Technical and Bibliographic Notes / Notes techniques et bibliographiques

The Institute has attempted to obtain the best original copy available for filming. Features of this copy which may be bibliographically unique, which may alter any of the images in the reproduction, or which may significantly change the usual method of filming, are checked below.

L'Institut a microfilmé le meilleur exemplaire qu'il lui a été possible de se procurer. Les détails de cet exemplaire qui sont peut-être uniques du point de vue bibliographique, qui peuvent modifier une image reproduite, ou qui peuvent exiger une modification dans la méthode normale de filmage sont indiqués ci-dessous.

- [x] Coloured covers/ Couverture de couleur
- [ ] Covers damaged/ Couverture endommagée
- [ ] Covers restored and/or laminated/ Couverture restaurée et/ou pelliculée
- [ ] Cover title missing/ Le titre de couverture manque
- [ ] Coloured maps/ Cartes géographiques en couleur
- [ ] Coloured ink (i.e. other than blue or black)/ Encre de couleur (i.e. autre que bleue ou noire)
- [ ] Coloured plates and/or illustrations/ Planches et/ou illustrations en couleur
- [x] Bound with other material/ Relié avec d'autres documents
- [x] Tight binding may cause shadows or distortion along interior margin/ La reliure serrée peut causer de l'ombre ou de la distorsion le long de la marge intérieure
- [ ] Blank leaves added during restoration may appear within the text. Whenever possible, these have been omitted from filming/ Il se peut que certaines pages blanches ajoutées lors d'une restauration apparaissent dans le texte, mais, lorsque cela était possible, ces pages n'ont pas été filmées.

- [ ] Coloured pages/ Pages de couleur
- [ ] Pages damaged/ Pages endommagées
- [ ] Pages restored and/or laminated/ Pages restaurées et/ou pelliculées
- [x] Pages discoloured, stained or foxed/ Pages décolorées, tachetées ou piquées
- [ ] Pages detached/ Pages détachées
- [x] Showthrough/ Transparence
- [x] Quality of print varies/ Qualité inégale de l'impression
- [x] Continuous pagination/ Pagination continue
- [ ] Includes index(es)/ Comprend un (des) index

Title on header taken from:/ Le titre de l'en-tête provient:

- [ ] Title page of issue/ Page de titre de la livraison
- [ ] Caption of issue/ Titre de départ de la livraison
- [ ] Masthead/ Générique (périodiques) de la livraison

- [x] Additional comments:/ Commentaires supplémentaires: Various pagings.

This item is filmed at the reduction ratio checked below/
Ce document est filmé au taux de réduction indiqué ci-dessous.

10X	12X	14X	16X	18X	20X	22X	24X	26X	28X	30X	32X
									✓		

CANADIAN ELECTRICAL NEWS AND STEAM ENGINEERING JOURNAL

OLD SERIES, VOL. XV.—No. 4.
NEW SERIES, VOL. III.—No. 12.

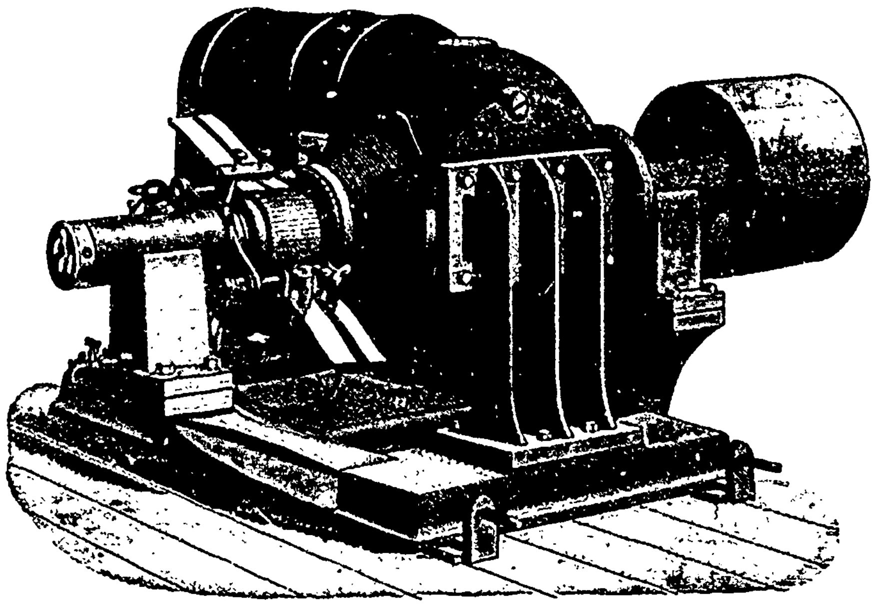
DECEMBER, 1893

PRICE 10 CENTS
$1.00 PER YEAR

Please mention the ELECTRICAL NEWS when corresponding with advertisers.

KAY ELECTRIC WORKS

No. 263 James Street N., Hamilton, Ont.



. . . MANUFACTURERS OF . . .

DYNAMOS

For Arc and . . . . . .
Incandescent Lighting.

MOTORS

From ⅛ H. P. to 50 H. P.

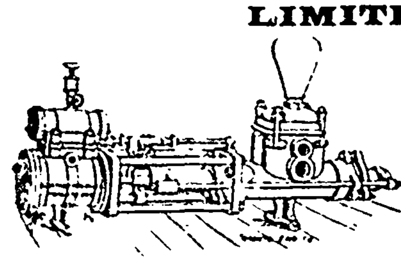
Electro Plating Machines and General Electrical Appliances. Special attention to Mill and Factory Lighting. . . . . .

WRITE FOR CIRCULARS.

NORTHEY MFG. CO. • TORONTO.... ...ONTARIO.

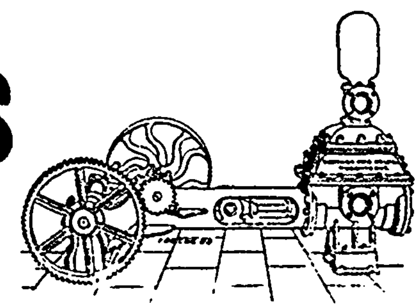
LIMITED

MANUFACTURERS OF



STEAM AND POWER PUMPS

For General Water Supply and Fire Protection.



BOILER FEED PUMPS AND PUMPS FOR ALL DUTIES

CONDENSERS, ETC.

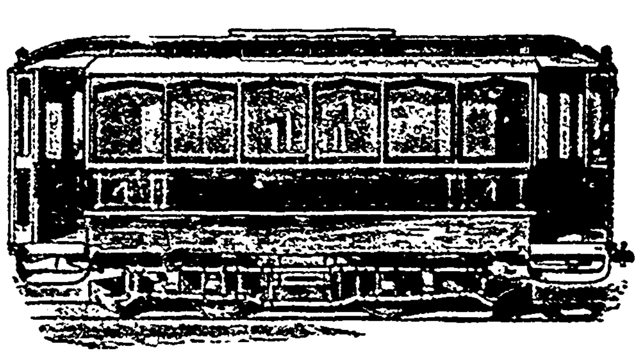
HIGH CLASS PUMPING ENGINES

FOR HIGH DUTY, SUITABLE FOR TOWN AND CITY WATERWORKS.

FINE - - ELECTRIC

Street Cars

. . . . OUR SPECIALTY . . . .

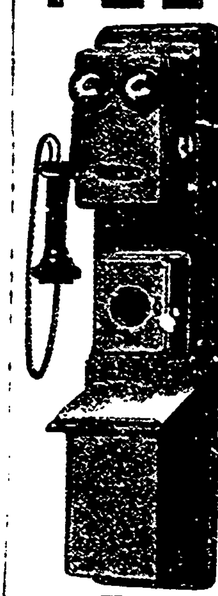


We also manufacture Horse and Trail Cars of every description.

PATTERSON & CORBIN,

ST. CATHARINES, ONT.

TELEPHONES



WE MANUFACTURE

Standard Bell Telephones

AND

Warehouse Telephones.

ALSO

Carbon Transmitter Telephones.

Local exchanges fitted up. All line material supplied.

STE. JULIE, Sept 5th, 1892.

T. W. NESS, Esq., Montreal.

DEAR SIR,—We are happy to state that your telephones and switches are giving us good satisfaction. We have three sorts of switches and we find yours far preferable. There are now about forty of your telephones in operation on our line. Every one works well, and we intend to use no other.

Yours very truly,
THE MEGANTIC TELEPHONE CO.

Write us when you want anything electrical.

Key Sockets,	*Magneto Bells,*
Switches,	*Annunciators,*
Cut-outs,	*Bells,*
Wire,	*Batteries,*
Lamps,	*Push Buttons, &c.,*
Shades,	*Dynamos and Motors.*

T. W. NESS & CO.

Canadian Headquarters for Electrical Supplies

749 Craig Street, MONTREAL.

CANADIAN

ELECTRICAL NEWS

AND

STEAM ENGINEERING JOURNAL.

VOL. III. DECEMBER, 1893 NO. 12.

ON LIGHT AND OTHER HIGH FREQUENCY PHENOMENA.

BY NIKOLA TESLA.

(Continued.)

In the branch 3b a similar disposition as in 1b is illustrated, with the difference that the currents discharging through the gap d d are used to induce currents in the secondary S of a transformer T. In such case the secondary should be provided with an adjustable condenser for the purpose of tuning it to the primary.

Fig 2b illustrates a plan of alternate current high frequency conversion, which is most frequently used, and which is found to be most convenient. This plan has been dwelt upon in detail on previous occasions, and need not be described here.

