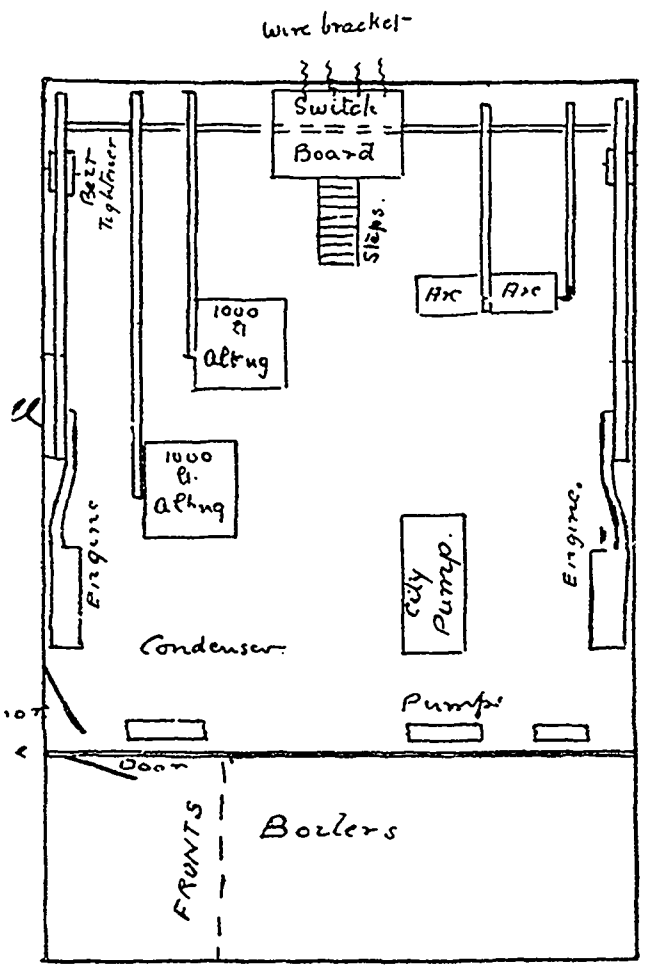
There is yet again the case of the small town, which, although beyond the size limit, and therefore offering a fair field for private enterprise, is yet sufficiently near to it to make investors cautious, although such a community may reasonably undertake its own lighting. The problem is greatly simplified if it has already decided the general question of municipal ownership, by owning its waterworks, for then the two can be operated together under almost the same management, by the same boilers, the same engineers and help, in the same building, and the employees of the two departments can be almost interchangeable. As a result of this system, not only will light be cheap, but water will also cost less, relatively, and there will be a greater number of experienced practical engineers employed around the works, to the obvious benefit of all the machinery.

It would be easy to point out the many direct and indirect advantages accruing from such combination of departments, from the standpoint of pure theory; but a citation of actual results obtained in one typical case will be much more convincing, and is not far to seek. Orillia is a town of about 4,700 population, and may therefore be taken as representing the class above referred to. To the Mayor, Mr. Geo. Thomson, is due the credit of having combined two municipal enterprises—waterworks and electric lighting—with street and private. There always had been arc-lighting for the streets, but as the people desired house lights too, and there were no offers from private individuals, the matter was at once taken in hand by the Council, with the result that, for compactness and economy, Orillia has a little plant that seems hard to beat. To fully appreciate its advantages, it is well to state that the waterworks plant had been in operation for some time previously, requiring one boiler, one pumping engine, one fireman, one engineer—all working during a part of each 24 hours, under the management of a committee of the Council. The electric light plant was installed in the waterworks building, and required extra—one boiler, two engines and dynamos, one fireman, one engineer, also all working part of the 24 hours, and managed by the same committee. The extra work thrown upon the town clerk is said to be "great," perhaps may necessitate the employment of an extra clerk. So far the advantages may not be evident, but every little consideration will show that the electric light and the waterworks service allow of each boiler working almost continuously for 24 hours a day, while the duplication of boilers gives a good chance for thoroughly cleaning and overhauling them alternately. The two engineers can take night and day spell, week about alternately;

the one "off" for the day can look after general repairs, cleaning, &c., and so the plant is better looked after. The two firemen also relieve each other week about, the one who is "off" during the day doing all the line work--trimming the arc lamps, of which there are 40--and any little repairs. The electric lighting books, being under the charge of the town clerk, add nothing to the municipal expenses, and even if an extra clerk is necessary, the probability is that his time will be divided between the electric lighting and the general municipal books. The whole municipal accounting, therefore, will undoubtedly be better and more expeditious, and although the price at which lights are sold is very moderate, the income derived therefrom will be sufficient to secure first class advice as to general management.

Evidence of proper attention to business principles is to be seen in every detail of the combined plant. Excellent machinery was purchased in the first place—general electric alternating dynamos and apparatus, Wheelock engines, Northey condenser—and installed properly by the various makers, who were thereby made to prove their guarantees. Well qualified engineers were engaged to run it, and given fair salaries. The wisdom of this policy is often not appreciated (impractical employers preferring cheap men to expensive good men, and putting down the greater cost of repairs to faulty machinery), but is at once made plain in this plant, not only by its thoroughly workmanlike appearance, but by the arrangements made for keeping it in perfect working order. The engines are periodically "indicated"; boilers examined and properly cleaned; temperature taken of feed and condensing waters; arc lamps brought in, in turn, off the line for cleaning and repairs, and many other little attentions paid that second rate engineers would neither think of nor be competent to undertake, but which greatly conduce to long life and efficiency.

It is greatly to be regretted that no station records are kept which would enable the cost of production per K.W.H. to be known, but figures are given below which will prove of great interest to many station men, and which certainly show a most satisfactory result. The accompanying diagram gives the general arrangement of the plant. The switchboard being on a raised platform, is a very convenient and sightly feature; while the pumps, being in the engine room, are thus under the engineer's immediate supervision. Another excellent plan: The two halves of the shafting are connected by a clutch, which permits of any desired combination of engine and dynamo.



The electric light employees are, with their salaries. One engineer at $700 per annum; one fireman at $1.25 per day. It has already been explained that the two firemen take line work week about, with their firing shift, so the expense of a trimmer is saved; and as the cost of installing lamps in houses is paid for by the consumer, outside help can be employed for that purpose, entailing no expense on the station. Wood for fuel costs $1.75 per cord, and is consumed at the rate of 5 cords per night in winter and 3 in summer. The operating expenses of the entire plant, arc and incandescent, are, therefore, taking no account of such items as oil, waste, repairs, &c., of which no data are given:

Engineer at $700	$ 700
Fireman at $1.25 per day	460
Fuel (7 summer and 5 winter months)	2,435
Carbon estimate	570
Total	$4,165

The capacity of the incandescent plant is 2,000 16 C.P. lamps, of which nearly 1,400 are already installed and running; and 40 2,000 C.P. arcs. The prices per lamp vary from 30c. per month for residences to 80c. for hotels, being based on the number of hours of illumination; and taking one-third of the number at 60c., and the remainder at 30c., which certainly allows a margin, gives a yearly income of $5,468.22. This leaves a balance of $1,303, against which must be placed the miscellaneous items, unspecified lamp renewals being at the consumer's expense. This balance will remain a net profit, and will probably be enough to pay the salaries of the waterworks engineer and fireman. Or it can, if preferred, be drawn upon to pay interest on the bonds sold to provide the cost of the electric installation. Then it would appear, that working the incandescent plant at two-thirds of its rated capacity, brings in a sufficient income to defray its own expenses, pay off its own debt, and do the town lighting *free;* besides all the indirect advantages indicated above. It is perfectly obvious that the remaining third of the capacity will bring in a net income that may be used, as municipal income, in streets or public buildings, market house, &c., and will be a still further advantage to the public. The writer believes that the advantages of municipal ownership, as regarded from the purely theoretical standpoint, are fully realized in the above case, and are equally attainable in every other case when accompanied by caution, enterprise and public spirit.

