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ELECTRICAL NEWS
AND
STEAM ENGINEERING JOURNAL

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CANADIAN

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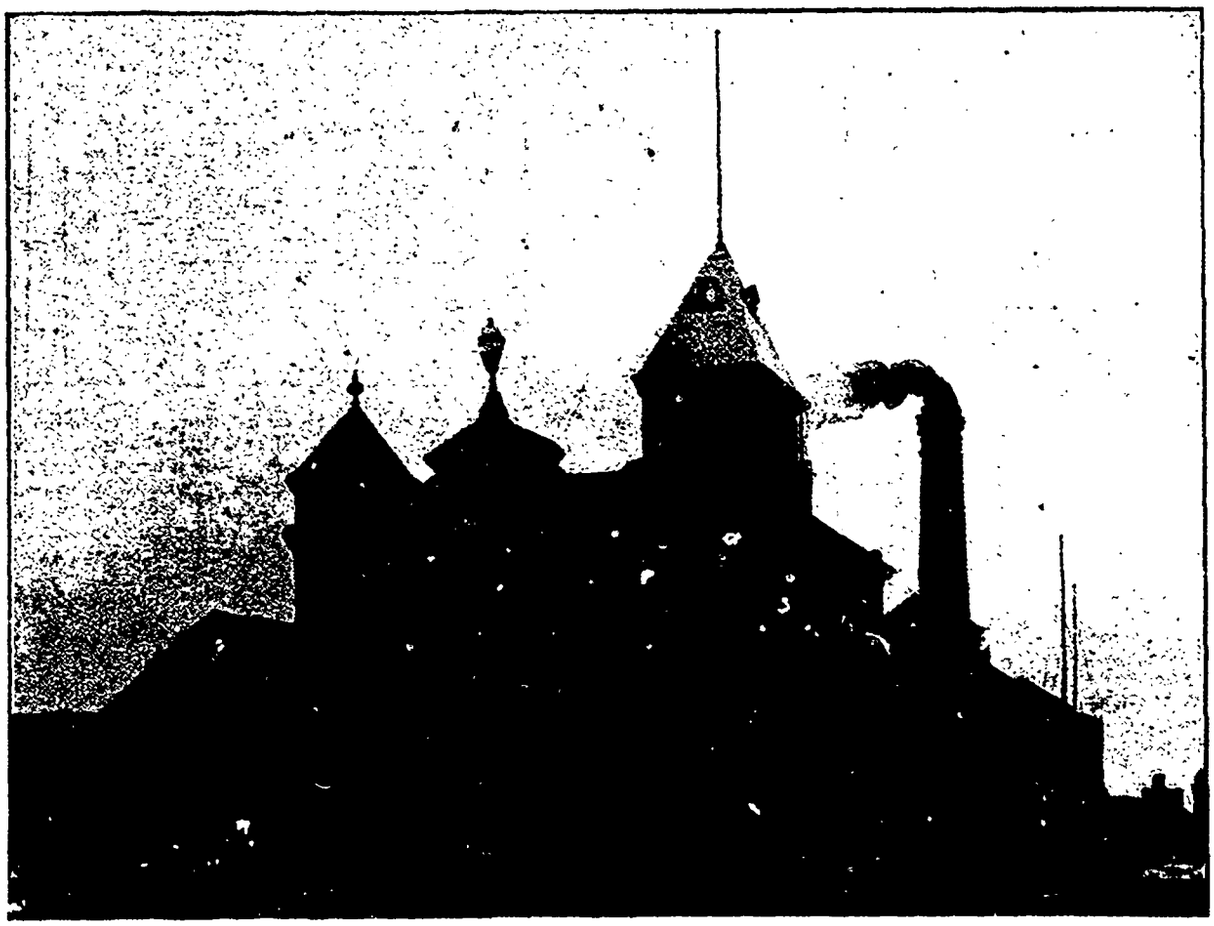
AND

STEAM ENGINEERING JOURNAL.

VOL. IV. MARCH, 1894 NO. 3.

THE TORONTO ELECTRIC LIGHT COMPANY'S NEW STATION.

THE accompanying illustration represents the new buildings and plant of the Toronto Electric Light Company. They consist of spacious engine and dynamo rooms, boiler house and office. The offices, as seen in the cut, front the Esplanade at the corner of Scott street. On the ground floor are the public offices, manager's office, private room and lavatory; on the second floor is a large room used as a board-room, library, with spiral staircase to tower, laboratory and instrument room, and clerk's



private room. The interior finish is all quartered oak, polished, which presents a very handsome appearance. The dynamo room immediately in rear of the offices contains the power generators for the 250 and 500 volt systems on the main floor, with smaller dynamos for arc lighting on a raised platform over the shafting. The whole is driven by the pair of compound vertical Corliss engines of one thousand horse power, of which we gave an illustration in a previous number. Further on is the boiler house, of brick, containing four water tube boilers of 250 h. p. capacity each, with accommodation for double that amount. The brick chimney shaft is 22 feet square at the foundation and 125 feet in height, having a square flue parallel from bottom to top, 8 feet on each side. The foundations for boiler and engines are of the most massive character, and required considerable skill in their design and execution, as the whole had to be built on the mud bottom of the slip, and at the same time the depth of water had to be maintained in the dock alongside. As the slip could not be filled up, piles were driven to the rock and cut off by a specially designed circular saw about two feet below the water. On these massive stones were laid, some of which weighed over three tons, the interstices of the piling being filled with broken stone and cement. Upon the lower courses of large stones the engine and boiler foundations were built, and are found after a year's use to be as firm and solid as ever.

The smoke-stack was built on a similar foundation, poles being driven as close together as possible over the whole area. Difficulty was found here, as there was only about two feet of loose mud over the rock, not enough in some cases to hold the piles down in the ten feet of water that was over it. Now that the entire work is completed, however, its solidity and freedom from vibration leaves nothing to be desired. The advantages in being at the headquarters of fuel supply and having unlimited water at command for boiler supply and condensing purposes, far more than compensate for the extra difficulty and expense of obtaining a good foundation.

The extension of the company's wharves to the new line afford abundant room for coal storage and a pole yard, the size being 600 by 140 feet. The whole of the work, including foundations and superstructure, was designed by and executed under the immediate supervision of the manager of the company, Mr. J. J. Wright.

The recent storms are said to have cost the Bell Telephone Company about $45,000 for repairs to their system in Eastern Ontario.

The town council of Carleton Place, Ont., have been considering the question of granting a bonus of $20,000 and exemption from taxes for 15 years, to Messrs. T. W. Ness & Co., of Montreal, for the purpose of inducing them to remove their manufactory to that place. Application is to be made to the Ontario Legislature for authority to carry out the undertaking. A condition of the bargain is that Messrs. Ness & Co. must employ constantly an average of 100 hands.

QUESTIONS AND ANSWERS.

J. W. R., Hamilton, Ont., writes "The Hamilton Spectator states that the new Blake pumping engine at Toronto has had to have a new set of pumps placed in it, and that it has been standing idle for the last two months for this purpose. This engine broke down disastrously soon after its erection last year. As no account of it has appeared in the Toronto daily papers, the stationary engineers would like your account of the trouble. The Hamilton 8,000,000 gallon pump has now run six years without any trouble whatever, and with great fuel economy; so also have the Kingston and London ones—all built here by Killey.

ANSWER We have made inquiries of the officials of the Toronto Waterworks Department respecting the subject of our correspondent's inquiry, and are informed that the first breakdown of the Blake engine took place while the engine was under test by the manufacturers, and before its acceptance by the city. The break down was due to the breaking of the crank pin, as the result of which the cylinder head of the engine was blown out. The breaking of the crank pin is said to have been caused by an internal flaw in the metal which was not observable on the surface. The engine was again shut down on the evening of the 8th of January, and has not been in operation since. It is stated that after the engine had been for some time in operation the manufacturers concluded that the cylinders were not sufficiently heavy for the unusually severe work which was required of them, and decided to replace them by cylinders of greater weight. To do this required the shutting down of the machine for about six weeks. This is the explanation of the difficulty as it has been given to us by the officials of the Department.

"Meter," Arnprior, Ont., writes: Would you please answer through your journal the following questions:

1 Kindly give the principle of construction of alternating current motors to drive fans.

2. What would be the effect in the reading of a Shallenberger meter, certified correct with 16,000 alternations per minute, if the alternations were lowered to 14,000?

3 What are the qualifications necessary to obtain 2nd class engineer's papers, and what books do you recommend as being useful in qualifying for papers?

4. What kind of storage battery is best adapted for a boat with one h. p. motor; also weight of batteries that would supply 1 h. p. motor for 12 hours, they being charged by a 4 ampere circuit of about 500 volts?

ANSWER.—The time at our disposal will not admit of an answer being given until our April issue. 2. The storage battery having the least weight for a given output is best suited for boat propulsion, but the numerous forms of lead plate batteries differ very little from each other in this respect. Their average weight, with cells and acid solution complete, is about 140 pounds for a capacity (at normal discharge rate) of 1 kilowatt hour. For a one h. p. motor running 12 hours, i. e., for 12 horse power hours delivered by your motor, you should provide at least 12 kilowatt hours battery capacity. We should say that 500 volts is too high a voltage for use in a boat, on account of insulation difficulties. 100 volts is quite as high as can be managed comfortably. 3. This information may be obtained by writing to any member of the Board of Examiners of the Ontario Engineers Association. The names and addresses of the examiners are printed on our editorial page. 4. The Shallenberger meter readings will not be correct on a circuit of different frequency from that for which the meter is adjusted, but not in proportion to the number of alternations per minute. A little adjustment can be made in the meter fro change in frequency by changing the angle of the secondary coil. The makers state "the meter is practically correct within 1000 alternations per minute above or below that or which it is adjusted."

TELEGRAPHIC REVOLUTIONS.

THE days for the use of the primary battery for telegraphy in this country are numbered. It will not be long before the batteries that are now used in the various stations of the New England states will be relegated to antiquity. At the main Boston office, where 14,000 cells were employed for sending messages the first year, occupying one-fifth to one-sixth the space, there are now motor dynamos which take up but a small room in the basement. The advantages of the motor dynamo or transformers, as they are generally called, are many.

The saving alone over the whole system is said to be between 40 and 45 per cent. This remains to be demonstrated, however. Then, again, the new practice has the great advantage of cleanliness and steadiness.

With the use of the cells the voltage varied from 26 to 36 points from the standard of 180 volts supposed to be delivered. With the motor dynamo as a generator of current, there is hardly any variation; at the most, 2 or 3 volts. The motor dynamo transforms or reduces the ordinary direct incandescent light current into one of small volume for the telegraph business.

In the Western Union Company's Boston office the current is taken in a commutator on one side of the machine and sent out from a commutator on the opposite side, the transformation being effected by two different windings on the armature.

The Boston plant has at present nineteen of these transformers in use and will put in addition probably ten more. Of these machines now in use five are of 3 horse-power each, three are 1 one-horse, two are ½ horse-power, two are ¼ horse-power and seven are ⅛ horse power. The potential of these machines varies anywhere from 25 up to 260.

The farthest point to which a message has to be sent from Boston is Buffalo, N. Y., and this can be accomplished by throwing one large machine of 260 into service, or several connected in tandem, or in series. The small machines, which are wound from 50 to 70 volts, are thrown into what is known as the loop from New York to Portland, thus necessitating the send of but one message.

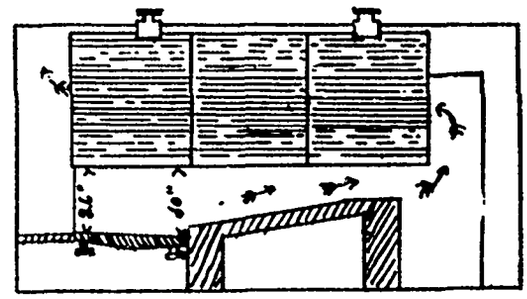
METHODS OF BOILER SETTING.

Editor ELECTRICAL NEWS.

SIR,—In response to the request of the Hamilton Association C. A. S. E. re boiler setting in your last issue, I would like to give a little of my experience in that line. But first let me say, that it is with no desire to criticise my Hamilton friends or assail the decision they may have arrived at on this important subject; but simply to get and try to give information, that being the object of the C. A. S. E.

About eighteen months ago I took charge of a new plant; the boiler is 14 ft. × 66", and was bricked in before I took charge and was set somewhat like the sketch of the Hamilton plant referred to above, with the bridge built perpendicular and circled round the boiler; but it did not give the satisfaction I would like.

About a month ago, another boiler of exactly the same dimensions, and built by the same firm, was placed by the side of the first one. With boiler No. 2 I was more anxious to have a little of my own way, as regards the setting, and the firm gave instructions that my wishes should be attended to in every particular. This is a rough sketch of the setting:



Now here are two boilers identical in every respect, but which differ in the setting; No. 1 has the plumb bridge which is circled and built to within 8" of the boiler. Now it will be seen by looking at the sketch that the greatest heat will strike the boiler at or near the bridge, and in this case on one of the two seams running around it. In No. 2 there is practically no bridge wall, only raised about 6" to keep the coal in place, then a flat bed sloping to within 10" of the boiler.