Some of these results were obtained by the use of a high frequency alternator. A description of such machine will be found in my original paper before the American Institute of Electrical Engineers, and in periodicals of that period, notably in the *Electrical Engineer* of March 18, 1891.

I will now proceed with the experiments.

ON PHENOMENA PRODUCED BY ELECTROSTATIC FORCE

The first class of effects I intend to show you are effects produced by electrostatic force. It is the force which governs the motion of the atoms which causes them to collide and develop the life-sustaining energy of heat and light, and which causes them to aggregate in an infinite variety of ways, according to Nature's fanciful designs, and to form all these wondrous structures we perceive around us ; it is, in fact, if our present views be true, the most important force for us to consider in Nature. As the term electrostatic might imply a steady electric condition, it should be remarked that in these experiments the force is not constant, but varies at a rate which may be considered moderate, about one million times a second, or thereabouts. This enables me to produce many effects which are not producible with an unvarying force.

When two conducting bodies are insulated and electrified, we say that an electrostatic force is acting between them. This force manifests itself in attractions, repulsions and stresses in the bodies and space or medium without. So great may be the strain exerted in the air, or whatever separates the two conducting bodies, that it may break down, and we observe sparks or bundles of light or streamers, as they are called. These streamers form abundantly when the force through the air is rapidly varying. I will illustrate this action of electrostatic force in a novel experiment in which I will employ the induction coil before referred to. The coil is contained in a trough filled with oil, and placed under the table. The two ends of the secondary wire pass through the two thick columns of hard rubber, which protrude to some height above the table. It is necessary to insulate the ends or terminals of the secondary heavily with hard rubber, because even dry wood is by far too poor an insulator for these currents of enormous potential differences. On one of the terminals of the coil I have placed a large sphere of sheet brass, which is connected to a larger insulated brass plate, in order to enable me to perform the experiments under conditions which, as you will see, are more suitable for this experiment. I now set the coil to work and approach the free terminal with a metallic object held in my hand, this simply to avoid burns. As I approach the metallic object to a distance of eight or ten inches, a torrent of furious sparks breaks forth from the end of the secondary wire, which passes through the rubber column. The spark ceases when the medal in my hand touches the wire. My arm is now traversed by a powerful electric current, vibrating at about the rate of one million times a second. All around me the electrostatic force makes itself felt, and the air molecules and particles of dust flying about are acted upon and hammering violently against my body. So great is this agitation of the particles, that when the lights are turned out you may see streams of feeble light appear on some parts of my body. When such a streamer breaks out on any part of the body it produces a sensation like the pricking of a needle. Were the potentials sufficiently high and the frequency of the vibration rather low, rather low, the skin would probably be ruptured under the tremendous strain, and the blood would rush out with great force in the form of fine spray or jet so thin

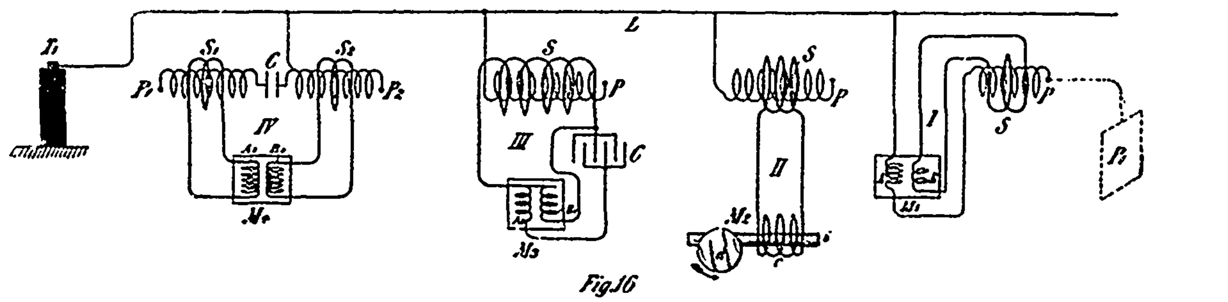


Fig.16

WAYS OF OPERATING MOTORS WITH ONLY ONE LEAD

as to be invisible, just as oil will when placed on the positive terminal of a Holtz machine. This breaking through of the skin though it may seem impossible at first, would perhaps occur by reason of the tissues under the skin being incomparably better conducting. This, at least, appears plausible, judging from some observations.

I can make these streams of light visible to all, by touching with the metallic object one of the terminals as before, and approaching my free hand to the brass sphere, which is connected to the second terminal of the coil. As the hand is approached the air between it and the sphere, or in the immediate neighborhood, is more violently agitated and you see streams of light now break forth from my finger tips and from the whole hand (Fig. 5). Were I to approach the hand closer, powerful sparks would jump from the brass sphere to my hand, which might be injurious. The streamers offer no particular inconvenience, except that in the ends of the finger tips a burning sensation is felt. They should not be confounded with those produced by an influence machine, because in many respects they behave differently. I have attached the brass sphere and plate to one of the terminals in order to prevent the formation of visible streamers on that terminal, also in order to prevent sparks from jumping at a considerable distance. Besides the attachment is favorable for the working of the coil.

The streams of light which you have observed issuing from my hand are due to a potential of about 200,000 volts, alternating in irregular intervals, something like a million times a second. A vibration of the same amplitude, but four times as fast, to maintain which over 3,000,000 volts would be required, would be more than sufficient to envelop my body in a complete sheet of flame. But this flame would not burn me up , quite contrarily, the probability is that I would not be injured in the least. Yet a hundredth part of that energy, otherwise directed, would be amply sufficient to kill a person.

The amount of energy which may thus be passed into the body of a person depends on the frequency and potential of the currents, and by making both of these very great, a vast amount of energy may be passed into the body without causing any discomfort, except, perhaps, in the arm, which is traversed by a true conduction current. The reason why no pain in the body is felt, and no injurious effect noted, is that everywhere, if a current be imagined to flow through the body, the direction of its flow will be at right angles to the surface, hence the body of the experimenter offers an enormous section to the current, and the density is very small, with the exception of the arm, perhaps, where the density may be considerable. But if only a small fraction of that energy would be applied in such a way that a current would traverse the body in the same manner as a low frequency current, a shock would be received which might be fatal. A direct or low frequency alternating current is fatal, I think, principally because its distribution through the body is not uniform, as it must divide itself in minute streamlets of great density, whereby some organs are vitally injured. That such a process occurs I have not the least doubt, though no evidence might apparently exist or be found upon examination. The surest way to injure and destroy life is a continuous current, but the most painful is an alternating current of very low frequency. The expression of these views which are the result of long-continued experiment and observation, both with steady and varying currents, is elicited by the interest which is at present taken in this subject, and by the manifestly erroneous ideas which are daily propounded in journals on this subject.

I may illustrate an effect of an electrostatic force by another striking experiment, but before I must call your attention to one or two facts. I have said before, that when the medium between two oppositely electrified bodies is strained beyond a certain limit it gives way and, stated in popular language, the opposite electric charges unite and neutralize each other. This breaking down of the medium occurs principally when the force acting between the bodies is steady, or varies at a moderate rate. Were the variation sufficiently rapid such a destructive break would not occur, no matter how great the force, for all the energy would be spent in radiation, convection and mechanical and chemical action. Thus the spark length, or greatest distance through which a spark will jump between the electrified bodies, is the smaller the greater the variation or time rate of change. But this rule may be taken to be true only in a general way, when comparing rates which are widely different.

I will show you by an experiment the difference in the effect produced by a rapidly varying and a steady or moderately varying force. I have here two large circular brass plates p p (Fig. 6a and 6b), supported on movable insulating stands on the table, connected to the ends of the secondary of a similar coil as the one used before. I place the plates 10 or 12 inches apart, and set the coil to work. You see the whole space between the plates, nearly two cubic feet, filled with uniform light Fig. 6a. This light is due to the streamers you have seen in the first experiment, which are now much more intense. I have already pointed out the importance of these streamers in commercial apparatus and their still greater importance in some purely scientific investigations. Often they are too weak to be visible, but they always exist, consuming energy and modifying the action of the apparatus. When intense, as they are at present, they produce ozone in great quantity, and also as Prof. Crooks has pointed out, nitrous acid. So quick is the chemical action that if a coil such as this one is worked for a very long time, it will make the atmosphere of a small room unbearable, for the eyes and throat are attacked. But when moderately produced the streamers refresh the atmosphere wonderfully, like a thunderstorm, and exercise unquestionably a beneficial effect.

In this experiment the force acting between the plates changes in intensity and direction at a very rapid rate. I will now make the rate of change per unit time much smaller. This I effect by rendering the discharges through the primary of the induction coil less frequent, and also by diminishing the rapidity of the vibration in the secondary. The former result is conveniently secured by lowering the E. M. F. over the air gap in the primary circuit, the latter, by approaching the two brass plates to a distance of about three or four inches. When the coil is set to work you see no streamers or light between the plates, yet the medium between them is under a tremendous strain. I still further augment the strain by raising the E. M. F. in the primary circuit, and soon you see the air give way and the hall is illuminated by a shower of brilliant and noisy sparks, Fig. 6b. These sparks could be produced also with unvarying force; they have been for many years a familiar phenomenon, though they were usually obtained from entirely different apparatus. In describing these two phenomena, so radically different in appearance, I have advisedly spoken of a "force" acting between the plates. It would be in accordance with accepted views to say that there was an "alternating E. M. F." acting between the plates. This term is quite proper and applicable in all cases where there is evidence of at least a possibility of an essential interdependence of the electric state of the plates, or electric action in their neighborhood. But if the plates were removed to an infinite distance, or if at a finite distance, there is no probability or necessity whatever for such dependence. I prefer to use the term "electrostatic force," and to say that such a force is acting around each plate or electrified insulated body in general. There is an inconvenience in using this expression, as the term incidentally means a steady electric condition; but a proper nomenclature will eventually settle this difficulty.