THE WELSBACH GAS BURNER.

THE process employed in manufacturing the mantles used in the Welsbach incandescent gas burners, which are now so well known in London, is one of considerable interest and delicacy. These mantles, upon which depends the distinctive character of the Welsbach light, are a sort of elongated hood, which hangs over the burner and becomes brilliantly incandescent in the heat of the flame. They are made of fine cotton netting, carefully washed in order to render it chemically clean. The first step is to soak these cotton mantles in a complex fluid containing salts of a number of earthy metals. They are then dried, and, after undergoing one or two intermediate operations, are strongly heated in a Bunsen flame, by which the cotton is burnt away. The skins or films which are left behind consist of the substances dissolved in the fluid just mentioned, and are so fragile as to crumble to dust at a touch. To make them sufficiently strong to bear handling they are dipped in collodion, and after being trimmed with scissors wetted with methylated spirit, are packed in boxes for distribution. The light obtained as a result of this treatment is comparatively rich in actinic rays, so that it is quite possible to take good photographs by means of it, and it is claimed that less gas is consumed to produce a given amount of light than in other forms of burner, and that less heat is developed. The company which owns the patents for this country has lately brought out a novel form of glass chimney, which consists of a ring of elliptical glass rods held in position by brass bands at the top and bottom. This is stated to be less liable to break than the ordinary chimney, and moreover, to yield a more diffused light.

It is proposed to extend the Montreal Park & Island Railway to the village of St. Laurent.

THE CANADIAN GENERAL ELECTRIC COMPANY'S WORKS AT PETERBORO'

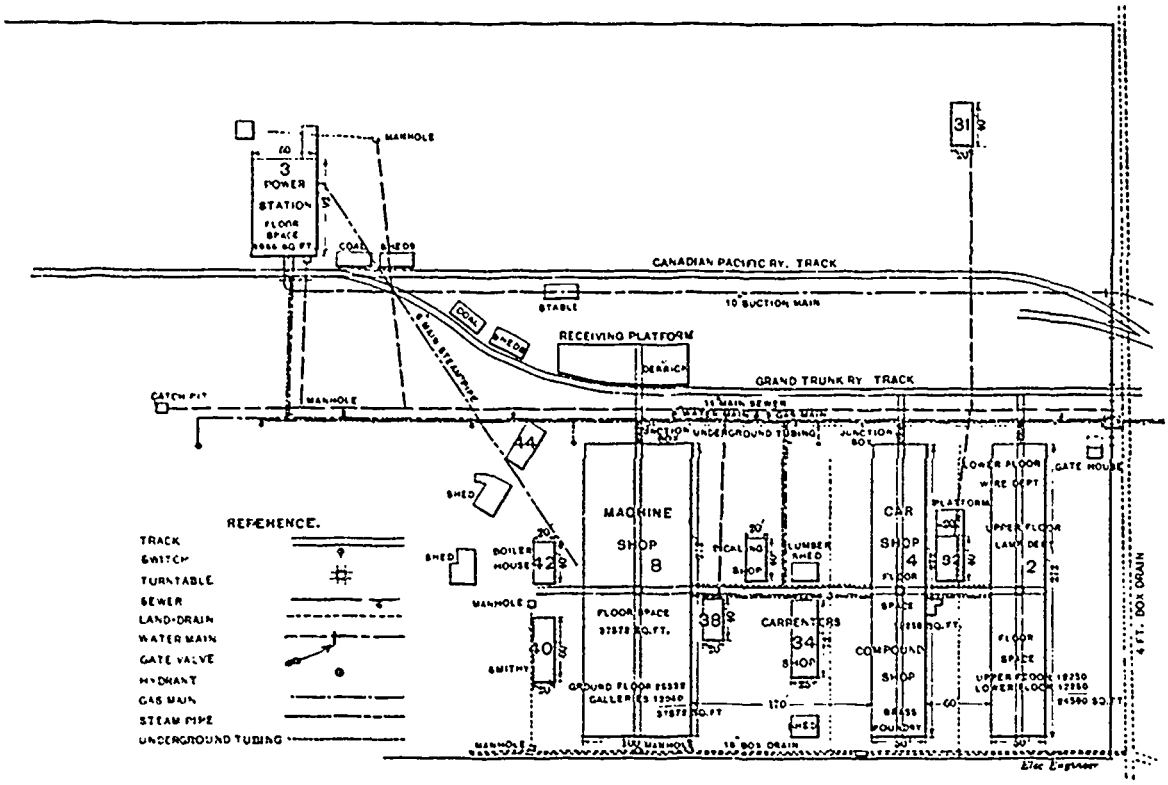
THE Peterboro' factories of the Canadian General Electric Co. (Ltd.) are in extent by far the largest in the Dominion, and for completeness of appointment and variety of output are probably unsurpassed in America. An examination of the ground plan of the works as given below reveals at a glance the great care in arrangement and minute attention to detail with which every possible facility has been provided for handling the immense output of the shops through the various stages of manufacture from its entrance as raw material to its final shipment as finished apparatus.

The factories are located in an admirably situated enclosure of some forty acres, in the south-west corner of the town. Switches from the main track of the Grand Trunk and C. P. R. lines extend through the grounds and provide for the rapid and economical handling of all materials used. The three hundred horse-power required for the different shops is furnished by individual motors conveniently located, receiving their current from an isolated power house, which is in itself a model of central station construction. The three principal buildings, the main machine shop, the tube and carpentering shop and the wire shop, have an aggregate floor space of some 75,000 square feet, and there are besides some fifteen smaller buildings devoted to various purposes.