It is only just to say that I have not been able to weigh the coal and water and make a thorough test of the two boilers separately, but I have no hesitation in saying that No. 2 makes more steam and is more satisfactory in every respect than No. 1. That this is the case is particularly noticeable in getting up steam and before they are connected together; the steam in No. 2 always gains from 10 to 15 lbs. on No. 1. I believe the greater advantage lies in the more equal distribution of the heat under the boiler, and at the same time the liability to unequal expansion is lessened. I might give other reasons for recommending this plan of setting, but will refrain lest I should take up too much space.

GEO. GILCHRIST,
Toronto No. 1 C.A.S.E.

According to the decision of the Supreme Court of Georgia in The Western Union Telegraph Company vs. Rountree, under the act of October 22, 1887, a telegraph company is not liable for the penalty of $100 for a verbal, though material, inaccuracy in the transmission of a message, and the words "shall transmit and deliver * * * with impartiality and good faith, and with due diligence," relate, so far as the purposes of this act is concerned, to the time within which the transmission and delivery must be accomplished, and not to accuracy and correctness in sending and transcribing dispatches. In the case of The Western Union Telegraph Company vs. Timmons the court held that a non-resident of a city does not make himself a resident within the meaning of the proviso to the second section of the act of October, 22, 1887, touching the duties of telegraph companies, by giving to the company an address within the city at which he can be found temporarily. The second section of the act, the court said, deals exclusively with the duty of delivery to residents of cities and towns, and persons residing within a limit of one mile from the telegraph office. The duty of delivery to other persons is not embraced in that section, but in the general requirement set forth in the first section, and as to non-residents, the question whether due diligence in making delivery requires the company to go outside of its office to deliver at a designated place within a city or town is one of fact for the determination of a jury on the circumstances of each case, including any right and reasonable usage of the company in dealing with messages of this kind, and if the company in the conduct of its business delivers outside of its office to one customer it must to another under like circumstances and conditions.

THE ECONOMICAL INSTALLATION OF SMALL LIGHTING PLANTS.

By J. B. Calhoon.

A careful investigation of the small electric light plants throughout the country will show, says the Electrical World, that many of them are only just barely clearing expenses, without netting any profit to the owners; as many more are running at a loss, while a very few are a source of profit. One fault of these stations which tends to make them non-profitable is the lack of economy in their operation. By economy we mean a true spirit of economy, and not a spirit of parsimony which sometimes passes for economy among the people who have considerable to do with electric properties. But leaving this out of the question, if we were to take a very small plant, say one running 600 or 700 incandescent lights, and try to run this at a profit in a country town, we find that, handling this as best we can with the old methods, there is little or no profit derived from its operation, especially if we charge off a certain percentage for depreciation each year. Now let us look into this a little more closely and see if we can ascertain why such a plant should not yield a fair return on the investment. In the first place, situated as our plant is in a country village with its long, straggling streets and extensive distances to cover, with only an occasional store, and here and there a light to be placed on the highway, if we run the two-wire system and use the direct current incandescent machine, we find that we are using a great deal of copper to maintain the required service, and that the cost of this copper is so great that the return for the use of the few scattered lights is insufficient to pay a fair rate of interest on so much copper.

We can resort to the alternating current and distribute at a potential of 1,000 or 2,000 volts, as the case may be, and so cover the main points to be lighted at a fairly reasonable outlay, but this will necessitate the use of a large number of small transformers, which means the production of light at a less efficiency and greater expense than if we could make use of large transformers. This will, however, furnish us with an incandescent system of lighting from which we can hope for some return of our investment. Or, we can install an arc plant which will enable us to distribute lights over the required area, and this will be perfectly satisfactory for street lighting and for use in some large buildings and stores, but it will not meet the demand for lighting private houses, small stores, and the various odds and ends which are liable to require light; therefore it is questionable if the arc light plant will be a profitable one, and it cannot contract for any of the small installations and practically will only serve to light the town. Again, as we start with the assumption that the town is too small to warrant the installation of both arc and incandescent circuits, it becomes necessary to decide upon some plan which will meet all conditions in a fairly satisfactory manner. After carefully watching the operation of alternating circuits with three-wire transformers I am convinced that this three-wire transformer system is the one which will be the most profitable to install in such places as mentioned above, as well as in larger towns and cities where distribution is to be made at long distances from the central stations and over a considerable area.

The system is an extremely simple one and is well illustrated by the plant of the Peterborough Electric Light and Power Company, Peterborough, N. H. In brief, the idea is to place large transformers at certain points, which may be called centres of distribution for the area in which said transformers are situated, carrying the primary to those transformers at 1,000 to 2,000 volts and running off three wires from the secondary coils and carrying these along the streets to the points where they are needed. The difference of potential between the two outside lines will be 104, and between the middle and outside lines 52 volts. We can then tap directly off these lines and enter any house or building that wants lights without the necessity of installing any small transformers; in other words, we have by following out this method as flexible a system for incandescent lighting as the three-wire system now so much used for.

This method presents some remarkable features deserving the earnest study of those interested in such work, the principal being the great saving effected in copper over a two-wire system and the saving effected by the use of large transformers over small ones. This also presents a system which is flexible to an extreme degree in that, as the demands for lights increase and we reach the capacity of our transformer installed, we have but to put up another large transformer and we have another centre of distribution to cover the same area, or, if lights are wanted beyond a reasonable distance from our first transformer, by the installation of a second at this further point, we shall have very little loss in transmitting the current to it over the primary wire at 1,000 volts, so that we are ready to take a contract with any and every householder and furnish him with light at a price which shall be reasonable and which will prove as beneficial to the user as to the plant. It will be seen at once that this is one of the great features of such an installation. It is not necessary to skip anything, but to reach out and get all the business that there is in the whole town, and if this is done, I think I can safely assure the payment of a handsome dividend on the investment.

Application will be made to the Dominion Parliament by the Plate Glass and Boiler Insurance Co., of London, Ont., for power to insure against loss of life or injury to person of engineers or firemen in charge of steam boilers.

ON LIGHT AND OTHER HIGH FREQUENCY PHENOMENA.

By Nikola Tesla.

(Continued.)

In this experiment the potential difference at the terminals of the lamps varies in sign theoretically three to four million times a second. The ends of the filaments are correspondingly electrified, and the gas in bulbs is violently agitated and a large portion of the supplied energy is thus converted into heat. In the non exhausted bulb, there being a few million times more gas molecules than in the exhausted one, the bombardment, which is most violent at the ends of the filament, in the neck of the bulb, consumes a large portion of the energy without producing any visible effect. The reason is that, there being many molecules, the bombardment is quantitatively considerable, but the individual impacts are not very violent, as the speeds of the molecules are comparatively small owing to the small free path. In the exhausted bulb, on the contrary, the speeds are very great, and the individual impacts are violent and therefore better adapted to produce a visible effect. Besides, the convection of heat is greater in the former bulb. In both the bulbs the current traversing the filaments is very small, incomparably smaller than that which they require on an ordinary low-frequency circuit. The potential difference, however, at the ends of the filaments is very great and might be possibly 20,000 volts or more if the filaments were straight and their ends far apart. In the ordinary lamp a spark generally occurs between the ends of the filament or between the platinum wires outside, before such a difference of potential can be reached.

It might be objected, in the experiment before shown, that, the lamps being in multiple arc, the exausted lamp might take a much larger current, and that the effect observed might not be exactly attributable to the action of the gas in the bulbs. Such objections will lose much weight if I connect the lamps in series with the same result. When this is done, and the discharges are directed through the filaments, it is again noted that the filament in the none-exhausted bulb, l_1, remains dark, while that in the exhausted one, l, glows even more intensely than under its normal conditions of working, Fig. 22b. According to general ideas, the current through the filaments should now be the same, were it not modified by the presence of the gas around the filaments.

At this juncture I may point out another interesting feature, which illustrates the effect of the rate of change of potential of the currents. I will leave the two lamps connected in series to the bars B, B_1, as in the previous experiment, Fig. 22b, but will presently reduce considerably the frequency of the currents, which was excessive in the experiment just shown. This I may do by inserting a self-induction coil in the path of the discharges, or by augmenting the capacity of the condensers. When I now pass these low frequency discharges through the lamps, the exhausted lamp, l, again is as bright as before, but it is noted also that the non exhausted lamp, l_1, glows, though not quite as intensely as the other. Reducing the current through the lamp, I may bring the filament in the latter lamp to redness, and though the the filament in the exhausted lamp l, is bright, Fig. 22c, the degree of its incandescence is much smaller than in Fig. 22b, when the currents were of a much higher frequency.

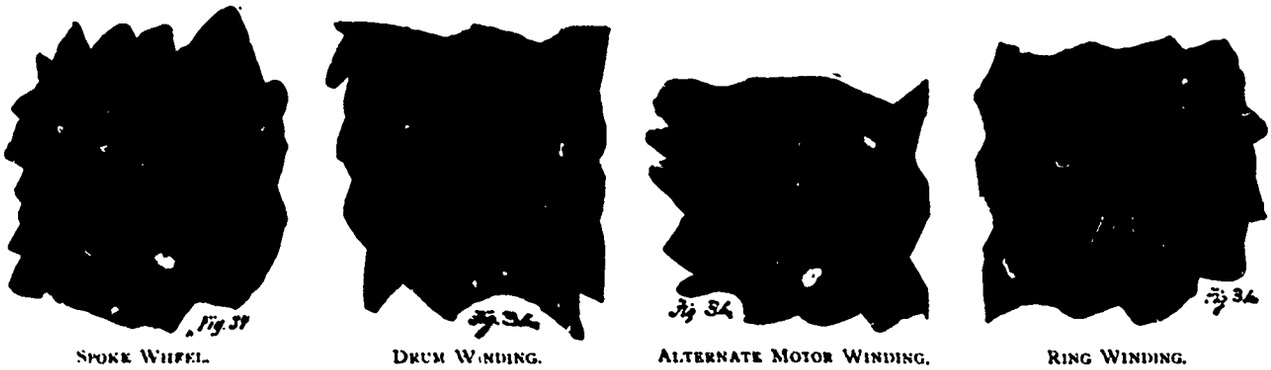
In these experiments the gas acts in two opposite ways in determining the degree of the incandescence of the filaments; that is, by convection and bombardment. The higher the frequency and potential of the currents, the more important becomes the bombardment. The convection, on the contrary, should be the smaller, the higher the frequency. When the currents are steady, there is practically no bombardment, and convection may therefore with such currents also considerably modify the degree of incandescence and produce results similar to those just before shown. Thus, if two lamps exactly alike, one exhausted and one not exhausted, are connected in multiple arc or series to a direct current machine, the filament in the non-exhausted lamp will require a considerably greater current to be rendered incandescent. This result is entirely due to convection, and the effect is the more prominent the thinner the filament. Prof. Ayrton and Mr. Kilgour some time ago published quantitative results concerning the thermal emissivity by radiation and convection, in which the effect of thin wires was clearly shown. This effect may be strikingly illustrated by preparing a number of small, short glass tubes, each containing through its axis the thinnest obtainable platinum wire. If these tubes be highly exhausted, a number of them may be connected in multiple arc to a direct current machine, and all of the wires may be kept at incandescence with a smaller current than that required to render incandescent a single one of the wires if the tube be not exhausted. Could the tubes be so highly exhausted that convection would be nil, then the relative amounts of heat given off by convection and radiation could be determined without the difficulties attending thermal quantitative measurements. If a source of electric impulses of high frequency and very high potential is employed, a still greater number of the tubes may be taken and the wires rendered incandescent by a current not capable of warming preceptibly a wire of the same size immersed in air at ordinary pressure, and conveying the energy to all of them.

I may here describe a result which is still more interesting, and to which I have been led by the observation of these phenomena. I noted that small differences in the density of the air produced a considerable difference in the degree of incandescence

of the wires, and I thought that, since in a tube, through which a luminous discharge is passed, the gas is generally not of uniform density, a very thin wire contained in the tube might be rendered incandescent at certain places of smaller density of the gas, while it would remain dark at the places of greater density, where the convection would be greater and the bombardment less intense. Accordingly a tube, t, was prepared, as illustrated in Fig. 23, which contained through the middle a very fine platinum wire w. The tube was exhausted to a moderate degree, and it was found that when attached to the terminal of a high frequency coil the platinum wire w would, indeed, become incandescent in patches, as illustrated in Fig. 23. Later a number of these tubes with one or more wires were prepared, each showing this result. The effect was best noted when the striated discharge occurred in the tube, but was also produced when the striæ were not visible, showing that, even then, the gas in the tube was not of uniform density. The position of the striæ was generally such that the rarefactions corresponded to the places of incandescence or greater brightness on the wire w. But in a few instances it was noted that the bright spots on the wire were covered by the dense parts of the striated discharges as indicated by l in Fig. 23, though the effect was barely preceptible. This was explained in a plausible way by assuming that the convection was not widely different in the dense and rarefied places, and that the bombardment was greater on the dense places of the striated discharge. It is, in fact, often observed in bulbs that under certain conditions a thin wire is brought to higher incandescence when the air is not too highly rarefied. This is the case when the potential of the coil is not high enough for the vacuum, but the result may be attributed to many different causes. In all cases this curious phenomenon of incandescence disappears when the tube, or rather wire, acquires throughout a uniform temperature.