I now return to the experiment to which I have already alluded, and with which I desire to illustrate a striking effect produced by a rapidly varying electrostatic force. I attach to the end of the wire l (Fig. 7), which is in connection with one of the terminals of the secondary of the induction coil, an exhausted bulb b. This bulb contains a thin carbon filament f, which is fastened to a platinum wire w, sealed in the glass and leading outside of the bulb where it connects to the wire l. The bulb may be exhausted to any degree attainable with ordinary apparatus. Just a moment before you have witnessed the breaking down of the air between the charged brass plates. You know that a plate of glass or any other insulating material, would break down in like manner. Had I, therefore, a metallic coating attached to the outside of the bulb, or placed near the same, and were this coating connected to the other terminal of the coil, you would be prepared to see the glass give way if the strain were sufficiently increased. Even were the coating not connected to the other terminal, but to an insulated plate, still, if you have followed recent developments, you would naturally expect a rupture of the glass.

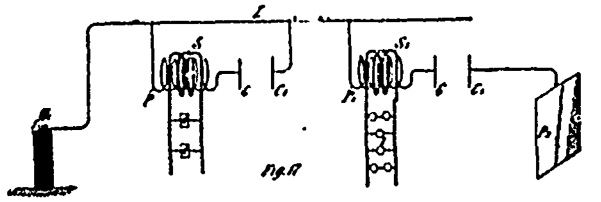
But it will certainly surprise you to note that under the action of the varying electrostatic force the glass gives way when all other bodies are removed from the bulb. In fact, all the surrounding bodies we perceive might be removed to an infinite distance without affecting the result in the slightest. When the coil is set to work the glass is invariably broken through at the seal, or other narrow channel, and the vacuum is quickly impaired. Such a damaging break would not occur with a steady force, even if the same were many times greater. The break is due to the agitation of the molecules of the gas within the bulb, and outside of the same. This agitation, which is generally most violent in the narrow pointed channel near the seal causes a heating and rupture of the glass. This rupture, would, however, not occur, not even with a varying force, if the medium filling the inside of the bulb and that surrounding it were perfectly homogeneous. The break occurs much quicker if the top of the bulb is drawn out into a fine fibre. In bulbs used with these coils such narrow, pointed channels must therefore be avoided.

When a conducting body is immersed in air, or similar insulating medium, consisting of, or containing, small freely movable particles capable of being electrified, and when the electrification of the body is made to undergo a very rapid change—which is equivalent to saying that the electrostatic force acting around the body is varying in intensity—the small particles are attracted and repelled, and their violent impacts against the body may cause a mechanical motion of the latter. Phenomena of this kind are noteworthy, inasmuch as they have not been observed before with apparatus such as has been commonly in use. If a very light conducting sphere be suspended on an exceedingly fine wire, and charged to a steady potential, however high the sphere will remain at rest. Even if the potential would be rapidly varying, provided that the small particles of matter, molecules or atoms, are evenly distributed, no motion of the sphere should result. But if one side of the conducting sphere is covered with a thick insulating layer, the impacts of the particles will cause the sphere to move about, generally in irregular curves, Fig. 8a. In like manner, as I have shown on a previous occasion, a fan of metal sheet, Fig. 8b, covered partially with insulating material as indicated, and placed upon the terminal of the coil so as to turn freely in it, is spun around.

All these phenomena you have witnessed, and others, which will be shown later, are due to the presence of a medium like air, and would not occur in a continuous medium. The action of the air may be illustrated still better by the following experiment: I take a glass tube t, Fig. 9, of about an inch in diameter, which has a platinum wire w sealed in the lower end, and to which is attached a thin lamp filament f. I connect the wire with the terminal of the coil and set the coil to work. The platinum wire is now electrified positively and negatively in rapid succession, and the wire and air inside of the tube are rapidly heated by the impacts of the particles, which may be so violent as to render the filament incandescent. But if I pour oil in the tube, just as soon as the wire is covered with the oil, all action apparently ceases and there is no marked evidence of heating. The reason of this is that the oil is a practically continuous medium. The displacements in such a continuous medium are, with these frequencies, to all appearance incomparably smaller, than in air, hence the work performed in such a medium is insignificant. But oil would behave very differently with frequencies many times as great, for even though the displacements be small, if the frequency were much greater, considerable work might be performed in the oil.

The electrostatic attractions and repulsions between bodies of measurable dimensions are, of all the manifestations of this force, the first so-called electrical phenomena noted. But though they have been known to us for many centuries, the precise nature of the mechanism concerned in these actions is still unknown to us, and has not been even quite satisfactorily explained. What kind of mechanism must that be? We cannot help wondering when we observe two magnets attracting and repelling each other with a force of hundreds of pounds with apparently nothing between them. We have in our commercial dynamos magnets capable of sustaining in mid-air tons of weight. But what are even these forces acting between magnets when compared with the tremendous attractions and repulsions produced by electrostatic force, to which there is apparently no limit as to intensity. In lightning discharges bodies are often charged to so high a potential that they are thrown away with inconceivable force and torn asunder or shattered into fragments. Still even such effects cannot compare with the attractions and repulsions which exists between charged molecules or atoms, and which are sufficient to project them with speeds of many kilometres a second, so that under their violent impact bodies are rendered highly incandescent and are volatilized. It is of special interest for the thinker who inquires into the nature of these forces to note, that whereas the actions between individual molecules or atoms occur seemingly under any condition, the attractions and repulsions of bodies of measurable dimensions imply a medium possessing insulating properties. So, if air, either by being rarefied or heated, is rendered a more or less conducting, these actions between two electrified bodies practically cease, while the actions between the individual atoms continue to manifest themselves.

An experiment may serve as an illustration and as a means of bringing out other features of interest. Some time ago I showed that a lamp filament or wire mounted in a bulb and connected to one of the terminals of a high tension secondary coil is set spinning, the top of the filament generally describing a circle. This vibration was very energetic when the air in the bulb was



SINGLE WIRE CONVERSION AND DISTRIBUTION, WITH SIMPLE MEANS FOR REGULATING THE EFFECTS.

at ordinary pressure, and became less energetic when the air in bulb was strongly compressed. It ceased altogether when the air was exhausted, so as to become comparatively good conducting. I found at that time that no vibration took place when the bulb was very highly exhausted. But I conjectured that the vibration which I ascribed to the electrostatic action between the walls of the bulb and the filament should take place also in a highly exhausted bulb. To test this under conditions which were more favorable, a bulb like the one in Fig. 10 was constructed. It comprised a globe b, in the neck of which was sealed a platinum wire w carrying a thin lamp filament f. In the lower part of the globe a tube t was sealed so as to surround the filament. The exhaustion was carried as far as it was practicable with the apparatus employed.

This bulb verified my expectation, for the filament was set spinning when the current was turned on, and became incandescent. It also showed another interesting feature, bearing upon the preceding remarks, namely, when the filament had been kept incandescent some time, the narrow tube and the space inside were brought to an elevated temperature, and as the gas in the tube then became conducting the electrostatic attraction between the glass and the filament became very weak or ceased, and the filament came to rest. When it came to rest it would glow far more intensely. This was probably due to its assuming the position in the centre of the tube where the molecular bombardment was most intense, and also partly to the fact that the individual impacts were more violent and that no part of the supplied energy was converted into mechanical movement. Since, in accordance with accepted views, in this experiment the incandescence must be attributed to the impacts of the particles, molecules or atoms in the heated space, these particles must, therefore, in order to explain such action, be assumed to behave as independent carriers of electric charges immersed in an insulating medium; yet there is no attractive force between the glass tube and the filament because the space in the tube is, as a whole, conducting.

It is of some interest to observe in this connection that whereas the attraction between two electrified bodies may cease owing to the impairing of the insulating power of the medium in which they are immersed, the repulsion between the bodies may still be observed. This may be explained in a plausible way. When the bodies are placed at some distance in a poorly conducting medium, such as slightly warmed or rarefied air, and are suddenly electrified, opposite electric charges being imparted to them, these charges equalize more or less by leakage through the air. But if the bodies are similarly electrified, there is less opportunity afforded for such dissipation, hence the repulsion observed in such case is greater than the attraction. Repulsive actions in a gaseous medium, are, however, as Prof Crookes has shown, enhanced by molecular bombardment.

ON CURRENT OR DYNAMIC ELECTRICITY PHENOMENA.

So far, I have considered principally effects produced by a varying electrostatic force in an insulating medium, such as air. When such a force is acting upon a conducting body of measurable dimensions, it causes within the same, or on its surface, displacements of the electricity and gives rise to electric currents, and these produce another kind of phenomena, some which I shall presently endeavor to illustrate. In presenting this second class of electric effects, I will avail myself principally of such as are producible without any return circuit, hoping to interest you the more by presenting these phenomena in a more or less novel aspect.

It has been for a long time customary, owing to the limited experience with vibratory currents, to consider an electric current as something circulating in a closed conducting path. It was astonishing at first to realize that a current may flow through the conducting path even if the latter be interrupted, and it was still more surprising to learn that sometimes it may be even easier to make a current flow under such conditions than through a closed path. But that old idea is gradually disappearing, even among practical men, and will soon be entirely forgotten.