As might naturally be expected the most striking feature of these factories is the great variety of the work required to be be turned out. A recent visit to Peterboro' showed in a hurried run through the works over how wide a range of work their operations actually extended. On the main floor of the machine shop, were in course of construction at the same time the three huge 1,000 horse power double unit generators for the Montreal Street Railway Co.; incandescent dynamos, alternating and direct current, coming through literally by the dozen; "Wood" arc apparatus, which the company has adopted as standard; mining apparatus, drills, generators and locomotives; street railway motors of the well known C. G. E. 800 type; direct connected units complete with their engines, transformers; snow sweepers, etc. The galleries are devoted to the manufacture of the smaller parts of the heavy machinery and to the lighter class of apparatus and supplies: Type "K" controllers; Thomson recording watt-meters; indicating instruments of all kinds, arc lamps; sockets and lamp bases, porcelain rosettes and cutouts, and the thousand and one other minutiae which go to make up a complete electrical system. In the lamp works, recently removed from Hamilton, the different departments are thoroughly equipped for the manufacture of incandescent lamps of the most approved type, and on a scale which should for some time at least meet all possible developments of the business. In the wire works provision is made for turning out insulated wire of every description from standard weatherproof or C. C. rubber covered to flexible cord or armoured cable.

A recent departure of the company is into the field of car building, and the cars so far completed show a solidity of construction combined with quiet elegance of finish which it would be difficult to excel.

In so brief a sketch as this, it is impossible to do more than *touch on the many and interesting features presented by the* factories of the Canadian General Electric Co., but to anyone interested in the enormous development of electrical industries *in the last few years, a day's visit to the company's works at* Peterboro' will prove an instructive and fruitful experience.



GROUND PLAN OF GENERAL ELECTRIC COMPANY'S WORKS, PETERBORO', ONT.

QUESTIONS AND ANSWERS.

W. R. R., Stayner, Ont., writes. 1. What is the maximum voltage of electric current that a Blake telephone transmitter will stand without effect on its action? 2 Why will it not stand any amount of current? 3. What is meant by a multiphase alternating dynamo?

ANS. 1.—The best results are obtained from a Blake transmitter when the current in the primary circuit is from 1-2 amp. A pressure of from 1-2 volts will cause such a current to flow through an ordinary Blake transmitter and induction coil. 2. If the voltage is increased more current will flow, the carbon button at the point of contact with the platinum spring will be burnt, thus blurring the articulation. If still more current is sent through, the insulation of the wire of the induction coil will be destroyed and possibly the wire itself fused. 3. A dynamo supplying several circuits with alternating current, of the same frequency on all circuits, but differing in phase by predetermined amounts in different circuits.

W. B. S., Montreal, writes: I note L. O' C.'s remarks re broken wires near commutator, and may say that I have had similar trouble with a motor having a Gramme ring armature which was manufactured by a United States firm. I tried the effect of soldering on a piece of heavier wire and leading it to the commutator, but even this broke in the middle, the soldering of the pieces both at armature wire end and commutator end remaining intact. As I made sure that the motor was right every other way, I fear there must be some additional cause as well as vibration to account for this, and would (like friend L. O' C.) be glad of enlightenment.

ANS.—Staying the leads by weaving them together is a better preventative than stiffening them individually with an auxiliary wire. The latter plan by the added weight to the wire may sometimes increase the tendency to injurious vibration. Staying *by weaving is generally found to overcome the trouble.*

DIRECT CURRENT MOTOR AND DYNAMO DESIGN.* I.

BY GANO S. DUNN

I wish to refer to night to several features of direct current motor and generator design, and not to pretend to cover the whole subject, and I trust this will not be without interest to you.

The first point I wish to bring out is how very imperfect are our means of rating electrical machinery. We have good means of rating other machinery, but we do not have good means of rating electrical machinery. The steam engine is rated by the diameter of its cylinder and length of stroke and its speed. It is not sold by horse power, because an engine which could develop 100 horse power 3-10ths cut-off would develop 200 horse power at 6-10ths cut-off. In electricity the problem is similar, but we have no way of rating motors by the diameter of cylinder and length of stroke as they have in steam engine practice, and we are continually suffering on this account. Water wheels are not sold by horse power. You do not buy a 50 horse power water wheel; you buy a 28-inch water wheel and run it at so many feet head, and then figure out how much power you can get from it, and if is is not enough, you buy a 30-inch wheel.

The limits of loading an electric motor are really two only; namely, you have reached the load of a motor when it begins to heat so much that it is dangerous to continue to run it, and you have also reached its limit of load when it sparks so badly that if you run it longer it will destroy its commutator. There are builders to-day who build a motor which will have a very high efficiency at one-third load, but which will spark if it is overloaded, and there are other makers who build a machine which

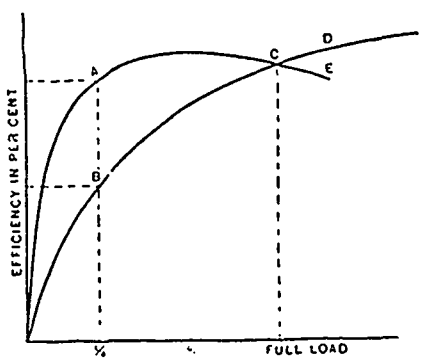


FIG. 1.

has not a high efficiency at light loads, but which will stand three and four times normal load without sparking. Now both of those motors are listed in the catalogues, are charged for and are known as, let us say, 10 horse power motors.

If you buy a 10 horse power motor without knowing something about these facts—it is possible that you will be very much disappointed. If it is agreed that we should call a motor that runs at about 6 horse power, but is capable of running at 10 horse power continuously without dangerous overheating, but will never be called upon for more than 10 horse power,—if we should agree to call such a motor a 10 horse power motor, very well. But then we ought to call the motor which is used in crane service, which is called upon for 30 or 40 horse power for periods of ten minutes at intervals, something more than, or different from, 10 horse power, and the builder ought not to be obliged to make one motor fill one user's requirements and another user's requirements, when their requirements differ so much. Suppose we sell two 10 horse power motors to ordinary customers. We may hear a report from one of them that this motor is not a good motor; it does not give 85 per cent. efficiency at one-third load. While the other one will say this motor is not a good motor; it sparks very badly when loaded to 300 per cent. of its normal load for a few moments. In view of these facts horse power is not a fair way to rate machines.

The lines between these kinds of motors are not so distinctly drawn as I have pointed out, but for the purposes of illustration I have shown here two curves, A and B, Fig. 1. A is the curve of a motor of the kind first mentioned above. It is expected to run at 6 horse power average, can give 10 horse power all day long if you require it, but must not give any more, and has a very high efficiency at light loads. Such a motor is an ordinary power motor for running a printing or machine shop. The other motor, whose curve is shown at B, is a motor whose efficiency at light loads is very low; it is not much more than half of the former. But its efficiency at full load is exactly equal, and at overload is even higher than this other motor. Motor B is much superior for its work to the former motor, because whenever it does run it runs at three times its rated load, and motor A, whenever it runs, as I will show later, runs at only one third its rated load. Put motor B on the load that A is built for, and A on the load that B is built for, which is what you are likely to do, and you will not secure the best results.