Disregarding now the modifying effect of convection, there are then two distinct causes which determine the incandescence of a wire or filament with varying currents; that is, conduction current passing *through* it. If the frequency and potential, and principally the latter, be increased, the insulated plate need be but very small, or may be done away with entirely; still the filament will become incandescent, practically all the heating being then due to the bombardment. A practical way of combining both the effects of conduction current and bombardment is illustrated in Fig. 24, in which an ordinary lamp is shown provided with a very thin filament which has one of the ends of the latter connected to a shade serving the purpose of the insulated plate, and the other end to the terminal of a high tension source. It should not be thought that only rarefied gas is an important factor in the heating of a conductor by varying currents, but gas at ordinary pressure may become important, if the potential difference and frequency of the currents is excessive. On this subject I have already stated that when a conductor is fused by a stroke of lightning the current through it may be exceedingly small, not even sufficient to heat the conductor perceptibly were the latter immersed in a homogeneous medium.

From the preceding it is clear that when a conductor of high resistance is connected to the terminals of a source of high frequency currents of high potential, there may occur considerable dissipation of energy, principally on the ends of the conductor, in consequence of the action of the gas surrounding the conductor. Owing to this, the current through a section of the conductor at a point midway between its ends may be much smaller than through a section near the ends. Furthermore, the current passes principally through the outer portions of the conductor, but this effect is to be distinguished from the skin effect as ordinarily interpreted, for the latter would or should occur also in a continuous incompressible medium. If a great many incandescent lamps are connected in series to a source of such currents, the lamps at the ends may burn brightly, whereas those in the middle may remain entirely dark. This is due principally to bombardment, as before stated. But even if the currents be steady, provided the difference of potential is very great, the lamps at the ends will burn more brightly than those



SPOKE WHEEL. DRUM WINDING. ALTERNATE MOTOR WINDING. RING WINDING.

SOME OF THE DESIGNS PRODUCED BY INTERMITTENT DISCHARGES.

current and bombardment. With steady currents we have to deal only with the former of these two causes, and the heating effect is a minimum, since the resistance is least to steady flow. When the current is a varying one, the resistance is greater, and hence the heating effect is increased. Thus, if the rate of change of the current is very great, the resistance may increase to such an extent that the filament is brought to incandescence with inappreciable currents; and we are able to take a short and thick block of carbon or other material and bring it to bright incandescence with a current incomparably smaller than that required to bring to the same degree of incandescence an ordinary thin lamp filament with a steady or low frequency current. This result is important, and illustrates how rapidly our views on these subjects are changing and how quickly our field of knowledge is extending. In the [illegible] of incandescent lighting, to view this result in one aspect only, it has been commonly considered as an essential requirement for practical success that the lamp filament should be thin and of high resistance. But now we know that the resistance to the steady flow of the filament does not mean anything; the filament might as well be short and thick; for if it be immersed in rarefied gas it will become incandescent by the passage of a small current. It all depends on the frequency and potential of the currents. We may conclude from this that it would be of advantage, so far as the lamp is considered, to employ high frequencies for lighting, as they allow the use of short and thick filaments and smaller currents.

If a wire or filament be immersed in a homogeneous medium, all the heating is due to true conduction current; but if it be inclosed in an exhausted vessel, the conditions are entirely different. Here the gas begins to act, and the heating effect of the conduction current, as shown in many experiments, may be very small compared with that of the bombardment. This is especially the case if the circuit is not closed and the potentials, of course, very high. Suppose a fine filament inclosed in an exhausted vessel be connected with one of its ends to the terminal of a high tension coil, and with its other end to a large insulated plate. Though the circuit is not closed, the filament, as I have before shown, is brought to incandescence. If the frequency and potential be comparatively low, the filament is heated by the in the middle. In such case there is no rhythmical bombardment and the result is produced entirely by leakage. This leakage or dissipation into space when the tension is high is considerable when incandescent lamps are used, and still more considerable with arcs, for the the latter act like flames. Generally, of course, the dissipation is much smaller with steady than with varying currents.

I have contrived an experiment which illustrates in an interesting manner the effect of lateral diffusion. If a very long tube is attached to the terminal of a high frequency coil, the luminosity is greatest near the terminal and falls off gradually toward the remote end. This is more marked if the tube is narrow.

A small tube about one-half inch in diameter and twelve inches long, Fig. 25, has one of its ends drawn out into a fine fibre f nearly three feet long. The tube is placed in a brass socket T which can be screwed on the terminal T_1 of the induction coil. The discharge passing through the tube first illuminates the bottom of the same, which is of comparatively large section; but through the long glass fibre the discharge cannot pass. But gradually the rarefied gas inside becomes warmed and more conducting, and the discharge spreads into the glass fibre. This spreading is so slow that it may take half a minute or more until the discharge has worked through up to the top of the glass fibre, then presenting the appearance of a strongly luminous thin thread. By adjusting the potential at the terminal the light may be made to travel upward at any speed. Once, however, the glass fibre is heated the discharge breaks through its entire length instantly. The interesting point to be noted is that, the higher the frequency of the currents, or in other words the greater relatively the lateral dissipation, at a slower rate may the light be made to propagate through the fibre. This experiment is best performed with a highly exhausted and freshly made tube. When the tube has been used for some time the experiment often fails. It is possible that the gradual and slow impairment of the vacuum is the cause. This slow propagation of the discharge through a very narrow glass tube corresponds exactly to the propagation of heat through a bar warmed at one end. The quicker the heat is carried away laterally the longer time it will take for the heat to warm the remote end. When the

current of a low frequency coil is passed through the fibre from end to end, then the lateral dissipation is small, and the discharge instantly breaks through almost without exception.

After these experiments and observations, which have shown the importance of the discontinuity or atomic structure of the medium, and which will serve to explain, in a measure at least, the nature of the four kinds of light effects produceable with these currents, I may now give you an illustration of these effects. For the sake of interest I may do this in a manner which to many of you might be novel. You have seen before that we may now convey the electric vibration to a body by means of a single wire or conductor of any kind. Since the human frame is conducting I may convey the vibration through my body.

First, as in some previous experiments, I connect my body with one of the terminals of a high tension transformer, and take in my hand an exhausted bulb which contains a small carbon button mounted upon a platinum wire leading to the outside of the bulb, and the button is rendered incandescent as soon as the transformer is set to work (Fig. 26). I may place a conducting shade on the bulb which serves to intensify the action, but it is not necessary. Nor is it required that the button should be in conthrough ducting connection with the hand through a wire leading the glass, for sufficient energy may be transmitted through the glass itself by inductive action to render the button incandescent.

Next I take a highly exhausted bulb containing a strongly phosphorescent body, above which is mounted a small plate of aluminum on a platinum wire leading to the outside, and the currents flowing through my body excite intense phosphorescence in the bulb, Fig. 27. Next again I take in my hand a simple exhausted tube, and in the same manner the gas inside the tube is rendered highly incandescent or phosphorescent, Fig. 28. Finally, I may take in my hand a wire—bare or covered with thick insulation, it is quite immaterial; the electric vibration is so intense as to cover the wire with a luminous film, Fig. 29.

A few words must now be devoted to each of these phenomena. In the first place, I will consider the incandescence of a button or of a solid in general, and dwell upon some facts which apply equally to all these phenomena. It was pointed out before that when a thin conductor, such as a lamp filament, for instance, is connected with one of its ends to the terminal of a transformer of high tension, the filament is brought to incandescence partly by a conduction current and partly by bombardment. The shorter and thicker the filament, the more important becomes the latter, and, finally reducing the filament to a mere button, all the heating must practically be attributed to the bombardment. So in the experiment before shown, the button is rendered incandescent by the rhythmical impact of freely movable small bodies in the bulb. These bodies may be the molecules of the residual gas, particles of dust or lumps torn from the electrode; whatever they are, it is certain that the heating of the button is essentially connected with the pressure of such freely movable particles, or of atomic matter in general in the bulb. The heating is the more intense the greater the number of impacts per second and the greater the energy of each impact. Yet the button would be heated also if it were connected to a source of steady potential. In such a case electricity would be carried away from the button by the freely movable carriers or particles flying about, and the quantity of electricity thus carried away might be sufficient to bring the button to incandescence by its passage through the latter. But the bombardment could not be of great importance in such case. For this reason it would require a comparatively very great supply of energy to the button to maintain it at incandescence with a steady potential. The higher the frequency of the electric impulses, the more economically can the button be maintained at incandescence. One of the chief reasons why this is so, is, I believe, that with impulses of very high frequency there is less exchange of the freely movable carriers around the electrode, and this means that in the bulb the heated matter is better confined to the neighborhood of the button. If a double bulb, as illustrated in Fig. 30, be made, comprising a large globe B and a small one b, each containing as usual a filament f mounted on platinum wire w and w, it is found, that if the filaments f f be exactly alike, it requires less energy to keep the filament in the globe b at a certain degree of incandescence than in the large globe, B. This is due to the confinement of the movable particles around the button. In this case, it is also ascertained, that the filament in the small globe b is less deteriorated when maintained a certain length of time at incandescence. This is a necessary consequence of the fact that the gas in the small bulb becomes strongly heated and therefore a very good conductor, and less work is then performed on the button, since the bombardment becomes less intense as the conductivity of the gas increases. In this construction, of course, the small bulb becomes very hot, and when it reaches an elevated temperature the convection and radiation on the outside increase. On another occasion, I have shown bulbs in which this drawback was largely avoided. In these instances a very small bulb, containing a refractory button, was mounted in a large globe, and the space between the walls of both was highly exhausted. The outer large globe remained comparatively cool in such constructions. When the large globe was on the pump and the vacuum between the walls maintained permanent by the continuous action of the pump, the outer globe would remain quite cold, while the button in the small bulb was kept at incandescence. But when the seal was made, and the button in the small bulb maintained incandescent some length of time, the large globe too would become warmed. From this I conjecture that if vacuous space (as Prof. Dewar finds) cannot convey heat, it is so merely in virtue of our rapid motion through space or, generally speaking, by the motion of the medium relatively to us, for a permanent condition could not be maintained without the medium being constantly renewed. A vaccum cannot, according to all evidence, be permanently maintained around a hot body.

In these constructions, before mentioned, the small bulb inside would, at least in the first stages, prevent all bombardment against the outer, large globe. It occurred to me then, to ascertain how a metal sieve would behave in this respect, and several bulbs, as illustrated in Fig. 31, were prepared for this purpose. In a globe b, was mounted a thin filament f (or button) upon a platinum wire w passing through a glass stem and leading to the outside of the globe. The filament f was surrounded by a metal sieve s. It was found in experiments with such bulbs that a sieve with wide meshes apparently did not in the slightest affect the bombardment against the globe b. When the vacuum was high, the shadow of the sieve was clearly projected against the globe, and the latter would get hot in a short while. In some bulbs the sieve was connected to a platinum wire sealed in the glass. When this wire was connected to the outer terminal of the induction coil (the E. M. F. being kept low in this case) or to an insulated plate, the bombardment against the outer globe b was diminished. By taking a sieve with fine meshes the bombardment against the globe b was diminished, but even then if the exhaustion was carried very far, and when the potential of the transformer was very high, the globe b would be bombarded and heated quickly, though no shadow of the sieve was visible owing to the smallness of the meshes. But a glass tube or other continuous body mounted so as to surround the filament, did entirely cut off the bombardment and for a while the outer globe b would remain perfectly cold. Of course when the glass tube was sufficiently heated, the bombardment against the outer globe could be noted at once. The experiments with these bulbs seemed to show that the speeds of the projected molecules or particles must be considerable (though quite insignificant when compared with that of light), otherwise it would be difficult to understand how they could traverse a fine metal sieve without being affected, unless it were found that such small particles or atoms cannot be acted upon directly at measurable distances. In regard to the speed of the projected atoms, Lord Kelvin has recently estimated it at about one kilometre a second or thereabouts in an ordinary Crookes bulb. As the potentials obtainable with a disruptive discharge coil are much higher than with ordinary coils, the speeds must, of course, be much greater when the bulbs are lighted from such a coil. Assuming the speed to be as high as five kilometres and uniform through the whole trajectory, as it should be in a very highly exhausted vessel, then if the alternate electrifications of the electrode would be of a frequency of five million, the greatest distance a particle could get away from the electrode would be one millimetre, and if it could be acted upon directly at that distance, the exchange of electrode matter or of the atoms would be very slow, and there would be practically no bombardment against the bulb. This at least should be so, if the action of an electrode upon the atoms of the residual gas would be such as upon electrified bodies which we can perceive. A hot body inclosed in an exhausted bulb produces always atomatic bombardment, but a hot body has no definite rhythm, for its molecules perform vibrations of all kinds.

If a bulb containing a button or filament be exhausted as high as is possible with the greatest care and by the use of the best artifices, it is often observed that the discharge cannot, at first, break through, but after some time, probably in consequence of some changes within the bulb, the discharge finally passes through and the button is rendered incandescent. In fact, it appears that the higher the degree of exhaustion, the easier is the incandescence produced. There seems to be no other causes to which the incandescence might be attributed in such case, except to the bombardment or similar action of the residual gas or of particles of matter in general. But if the bulb be exhausted with the greatest care, can these play an important part? Assume the vacuum in the bulb to be tolerably perfect, the great interest then centres in the question: Is the medium which pervades all space continuous or atomic? If atomic then the heating of a conducting button or filament in an exhausted vessel might be due largely to etherbombardment, and then the heating of a conductor in general through which currents of high frequency or high potential are passed must be modified by the behavior of such medium; then also the skin effect, the apparent increase of the ohmic resistance, etc., admit, partially, at least, of a different explanation.