If I connect an insulated metal plate P, Fig. 11, to one of the terminals T of the induction coil by means of a wire, though this plate be very well insulated, a current passes through the wire when the coil is set to work. First I wish to give you evidence that there is a current passing through the connecting wire. An obvious way of demonstrating this is to insert between the terminals of the coil and the insulated plate a very thin platinum or German silver wire w and bring the latter to incandescence of fusion by the current. This requires a rather large plate or else current impulses of very high potential and frequency. Another way is to take a coil C, Fig. 11, containing many turns of thin insulated wire, and to insert the same in the path of the current to the plate. When I connect one of the ends of the coil to the wire leading to another insulated plate P, and its other end to the terminal T_1 of the induction coil, and set the latter to work, a current passes through the inserted coil C and the existence of the current may be made manifest in various ways. For instance, I insert an iron core i within the coil. The current being one of very high frequency, if it be of some strength will soon bring the iron core to a noticeably higher temperature, as the hysteresis and current losses are great with such high frequencies. One might take a core of some size, laminated or not, it would matter little, but ordinary iron wire 1-16 or 1-8 of an inch thick is suitable for the purpose. While the induction coil is working, a current traverses the inserted coil, and only a few moments are sufficient to bring the iron wire i to an elevated temperature sufficient to soften the sealing-wax s, and cause a paper washer p, fastened by it to the iron wire to fall off. But with the apparatus such as I have here, other, much more interesting, demonstrations of this kind can be made. I have a secondary S, Fig. 12, of coarse wire, wound upon a coil similar to the first. In the preceding experiment the current through a the coil C, Fig. 11, was very small, but there being many turns strong heating effect was, nevertheless, produced in the iron wire. Had I passed that current through a conductor in order to show the heating of the latter, the current might have been too small to produce the effect desired. But with this coil provided with a secondary winding I can now transform the feeble current of high tension which passes through the primary P into a strong secondary current of low tension, and this current will quite certainly do what I expect. In a small glass tube (t, Fig. 12) I have inclosed a coil platinum wire, w, this merely in order to protect the wire. On each end of the glass tube is sealed a terminal of stout wire to which one of the ends of the platinum wire, w, is connected. I join the terminals of the secondary coil to these terminals and insert the primary p, between the insulated plate P_1 and the terminals T_1 of the induction coil as before. The latter being set to work, instantly the platinum wire w is rendered incandescent, and can be fused even if it be very thick.

Instead of the platinum wire I now take an ordinary 50-volt 16-c. p. lamp. When I set the induction coil in operation the lamp filament is brought to high incandescence. It is, however, not necessary to use the insulated plate, for the lamp, (l, Fig. 13) is rendered incandescent even if the plate P_1 be disconnected. The secondary may also be connected to the primary as

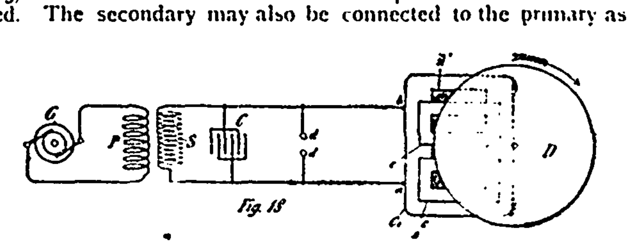


Fig. 18

OPERATING A MOTOR BY DISRUPTIVE DISCHARGES.

indicated by the dotted line in Fig. 13, to do away more or less with the electrostatic induction or to modify the action otherwise.

I may here call attention to a number of interesting observations with the lamp. Frist, I disconnect one of the terminals of the lamp from the secondary S. When the induction coil plays, a glow is noted which fills the whole bulb. This glow is due to electrostatic induction. It increases when the bulb is grasped with the hand, and the capacity of the experimenter's body thus added to the secondary circuit. The secondary, in effect, is equivalent to a metallic coating, which would be placed near the primary. If the secondary, or its equivalent, the coating, were placed symmetrically to the primary, the electrostatic induction would be nil under ordinary conditions, that is, when a primary return circuit is used, as both halves would neutralize each other. The secondary is, in fact, placed symmetrically to the primary, but the action of both halves of the latter, when only one of its ends is connected to the induction coil, is not exactly equal, hence electrostatic induction takes place, and hence the glow in the bulb. I can nearly equalize the action of both halves of the primary by connecting the other free end of the same to the insulated plate, as in the preceding experiments.

When the plate is connected, the glow disappears. With a smaller plate it would not entirely disappear, and then it would contribute to the brightness of the filament when the secondary is closed, by warming the air in the bulb.

To demonstrate another interesting feature, I have adjusted the coils used in a certain way. I first connect both the terminals of the lamp to the secondary, one end of the primary being connected to the terminal T^1 of the induction coil, and the other to the insulated plate P^1 as before. When the current is turned on, the lamp glows brightly, as shown in Fig. 14b, in which C is a fine wire coil and S a coarse wire secondary wound upon it. If the insulated plate P_1 is disconnected, leaving one of the ends a of the primary insulated, the filament becomes dark or generally diminishes in brightness (Fig. 14a). Connecting, again the plate P_1 and raising the frequency of the current, I make the filament quite dark or barely red, Fig. 15b. Once more I will disconnect the plate. One will, of course, infer that when the plate is disconnected, the current through the primary will be weakened, that therefore the E. M. F. will fall in the secondary S, and that the brightness of the lamp will diminish. This might be the case, and the result can be secured by an easy adjustment of the coils; also by varying the frequency and potential of the currents. But it is perhaps of greater interest to note that the lamp increases in brightness when the plate is disconnected (Fig. 15a). In this case all the energy the primary receives is now sunk into it, like the charge of a battery into an ocean cable, but most of that energy is recovered through the secondary and used to light the lamp. The current traversing the primary is strongest at the end b, which is connected to the terminal T^1 of the induction coil, and diminishes in strength towards the remote end a. But the dynamic inductive effect exerted upon the secondary S is now greater than before when the suspended plate was connected to the primary. These results might have been produced by a number of causes. For instance, the plate P^1 being connected, the reaction from the coil C may be such as to diminish the potential at the terminal T_1 of the induction coil, and therefore weaken the curren through the primary of the coil C. Or the disconnecting of the plate may diminish the capacity effect with relation to the primary of the latter coil to such an extent that the current through it is diminished, though the potential at the terminal T^1 of the induction coil may be the same or even higher. Or the result might have been produced by the change of phase of the primary and secondary currents and consequent reaction. But the chief determining factor is the the relation of the self-induction and capacity of coil C and plate P_1, and the frequency of the currents. The greater brightness of the filament in Fig. 15a is in part due to the heating of the rarefied gas in the lamp by electrostatic induction, which, as before remarked, is greater when the suspended plate is disconnected.

Still another feature of some interest I may here bring to your attention. When the insulated plate is disconnected and the secondary of the coil opened by approaching a small object to the secondary, but very small sparks can be drawn from it, showing that the electrostatic induction is small in this case. But upon the secondary being closed upon itself or through the lamp, the filament glowing brightly, strong sparks are obtained from the secondary. The electrostatic induction is now much greater, because the closed secondary determines a greater flow of current through the primary, and principally through that half of it which is connected to the induction coil. If now the bulb be grasped with the hand, the capacity of the secondary with reference to the primary is augmented by the experimenter's body and the luminosity of the filament is increased, the incandescence now being due partly to the flow of the current through the filament and partly to the molecular bombardment of the rarefied gas in the bulb.

The preceding experiments will have prepared one for the next following results of interest, obtained in the course of these investigations. Since I can pass a current through an insulated wire merely by connecting one of its ends to the source of electrical energy, since I can induce by it another current, magnetize an iron core, and, in short, perform all operations, as though a return circuit were used, clearly I can also drive a motor by the aid of only one wire. On a former occasion I have described a simple form of motor, comprising a single exciting coil, an iron and disc. Fig. 16 illustrates a modified way of operating such an alternate current motor by currents induced in a transformer connected to one lead, and several other arrangements for circuits for operating a certain class of alternate motors founded on the action of currents of differing phase. In view of the present state of the art it is thought sufficient to describe these arrangements in a few words only. In the diagram, Fig. 16 II. shows a primary coil P, connected with one of its ends to the line L leading from a high tension transformer terminal T^1. In inductive relation to this primary P is a secondary S of coarse wire in the circuit of which is a coil c. The currents induced in the secondary energize the iron core i, which is preferably, but not necessarily, subdivided, and set the metal disc d in rotation. Such a motor M^2 is diagrammatically shown in Fig. 16 II., has been called a "magnetic lag motor," but this expression may be objected to those by who attribute the rotation of the disc to eddy currents circulating in minute paths when the core i is finally subdivided. In order to operate such a motor effectively on the plan indicated the frequencies should not be too high, not more than four or five thousand, though the rotation is produced even with ten thousand per second, or more.

In Fig. 16 I. a motor M_1, having two enegizing circuits, A and B, is diagrammatically indicated. The circuit A is connected to the line L, and in series with it is a primary P, which may have its free end connected to an insulated plate P_1, such connection being indicated by the dotted lines. The other motor circuit B is connected to the secondary S, which is in inductive relation to the primary p. When the transformer terminal T^1 is alternately electrified, currents traverse the open line L and also circuit A and primary P. The currents through the latter induce secondary currents in the circuit S, which pass through the energizing coil B of the motor. The currents through the secondary S and those through the primary P differ in phase 90 degrees, or nearly so, and are capable of rotating an armature placed in inductive relation to the circuits A and B.