This A curve machine is the type of ordinary power motor running machinery by a belt. The B curve machine is a type of railway motor or motor for operating cranes, or for other intermittent and very heavy work. These two conditions affect the design of a motor very much, and the way they affect it is this. At the point C both motors have the same efficiency. That means that the losses in both motors are equal. But why, then, does curve A differ from B? The difference is in the distribution of the losses. The losses in a motor are of two kinds, fixed and variable. The fixed losses are the losses due to field current,

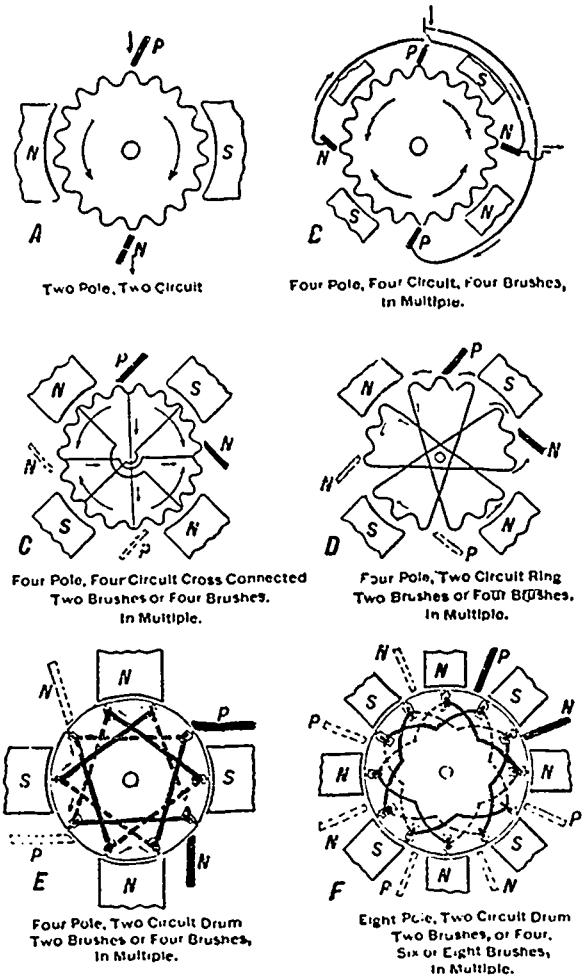


FIG. 2.

hysteresis and eddy currents, brush friction and bearing friction. The variable losses are the losses due to armature resistance and the losses due to commutation. Now motor A is a machine with a small magnetic circuit using comparatively few lines of force. Therefore the wire that is wound around the magnetic circuit to keep it excited need not be very great, and therefore will take but a small amount of current to energize it. The iron in the armature will be small in quantity, and therefore the hysteresis and eddy currents will be low, and the bearings will be rather light because this motor is never called upon for more than rated load. Therefore the fixed losses are light. The variable losses, such as armature resistance and commutation losses, may be high in this machine without detriment. The reverse of these conditions is true in machine B. These points are of great importance, but they have not received attention.

As a result of tests made on about 200 power motors, at the instance of Mr. H. L. Lufkin of the Crocker-Wheeler Co., it was

* A lecture delivered before the New York Electrical Society, November 27, 1894.

found that these 200 motors on actual commercial circuits did not average one-third of their load. The readings were taken in this manner. It is customary wherever a motor is installed to put in a meter that measures the current taken. Now if this were a 10 horse power motor and ran 10 hours per day, it ought to have 100 horse power hours for every day it runs. The meter readings were taken and the average was between 25 and 30 per cent. of the power that the motor could have given according to what was stamped on its name plate. Now if we build a motor with the kind of an efficiency curve B, and use it for a purpose such as I have just spoken of, where a motor averages only one-third load, it is practically equivalent to taking a motor of only one-half the efficiency.

Another thing with regard to the rating of motors is the speed. Other things being equal, a high speed motor is cheaper to build than a low speed one. It is a smaller machine operated at greater activity. If brought to the same speed it would have less power. A motor, to be compared carefully, ought to have these points determined:

1. At what portion of its load does it commence to spark?
2. At what portion of its load will its temperature rise abnormally?
3. What is its efficiency at various points?
4. At what speed does it run?

Reduce all these things to a common basis and you have a fair method of comparing motors.

Too much importance has heretofore been attached to full load efficiencies. Motor engineers boast that their machines have 90 per cent. efficiency, and some other maker's machines have only 88 per cent. efficiency. They speak of the highest efficiency that the machine is capable of, or of the efficiency of which they are most proud. Now that may not be the efficiency which the customer wants to know. There are many cases where a motor of 85 per cent. efficiency would take less current

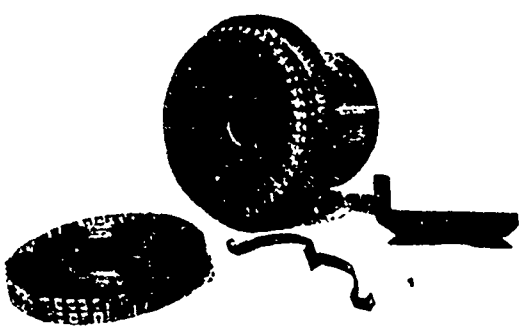


FIG. 3.

to run a printing office than a motor of 90 per cent. efficiency, for this reason. At point D, Fig. 1 is a motor of 90 per cent. efficiency. But the printing office runs at only about one third the power of its motor, and would therefore realize the efficiency at B; whereas at point E here is a motor which has 85 per cent. efficiency, and if the printer bought that he would realize the efficiency at A, which is much higher than that at B.

The next feature to which I wish to call your attention is the most recent methods of winding. I cannot go into this more than slightly, but it might be well to give some idea of what they are. In winding bi-polar machines, windings are all on the same principle; they are two-circuit. As the current leaves the brush, in diagram A Fig. 2,* half goes down one side of the armature and half down the other and joins the bottom brush and goes out. Now there is not much room for modifications in that winding. It can be made ring or drum, and that is practically all. But when we come to the multi-polar machines there is a great variety of windings which we can use. If we imagine B, Fig. 2, to be a 4 pole machine, with an armature a ring in which the wire is wound around and around, then the current may be taken off this armature by brushes P, N, P, N. These are the field magnets of alternate polarity and each field-magnet generates a portion of the total current. This is called 4-circuit, because there are four circuits from which the current is collected in the armature.

The earliest multi polar machines were wound in this fashion, but there are some objections to it. If one pole is stronger than its neighbor, then when it sends its current to be collected it will be under greater pressure than the one coming from the other pole, and if there is sufficient difference will neutralize it and send a reversed current through its winding. This causes heating, diminishes output and reduces the efficiency of the machine. Now it is very easy for one magnet to become weaker than another one in an actual machine. Suppose, for instance, that the bearings of the machine wear. The armature will settle down and will be nearer the bottom magnets than it will be to the top, and they will make stronger currents than the top ones will. Then again, if the windings on the magnets are not very carefully made, and one has a few more turns of wire than the other, it will be stronger, and there are a great many ways that the effect of inequality of electromotive forces generated under the poles will produce very bad results.

To overcome this, windings were invented which are called 2-circuit windings. The object of the 2-circuit winding is that the wire shown in D, Fig. 2, instead of going along always under the weak pole, between every section cuts across and goes under a strong pole and comes back, and the winding under the strong pole cuts across every other section to the weak, so that by the time the brush is reached, the windings have each had acting upon them both the weak and strong poles, and the result has been to make equal electromotive forces and produce no trouble.