It is certainly more in accordance with many phemonena observed with high-frequency currents to hold that all space is pervaded with free atoms, rather than to assume that it is devoid of these, and dark and cold, for so it must be, filled with a continuous medium, since in such there can be neither heat nor light. Is, then, energy transmitted by independent carriers or by the vibration of a continuous medium? This important question is by no means as yet positively answered. But most of the effects which are here considered, especially the light effects, incandescence, phosporescence, involve or the presence of free atoms and would be impossible without these.

(To be Continued.)

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THERE are 546 students enrolled on the books of the Toronto Technical School. The accommodation afforded by the present building has been found to be very inadequate to the requirements. A committee has therefore been appointed to petition the City Council for increased accommodation.

IT is strange notwithstanding the fact is now known that a fan motor will keep the frost off a window that there should not be more of them in use. To any store having incandescent light a fan surely is a good investment, as it can be used in winter to keep the frost off the windows and in summer to assist the ventilation of the apartments.

IN view of the lack of agreement between various County Judges as to whether gas mains in the public streets are subject to taxation as real property, the Ontario Legislature has been petitioned by several of the municipalities to decide the question by legislation. Sir Oliver Mowat has expressed the opinion that the mains should be taxed where it can be shown that the Company is paying a dividend. The Government has promised to consider the matter.

To many seekers after electrical knowledge the announcement has been received with regret that the course of lectures announced to be delivered by Prof. Cox at McGill University will not take place. Purchasers of tickets for the course of lectures have been notified to this effect and requested to call and have their money refunded. A rumor is current to the effect that the faculty of McGill do not wish the professors to lecture to other than regular students of the University.

A FEW days ago there appeared a letter in one of our daily papers under the caption, "Something Wanted in Toronto." The letter went on to state that repair shops for electrical apparatus, where duplicate parts of motors could be kept was a thing much needed in Toronto. It is known to some that there are such places in Toronto, where everything of the sort can be obtained, but the proprietors of these establishments do not avail themselves of the advertising columns of the press, consequently work they might get is sent away to other places to be done.

THE Hon. Mackenzie Bowell, who recently returned from Australia, which he visited with the object of developing our trade relations, indicated in his speech before the Manufacturers' Association, many lines of trade which are being supplied by the manufacturers of the United States, with whom the manufacturers of Canada might profitably enter into competition. Among other information, Mr. Bowell stated that it should be possible for Canadian manufacturers of electrical machinery and appliances to find a considerable market in Australia for these lines of production. No doubt the hint will not be thrown away on this class of manufacturers, who are undoubtedly among the most wide-awake and enterprising in the Dominion

A PETITION has been presented to the Ontario Legislature by Mr. Bronson, at the request of certain steam users of the City of Ottawa, praying that the Engineers' Act may be so amended that engineers operating engines of 15 horse power and over must hold certificates as a proof of their competency. A similar amendment to the existing law is to be asked for by the Executive of the C. A. S. E. This we regard as a step in the right direction, and one which should receive the support of all interested in the endeavor to bring about a higher standard of education and efficiency on the part of engineers.

IT was pointed out in the ELECTRICAL NEWS some time ago, that the inauguration of rapid street railway transit in Toronto would have a tendency to induce business men and others employed down town to lunch at home instead of at the restaurants. The fact that correspondents of the daily papers are complaining that standing room only can be procured on cars on certain lines during lunch hour is a proof of the correctness of the assumption. It is safe to say that the railway company's business might be largely increased by a reduction in the price of tickets used between the hours of noon and two o'clock p. m.

LARGE incandescent lamps are beginning to make their appearance in several buildings in Montreal, 200 and 300 c. p. lamps being used. The manufacturers of these lamps claim a higher efficiency than the ordinary 16 c. p. lamps. If this claim is borne out the large lamps will no doubt become popular for interior illumination of large areas, such as stores, halls, etc. At the same time, however, it must be borne in mind that the color of the light is still of a yellow hue and the distinguishing colours of silks and other goods, as for example certain shades of green as compared with blue, cannot be told by it with the precision that they can by the arc light.

THE absurd method of giving lights by contract is still followed by a few companies, and it would surprise some electrical people to know that this is even done in Montreal where they might suppose the electric people would know better. What is to hinder a man, contracting for a certain number of 16 c. p. lights from buying a few 32's or 50's if he choose and screwing them into his sockets in place of the 16's as often as he sees fit? The inspectors (if there are any) certainly will not make their rounds and examine the lamps after 6 o'clock at night, and this is just the time when such exchanges would be made—in fact it *is* done, and the cases are not few either.

A GREAT deal of interest has been aroused by the offer of the Metropolitan Traction Company, of New York, to give a prize of $50,000 to the inventor of a practical street railway system to take the place of the trolley and cable systems. The offer has apparently been made in good faith, as evidenced by the fact that the judgment of the merits of the inventions which may be submitted is placed entirely outside of the Company's hands. The offer of so large an amount of money bears testimony to the value of the trolley system. We are in accord with the opinion of the New York Electrical Review, which states that the man who invents such a system as the Metropolitan specifies can get $1,000,000 for it just as easily as he can get $50,000.

THE discussion which for some time past has been going on in these columns with regard to the relative advantages of high versus slow speed engines for electric railway work, might we think be profitably supplemented by one in which proper consideration would be given to appliances for bringing to a sudden stop electric cars while travelling at a high rate of speed. This is one of the most important subjects to which attention can be called at the present time, in view of the demand for rapid transit in cities, the danger to human life which attends compliance with this demand, and the serious financial losses to which street railway companies have recently been subjected by adverse decisions of the Courts in actions for damages. The question as to what should be the limit of speed for electric cars and a suitable means of determining the speed at which cars are being run might very properly form a feature of the discussion. We invite an expression of views from our readers on this important subject.

The difficulty which we referred to in our last issue as existing in Truro, N. S., between the telephone and electric light companies has, we are pleased to note, been satisfactorily arranged, the contestants like sensible people, having decided to call the fight off rather than demonstrate which has the longer purse. The local electric light company proposed to give its patrons a free telephone system and had actually erected a plant with this view. The Nova Scotia Telephone Company then took steps for the prompt instalment of an electric light plant with such a big cut in rates that there was nothing left in the business and at the same time boldly announced that if necessary for the protection of their business, they would do the same in every town in the province. The lighting company recognized the inevitable and withdrew before it was too late. Such a fight would have been worse than useless, absolutely senseless, as both sides would have been hard hit financially, two legitimate lines of business would have been destroyed, and no one would have benefitted permanently. Of course the trouble was the culmination of recurring differences over trivial matters. Electric companies occupying the same field, but in no sense rivals, may and should be mutually helpful in working together harmoniously. This little far away scrimmage has an important moral which it were advantageous and profitable to be generally recognized and regarded.

THE attention of superintendents of electric lighting stations was directed in these columns a few months ago to the necessity of frequently examining current meters, and thereby satisfying themselves that they were in proper working condition. The fact was mentioned that one cause of inefficiency was found to be the disposition of spiders to weave their webs about the mechanism of the meter in such a way as to prevent it from properly recording the current. A case of this kind has just come to light in St. Thomas, Ont. The meter in one of the stores in that city, when examined, showed no change from the preceding month, notwithstanding that the regular amount of light had been used. The experiment was tried of increasing the number of lamps used, in the belief that the small amount of current previously employed was not sufficient to operate the mechanism of the meter. When it was discovered that the increased current consumed had no effect upon the meter, an examination was made, and it was found that the industrious spider was at the bottom of the difficulty.

THE question as to who should be liable for the cost of protecting railway crossings in cases where steam railroads are crossed by electric street cars within the boundaries of city municipalities, has been argued within the last few days before the Railway Committee of the Privy Council at Ottawa, in connection with the dispute on this point which has arisen between the Grand Trunk and Canadian Pacific Railway Companies and the Toronto Street Railway Company, with reference to the King street east crossing. Mr. B. B. Osler, counsel for the Toronto Street Railway Company, raised the novel contention that an electric street railway was a highway for the carrying of passengers, on the same principle as if busses or carriages were used; that the right to use the highway for this purpose was granted to them under the General Public Act, this right being recognized by the Provinces of Ontario and Quebec. From this contention he argued that the question was one beyond the jurisdiction of the Committee, and one which should be submitted to the Supreme Court for final decision. The Committee decided to hear the arguments in the case, and reserved its judgment as to the question of jurisdiction.

Several city municipalities are considering the advisability of purchasing the necessary electric plant and doing their own lighting. The impression has seemingly got abroad that it would be possible to get cheaper light by this method than by contract with a private company. The ratepayers of the City of London apparently thought otherwise, and voted down a by-law submitted to them recently by the City Council to authorize the appropriation of money for the purchase of an electric plant. The cities of Hamilton, Woodstock and Ottawa are now considering the question. The last named city has obtained offers from several manufacturing companies for the supply of the necessary machinery for a 500 light plant. The estimated cost of such a plant, exclusive of poles, is about $200,000. The interest and sinking fund on this amount would be about $12,000 per year. The city now pays, under contract, $26,000 a year for lighting. This would leave $14,000 per year with which to operate the plant, and the aldermen who have been appointed to deal with the subject appear to think that a large proportion of this amount could be saved. It seems questionable, however, whether they are at pres in possession of the information necessary to enable them to arrive at a conclusion on this point, and therefore it may not be out of place for us to submit the estimate of one of the most experienced station managers in Canada, as to the cost of operating at Ottawa a 500 light plant. It is as follows:

	Per Year.
Salary of Superintendent	$ 1,500 00
Two dynamo tenders and one oiler and cleaner, 3 men at $500	1,500 00
Seven trimmers at $500	3,500 00
Three patrol men at $500	1,500 00
One outside repairer with horse and wagon	1,000 00
One lamp repairer in station	500 00
Carbons for 500 lamps	5,470 00
Wear and tear and repair	5,000 00
Oil, &c.	250 00
Insurance	500 00
Globes	850 00
Sundries, tools, &c	500 00
	$22,070 00
	14,000 00
Loss to municipality	$ 8,070 00

It would be well for municipal officials and the daily press to obtain their data from impartial sources. Many of the estimates of cost published in the daily papers—the Hamilton *Herald* for example—are very wide of the mark; and we surmise were either furnished by the representative of an electric manufacturing company desirous of securing an order, or a person on the look-out for a position in the city's employ.

NOTES FOR ENGINEERS.

If steam boilers are required to carry safely a working pressure of 160 pounds per square inch, and the quantity of steam is so great that boilers with furnaces as large as a man can handle, even if fitted with shaking grates, should be used, what style of boiler would be most serviceable?

The ordinary make of horizontal tubular boiler of 72 inches diameter and 16 feet in length would take a furnace as large as a man can well manage.

What thickness of plates would be necessary, allowing a factor of safety of 5, and making butt joints with double straps, giving 80 per cent. of solid plate as the strength of joint. The plate to have a tensile strength of 60,000 pounds per square inch?

The problem is, having the diameter of boiler and the strength of joint and of plate given, and the pressure and facts of safety, to find the thickness. The inside diameter of the shell in inches at the largest of the rings, multiplied by the working pressure, will form one side of an equation. The other side is found by taking the tensile strength per square inch multiplied by two, and divided by the factor of safety and multiplied by the fraction representing the percentage of strength of joint, and by whatever number will make it equal the figures found for the first side of the equation. This last number is the required thickness of plate, and is found by dividing the first side of the equation by the quantity found by the process stated.

In the example, the boiler is to be about 72 inches diameter, and 72 may be used as the internal diameter. The pressure is to be 160, therefore $160 \times 72 = 11520$ pounds per square inch is the strain put upon the boiler plate by the steam pressure. To resist this there are two thicknesses of metal, one on each side of the boiler. The metal is 60,000 pounds per square inch; multiplied by 2, it is 120,000; but it is to be strained to only *one-fifth*, therefore, 120,000 divided by $5 = 24{,}000$. Then the joint is 80% of the solid metal, and as 80% is eight-tenths, the 24,000 must be divided by ten and multiplied by eight—that gives 19,200. If the plates were *one* inch thick it would give a strength of 19,200 pounds, and by the first part of the calculation, 11,520 pounds was all that was required. Therefore, 11,520 divided by 19,200 gives the fraction of an inch which would represent the thickness of plate. $\frac{11520}{19200}$ reduced to its lowest terms is three-fifths, and the plate would require to be three-fifths of an inch thick or nearly five-eighths of an inch. This is too heavy to have exposed to the action of the fire, and it may at once be settled that for steam pressure of 160 pounds per square inch and over, and where large quantities of steam are required the horizontal tubular boiler is unsuitable.

The same line of reasoning will show that for internally fired boilers the outer shells require to be so large in diameter, and to be made of such very thick plate, that it is desirable to look out for some other style.

Hitherto most marine boilers carrying 160 lbs. steam pressure have been made with internal furnaces and enormously heavy shells. At the present time there is a demand for something better, and for higher steam pressure. This has led some to adopt the water tube boiler, and the old dispute as to whether tubes should contain water or fire in a steam boiler is revived with all appearances in favor of "water" being victorious, owing to the demand for increased pressure.