In Fig. 16 III. a similar motor M_3 with two energizing circuits A^1 and B_1 is illustrated. A primary P. connected with one of its ends to the line L, has a secondary S, which is preferably wound for a tolerably high E. M. F., and to which the two energizing

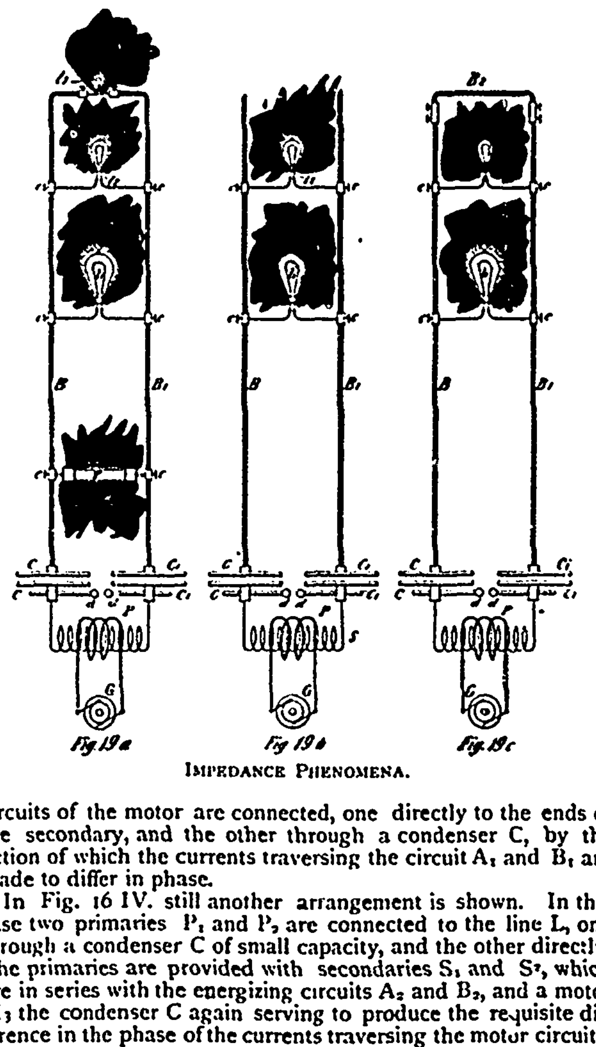


Fig 19a Fig 19b Fig 19c

IMPEDANCE PHENOMENA.

circuits of the motor are connected, one directly to the ends of the secondary, and the other through a condenser C, by the action of which the currents traversing the circuit A_1 and B_1 are made to differ in phase.

In Fig. 16 IV. still another arrangement is shown. In this case two primaries P_1 and P_2 are connected to the line L, one through a condenser C of small capacity, and the other directly. The primaries are provided with secondaries S_1 and S^2, which are in series with the energizing circuits A_2 and B_2, and a motor M_3 the condenser C again serving to produce the requisite difference in the phase of the currents traversing the motor circuits. As such phase motors with two or more circuits are now well known in the art, they are here illustrated diagrammatically. No difficulty whatever is found in operating a motor in the manner indicated, or in similar ways, and although such experiments up to this day present only scientific interest, they may at a period not far distant be carried out with practical objects in view.

It is thought useful to devote here a few remarks to the subject of operating devices of all kinds by means of only one leading wire. It is quite obvious that when high-frequency currents are made use of, ground connections are—at least when the E. M. F. of the currents is great—better than a return wire. Such

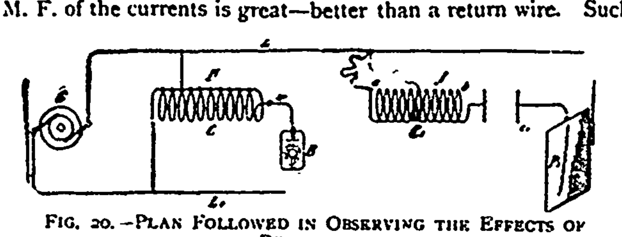


FIG. 20.—PLAN FOLLOWED IN OBSERVING THE EFFECTS OF RESONANCE.

ground connections are objectionable with steady or low frequency currents, on account of destructive chemical actions of the former, and disturbing influences exerted by both on the neighboring circuits; but with high frequencies these actions practically do not exist. Still, even ground connections become superfluous when the E. M. F. is very high, for soon a condition is reached when the current may be passed more economically through open than through closed conductors. Remote as might seen an industrial applicant of such single wire transmission of energy to one not experienced in such lines of experiment, it will not seem so to any one who for some time has carried on investigations of such nature. Indeed I cannot see why such a plan could not be practicable. Nor should it be thought that for carrying at such a plan currents of very high frequency are implicitly required, for just as soon as potentials of, say, 30,000 volts are used the single wire transmission may be effected with low frequencies, and experiments have been made by me from which these inferences are made.

When the frequencies are very high it has been found in certain elementary rules I have also found it practicable to operate ordinary series or shunt direct current motors with such disruptive discharges, and this can be done with or without a return wire.

Among the various current phenomena observed perhaps the most interesting are those of impedance presented by conductors to currents varying at a rapid rate. In my first paper before the American Institute of Electrical Engineers I have described a few striking observations of this kind. Thus I showed that when such currents or sudden discharges are passed through a thick metal bar there may be points at the bar only a few

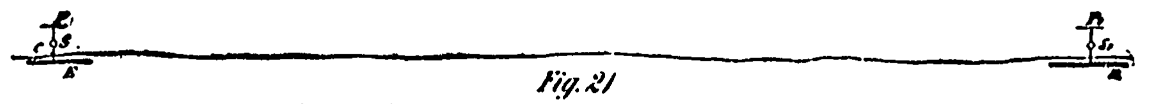


Fig. 21

ENERGY TRANSMISSION TO ANY DISTANCE WITHOUT WIRES.

laboratory practice quite easy to regulate the effects in the manner shown in diagram Fig 17. Here two primaries P and P are shown, each connected with one of its ends to the line L, and with the other end to the condenser plates C and C_1, respectively. Near these are placed other condenser plates C_1 and C'_1, the former being connected to the line L, and the latter to an insulated larger plate P_2. On the primaries are wound secondaries S and S^1 of coarse wire, connected to the devices m and d respectively. By varying the distances of the condenser plates C and C_1, and C^2 and C'_1, the currents through the secondaries S and S^1 are varied in intensity. The curious feature is the great sensitiveness, the slightest change in the distance of the plates producing considerable variations in the intensity or strength of the currents. The sensitiveness may be rendered extreme by making the frequency such that the primary itself without any plate attached to its free end satisfies, in conjunction with the closed secondary, the condition of resonance. In such condition an extremely small change in the capacity of the free terminal produces great variations. For instance, I have been able to adjust the conditions so that the mere approach of a person to the coil produces a considerable change in the brightness of the lamps attached to the secondary. Such observations and experiments possess of course at present chiefly scientific interest, but they may soon become of practical importance.

Very high frequencies are of course not practicable with motors on account of the necessity of employing iron cores. But one may use sudden discharges of low frequency and thus obtain certain advantages of high frequency currents without rendering the iron core entirely incapable of following the changes and without entailing a very great expenditure of energy in the core. I have found it quite practicable to operate, with such low frequency disruptive discharges of condensers, alternating current motors. A certain class of such motors which I advanced a few years ago, which contained closed secondary circuits, will rotate quite vigorously when the discharges are directed through the exciting coils. One reason that such a motor operates so well with these discharges is that the difference of phase between the primary and secondary currents is 90 degrees, which is generally not the case with harmonically rising and falling currents of low frequency. It might not be without interest to show an experiment with a a simple motor of this kind, inasmuch as it is commonly thought that disruptive discharges are unsuitable for such purposes. The motor is illustrated in Fig. 18. It comprises a rather large iron core i with slots on the top into which are imbedded thick copper washers c c. In proximity to the core is a freely movable metal disc D. The core is provided with a primary exciting coil C, the ends a and b of which are connected to the terminals of the secondary S of an ordinary transformer, the primary P of the latter being connected to an alternating distribution circuit or generator G of low or moderate frequency. The terminals of the secondary

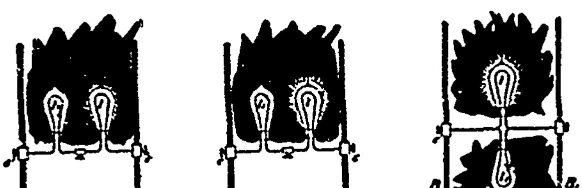


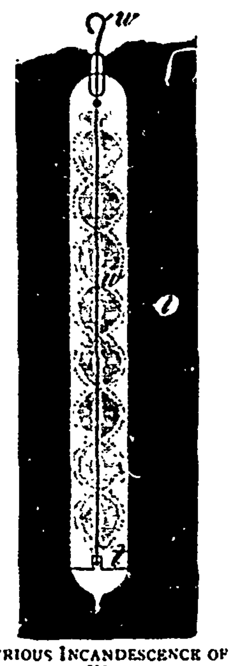
Fig. 22c Fig. 22b Fig. 22a

SHOWING THE EFFECT OF THE PRESENCE OF A GASEOUS MEDIUM.