In actual winding these connections are not made on the armature in this form of two-circuit winding, but are made inside the commutator. This commutator is of the kind shown in Fig. 3. Every bar is connected to the bar directly oppositeto it by a bird-wing form of connecter. The connecter is shaped in the following way: It starts down, goes over in the form of a bird-wing, goes inside about an inch, and after it has reached the under layer of windings it makes the rest of its circuit until it gets down to the bottom. The armature is wound the same as a 4-circuit armature, but when its ends are put into the commutator, these cross connecters have the effect of making the alternate poles generate part of the electromotive force, as shown in the diagram. The armature I have described is but one kind of a 2-circuit armature, but there are other kinds that are used just about as much. The other kind of armature is not wound in ring form, but is like that shown at E in Fig. 2. Now the armature I have just described was wound as a cell, which was connected to another on the other side. There will be no short circuiting due to unequal voltages. (A model of this kind of an armature was exhibited.) I will not describe farther the 2-circuit windings, since they are all on the same principle.

There is another advantage in the 2-circuit winding besides stopping the interaction of parts of the armature against itself; and that is, that for very high voltage machines, if we had a 4-circuit armature as previously described in B, Fig. 2, the wire under each pole would have to generate full voltage. In a 500

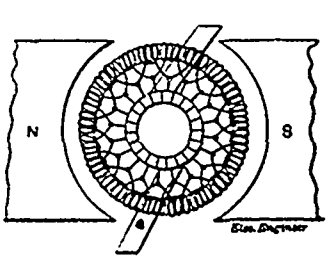


FIG. 4.

volt machine, each pole would have to generate 500 volts, so that the little current it contributed would be at the same pressure as the other current. That necessitates fine wire. If there are only two circuits each pole contributes only half the voltage and the wire may be of twice the size, which is a very important consideration. When we get into very large machines, however, then the wire gets too big for us to handle in 2-circuit machines and we go back to the 4-circuit windings.

The next form of winding that I wish to describe is one in use by the General Electric Co. and known as a double winding. The reason for a double winding is this: It is a rule among electricians that the voltage between any two bars of the commutator must not be greater than, say, 20 volts. If it is much greater in a large machine, any little accident—a piece of carbon—would make a flash, and, once started, the whole commutator

* From "The Practical Management of Dynamos and Motors, by F. B. Crocker & S. S. Wheeler

would blaze and there would be a short circuit and great trouble. To keep that down the voltage between the bars must be kept down low.

The voltage generated by a machine is proportional to the size of the magnets and the number of the windings. Now as the magnets get large the windings need be fewer in order to generate the same voltage. As our machines get larger and our magnets get larger we only need a few turns of the heavy conductors on the armature to give us, say, 110 volts for lighting. We soon reach the point where, say, 10 turns on the armature would be enough to give us 110 volts. That would give us 10 sections to our commutator, and as half the sections are on one side, and half on the other, that would give us only five sections of the commutator among which to distribute 110 volts and that would be more than our limit. Now what are we to do? We cannot increase the number of turns because we could get more voltage than we wanted. We cannot decrease the size of the magnets because then we would have sparking and armature reaction and other troubles. There are two things for us to do; one is, to use the multi-polar machines, which have a number of small magnets each contributing to the total current, or to use the form of winding shown in Fig. 4. Now in this diagram there are ten coils and ten commutator bars belonging to each winding. When we use the windings in conjunction we have the voltage due to ten coils and the commutator bars due to twenty, and that is achieved in this manner. The windings are wound just as if they belonged to two different machines. One winding is entirely disconnected from the other and it generates, say, its 110 volts with its few commutator bars—too few to be used by itself. The other winding is entirely separate and it generates its 110 volts with few commutator bars—too few to be used by itself. But when we put these two windings together, then we have still 110 volts, but we have double the current, because each of the windings contributes some, and we have double the number of commutator bars. Now that is in reality just like two dynamos. The brushes are made so wide that they cover at least two of the commutator bars, so that each winding is free to contribute its share of the current, no matter what the position of the armature is. We have shown this for a bi-polar machine. But if we go into multi-polar machines we will soon reach a size where we are again face to face with it, and we would have to increase our poles and would soon catch up with this difficulty again, and this method of double winding is an excellent one for overcoming it. It has also the advantage that the collection at the brush is better.

A FEW TELEPHONE FIGURES.

There are now in operation in the United States alone more than half a million miles of telephone line, bringing into speaking relations over 250,000 telephonic subscribers, and employing in daily service over 600,000 telephones, by means of which 600,000,000 messages are transmitted annually. These figures, given on the authority of Mr. Arthur V. Abbott of the Chicago Telephone Company, most graphically portray the remarkable proportions which Prof. Bell's invention has assumed. The earliest application of the telephone necessitated a wire extending from each station to every other one with which communication was desired. How impractical a method this is, however, for covering a territory of any magnitude can be seen without much difficulty. In both New York and Chicago, for example, about 10,000 subscribers have telephonic communication. The most compact system of underground circuits needs about four square inches for every 100 lines, so that, to unite each of the 10,000 subscribers with the remaining 9,999 would require a space of more than a yard square simply to contain the necessary conductors. No present city street could afford the required room for the subways. If communication were thus attempted, each subscriber, according to Mr. Abbott's figures, would require nearly 200 miles of cable, and should the distribution be undertaken by means of aerial wires, pole lines 1,000 feet high would be required to accommodate the necessary circuits. It is to the impossible complexity of such a system, which became apparent even in the earliest telephonic days, that the telephone central station and the telephone switchboard owe their origin and development, accomplishing to-day results whose convenience and importance are all but lost sight of in the busy whirl of existence, and can perhaps be best appreciated only by comparison with the meagre telephone facilities of a dozen years ago.—Cassier's Magazine.

SPARKS.

It is said to be the intention of the London Street Railway Co. to again ask permission from the Ontario Legislature to extend their lines to Springbank.

The new power station of the Petrolea, Ont., Light, Heat & Power Co., will shortly be completed. The motive power will consist of a 125 h. p engine and boiler.

The construction of an electric railway between the town of Collingwood and the village of Nottawa, is said to be receiving the favorable consideration of local capitalists.

The Central Telphone Co., Limited, has been incorporated with a capital of $3,000 to construct lines along the route of the Nova Scotia Central Railway, from Bridgewater to New Germany, N. S.

Mr. Myles, President of the Hamilton, Grimsby & Beamsville Electric Railway, is reported to have announced that the earnings of the road for the first two months of its operation reached upwards of $4,000.

The Seaforth Electric Light Co., which recently purchased the municipal lighting plant, and have since erected a power station, are operating 800 inc. and 75 arc lights, and are said to have one of the best equipped plants *In Ontario.*

Mr. H. S. Thornberry, of the Toronto Electrical Works, would like to secure the address of manufacturers of wood cases for electrical bells and such like apparatus. It is a singular fact that he has not found in any of the electrical journals the name of a manufacturer in this line.

The St John, N. B., Electric Railway Co. have threatened to sue the city for damages for having been compelled to desist running their cars until all the wires blown down by the recent storm were repaired. The company contended that some of their lines could be operated with safety under the existing circumstances.