A water tube boiler made for a Torpedo Destroyer boat for the British Navy, when filled with water ready for use, weighed a little over six tons.

Steam was got up to working pressure from cold water in twenty-two minutes, and boiler made steam so rapidly that over 12,000 pounds of water per hour were required to keep up the supply. This shows that it is possible to construct a steam boiler safe for the high pressures in use, (180 to 200 lbs. per square inch) which, when ready for steam, will weigh less than seven tons, and will require no brick setting, and yet give four hundred horse power according to United States Government standard.

He is something for electrical engineers to investigate. If such boilers can be made and used in a war vessel, why can they not be got for an electric station?

ERRATA.

An error inadvertently crept into the paper published in the February number of the NEWS on the "T. H. Dynamo," by Mr. James Burnett. In second column, "the two leading (top brushes) are moved about three times as *fast* as the two following (side brushes)," the word "slow" should be substituted for the word "fast".

A committee of the Hamilton City Council has been appointed to inquire into the cost of electric machinery and the expense of operating the same. This information is required to enable the Council to decide whether or not it would be profitable for the City to undertake to do its own lighting.

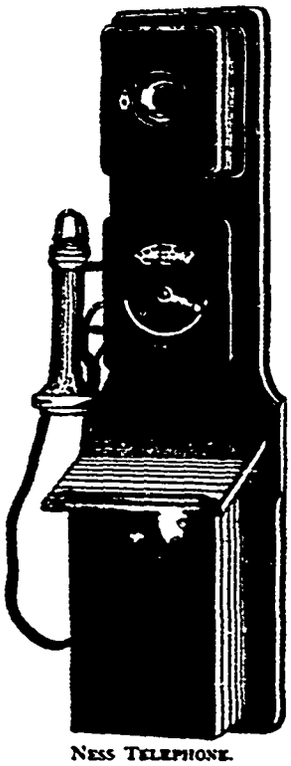
The "Montreal Junior Electric Club" has been organized, and has had several interesting meetings. The officers of the club are E. W. Sayer, president, William Sutton, vice-president, H. Street, Treasurer; H. O. J. Overton, Secretary, 19 Burnside street. At the last meeting of the club interesting papers were read on "Electric Bells and Batteries," by Mr. Wm. Smith and "The Discovery and Early Experiments of Electricity and Magnetism," by Mr. E. W. Sayer. The meeting was held at No. 6 Richmond avenue.

MOONLIGHT SCHEDULE FOR MARCH.

Day of Month.	Light.	Extinguish.	No. of Hours.
	H.M.	H.M.	H.M.
1.....	P. M. 6.00	A.M. 4.40	10.40
2.....	" 6.20	" 5.00	10.40
3.....	" 6.20	" 5.00	10.40
4.....	" 6.20	" 5.00	10.40
5.....	" 6.20	" 5.00	10.40
6.....	" 6.20	" 5.00	10.40
7.....	" 6.20	" 5.00	10.40
8.....	" 6.20	" 5.00	10.40
9.....	" 6.20	" 5.00	10.40
10.....	" 6.40	" 5.00	10.20
11.....	" 8.10	" 5.00	8.50
12.....	" 9.00	" 5.00	8.00
13.....	" 10.00	" 5.00	7.00
14.....	" 10.40	" 5.00	6.20
15.....	" 11.20	" 5.00	5.40
16.....	" 12.00	" 5.00	5.00
17.....	.....	" 5.00	
18.....	A.M. 1.10	.....	3.50
19.....	No light.	No light.	....
20.....	No light.	No light.	....
21.....	No light.	No light.	....
22.....	No light.	No light.	....
23.....	P. M. 6.10	P. M. 9.10	3.00
24.....	" 6.10	" 10.20	4.10
25.....	" 6.10	" 11.00	4.50
26.....	" 6.10	" 12.00	5.50
27.....	" 6.20	A. M. 12.30	6.10
28.....	" 6.20	" 1.00	6.40
29.....	" 6.20	" 1.30	7.10
30.....	" 6.20	" 2.40	8.20
31.....	" 6.20	" 3.50	9.30
		Total,	206.40

AN AUTOMATIC WAREHOUSE TELEPHONE.

A new warehouse telephone has just been placed upon the market by the well-known telephone and electrical manufacturing firm of T. W. Ness & Co., Montreal. The special feature of this new instrument, which is the invention of Mr. T. W. Ness, and has been patented in Canada, the United States and other countries, is an automatic switch return, by means of which the switch is brought back automatically to its normal point after conversation is finished. Those who are familiar with the old system, in which connection is made by inserting a plug in a socket corresponding with the line desired, which plug requires to be withdrawn after through talking, but is constantly overlooked, or the old style of switch, which requires to be returned by hand to its normal point, will at once see and appreciate the value of this new invention.



NESS TELEPHONE.

The automatic switch, receiver hook and bell are combined in the centre box. This automatic system is particularly suitable for connecting the different departments of factories, warehouses, offices, banks, colleges, etc., and it will be observed that no central office for making the different connections is required. Each instrument in a series has switch points corresponding or connecting with each of the other instruments, so that any one telephone can call up, or be called up, by any other by simply turning the switch lever around to the point corresponding with the instrument desired, and at the same time "ringing up," which is done by pressing the lever down upon the outer ring, shown below the switch points; this causes the bell of the instrument required to ring. After conversation is finished, the hanging up of the receiver causes the switch lever to return automatically to its own point, thus leaving the telephone in position to be called up by any other instrument. When desired, the instruments can be so arranged that only certain ones in a series can call up certain others, instead of having the whole system interchangeable. In ringing up, only the bell of the instrument required sounds, so none of the others are disturbed, and conversation is at the same time private. In a series of, say, eight instruments, 1 and 3, 2 and 4, 5 and 6, might converse at the same time, without interfering with one another.

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.

MONTREAL ASSOCIATION NO. 1.

In a letter dated the 8th of February, addressed to the officers and members of the above Association, Mr. Joseph G. Robertson, the President, announces his intention of resigning office, giving as his reason the lack of interest manifested by a large number of the membership in the work of the Association.

KINGSTON ASSOCIATION NO. 10.

We are pleased to learn from Mr. H. Hoppins, the treasurer of the above Association, that the membership is steadily increasing, the meetings are well attended, and the discussions animated and interesting. This information is very satisfactory as far as it goes, but it would interest many of our readers to learn more in detail what the animated and interested discussions are about.

HAMILTON ASSOCIATION NO. 2.

HAMILTON Feb. 20th, 1894.

Editor ELECTRICAL NEWS.

The two last meetings of the above Association were ones of no small interest. At the regular meeting on Feb. 2nd, Mr. S. H. Milson was initiated and other business of importance transacted.

At the instruction meeting held on Feb. 17th, a very interesting time was spent, the subject for discussion being the most economical and best methods of handling a steam plant. The first question asked was what is the best and most economical boiler to be employed, and was discussed at some length. The water tube boiler was spoke of as being a good steam generator and a good many things were said about its form of construction.

Other questions asked were regarding the best style of grate bars to be employed and whether it is necessary to have different styles of grate bars for different kinds of coal; many instructive points were brought out under this head.

We find that this system of having instruction meetings is the means of getting all present interested, as is indicated by the number of those who take part in the discussions.

Another important matter which was dealt with at the last two meetings, and which we are sure from past experience a great many members of sister lodges will hear of with pleasure, was concerning our annual dinner, which is to be held on the evening of March 22nd at the Commercial Hotel. An extraordinary good time is promised to all who shall be present on that evening.

WM. NORRIS,
Rec.-Secretary.

OTTAWA ASSOCIATION NO. 7.

ditor ELECTRICAL NEWS.

SIR,—At the last regular meeting we were favored with the unexpected presence of Bros. Thomas Stewart, of Arnprior, and F. M. Donaldson, of Toronto, who gave very interesting addresses on the construction and efficiency of steam boilers, accompanied with blackboard examples.

The steam dome received its fair share of attention, and particularly the misleading idea that it is an absolute necessity to have one on all boilers in order to obtain what is termed dry steam. It was very clearly demonstrated that by the use of a dry pipe extending lengthwise in a well designed boiler, a better quality with more uniformity could be obtained.

The next thing considered was the weakness due to the cutting of the plate for the passage of steam to the steam dome, this hole being sometimes made the full diameter of the dome. Even if it were smaller and re-intorced it is very doubtful if the strength obtained would be sufficient to overcome the weakness caused by the cutting. Another objection to the steam dome was that the part of shell within was in a balanced condition so far as steam was concerned—the pressure being the same below as above it, consequently the strains on the other parts of the shell have a tendency to flatten that part under the dome, and as it was not so effectively resisted, the joints were subjected to very trying strains. This interesting subject brought out remarks on the abuse to steam boilers by being in charge of incompetent men.

The boiler explosion at Byers' Corners furnished a good theme for discussion, and particular attention was drawn to the duties and liability of the working engineer, that of using the boiler carefully, of keeping it clean and examining it at such intervals as the nature of the water in use requires.

One common practice which was very much condemned is the overloading of safety valves—"to keep them from leaking" as the engineer (?), says and entire dependence on the steam gauge. One member here cited a case which came under his notice of a connection from boiler to steam gauge, including a syphon next to gauge, being exposed to a stiff current of air from the engine room window sufficiently cold to freeze the water from condensation in the pipe, consequently making the steam gauge useless, for it would not indicate the varying pressure in the boiler. Fortunately in that case the safety valve was in good working order; but any one can imagine the result if the safety valve had been overloaded or stuck to its seat. The speaker's opinion was that such was the cause of the last fatal explosion (except some expert brings forth the low water theory) as it was a portable saw mill, and as a general rule such mills are not very well protected from inclement weather, and the majority of men in charge of such portable boilers are using the safety valve lever as a tool rack.

After some appropriate remarks on the tensile strength of iron and steel and the bursting and safe working pressure of boilers, the President gave the first of a series of lessons on decimal fractions and decimal numerations. In opening his remarks he said that owing to numerous calculations relative to the steam engine decimals were absolutely necessary, the knowledge of their use and relation to ordinary fractions was dependent on their position to the unit, and that the decimal point was the most important in all calculations. After showing how to reduce ordinary fractions into decimals together with the signs and terms used universally, he announced that at the next meeting the first four rules of arithmetic would be the subjects taken.

Before the meeting adjourned a vote of thanks was tendered Bros. Donaldson and Stewart for their very instructive addresses.

PROGRESS.

TORONTO ASSOCIATION NO. 1.

The membership has increased rapidly of late. There has not been a meeting for a long time past without one, two or three members being initiated, and propositions for membership are being continually received.

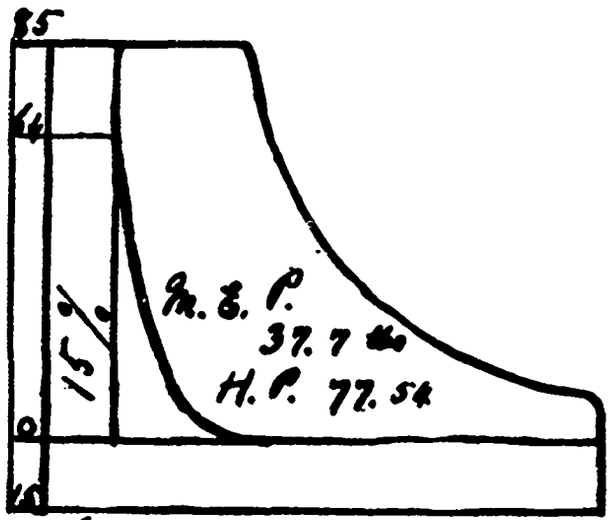
The meeting of Jan. 26th was an exceptionally good one with a numerous attendance, induced no doubt by the rumors of a war of arguments between the believers in high speed engines and the lovers of the slow speed engine.

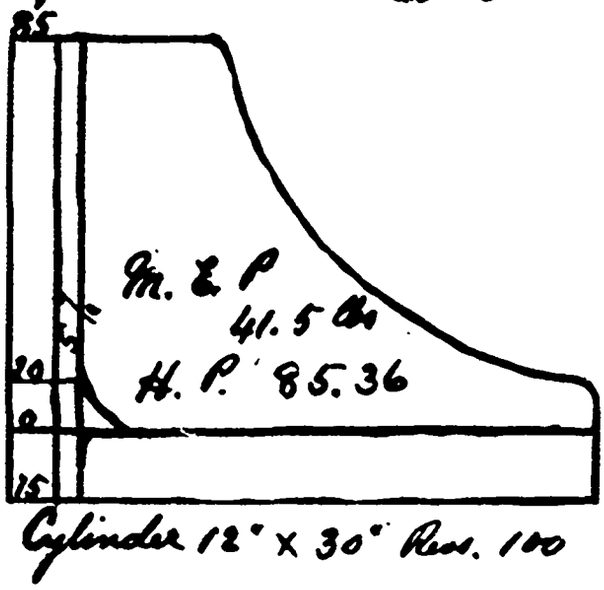
After routine business had been hastily disposed of, the doors were opened to the public.