S are attached to a condenser C which discharges through an open air gap d d, which may be placed in series or shunt to the coil C. When the conditions are properly chosen the disc D rotates with considerable effort, and the iron core i does not get very perceptibly hot. With currents from a high frequency alternator, on the contrary, the core gets rapidly hot and the disc rotates with a much smaller effort. To perform the experiment properly it should be first ascertained that the disc D is not set in rotation when the discharge is not occuring at d d. It is preferable to use a large iron core and a condenser of large capacity so as to bring the superimposed quicker oscillation to a very low pitch or to do away with it entirely. By observing

inches apart which have a sufficient potential difference between them to maintain at bright incandescence an ordinary filament lamp. I have also described the curious behavior of rarefied gas surrounding a conductor to such sudden rushes of current. These phenomena have been since more carefully studied, and one or two novel experiments of this kind are deemed of sufficient interest to be described here.

With reference to Fig. 19a B and B_1 are very stout copper bars, connected at their lower ends to plates C and C^1, respectively, of a condenser, the opposite plates of the latter being connected to the terminals of the secondary S of a high-tension transformer, the primary P of which is supplied with alternating currents from an ordinary low-frequency dynamo G, or distribution circuit. The condenser discharges through an adjustable gap d d as usual. By establishing a rapid vibration it was found quite easy to perform the following curious experiment: The



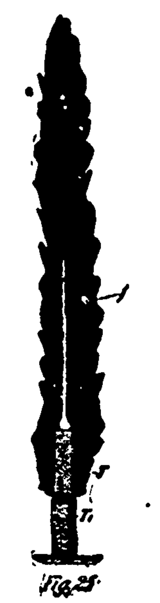


Fig. 23

CURIOUS INCANDESCENCE OF A WIRE.

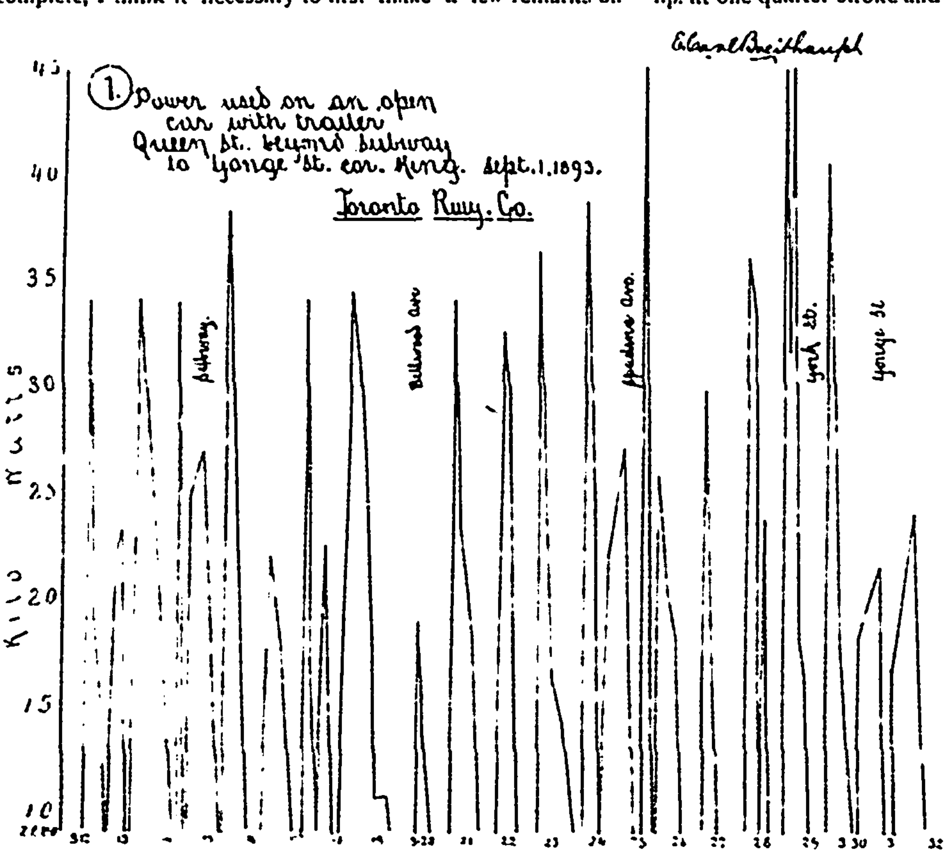
ILLUSTRATING LATERAL DIFFUSION.

bars B and B^1 were joined at the top by a low-voltage lamp l_3; a little lower was placed, by means of clamp c c, a 50 volt lamp l_2 and still lower another 100-volt lamp l_1 and finally at a certain distance below the latter lamp an exhausted tube T. By carefully determining the positions of these devices it was found practicable to maintain them all at their proper illuminating power. Yet they were all connected in multiple arc to the two stout copper bars and required widely different pressures. This experiment requires, of course, some time for adjustment, but is quite easily performed.

In Figs. 19b and 19c, two other experiments are illustrated which, unlike the previous experiment, do not require very careful adjustments. In Fig. 20b, two lamps l_1 and l_2, the former a 100-volt and the latter a 50-volt, are placed in certain positions as indicated, the 100-volt lamp being below the 50-volt lamp. When the arc is playing at d d, and the sudden discharges passed through the bars B B the 50-volt lamp will, as a rule, burn brightly, or, at least, this result is easily secured, while the 100 volt lamp will burn very low or remain quite dark, Fig. 19b. Now the bars B B may be joined at the top by a thick cross bar B_2, and it is quite easy to maintain the 100-volt lamp at full candle power while the 50-volt lamp remains dark, Fig. 19c. These results as I have pointed out previously, should not be considered to be due exactly to frequency, but rather to the time rate of change which may be great even with low frequencies. A great many other results of the same kind equally interesting, especially to those who are only used to manipulate steady currents, may be obtained, and they afford precious clues in investigating the nature of electric currents.

In the preceding experiments I have already had occasion to show some light phenomena, and it would be now proper to study those in particular, but to make this investigation more complete, I think it necessary to first make a few remarks on the subject of electrical resonance, which has to be always observed in carrying out these experiments.

(To be Continued.)



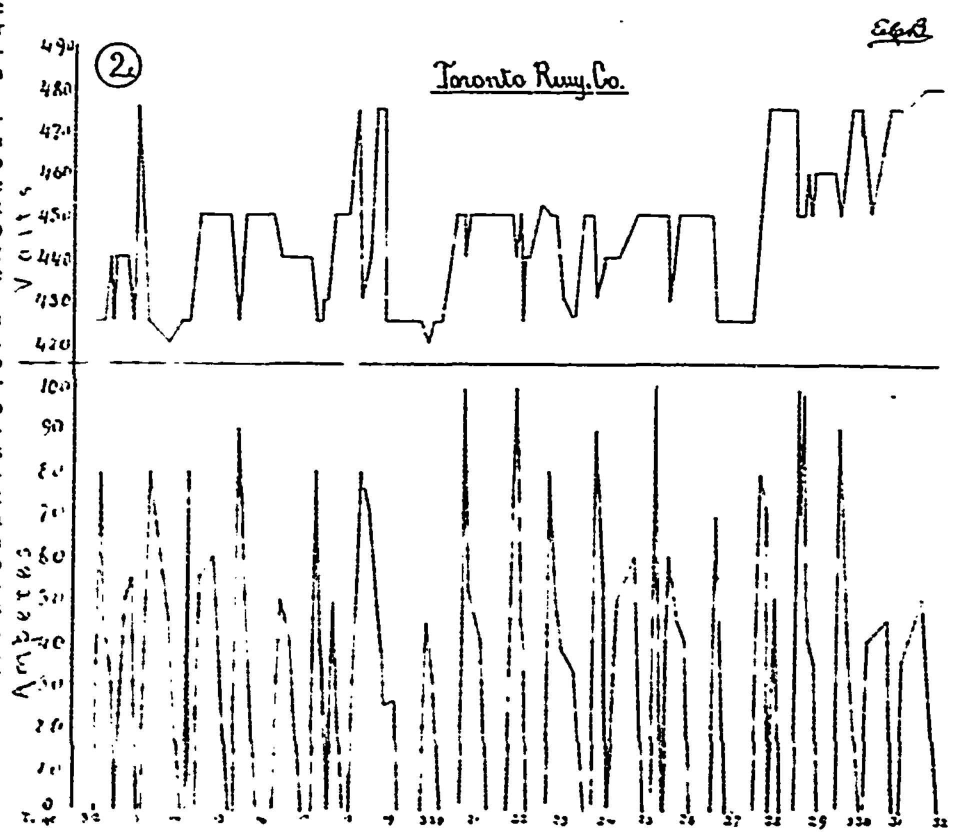
POWER CURVES.

E. CARL BREITHAUPT.

The accompanying power curves were presented before the last meeting of the Canadian Electrical Association in connection with a paper on Street Railways, and were intended especially to show the extreme variations in the duty required of a street railway motor. The readings were taken on a regular run of one of the cars of the Toronto Street Railway Co., drawing an open trailer on the Queen St. line.

The curves show the results obtained on the return trip, up Queen Street, from Lansdowne ave. to Yonge street, thence down Yonge to King street, a distance of about three miles. The total time was 19 minutes 50 seconds, thus showing an average speed of about nine miles per hour, including stops.