The town of Richmond, Que., with a population of 3,000, has two electric light systems, two telegraph offices, two telephone exchanges, a burglar alarm detective line, and is to be the headquarters of the Richmond Water Power & Manufacturing Co. In this town, at least, it cannot be said that electricity is in its infancy.

Mr. H. W. W. Kent, manager of the N. W. and B. I. Co., has gone to the Kootenay country and will first establish an exchange at Three Forks. The different mines in the neighborhood will be connected. Nelson and Kaslo have exchanges at present and these will be inspected by Mr. Kent and possibly improved. He expects to be away a couple of months or so.

Mr. T. Vian, chief promoter of the proposed electric railway at Hull, Que., has made arrangements for the construction of a line of electric railway from that city to Aylmer and Gatineau Point. He is debarred from building a line to Chelsey and the Quyon. This, however, will not block the scheme. The charter for electric lighting and heating has met with no opposition in the Legislature. It is the intention to proceed with the construction of the system at an early date.

The Citizens' Light & Power Co., who for three years past have supplied electric light for Montreal Harbor and the suburbs of St. Henri and Cote St. Antoine, have erected a large new power station in St Henri, in which is being installed a steam plant of 1,200 h. p. capacity. This plant will be used to operate the lights for the above-named corporations, as well as to furnish power for the operation of the electric railway which the Standard Light and Power Co. propose to construct to Lachine.

Mr. Wm. Bayley, a ratepayer of the city of Vancouver, recently obtained from the courts a rule nisi, calling upon the Corporation to show cause why the by law for raising $100 000 for the purchase of an electric lighting plant, passed on the 8th of October last, should not be quashed on the ground that the by-law was never duly carried out by the ratepayers in accordance with the provisions of the statute, that it did not receive a three-fifths majority of the votes of the ratepayers, and, further, was ultra vires of the Corporation. The case turned on the point whether or not a three-fifths majority was necessary for the passage of the by-law. Mr. Justice Drake, before whom the case was argued, decided that the by-law is valid.

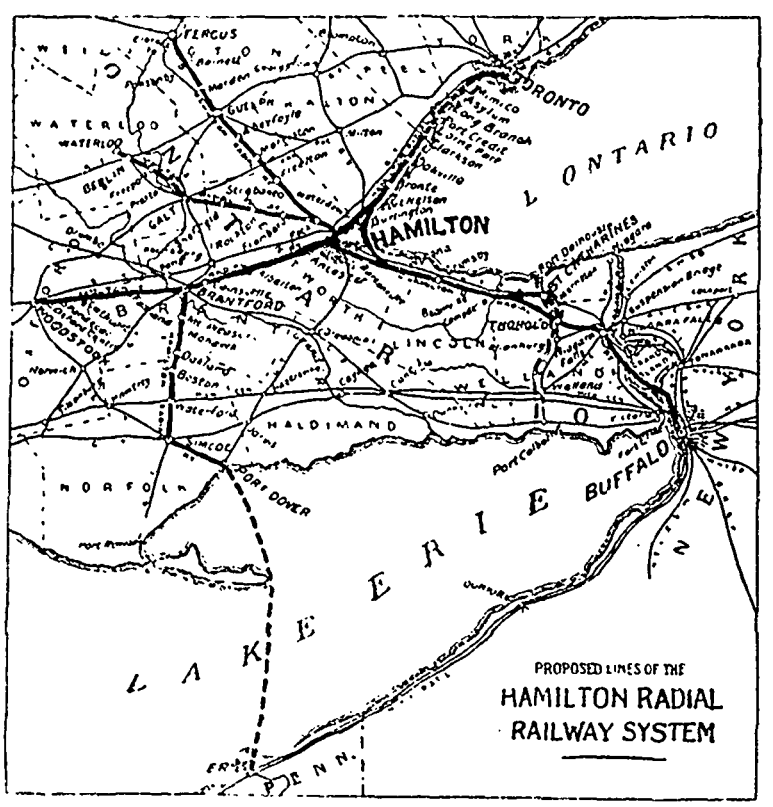
The officers of the Ottawa Electric Co. are as follows. Board of directors, Hon. F. Clemow, Hon. E H Bronson, T. Ahearn, J. W. McRae, C. Berkeley Powell, G. P. Brophy, Geo. H. Perley, D. Murphy, Wm. Scott; president and general manager, T. Ahearn, secretary-treasurer, G. S. Macfarlane (formerly with the Standard Co.); general superintendent, A. A. Dion (Chaudiere Co.), chief accountant, D. R Street (Chaudiere Co). The Line and Construction Department will be in charge of W. G. Bradley (of the Ottawa Co.) and the power houses will be in charge of Mr. John Murphy (Chaudiere Co.) The auditors are: Messrs Archer Bayley and Redmond Quain, formerly auditors of the Chaudiere Company. The working staff has already been largely reduced. The office of the new company will be at the corner of Sparks and Elgin streets, the premises formerly occupied by the Standard Company. The building formerly occupied by the old Ottawa Company as a power house, and which was vacated two years ago, is being converted into an electrical repair shop, which will be in charge of Mr. P. Beard, formerly power house foreman for the Standard Company. The use of the incandescent electric light has become very general, and the nightly output of current is larger than in any other place in Canada. Upwards of 100 electric motors, of various sizes, are in daily operation in Ottawa. These are used for machine shops, planing mills, passenger elevators, and in one instance a steam engine manufactory is provided with power from an electric motor.

ELECTRIC RAILWAY DEPARTMENT.

HAMILTON RADIAL RAILWAY.

HAMILTON, Canada, is to be the center, says the Street Railway Review, of a great electrical railway system which is being constructed by the Hamilton Radial Railway Company. The accompanying map shows the points which the system will embrace. There will be 227 miles of road, made up as follows: Hamilton to Toronto, 39 miles; Hamilton to Guelph, 29, (to Fergus, 21); Hamilton to Galt, 23, (to Waterloo, 35), Hamilton to Brantford, 22, to Woodstock, 48, and to Port Dover, 49). Hamilton to St. Catharines, 33, to Niagara Falls, 45, and to Buffalo, 67. The road will be up to steam road requirements, only the lines to Waterloo and Fergus being equipped with electricity.

This system of railways is designed to make the city of Hamilton the greatest commercial center of the Niagara peninsula, which includes a large fruit growing and farming region. To collect and bring the produce of this section to one point was the object which has engrossed the attention of John Patterson, who is about to see this plan perfected. Three of the branches will be built and equipped as steam roads, as a portion of the line from Niagara to Woodstock will be used as a link for a fast train service from New York to Chicago. The plans of the company contemplate the shortening of the distances between many of the towns, as compared with that of roads now in existence, in some cases from one-half to one and one-half miles, and in others one-third to one-half the distance is saved.



Another advantage over existing lines will be the frequency of trains. In one place for instance, where, under present conditions, it is necessary for a man to rise at 5 a.m. to reach Hamilton and return the same day, the Hamilton Radial Railway Company will have cars running every hour, making the trip in thirty to forty-five minutes. The system will also reach one-half the coal consuming population of Ontario, and will supply transportation to a population of about 700,000 persons, or about one-third of the entire population of the province.