Bro. Chas. Heale was the first to take the floor in favor of high speed engines. He said the subject of high speed in stationary engines had been well thought out by constructive and designing engineers. The principles of steam engine economy were well understood by Watt a century ago, and yet it is only within the last few years that we have got nearer to a satisfactory solution of the problem. Watt found that the great source of loss was the heating and cooling of the cylinder at each stroke. To remedy this defect he insulated the metal, attached a separate condenser, shortened the stroke, increased the number of revolutions, and in fact made a high speed engine. The principles that must govern the engineer to-day said Bro. Heale may be summarized thus :- The steam must enter the cylinder at the highest admissable pressure; all exterior waste of heat must be prevented as far as possible, and the much greater waste that occurs within the engine by cylinder condensation and re-evaporation must be checked as far as practicable; this could best be done by a high speed engine. The greatest amount of work must be done with due regard to the preceding conditions; this compelled the driving of the engine at the high highest safe speed and adoption of the highest economical M. E. P. The two first conditions gave maximum efficiency of engine. In additions to these requisites the designers and builders of engines were compelled by some modern industries to meet demands more imperative than in others; the chief of these are great regularity of speed, ease and cheapness of connecting them to their work, simplicity, compactness, rigidity, strength and durability. In the attempt to meet these demands the present high speed engine has taken shape. When the above qualities are blended in a high speed engine all difficulty of operation vanishes; high speed being a great revealer of defects, it follows necessarily that everything about the machine must be in first class working order, everything balanced and fitted up with the best workmanship; on the other hand slowly revolving machinery does not easily show defects, nor does it receive the same attention as the high speed. There is only one standard of work permissible in the high speed engine, and that is "perfection"—when it is otherwise the machine is a failure. Objections were made to the high speed engines, that on account of their great speed they were more liable to accidents, but after reading in the different mechanical papers so many accounts of fly wheel accidents charged up to the slow speed engine, he had concluued that the high speed engine was much safer to be with. Opponents of high speed lay great stress on the losses by clearance, entirely ignoring the advantages of compression in preventing cylinder condensation and the fact that by giving an engine a great speed the time allowed for cooling down on the return stroke is reduced, and the cylinder practically kept as Watt said it should be, viz., as hot as the steam that entered it; whereas the slow speed engine has its cylinder walls exposed to the atmosphere five or six times longer during a stroke than the high speed, therefore the losses from condensation must be greater in the slow speed. In addition to the advantages already enumerated, Bro. Heale added the great saving in space and foundations, lighter fly wheels, consequently less friction and immunity from bursting, the absence of belting and counter shafting, and when belts are required, short parallel ones with large contact can be used. High efficiency under great variations of load and steam pressure is a characteristic of the high speed engine owing to the action of the governor

increa ing compression with increasing expansion, and decreasing compression with decreasing expansion, thus utilizing the heat of compression to check cylinder condensation. Bro. Heale then gave some illustrations on the blackboard of the percentages of variations between friction and full load, also the opinions of several eminent authorities on steam engineering to convince his hearers that his arguments in favor of high speed engines were correct.

Bro. Wickens then took the floor in defence of the slow speed engine and said: I will first answer some of the statements made by Bro. Heale. I think as far as economy in the use of steam is concerned we cannot do better than to look at some of James Watts' old Cornish pumping engines. Some of those engines have been working continuously for the last 80 or 90 years setting an example of economy (120,000,000 foot pounds per 100 pounds of coal) that later engine builders have very rarely reached and still more seldom exceeded. Those engines give us an object lesson in durability that even the very best high speed builders do not expect to reach. Bro. Heale tells us of the great advances made by the high speed builders in the general workmanship and proportion of their engines; now I think we will all admit that the builders of slow speed engines have also adopted good proportions and better methods of construction, and his reference to the breakdowns or fly wheel accidents to the slow engines during the past year can hardly be taken as a very strong point against that style of engine, as it is only necessary to build the fly wheels stronger and put on automatic stops to act in case the governor fails in its duty. The mechanical engineers had hopes that a great saving in steam from cylinder condensation would follow a high rotative speed, but the result has been somewhat disappointing to them, or at least it has developed the fact that they lost more in the clearances they must necessarily use than they saved from cylinder condensation. I have made or copied 2 diagrams from 2 engines one a 12"×12" running at 300 revs., and one a 12"×30" running at 100 revolutions per minute. In doing this I have tried to get a good card from each engine. We will now look at the difference in them, using the same steam pressure and cutting off the steam at the same point in each case.





In some of the high speed engines the clearance is as much as 20% of piston displacement, and very few below 12%; in fact it is only recent engines that reach the lower figure. Slow speed clearances run from 3% to 8%; we will take 5% as a fair average, or .05% of piston displacement. The high speed piston displacement in our card is 1357.20 cubic inches; clearance equals 203.58, or 15%; this filled 600 times in one minute equals 122,148 cubic inches. If this was all lost it would be ruination to the economy of the engine. Part of it is utilized in compression to fill up the clearance. In this case the compression pressure went up to sixty pounds, thus reducing the loss by two-thirds, which would represent at least 4 lbs. water per h. p. per hour. This great amount of compression also has the effect of reducing the M. E. P. of the card, and the power of the engine accordingly. The M. E. P. is 37.7 lbs., and the H. P. is 77.54, as measured from the card. The slow speed engine has a piston displacement of 4071.6 cubic inches; the volume of the clearance is 5%, equals 203.58 cubic inches: this waste room is filled up 200 times per minute in this case, and amounts to 40.716 cubic inches. Now, in this card we only have about 16 lbs. pressure made by the compression, and our gain for that reason is very small. Our waste water amounts 2.021 lbs. per H. P. per hour; this is without any allowance for compression, so we presume that we gain .021 of a pound by it. The M. E. P. of the slow speed card is 41.5 and the total H. P. is 85.36. This gain in power is somewhat used up in extra friction with shafting, pulleys, etc. In oil and general wear the slow speed has the advantage. The manufacturers of high speeds have done wonders in the way of improving the methods of construction, and all these methods have been utilized by good slow speed engine makers.

Bro. Ed. Phillip, of the incandescent electric light station, then took the floor and proved himself an able advocate of the high speed engine. He said: I think in taking up this subject for debate we should have defined the term "high speed engine" and should have attached some specific purpose to the subject of debate. High speed applies really to piston speed, and as all piston speeds are high to-day compared to the time of James Watt, we may say all engines are high speed. I understand it is really Corliss or equivalent valve gear against wheel governors. Now I do not believe that engines with wheel governors are adapted in point of economy for all purposes, alongside of the long stroke automatic, but there are places with variable loads where the short stroke or high speed engine will show a greater degree of economy than the slow speed, as has been proved in railroad work in the United States. Take an engine with a load that is one-fourth its maximum,—the engine with high rotative speed will show a degree of economy over the slow speed, but as the load approaches maximum, so will the economy of the slow speed overbalance the high speed, and when the average and maximum load is nearly the same, the slow speed is the more economical. It is well known that in the high speed, condensation is less than in the slow speed; and as condensation is loss, this is one point in economy in favor of the high speed. The range of cut-off is much greater without loss of speed in the short stroke engine with wheel governor than in the long stroke or slow speed engine. Take the two kinds of engines and let each have one revolution, drop from no load to full load, and see the difference in the percentage of speed; for instance, an engine running 100 revolutions per minute and another running 300—the loss in the first is one per cent., in the latter ⅓ of one per cent., which is a very important factor, especially in electric lighting. The shape of the card in the modern high speed is the same as the Corliss; the only point that changes is the cut-off. A great many engineers object to the high speed engines on the score of hot boxes, broken cross-heads, bursting cylinders, &c., but these difficulties are only imaginary. I do not think a high speed engine requires any more watchfulness on the part of the engineer than the slow speed, and during the time that I have been operating them I have come to the conclusion that the high speed engine is better adapted to variable loads than the slow speed.

President Wilson Phillips said he supposed according to the rules of debate he as president should not be allowed to say anything either one way or another, but he could not allow some of the statements made by Bro. Ed. Philip, relative to slow speed engines, to go unchallenged. In the first place he contended it that is possible for the governor of a slow speed engine to work very accurately, even if the load thrown off and on amount to 70% of the total power of the engine. If when standing by an engine, when a load comes on and off a variation in speed is noticed, then there is something radically wrong with the governor. If a spring governor, there is too much tension or too little; if a ball governor, then the weights are not adjusted right. He had stood by slow speed engines driving electrical apparatus where changes of load were frequent, but not the least variation of speed in engines could be detected nor could any difference be observed in the lights, because the governors of those engines were working correctly. He said further that the slow speed engine does not require the same lynx-eyed watchfulness on the part of the engineer that the high speed does, for once it is in good working order it will keep so for a long time whilst a high speed may start up seemingly all right and before it has got through its trip it is pounding like so many steam hammers. In the matter of oiling, the oil can be put on a slow speed engine's bearings where it is required; the engineer does not need to throw it at random as does the engineer of the high speed, who oils the

frame and bed as much or more than he oils the wearing parts. Repairs to slow speed engines are infinitesimal compared with those of high speed. Slow speed engines do not often require cylinders to be bored out, nor boxes and bearings babbitted, piston rods turned up, &c., but it is a common occurrence for the high speed engine to undergo these repairs. Then as to the cleanliness of the two engine rooms, in the one everything is polished and bright, whilst in the other the floors reek with oil, the bed and frame of the engine ditto, and the passer-by is bespattered with oil from head to foot; the engines revolving so swiftly seem to draw all the dust from the four quarters of the earth, and it seems to settle on everything in the place. Then when there are many high speed engines at work the sum of all their great clearances must make the fuel bill very expensive, whilst in the slow speed all those wasteful clearances are compressed into the one engine, and percentage of clearance in the slow speed being so much less than in the high speed it must result in a great saving of fuel. Again, the roaring of exhausting steam of high speeds is very annoying, whilst with slow speeds the steam is exhausted down to atmospheric pressure, thus making but very little noise. Taking his own experience into consideration he preferred the slow speed to the high speed.

This ended the debate.

At the regular meeting on February 9th, there was a good attendence notwithstanding the very stormy night. Various reports from committees were received, commented upon and adopted. The president gave out the new pass-word and those members who were not present should get it without delay, as without it their admittance to future meetings will be difficult if not impossible.

The business part of the meeting was pushed through as rapidly as possible until "Good of the Order" was called. Under this heading the decision of the judges in the late debate on the subject of "High versus Slow Speed Engines" was loudly called for. By an agreement among the judges, Bro. Gilchrist had been appointed to render the verdict. In doing so he expressed his regret that the Association had appointed him as judge, thereby completely closing his mouth. During the hottest part of the debate he was obliged to hold himself down in his seat to keep from expressing his views. With great difficulty he managed to keep out of the discussion, but in future some other person would have to be judge, for he proposed having a hand in the next debate. He hoped the two contending parties would bury the hatchet and immediately go in training for another fight, for he believed such debates were the making of young engineers. By a series of calculations which he explained he declared that the advocates of "slow speed" had beaten the "high speed" men by six points to four. This decision of the judges is not to be regarded as any reflection on high speed engines, but that the slow speed advocates presented their case in a better light than the high speed men. The "high speed" men, after putting their heads together for a few moments, were overheard predicting renewal of the battle and an overwhelming defeat for their opponents in the near future.

Bro. Edkins, who had arrived home a few days before the meeting from a visit to his home in England was asked as to his welfare, and for a few words about his trip. In a short speech he expressed his thanks for the interest manifested in his welfare and assured the brethren that he had enjoyed himself thoroughly, with the exception of the return trip, on which his vessel had encountered foul weather and accidents by reason of which she was delayed for six days. He then described the series of accidents that befel his ship and the means the engineers aboard took to repair the damages.

The "Question Box," which is always present, was on this occasion overflowing, and the president had serious intention of calling a special meeting to dispose of the numerous questions. However, some were answered, and some taken home by members to be explained at next meeting on February 23rd.

CHAS. F. KINSEY,
Corresponding Secretary.

ANNUAL DINNER MONTREAL NO. 1.

The annual dinner of this Association was held on the evening of February 2nd, at the Richelieu Hotel, and was a most enjoyable affair.

The chair was occupied with much felicity by the President, Mr. J. G. Robertson, who first proposed the toast of "Queen and Country" which was duly honored.

This was followed by the toast of "Electrical Engineering," which was responded to by Messrs. J. Smillie and J. J. York.

Mr. Smillie, after explaining that he had been called upon most unexpectedly and felt unprepared to respond to the toast of one of the most important sciences that the practical mind had to grapple with to-day, said every one at present was almost compelled to take an interest in electricity for the practical applications of it were to be met everywhere. It used to be said that an electrical engineer should be nine parts mechanical and one part electrical. Now, however, electricity and mechanics were more nearly equal and he considered that the proportions should be about three parts mechanical and two electrical. Electricity and mechanics had both made great progress, but recent accidents had shown that there was something still to be accomplished in the practical application of these sciences.

Bro. J. J. York, in replying, said it was strange no explanation had been given of the cause of the accident which had recently happened to engines in electric power and lighting stations.

If he had time he would like to make some experiment to ascertain if possible why these engines had run at a considerably higher speed just before the accidents, which apparently was the cause of the break down. He might then be able to throw some light on the question. Notwithstanding the fact that the strength of the fly wheels had been increased in modern times, they still occasionally gave way.

The next toast was that of the "Manufacturing Interest" and was responded to by Messrs. Hugh Vallance Andrew Young and H. Mitchell.