The trolley is No. 00 hard drawn copper wire, fed at Spadina Ave. and at the Subway by No. 0000 feeders. The roadbed is practically level with the exception of two short but sharp grades at the Subway. The number of passengers carried varied from 15 to 30, averaging about 30, and the readings at the motor terminals indicated a very quick and wide variation in the amount of power supplied to the motor, twice reaching a maximum of 45 Killowatts; this was on starting at Spadina Ave., when there were fifty passengers on board, and again on starting near York street. In both cases the readings were only momentary. At the Subway the number of passengers was fifteen and the maximum reading on the up grade was only 27 Killowatts.



The voltmeter readings did not vary much. The maximum can be taken at 475 volts and the minimum at 425 volts, though 420 volts was twice indicated, the total variation was therefore only 11 per cent. of the mean voltage, which, considering the fact that the feeders are over one and one-half miles apart, must be considered very satisfactory.

The power house is equipped with four Armington & Sims high speed, compound condensing engines, each rated at 600 hp. at one quarter stroke and each belted directly to two Edison 200 K.W. generators. The total load as indicated at the station was very steady, showing a fluctuation of not over 5 per cent. during several hours. This goes to prove an assertion which was made in the paper above referred to, viz., that on a road where a large number of cars are operated, the fluctuations observed on the separate cars, tend to equalize each other and the consequent variation of the total load from minute to minute is therefore only a small one. The total load will of course be greater or less during certain hours of the day when traffic is exceptionally heavy or light.

Curves of this kind are always instructive, and they should be taken at regular intervals in every electric plant, especially where losses may occur which are not easily detectable; they show a full analysis of what is going on, where and how the power generated at the central station is being expended.

Berlin, Nov. 22nd, 1893.

PERSONAL.

Mr. H. P. Dwight, manager of the Great Western Telegraph Company, is on a visit to the North-West.

Mr. A. E. Edkins, Prov.-Deputy of the C. A. S. E., will sail from New York for England on the 6th inst., having obtained six weeks leave of absence for the purpose of spending the holiday season with relatives in the old land. We wish him *bon voyage.*

Mr. J. B. Griffith, manager of the Hamilton Street Railway, has just returned from an extended visit to California, and reports himself greatly improved in health.

Mr. J. H. Killey, the well-known engineer, of Hamilton, Ont., has been appointed consulting engineer at London, Ont., to the Steam Boiler and Plate Glass Insurance Company of that city.

Mr. Arendt Angstrom lately resigned his position of architect and constructing engineer to the Cleveland Ship Building Company, to accept the position of general manager of the Bertram Engine Works Company, Toronto.

An electric railway between Welland and Fonthill, to be used for the carriage of fruit and passengers, is talked of.

MONTREAL ELECTRIC CLUB.

Nov. 6th. Besides other business, the following officers were elected to fill vacancies for the balance of the year: vice-president, H. W. Woodman; treasurer, L. M. Pinolet; committee of management, H. Ritchie, R. W. Herring and Jas. Douglas. Mr. R W. Herring then read his paper on "Steamboat Lighting by Electricity." Some interesting remarks by Mr. J. C. Gough on the importance to the electrical engineer of a knowledge of steam engineering, brought the meeting to a close, votes of thanks being given to Mr. Herring for his paper and to Mr. Gough for his talk.

Nov. 20th.—After the transaction of business, Mr. J. C. Gough read a paper on "The Philosophy, Application, Construction and Improvement of the Steam Engine," which was listened to with much attention and led to considerable discussion. A vote of thanks was given Mr. Gough for his interesting paper.

Mr. W. B. Shaw, President of the Montreal Electric Club, whose portrait is herewith presented, was born at Saltcoats, Ayrshire, Scotland. He came to Canada about fifteen years ago, since which time he has resided in Montreal, having completed his school days at the High School in that city. After leaving school Mr. Shaw entered the employ of Mr. Binks as book-keeper, and while thus engaged, occupied his leisure hours with the study of electricity. His first experience at practical work was gained with Mr. H. T. Hibbard, after whose unfortunate failure he took a position as electrician with Mr. T. W. Ness, which he held for three years, resigning to go as assistant to Mr. Starr, general agent of the Royal Electric Co. On the first of May last, in company with his brother, Mr. John Shaw, and Mr. Walter F. Taylor, the Montreal Electric Company was organized, and he entered into business on his own account.

W. B. SHAW,
President Montreal Electric Club.

THE BELL TELEPHONE COMPANY'S FACTORY, MONTREAL.

A REPRESENTATIVE of the ELECTRICAL NEWS was recently afforded the opportunity of making an inspection of the large manufactory of the Bell Telephone Company on Aqueduct Street, Montreal, in which is manufactured most of the apparatus and supplies required in the Company's business, and offered to purchasers through its Sales Department. The factory comprises two buildings, each 150 x 50 feet in size, and being connected only by an iron passageway. The front building is three stories in height and the rear building two stories. The buildings have a frontage of 150 feet on Aqueduct street. They are constructed of brick on a foundation of masonry, and are designed in such a way as to offer but little inflammable material as food for fire. In addition every precaution has been exercised for their protection should a fire occur. A fire pump, situated in the boiler room, is connected with a 25,000 gallon tank as well as with a hydrant on a pipe connected with the city mains, so that if by chance the pressure from the city mains should fail, the tank would afford the requisite pressure. The fire pump has a capacity of 500 gallons per minute, for which a pressure of 40 pounds per square inch is maintained on the boilers at night.

The first floor of the front building is occupied by the offices of the Superintendent, Mr. C. W. Brown, clerks and draughtsmen, machine shop and tool manufactory. The machine tools are of the lighter order, and are mostly employed on brass-work. Several of the machines here seen have no counterpart in Canada, as for example one which is fitted with 24 drills and can bores 24 holes at one operation.

On the next floor is the assembling room, where the parts composing the various kinds of apparatus are put in their proper positions. Here is being put together the new switchboard for the Toronto Exchange which it is expected will be completed early in the new year. Any attempt at a description of this board is deferred until a later date, but it may be stated that without having examined the nature of its construction it would be difficult if not impossible to conceive of the infinitude of its parts and the immense amount of skill, care and labor involved in it. The manufacture of this board has been proceeded with deliberately with the object of embodying in it the very latest improvements, and this determination has necessitated a number of changes since the undertaking began.

From the wire covering department is turned out about 1000 lbs. of covered wire per month, most which of is consumed in the the Company's business. This is easy to understand when it is remembered that every set of telephone instruments contains half a mile of wire. Some of the wire seen on the covering machines measured only 5-1000ths of an inch in thickness. On this floor there is also the Inspection Department, where every instrument is tested before leaving the factory.

In the basement are the Storage and Shipping Departments, the manufactured articles being lowered from the various floors by a hoist. Here are quantities of materials of almost every description, for use in the manufactory and in the various branches of the company's business throughout the country, for all of which this is the headquarters of supply. Scores of boxes of magneto bells, and miles of cable and wire are here stored; also vulcanized fibre, the product of the Vulcanized Fibre Company's factory at Wilmington, Del., for insulation in dry places, and sheets of hard rubber to be similarly employed in damp positions. Enquiry as to the life of iron wire brought the reply that in cities where it is subjected to an atmosphere impregnated with gases of various kinds, its duration is only about three years, and in sea-side towns, such as Halifax, the influence of the salt-air is such as to destroy iron wire in about six months. For this reason, it has been found more profitable in such a location to use phosphor bronze wire, the greater first cost being more than repaid by its enduring quality.

The rear building contains a department in which are manufactured all the batteries used in the Bell instruments throughout Canada. There is one thing connected with these batteries which it is a matter of regret to learn has not been procurable in Canada thus far, namely, the porous earthenware cups, of which 10,000 per year are imported from the Northwestern States. The manufacture of these cups is being experimented upon, and it is hoped that shortly their successful production will be achieved. This building contains also a lumber store-room and dry kiln, and a wood-working shop where all the cabinet work connected with the instruments, switchboards, etc., is made, as well as the cable boxes and cross arms. Of the latter there will be turned out 50,000 this year. There is also a nickel-plating department, buffing room, brass foundry, and engine room. The latter contains a 125 h. p. Corliss engine, manufactured by Laurie Bros., operated by two 100 h. p. tubular boilers located in a detached building near by. The engineer in charge gives it the best of attention.

The factory throughout is systematically arranged with a view to economy and efficiency of operation. Cleanliness and order are everywhere apparent. The number of regular employees is about 200. The Company find that their manufacturing capacity must shortly be increased, and contemplate increasing the height of their factory in order to provide the additional room required.

Mr. Brown, who exercises such efficient oversight of this department of the business, has grown up from a boy with the Company's business, having been employed in the factory in Boston, where the experimental work was done on the first Bell telephones.

The annual report of the Electric Light Department of the City of New Westminster, B. C., shows that at the beginning of the year there was a deficit of $1,000, but during the last three months, the department not only made their charges, but earned a small margin of profit. The extension of the system, however, has necessitated considerable expenditure, and this with the deficit on hand at the commencement of the year, leaves the department at the close of the year with an overdrawn account of $12,000. Additional expenditure will be necessary for the farther extension of the works to meet the demands for incandescent light. For this purpose these four plans are proposed:—1. To remove the present office, purchase an additional engine and another 1,500 light dynamo and, perhaps, a half-arc machine at an estimated cost of $3,000. 2. To buy a portion of the lot on the north side, extend the present building in that direction and increase the lighting capacity to 3,650 at a cost of from $15,000 to $20,000. 3. To purchase the lot on the south side and erect a building 33 feet wide and increase the capacity to 5,000 at a cost of from $20,000 to $25,000. 4. To purchase the lot on the south and erect thereon a 60 ft. building and increase the capacity to 12,000 at an estimated cost of $25,000 to $30,000. If proper additions are made to the plant it is estimated that the income can be increased by $1,000 per month. Mr. P. Bowler is the City's electrician.