The territory is served by the Grand Trunk Railway and and small branches of the Canadian Pacific and the Michigan Central Railroads, but as will be seen on the map, they do not cover the field as the Radial Company proposes to do. The prospects for revenue are good. Bonds are issued with ten years' interest paid up, making the stock the only claim on the net earnings for that period. It has been estimated that it is only necessary to earn $1,400 per mile to make 7 per cent., and this is such a small amount to be expected from a territory so rich in resources, that the most sanguine expectations of the people interested in the enterprise are likely to be exceeded.

Work of construction has been delayed for some time on account of the large expense. But now the cheapness with which a first-class road can be constructed as compared with the cost a few years ago, has removed that obstacle. The eyes of all persons interested will be turned towards this road as the work of construction progresses, for particular attention will be paid to the development of high speed on its electric lines. Plans are being made and figures prepared with the expectation of handling 50-mile transmissions commercially, using the three-phase system at 20,000 volts pressure. At present the plans have not progressed sufficiently for details to be presented, but engineers are confident this prodigious feat can be accomplished.

The Hamilton Radial Railway Company is incorporated with $2,000,000 capital, being owned largely by Boston and Eastern capitalists. It is reported that the Canadian Pacific Railway Company is also interested. The company will probably use the charter of the Canadian Pacific for a line from Hamilton to Woodstock, with a promise of the usual Dominion subsidy of $3,200 a mile, and the charter of the Niagara Central from Hamilton to Niagara Central with a bridge franchise. Recently was purchased the St Catharines & Niagara Central Railway which runs twelve and one-half miles on the way of the system. It is expected that the city of Hamilton will give a bonus of $400,000 on account of the benefit the road will be to the city.

ECONOMY IN STEEL RAILS.

A PROCESS for re-rolling steel rails has recently been patented by Mr. E. W. McKenna, late assistant general superintendent of the Chicago, Milwaukee & St. Paul Railway. By careful tests, the Engineering News tells us, Mr. McKenna ascertained that a rail wears out by deformation of the head and not by actual loss of metal. Sections of 60-pound rail, removed from the track and weighed, were found to have lost only 0.117 to 0.135 pound per yard in ten to fourteen years of service. He, therefore, devised a process by which the worn-out rails are heated in a furnace and the deformed heads are re-rolled into the proper form. The loss of transverse section in this re-rolling is about two pounds per yard, of which part is gained as elongation, leaving the net loss only one-half pound per yard for oxidation and the same amount for loss in crop ends. By this process, which is said to be inexpensive to carry out, a steel rail of 75 pounds or heavier can be renewed from five to fifteen times before its section is so greatly reduced as to make it necessary to scrap it. If Mr. McKenna's invention proves a practical success, the rail mills will have to close up or turn to other products. The demand for rails for renewals is what the rail mills have been chiefly relying on since speculative railway building came to an end."

A FACTORY BURNED.

Editor ELECTRICAL NEWS.

SIR,—The Whitney Electrical Instrument Co.'s works at Sherbrooke, Que., were damaged by fire to the extent of about ten thousand dollars, on Saturday night, Dec. 29. Insurance, five thousand. Canadian orders will be promptly attended to at their Penocock, N. H., factory until the works are rebuilt.

C. E. SHEDRICK, Supt.

The Coaticook Electric Light Co., of Coaticook, Que., has dissolved, and a new company composed of Fritz E. Lovell and Moodie B. Lovell formed, style unchanged.

HAMILTON, GRIMSBY AND BEAMSVILLE ELECTRIC RAILWAY.

IN response to a request for information, Mr. A. J. Nelles, manager of the above railway, has kindly furnished the ELECTRICAL NEWS with the following particulars of the freight and passenger tariffs in use by the company:

"Our freight tariff is based upon one cent per mile for 100 lbs. first class, using the Canadian classification for classifying goods. Our passenger tariff is based upon one and a half cents per mile with usual proportions for return tickets. We also issue books of 50 and 100 tickets at a reduced rate. School, workingmen's, and commutation tickets are scaled as to distance; milk, per can.

I have adopted a ticket that after considerable thought and experience with a service extending 18 miles and on which cars are expected to pick up passengers at every house and charge accordingly, fills the bill exactly—viz., a 1000 mile coupon book, which we sell at ten dollars. We have the road miled off, and we take off a coupon for each mile travelled by the passenger, but not less than five coupons for any single trip. This fills the bill, and puts each and every customer upon an equal footing. The "way freight" is going to be quite a problem to solve, as we will in the fruit season have fruit from every farm, which will be moved by special car several times each day."

TRADE NOTES.

A company is being formed in Perth for the manufacture of car and locomotive wheels.

The Dartmouth Electric Co., Dartmouth, N. S., are enlarging their plant, and have ordered a 125 horse power engine and boiler from the Robb Engineering Co. The engine will be a Robb-Armstrong tandem compound and the boiler a Monarch Economic with Adamson flanged furnace.

The Stanstead Electric Co., Stanstead Que., who have been running their station by water power, have decided to put in an auxiliary steam plant, and have placed their order with the Robb Engineering Co. for a 100 horse power Robb-Armstrong engine and Monarch Economic boiler.

A local company has been formed at Belleville, Ont., to be known as S. A. Lazier, Sons & Pringle, to manufacture for Canada the E. M. Electric Railway System, as description of which appears elsewhere in this number of the ELECTRICAL NEWS. The company are said to have secured the sole right to the E. M. patent for Canada.

The Dodge Wood Split Pulley Co., of Toronto recently received an order from an Australian machinery firm for 600 pulleys of various sizes. The pulleys manufactured by this company are said to be on sale in every important city in Europe, South and Central America and Australia, as well as throughout the Dominion of Canada.

Mr. C. F. Gildersleeve, of Kingston, states that the promoters have under consideration the proposal to operate the projected Kingston and Ottawa Railroad by electricity. No decision has yet been reached.

Notice is given that application will be made to the Legislature of Quebec for an Act to incorporate the Quinze Electric Co., to produce and sell electric light, heat and power, and to build, lease and operate electric railways in the vicinity of the Quinze Rapids, in the county of Pontiac. The proposed capital of the company is $50,000. The promoters are: John Bryson, of Fort Coulonge, lumberer; James B. Klock and Robert A. Klock, both of Klock's Mills, in the Province of Ontario, lumberers; James T. MacDougall, of Klock's Mills aforesaid, agent; and John Malcolm MacDougall, of the city of Hull, advocate.

Negotiations are in progress between the promoters of the Hamilton Radial Railway and the City Council of Hamilton, with regard to the amount of assistance which the city should grant to the enterprise. The railway originally asked for $400,000 in the shape of stock, to be purchased by the city. This proposition was afterwards amended, and the amount of stock reduced to $300,000, together with right of way for single track on Cannon street. The citizens of Hamilton seem to prefer that the city should grant the company a straight bonus of $200,000 to $250,000, while, on the other hand, the Trades and Labor Council have passed a resolution in favor of the city taking stock in the enterprise and having representation on the directorate of the company.