Mr. Vallance, in replying, said the manufacturing interests were in a flourishing condition in Canada, though somewhat unsettled by rumors of changes in the tariff. He advocated the placing of a higher duty on scrap iron, which would cause the rolling mills to use iron from native ores and lead to the establishment of smelting works throughout the country.

The toast of "Steam Engineering" was then proposed, and was responded to by Mr. P. Cowper, who said that though the methods employed in steam engineering had been improved since the time of James Watt the principles had practically remained the same. In his time, all engines were of the vertical type and to-day this type is returning to favor. He then gave a brief history of the steam engine from the first crude types to the present highly developed forms.

"The Faculty of Applied Science" was next toasted enthusiastically, but as Professor Nicholson of McGill University, who was to have replied, was unavoidably absent, there was no response.

The toast of "License Law and Inspection" followed, and was responded to by Mr. P. Fisher, who said that if governments were for the greatest good of the greatest number, the people should see that men were elected to Parliament who were pledged to introduce a license law. No one had a right to kill his neighbor with impunity. If he wished to kill his enemy and did it with a revolver, he would be punished by the government, but if he invited his enemy to visit his boiler room and increased the pressure so as to cause the boiler to explode and thus blow his enemy into eternity, the verdict would be "accidental death."

The next toast was to the "Brotherhood of Locomotive Engineers," which was coupled with the name of Mr. Thomas Clark, who said the present idea was to resort to legislation instead of strikes. Legislation could be easily obtained if all were united. He then gave a brief history of the Lehigh Valley Railroad strike which he said had been caused by the failure of the officers of the company to keep their agreement with the men.

The National Association of Stationary Engineers and the Canadian Association of Stationary Engineers were then toasted.

Bro. Hunt, in responding, said among other things, that the motto of the Canadian Stationary Engineers was "Forward." The Association endeavored to educate its members up to a high standard, and he hoped the engineers would never be obliged to resort to strikes in self defence.

Bro. York also responded, and in the course of his remarks said employers should understand that the object of the Association was to educate its members. The meetings were solely for the purpose of mutual improvement.

Mr. Cowper advised the younger members as well as the older ones if they were going to leave their employers to keep the machinery in the best possible order up to the last.

Then came the toast of the "Press" which was responded to very happily by the representative of the Canadian Engineer. During the evening songs were given by Messrs. Hunt, Cowper, and Wheeler.

We are indebted to Mr. C. E. Robertson, of Winnipeg, for some particulars of a meeting of engineers held in that city recently with the object of forming an Engineers' Association. The meeting was held in Mr. Robertson's office in the Grain Exchange. Among those present were the following:—Mr. C. E. Robertson, Edward Alberg, James T. McDonald, J. A. Binns, H. A. Stratton, L. Brandon, John Stanley, J. Schneider, T. Haynes, J. Harrison, T. Gordon, W. Brown, M. Saunders, Robert Hall, of Winnipeg, and C. R. Forge, of Morden. Mr. Robertson was elected chairman, and after having discussed the advantages which would be derived by engineers organizing themselves into a branch of the Canadian Association of Stationary Engineers, it was decided that a register and the necessary papers be prepared and signed, and an application made for a charter.

MONTREAL ELECTRIC CLUB.

MONTREAL, February 18th, 1894.

Editor CANADIAN ELECTRICAL NEWS.

DEAR SIR,—I have been requested by the Committee of the Montreal Electric Club to express to you through this medium the hearty thanks of the Club for the interest and encouraging remarks you have accorded them, and also for space for papers in your esteemed journal, which last I might say raises the tone of the articles, and stimulates the writers to further efforts.

Yours respectfully,
JAMES BURNETT, Secretary M.E.C.
19 Shuter street, Montreal.

Mr. G. W. Stevens, one of the largest property holders of Montreal, threatens to bring suit for $80,000 damages against the City, on the ground of depreciation of the value of his property, should the construction of an elevated railway on certain streets be permitted.

ELECTRIC RAILWAY DEPARTMENT.

THE MONTREAL STREET RAILWAY SYSTEM.

The Montreal Street Railway have lately experienced hard luck. In the temporary power house on Cote street they have two high speed engines, one belted to two Westinghouse generators, the other to two Edison. One night recently they had some trouble with the engine running the Westinghouse generator. This was promptly repaired, however, only to be followed the succeeding day by the one which was running the Edison generators going all to pieces. One piece went through the roof and fell in the yard. It is difficult to say what really was the trouble. The engine was one of the Harrisburg "Ideal." The brunt of the work was then thrown on to the remaining engine on Cote street and the one at the Royal Electric Company's works. At 6 o'clock on the same day the armature of one of the generators at the Royal Electric Works burnt out. The Street Railway Co., however, hustled things at their new power house on William street and are running part of it now.

Between the thankless public (who forget the old times, when their feet were soaking in wet pea straw and their heads thrust against a frosted canvass roof) and very inclement weather, they are indeed to be congratulated that they have managed to keep cars out on the road at all.

LEGAL DECISIONS.

The following cases were recently argued at Toronto before Chief Justice Galt, Justices Rose and McMahon :—

EWING V. TORONTO RAILWAY CO.—Judgment on motion by the defendants to set aside the verdict and judgment entered by Street, J., who tried the action at Toronto with a jury, awarding the plaintiff damages to the amount of $1,400 for injuries received by him in a collision with an electric car on the defendant's street railway line at Tannery Hollow in Yonge street in the City of Toronto. The plaintiff was going south in Yonge street on the street railway track in a democrat waggon driven by one McMillan, and was overtaken by the car, which was moving at a high rate of speed. The defendants contended on this motion that speed, however great, did not per se constitute negligence; that the very object of the legislation incorporating the company was to insure rapid transit; that the burden of care to avoid a collision lay on the person whose business it was to get out of the way, and not on the motorman, who had the right of way; that there was room on each side of the track; and that the accident was attributable to the negligence of McMillan in remaining on the track and attempting to keep ahead of the car (whose approach he had observed at a distance of 75 yards) until it was too late for him to turn off in safety. Motion dismissed with costs, the court holding that the case could not properly have been withdrawn from the jury, and as the evidence was of the most conflicting character the jury's findings could not be set aside or ignored. McMahon, J., referred to the fact that in Osgoodby v. Toronto Street Railway Co., a high rate of speed was held not to be per se evidence of negligence. Rose, J., was of the opinion that a rate of speed might be too great under certain circumstances, and not so under others, and that it was always a question for the jury.

GOSNELL V. TORONTO RAILWAY COMPANY.—Judgment on motion by the defendants to set aside the verdict and judgment entered by Street, J., who tried the action at Toronto with a jury, awarding the plaintiff damages to the amount of $1,160 for injuries received by him resulting from a collision between a waggon driven by him and a car on the defendants' street railway line at the intersection of Scollard and Yonge streets in the City of Toronto. The defendants contended that the evidence showed that the driver of the car had exercised due care and had done all in his power to stop the car, and that the plaintiff had been guilty of negligence. Motion dismissed with costs, the Court holding that the finding of the jury could not be interfered with upon the evidence.

GRINSTEAD V. TORONTO RAILWAY COMPANY.—Judgment on motion by the defendants to set aside the verdict and judgment for the plaintiff entered by Street, J., who tried the action with a jury, awarding him damages to the amount of $500 for his ejection from a car on the street railway line operated by the defendants. The plaintiff claimed to be entitled to ride on the car as a transfer under an agreement between certain persons (who subsequently assigned their rights thereunder to the company) and the corporation of the City of Toronto. The conductor refused to accept his statement that he had been properly transferred from another car, on which he had paid his fare, and the plaintiff's health suffered in consequence of his being obliged to wait in the street in very cold weather for another conveyance. On this motion the defendants contended that the evidence did not show that they were strictly speaking, subject to this clause of the agreement under which alone the plaintiff's action could be brought; that it was incumbent on the plaintiff, at all events, to show that transfer provisions were in force and that he had complied with them, and that the learned trial Judge had erred in allowing evidence to be given and damages to be assessed in respect of the injury to the plaintiff's health, such damages being too remote. The jury found $200 for the assault and $300 for the plaintiff's consequent sufferings. The jury found that the injury was the natural and probable result of the ejection. Under these circumstances the Court held that the case had been properly submitted to the jury, that there was evidence to go to the jury, that the defendants were operating the railway, and that the verdict could not be disturbed. Motion dismissed with costs.

THE PRESERVATION OF BELTS.—The following empirical formula for a machine belt preservative is due to L'Industrie: Warm in a covered vessel to a temperature of 50° C., 1 kilogramme of india-rubber broken up into pieces and mixed with 1 kilogramme of essence of turpentine. After the rubber has melted add 800 grammes of colophone; stir until this too is dissolved, then add 800 grammes of yellow wax. In another vessel put 3 kilogrammes of cod liver oil, and 1 kilogramme of tallow; heat this mixture until the tallow melts, and then pour it into the first vessel, stirring continually until the mass cools and solidifies. Belts, the working faces of which are occasionally treated with this compound, are said "to acquire greater solidity, and slipping at the pulleys is avoided."

SPARKS.

The Toronto Railway Company's cars have recently been fitted with passenger registering devices.

It is said to be the intention to extend the Walkerville Electric Railway to a point opposite Belle Isle, and to establish a ferry line to connect Belle Isle with the Canadian shore.

The necessary legislation has been obtained authorizing the Montmorency, Quebec and Charlevoix Railway Company to change their motive power to electricity and to run their line into the City of Quebec.

Mr. James Armstrong, on behalf of himself and other ratepayers of the Township of York, is endeavoring to quash a by-law passed by the township granting a bonus of $20,000 to the Toronto and Richmond Hill Railway.

A Sydney, N. B., law firm, at the head of which is Mr. Gillies, M. P. for Richmond, is asking for the incorporation of the Boynton Bicycle Electric Railway Company of Canada, to run from Winnipeg, Man., to Louisburg, N. S.

The construction of 50 new motor cars and 50 trailers has been commenced in the Toronto Railway Company's shops. From these shops 180 cars have been turned out. These cars are in use in Montreal, Winnipeg and elsewhere.

The Peterboro' Electric Railway Company has been much annoyed by stones being placed on the track by boys, and by drivers of vehicles getting in the way. The Railway Act, under which electric roads are operated, provides severe penalties for those who thus obstruct the cars.

Two of the new engines in the Montreal Street Railway Company's power house, were put in successful operation a few days ago, developing 1,000 h. p. There will ultimately be six engines. It is expected that 65 miles of road will be in operation at the commencement of the summer.

An inspection of the new bridges to be used in the double tracking of the Niagara Falls, Park and River Railway, was recently made by Mr. W. T. Jennings, the engineer, and Mr. W. A. Grant, general manager of the road. The second track is expected to be ready for traffic in the spring.

Mr. Campbell, manager of the Winnipeg Electric Street Railway, has returned to that city after spending a considerable time in Ontario. Immediately following his return, he announced a reduction in the price of tickets. 50 tickets are now being sold for $1.00. This reduction, it is understood, has been brought about by competition with other roads.

The following gentlemen have been elected directors of the Quebec Street Railway Company for the ensuing year: C. St. Michel, G. R. Renfrew, W. Hossack, J. C. Thomson, D. C. Thomson, G. Lemoine and F. Tessier. Messrs. C. St. Michel and W. Hossack were respectively elected President and Vice-President at a subsequent meeting of the new board.

The Hamilton Beach and Electric Railway Company is seeking incorporation. The capital stock of the company will be $48,000, divided into 480 shares of $100 each. The following are the incorporators: Messrs. John Calder, J. N. Waddell, A. E. Carpenter, Robert Campbell, of Hamilton; W. Kearns, M.L.A., Richard Baxter, and W. Allen, Burlington.

The Toronto Railway Company will apply to the Ontario Legislature for an amendment to their act of incorporation empowering the Board of Directors to increase the number of directors and make regulations in relation to the transfer of the stock of the company; also to authorize the company to establish superannuation, provident and insurance funds for its officers and employees.

Application is being made by officers of the London Street Railway Company for the incorporation of the London and Springbank Electric Street Railway Company, to construct and operate an electric railway from the boundary of London to a point on the river Thames near Springbank. Power is also sought to acquire or build a hotel and recreation grounds at Springbank.

Negotiations are in progress between the town council of Cornwall, Ont., and Mr. W.R. Hitchcock, who is seeking a franchise to operate an electric street railway to carry both passengers and freight. It is proposed to form a company for this purpose, and utilize power from the Cornwall Canal, which will be made available on the completion of the dams now in course of erection at Sheik's Island.

The Hamilton Radial Electric Street Railway Company is seeking to have its charter amended in such a way that the word "street" shall be struck out of the name of the Company and the capital stock increased from $1,000,000 to $2,000,000. The purpose is to extend the line from Hamilton to Niagara Falls and Brantford, from Oakville to Mimico, and from Elmira to other places in Waterloo County, also to convey power from Niagara Falls to Hamilton for manufacturing purposes. The Company claim to to have already secured contracts for the supply of 5 000 h.p. to Hamilton manufacturers.

The City Council of Toronto is seeking legislation from the Ontario Government to compel the Toronto Street Railway Company to place vestibules upon their cars. The Council will also ask power from the Legislature to enforce the terms of the franchise granted by the County of York to the Toronto and Mimico Electric Railway. This road is now within the City limits, and a dispute has arisen between the City Engineer and the company regarding the maintenance of the roadway between and at the sides of the track. There is also involved the question of the right of the City Council to representation on the Board of Directors of the Company.

The County Council of York, at its last meeting, approved of an agreement with the Metropolitan Railway Company giving to the company power to extend their line northerly on Yonge street, by electricity, cable or horse power, provided the northern limit of Richmond Hill is reached by said extension; also extending the company's franchises for 35 years from this date, renewable on such terms as may be determined by arbitration. Under the agreement, the company must build the road before the first of October, 1895, unless by the certificate of the County Engineer and Solicitor it shall appear that they were unavoidably prevented from so doing, in which case the time may be extended until the next ensuing meeting of the Council. After the line shall have been completed to Richmond Hill, the company must within two years proceed with the further extension of the line northward; in default of so doing the agreement may be revoked.

A company is being organized at Lethbridge, Alberta, to construct a telephone line between that place and Cardstone.

PERSONAL.

Mr. Henry W. Darling, late of Toronto, has been elected assistant treasurer of the General Electric Company in the United States.

Mr. Matthew Kennedy, of the firm of Wm. Kennedy & Sons, has been elected President of the Owen Sound Board of Trade, and Mr. S. J. Parker, of the Electric Light and Power Co., to a seat on the Council of the Board.

On severing his connection with the Royal Electric Company, to assume the management of the Montmorency Light and Power Company, Quebec, Mr. F. H. Badger, Jr., was presented by his fellow employees with a gold chain and locket.

The position of Electrical Superintendent of the Hamilton, Grimsby and Beamsville Electric Railway, has been offered to Mr. F. E. Handy, who lately returned to Toronto from Vancouver, B. C. Mr. Handy has accepted the position, and will enter on his duties on the first of April. The appointment is one which is likely to be mutually satisfactory to the parties concerned.

We regret to have to record the death of Mr. Mohr, manager of the Quebec and Levis Electric Light Company. Mr. Mohr's death was due to inflammation of the lungs, induced by a severe cold which he contracted while superintending repairs during a heavy snow-storm. The deceased, who was 67 years of age, was the original promoter of the telephone and electric light in the City of Quebec, and more recently of the proposed electric street railway.

For nearly half a century Geo. H. Simon lived the life of a recluse at Mimico, on the boundary of the City of Toronto. Very little was known about him, even by his immediate neighbors, beyond the fact that he was deeply interested in scientific studies and experiments. Latterly the fact leaked out that he was engaged on the problem of producing electricity without the aid of a steam engine, and he claimed that the discovery would shortly be put in practical form and patented. A couple of weeks ago the house in which the old man lived alone was discovered to be on fire, and the occupant in his frantic endeavors to save the building, and the models, etc., upon which he had for so many years been working, sustained such injuries from fire and frost as shortly afterwards proved fatal. The deceased was nearly 87 years of age. Whatever value might have attached to his labors had his life not been so suddenly cut off, it is impossible to say, as everything was swept away by the fire.

AN EXCELLENT IDEA.

The Columet electric street railway, operating about fifty-four miles of track in the southern part of Chicago and a number of its suburbs, has placed in each of its cars a map about 17 × 14 inches in size which shows plainly how to get to points on the line. The map is a blue print, the routes are shown in heavy white lines, and only the streets through which the tracks run are given. The names of these streets and of the suburbs are printed in large white letters, easily read from any seat in the car. The maps have proved of much value to the visitors in Chicago during the Columbian Exposition as well as to the residents of the sections where the lines run.

TRADE NOTES.

It is said to be the intention of the General Electric Co., to engage in the manufacture of electric cars.

The Toronto Railway Company have given a contract to the Canadian General Electric Company for 80 street car motors.

It is reported to be the intention of Messrs. T. W. Ness & Co., of Montreal, to establish a branch of their business in the United States.

Mr Waderlow, of Leamington, Ont., has made arrangements with an Illinois firm to commence the manufacture in Canada of steam governors.

The Electric Light Co., Windsor, N. S., are increasing their plant and have ordered a 150 horse power Tandem Compound Robb-Armstrong engine.

The Montreal Electric Company are manufacturing a transformer for doctors' and dentists' use for reducing a 52 volt incandescent current to a current of from 2 to 6 volts.

The Canadian General Electric Company have recently issued and sent out to their customers and friends, a very neat and useful souvenir in the shape of a memorandum book.

The fame of the "Packard" lamp has extended to Brazil, from which country an order for 10,000 lamps was received recently at the Packard Lamp Company's factory in Montreal.

Messrs. Ahearn & Soper are putting a new trolley bell or line insulator on the market. It is made of malleable iron and is said to be a great improvement over anything heretofore used for this purpose.

It is a good plan to watch your voltage pretty close on incandescent lighting mains, as a few volts variation above the normal is apt to play havoc with the lamps, and reduce their life very materially. Most standard machines will regulate very closely and need little watching, but as an engineer watches his water line, regardless of the fact that he has a tell tale on it too, so the dynamo tender should watch the voltage, or the potential indicator occasionally in spite of the fact that he has a regulator on the machine, either in the form of compound windings or otherwise. Plants that have no measuring instruments are not included here, as then the only guide is the lamp's brightness as judged by the eye, which is by no means a sure indication. Potential and current indicators are cheap now and should be used on every circuit, no matter if the dynamo is only lighting your own shop.—American Mechanic.

The new power station of the Montmorency Light and Power Company, Quebec, has been completed, and a contract given to the Royal Electric Company for a large alternating plant to replace the old one. The machinery will be operated by eight horizontal water wheels working under a head of 160 feet and run at 600 revolutions per minute. Four of these wheels are of a capacity of 620 h. p. each, and four of 310 h. p. each. The smaller wheels will be used to operate the arc plant and the larger wheels, the alternating dynamos, comprising four 210 k. w. machines, which will be run at 600 revolutions per minute, the current having a frequency of 60 periods per second and a pressure at full load of 2,500 volts. Two dynamos will be mounted upon a single base, connected by clutch coupling, and arranged so as to be capable of running in parallel and giving two phase currents for power; each pair will be belted to a 620 h. p. water wheel. The switch-board will be of marble, and so divided into sections as to allow of additional machines being connected.

SPARKS.

There is a movement on foot to establish an incandescent lighting plant at Napanee, Ont.

The Toronto Railway Co. have placed an order with Messrs. Ahearn & Soper, of Ottawa, for 40 additional Westinghouse equipments.

A dispatch from London, Eng., announces that Mr Geo. A. Goodwin, a Canadian, has been elected president of the Society of Engineers.

Mr. C. J Myles, president of the Hamilton, Grimsby and Beamsville Electric Railway, was in Ottawa a few days ago with the object of endeavoring to induce the Customs Department to allow the steel rails for the new road to be brought in free of duty.

Messrs. R Wilson Smith, John Torrance and Albert W. Atwater, of Montreal, Henry W. Darling, of Toronto and Boston, and Robert H. Fraser, of Toronto, are asking to be incorporated as the Toronto Suburban Railway Company, with power to take over the franchises and property of the City and Suburban Railway Company and the Davenport Street Railway Company.

At the annual meeting of shareholders of the Hamilton Electric Light and Power Company, held on the 9th of February, Mr. Robert Thomson was elected president, and Mr. John Knox, vice-president of the Company. The following directors were elected for the ensuing year: Robert Thomson, John Knox, J. M. Lottridge, Alexander Turner, Robert Evans and J. V. Teetzel, Q. C., of Hamilton, and Messrs. S. F. MacKinnon, A. H. Campbell and H. M. Pellatt, of Toronto.

The engineer of the steamer Ariel, owned by Messrs. Hiram Walker & Sons, of Walkerville, Ont., and which runs between Walkerville and Detroit, discovered a few days ago, when about to start up the engine, that some miscreant had unscrewed and removed a number of nuts and bolts, leaving the machinery in such a condition that serious damage would have resulted from putting it into operation had not the matter been fortunately found out. Detectives are at work on the case.

The Fire and Light Committee of the City Council of Woodstock, Ont., have been instructed to ascertain from the Electric Light Company of that place on what terms they would be willing to enter upon a renewal contract for one, two or three years from November next; also at what price they would be willing to sell their plant to the city; and if the information on these points is not considered satisfactory, to advertise for tenders for lighting and plant, and report to the Council in April.

The St. Jean Baptiste Electric Light Co., of Montreal, were reported to be in difficulties lately. They are said to have called a meeting of several of the important creditors, among whom might be mentioned Messrs. Ahearn & Soper, of Ottawa, and it is understood that the difficulties have been tided over and matters arranged. We hear that the arrangement for creditors over $200.00 was that they would receive notes for their claims at the rate of 50 cents on the dollar; the smaller creditors would probably be paid in full.

Some very striking and original effects in electrical illumination were introduced at the Academy of Music, Montreal, during the recent production of "Erminie" by the Montreal Amateur Operatic Club. Over 450 five c. p. Packard incandescent lamps were used to light up the stage and scenery. Bouquets and stands of flowers were made brilliant by miniature incandescent lamps among the flowers. On evenings when some of the local clubs attended in a body, the letters composing their initials were spelled out in lamps of the club color. These illuminations were a very attractive feature of the entertainments and reflected much credit upon Mr. C. W. Henderson, electrical contractor of Montreal, who designed and carried out the illuminations.

The Street Railway Review for February publishes illustrations and a description of the suspended railway spanning the Tennessee River at Knoxville, Tenn. Two cables 1⅜ inch diameter are stretched across the river a distance of 1,060 feet. The ends of the cables at one side of the river are 350 feet above the starting point at the other side, or in other words the grade is about 33 per cent. The cable furnishing the motive power is one half inch in diameter and its permanently fastened to the car. The supporting cables each have a breaking strain of 60 tons. These cables are 450 feet above the river. The power is furnished by 20 h. p. engines. The cars are 14 feet in length, exclusive of a three foot platform, and are 6 feet wide and 6½ feet high, with a seating capacity of 16 passengers. The up trip takes about three and a half minutes, and the decent about a half a minute by gravity. The road is said to be well patronized.

The annual meeting of the Bell Telephone Co., took place at Montreal on the 22nd of February, the President, Mr. C. F. Sise, presiding. The annual report showed the gross revenue for the past year to be $961,174.69, expenses, $724,791 42, making a net revenue of $236 383.37. The paid up capital is $2,421,600. The number of subscribers added during the year were 2,634 and the total number of sets of instruments now earning rental is 26,806. Twenty-four exchanges and fifteen agencies have been constructed and added to the system. The company now owns and operates 275 exchanges and 256 agencies. Two hundred and thirty-two miles of poles and 1,616 miles of wire were added to the long distance system in 1893. Of these 60 pole miles and 1,288 wire miles are in the Ontario department, and 172 pole miles and 328 wire miles are in the Eastern department. The long distance lines now owned and operated by the company comprise 12,071 miles of wire on 5,068 miles of poles. The assets of the company amount to $4,227,119.86, and liabilites $3,375,147.69, leaving a surplus of $851,972.17. There was no discussion on the report, and the shareholders showed their entire satisfaction by re-electing the old directorate.

Mr. Howard D. Black has resigned his position with the Royal Electric Co. of Montreal, and accepted that of electrician of the Chateau Frontenac Hotel at Quebec.

Mr. H. W. Woodman has severed his connection with the Montreal Street Railway Co., and accepted the position of electrician to the corporation of the town of Joliette, Que.

SPARKS.

Application is being made to the British Columbia Legislature for a charter for a new telegraph company which proposes to construct a line connecting South Westminster with Vancouver, Victoria and Nanaimo, and making connection with the Great Northern system.

In London, Eng., there was recently discovered the apparatus by means of which Franklin produced an electric light sufficient for reading purposes. The current was generated from a large cylinder of glass, which was rubbed by brushes with silk covers, and a light made its appearance between a ball and a metallic point.

It is reported that the Ottawa and Chaudiere Electric Light Companies have purchased for $45,000 four water lots on the Chaudiere, which formerly belonged to Messrs. Perley & Pattee. For some time the water power belonging to these lots has been employed to run the dynamos of the Ottawa company. By this purchase the electric companies have secured control of four twenty-sixths of the total power under lease from the Chaudiere.

The boiler in the steam saw mill owned by Joseph Warren, at Byers' Corners, near Ottawa, Ont., exploded a few days ago as the engineer was about to start up the machinery. The engineer, John Possett, a Swede, was blown a distance of thirty feet and had his skull fractured by a fragment of the boiler. Pieces of the boiler, tools, etc., were found hundreds of yards away from the scene of the explosion. Singularly enough, with the exception of the engineer, no one was injured.

The district assembly of the Knights of Labor of Montreal, on behalf of members of that organization who are employed as linemen by the various local electric companies, will memorialize the City Council to compel the use of better insulated wires. This action is taken in view of the many injuries which the linemen claim to have sustained by reason of poor insulation.

While ascending the steep incline near Brock's Monument at Queenston, the trolley of the motor car of a ballast train on the Niagara Falls Park and River Railway, jumped the wire, and before the brakes could be applied the train was plunging down the hill at frightful speed. It left the rails when opposite the old Methodist church, and plunged into the building, tearing away almost the entire front. Fortunately no one was injured. The incident is a striking indication of the necessity for more effective controlling devices for electric cars.