CANADIAN ASSOCIATION OF STATIONARY ENGINEERS.

Note.—Secretaries of the various Associations are requested to forward to us matter for publication in this Department not later than the 20th of each month.

HAMILTON ASSOCIATION NO. 9.

HAMILTON, Dec. 20th, 1894.

Editor ELECTRICAL NEWS.

I am very glad to report that Hamilton No. 2 are having very interesting meetings of late. At our last instruction meeting a very good course was taken by the special committeee; instead of the reading of papers a series of discussions were indulged in.

The first discussion arose on a question asked by a member of the committee as to which is the most advantageous, a dome or a dry pipe in a steam boiler. The question was discussed for some time, and among the different opinions a great many good points were struck.

A question on boiler feed was also taken up, as well as the proper blow-off for a boiler. These two last questions always give rise to plenty of discussion, notwithstanding they come up so often. There always appears to be something new to be gained out of a discussion by a body of practical engineers.

We also had with us Bro. Mitchell, of London, who is always ready to take part in any discussion that has a tendency to forward the objects of the C. A. S. E.

WM. NORRIS,
Cor.-Secretary.

CARLETON PLACE, Dec. 26th, 1894.

Editor ELECTRICAL NEWS

SIR,—I herewith send the names of the officers of Branch No. 16, C. A. S. E., and a brief outline of the Association: President, G. H. Routh; Vice-Pres., Jos. McKay; Sec., A. M. Schofield; Fin. Sec., Hy. Derrer; Treasurer, James Dougherty; Conductor, J. M. Murphy; Doorkeeper, David Welsh; Trustees, A Nichols, A. McCallum, J. D. Armstrong.

This Association was organized Nov. 6th, 1894, by Provincial Deputy Edkins. We have had one meeting each month thus far, but intend to meet twice a month in the future. We have 17 members, and prospects of more. We are going to take up a course in Mechanical Mining Science. The president has papers on this subject, and will give the members questions at one meeting and they will have till the next to answer them. After each one who wishes to take part has had his say on the question, the president will fully explain it. In this way I think the meetings will be both instructive and pleasant. I am of the opinion that Branch No. 16 will be a successful association. Hoping you will find space for these few remarks on Branch No. 16.

A. M. SCHOFIELD,
Rec. Sec., No. 16, C. A. S. E.

IMPORTANT TO TELEGRAPHISTS.

The following important order has just been issued by the United States Postmaster General to all appointed telegraphists The question, it is understood, have been drawn up by Mr Preece, Electrician-in-Chief to the Post Office

"Telegraphists recommended for promotion will, for the future, be examined in the following subjects

1. Crossing and looping wires with facility and certainty
2. Tracing and localising faults in instruments
3. Tracing and localising permanent and intermittent earth, contact and disconnections on wires.
4. Methods of testing the E M F and resistances of batteries and a general knowledge of the essential features of the various descriptions of batteries
5. System of morning testing, both as regards sending and receiving currents, with the necessary calculations in connection with the same
6. Making up special circuits in cases of emergency.
7. Joining up and adjusting single needle, single current, and double current Morse, both simplex and duplex, and Wheatstone apparatus.
8. Fitting a Wheatstone transmitter to an ordinary key-worked circuit.
9. A general knowledge of the principles of quadruplex and multiplex working.
10. Measuring resistances by Wheatstone Bridge."

The Telpher Cable Way across the Devil's Dyke was opened by the Mayor of Brighton on the 13th of October. On either side of the Dyke has been erected a light lattice-work tower. Over the tower is hung a steel wire rope, having its ends anchored to the ground, as in the case of a suspension bridge. At intervals along the rope are attached steel anchors, and resting on the tips of the arms of these ropes are about 2 ft. apart, and on them run the 4 wheels, from the axles of which are suspended the cars or cages, which seat eight people, four on each side sitting back to back. The cars are hauled to and fro by a small endless wire rope, worked by 4½ h. p. Crossley oil engine. The cars have two grippers, each grasping the endless driving rope, and when it is desired to reverse the direction in which the car is travelling, one gripper is released and the other tightened. The driving rope runs on the arms of the anchors which carry what is really the platform of the suspension bridge, and unless proper wheels are provided for this rope to run on, it will quickly cut off the arms.

SPARKS.

Observations and experience tend to prove that to secure the best results in both transmission and endurance, the diameter of pulleys for wire ropes should be from fifty to a hundred times the diameter of the ropes.

One of the most remarkable discoveries of modern times, says Metal, and one whose use it is hardly possible to foresee at the present time, is the fact that vacuum practically cuts off the transmission of heat. Radiant heat has long been supposed to follow laws similar to light and to be transmitted through space in the same way. The fact that heat does not radiate from a high vacuum works a revolution in one department at least of theoretical science.

In a recent number of Engineer a course of interesting applications of a dynamo to a centrifugal pump was shown. The pumps are shown in series. That is each centrifugal delivers into the one next beyond it and so on, there being four in all. The dynamo is placed on the same shaft as the four pumps, with two on each side. The water is delivered to a height of 157 feet. The plan seems to have been devised and the work directed by M. Dumont, of Paris.

Ball bearings have recently been perfected to a wonderful degree. It is reported that a street car, which was equipped with the latest inventions in ball bearings, that would do away almost entirely with friction, was drawn a distance of several hundred feet by a single man tugging gently at three strands of ordinary sewing thread attached to the car. Perhaps a more interesting experiment was that of a carriage manufacturer in the west, who put a another style of ball bearings upon the wheels of a large coach to which four horses were ordinarily hitched. Then he took a trained dog and harnessed and hitched him to the pole, when the dog drew a huge coach easily around the yard.

In view of the increasing number of fly-wheel accidents, Power asks if it would not be well in planning power plants, especially electric plants, to keep the vital and dangerous portions out of the plane of the engine pulleys? In the Lowell accident had not a large separator stood directly in the line of the wheel and received the impact of several large pieces, one of the boilers would have inevitably been unseated, with what additional damage and loss can only be surmised. Fortunately the flying fragments of a ruptured wheel will become confined to a narrow vertical plane, and this plane should be so situated with regard to the surroundings as to involve the least danger in case of accident.

In selecting indicator springs it is desirable to have them suited to the conditions of pressure and speed of engine. A good practice says the Stationary Engineer, is to use a stronger spring, for engines operated at a greater number of revolutions, than is the usual practice or as is generally determined by rules which were made before high speed engines became such an important factor as they are at the present time. A card received at this office a short time ago shows a greater initial than boiler pressure. The boiler pressure is 75 lbs. spring 40 and the height of diagram above the atmospheric line indicates 80 lbs. initial pressure: but then the lines of the card were so heavy that it would be difficult to make an average. A stronger spring would have overcome this difficulty and would have given a much closer approximation to the actual conditions existing. It is seldom necessary to make the height of card as much as 2"; a little less than this, say 1¾" is much better, especially on high speed engines.