CANADIAN ELECTRICAL NEWS AND STEAM ENGINEERING JOURNAL

PUBLISHED ON THE FIRST OF EVERY MONTH BY

CHAS. H. MORTIMER,

OFFICE: CONFEDERATION LIFE BUILDING,

Corner Yonge and Richmond Streets,

TORONTO, - - CANADA.

Telephone 2362.

64 TEMPLE BUILDING. - MONTREAL.

Bell Telephone 2299.

ADVERTISEMENTS.

Advertising rates sent promptly on application. Orders for advertising should reach the office of publication not later than the 15th day of the month immediately preceding date of issue. Changes in advertisements will be made whenever desired, without cost to the advertiser, but to insure proper compliance with the instructions of the advertiser, requests for change should reach the office as early as the 22nd day of the month.

SUBSCRIPTIONS.

The ELECTRICAL NEWS will be mailed to subscribers in the Dominion, or the United States, post free, for $1.00 per annum, 50 cents for six months. The price of subscription may be remitted by currency, in registered letter, or by postal order payable to C. H. Mortimer. Please do not send cheques on local banks unless 25 cents is added for cost of discount. Money sent in unregistered letters must be at senders' risk. Subscriptions from foreign countries embraced in the General Postal Union, $1.50 per annum. Subscriptions are payable in advance. The paper will be discontinued at expiration of term paid for if so stipulated by the subscriber, but where no such understanding exists, will be continued until instructions to discontinue are received and all arrearages paid.

Subscribers may have the mailing address changed as often as desired. *When ordering change, always give the old as well as the new address.*

The Publisher should be notified of the failure of subscribers to receive their papers promptly and regularly.

EDITOR'S ANNOUNCEMENTS.

Correspondence is invited upon all topics coming legitimately within the scope of this journal.

THE "CANADIAN ELECTRICAL NEWS" HAS BEEN APPOINTED THE OFFICIAL PAPER OF THE CANADIAN ELECTRICAL ASSOCIATION.

CANADIAN ELECTRICAL ASSOCIATION.

OFFICERS:

PRESIDENT:

J. J. WRIGHT, Manager Toronto Electric Light Company.

1ST VICE-PRESIDENT:

K. J. DUNSTAN, Local Manager Bell Telephone Company, Toronto.

2ND VICE-PRESIDENT:

JOHN CARROLL, Sec-Treas. Eugene Phillips Electrical Works, Montreal.

SECRETARY-TREASURER:

C. H. MORTIMER, Publisher ELECTRICAL NEWS, Toronto.

EXECUTIVE COMMITTEE.

D. THOMSON, Hamilton, Ont.

D. A. STARR, Royal Electric Company, Montreal.

H. O. FISK, Electrician Electric Light Company, Peterboro', Ont.

GEO. BLACK, G. N. W. Telegraph Co., Hamilton.

A. B. SMITH, Inspector Canadian Board Fire Underwriters, Toronto.

L. B. McFARLANE, Bell Telephone Company, Montreal.

T. R. ROSEBRUGH, Lecturer in Electricity, School of Practical Science, Toronto.

E. C. BREITHAUPT, Berlin, Ont.

JOHN YULE, Manager Guelph Gas and Electric Light Company, Guelph, Ont.

THOS. AHEARN, of Ahearn & Soper, Ottawa, Ont.

MONTREAL ELECTRIC CLUB.

OFFICERS

President, W. B. SHAW, -	Montreal Electric Co.
Vice-President, H. WOODMAN,	Montreal Street Railway Co.
Secretary, JAMES BURNETT, - -	9 Shuter Street.
Treasurer, L. M. PINOLET, -	1401 Dorchester Street.

CANADIAN ASSOCIATION OF STATIONARY ENGINEERS.

EXECUTIVE BOARD

President, G. HUNT, - - -	Montreal, Que.
Vice-President, WM. SUTTON	Toronto, Ont.
Secretary, J. J. YORK, -	Board of Trade Bldg. Montreal.
Treasurer, W. G. BLACKGROVE, - -	Toronto, Ont.
Conductor, T. KING,	Dresden, Ont.
Door Keeper, F. ROBERTS, - - -	Ottawa, Ont.

TORONTO BRANCH NO. 1.—Meets 2nd and 4th Friday each month in Room D, Shaftesbury Hall. Wilson Phillips, President; H. E. Terry, Secretary, 19 Hayter street.

HAMILTON BRANCH NO. 2. Meets 1st and 3rd Friday each month, in Maccabee's Hall. W. Sweet, President; Wm. Norris, Secretary, 211 Wellington Street North.

STRATFORD BRANCH NO. 3.—John Hoy, President; Samuel H. Weir, Secretary.

BRANTFORD BRANCH NO. 4.—Meets 2nd and 4th Friday each month. Thos. Pilgrim, President; John Ogle, Secretary, Brantford Cordage Co.

LONDON BRANCH NO. 5.—Meets in Sherwood Hall first Thursday in each month. F. Mitchell, President; Geo. Taylor, Secretary Treasurer, 356 Piccadilly Street.

MONTREAL BRANCH NO. 1.—Meets 1st and 3rd Thursday each month, in Engineers' Hall, Craig street. President, Jos. Robinson; first vice-president, H. Nuttall, second vice-president, Jos. Badger; secretary, J. J. York, Board of Trade Building, treasurer, Thos. Ryan.

ST. LAURENT BRANCH NO. 2.—Meets 1st and 3rd Tuesday each month, in Mechanics' Institute, 204 St. James street. Matthias Guimond, President; Alfred Latour, Secretary, 306 Delisle street, St. Cunegonde.

BRANDON, MAN., BRANCH NO. 1. Meets 1st and 3rd Friday each month, in City Hall. A. R. Crawford, President; Arthur Fleming, Secretary.

GUELPH BRANCH NO. 6.—Meets 1st and 3rd Wednesday each month at 7.30 p.m. C. Jorden, President, H. T. Flewelling, Secretary, Box No 8.

OTTAWA BRANCH, NO. 7.—Meets 2nd and 4th Tuesday, each month, corner Bank and Sparks streets; J. H. Thompson, President; Wm. O'Brien, Secretary.

DRESDEN BRANCH NO. 8.—Meets every 2nd week in each month, Thos. Merrill, Secretary.

BERLIN BRANCH NO. 9.—Meets 2nd and 4th Saturday each month at 8 p. m. W. J. Rhodes, President; G. Steinmetz, Secretary, Berlin Ont.

KINGSTON BRANCH NO. 10.—Meets twice each month over No. 1 Fire Station. J. Devlin, President; A. Strong, Secretary.

ONTARIO ASSOCIATION OF STATIONARY ENGINEERS.

BOARD OF EXAMINERS.

President, A. E. EDKINS, -	139 Borden st., Toronto.
Vice-President, R. DICKINSON, -	Electric Light Co., Hamilton.
Registrar, A. M. WICKENS,	280 Berkeley st., Toronto.
Treasurer, R. MACKIE, - -	28 Napier st. Hamilton.
Solicitor, J. A. MCANDREWS, -	Toronto.

TORONTO—A. E. Edkins, A. M. Wickens, E. J. Phillips, F. Donaldson.
HAMILTON—P. Stott, R. Mackie, R. Dickinson.
PETERBORO'—S. Potter, care General Electric Co.
BRANTFORD—A. Ames, care Patterson & Sons.
KINGSTON—J. Devlin (Chief Engineer Penetentiary), J. Campbell.
LONDON—F. Mitchell.

Information regarding examinations will be furnished on application to any member of the Board.

WE wish to state to readers of the NEWS that our columns are open for questions of general interest on Electrical and Engineering topics, and would request all our readers to make use of them for this object, when we will do our best to furnish suitable replies.

THE life of the English patent on the Edison incandescent lamp expired on the 10th of November. The Canadian patent will expire on the 19th of November next year, at which time it is believed the term of the American patent will likewise end, but on this point there seems to exist some uncertainty.

Water is in the wrong place when it gets inside the steam cylinder. If boiler primes, water will be sure to come along with the steam, but it may be separated by having steam pipe carried past the cylinder, and a branch at right angles to convey the steam. The steam will turn the corner, and the water pass straight on.

SOME Toronto friends we hear are thinking of getting together for social and educational purposes an Electric Club, similar to that in vogue in Montreal. We understand that the Montreal Club have at one of their late meetings adopted a new set of by-laws and constitution, which we presume will be forwarded to any inquirer by any of the Club's officers.

WITHIN the past fortnight a successful test has been made on the Erie canal of the adaptability of the trolley system for the propulsion of canal boats. It is expected that the substitution of electricity for animal power for this purpose will be the means of reducing by one-half the cost of propulsion. Another effect will be to restore to a considerable extent competition between water and rail freight transportation.

A STRANGE fact has been brought to light by Prof. Cahart while experimenting in arc lighting, viz., that with constant watts in an arc we may obtain very different candle powers by varying the current and pressure inversely, still keeping the watts, however, constant. With 450 watts and using a current of 8.4 amperes he procures 900 c. p. On raising the current to 10 amperes at 45 volts he only gets 450 c. p. A 500 watt arc, therefore, gives more light (*i. e.*, 950 c. p. with 9 amperes at 55 volts), while with 45 volts 11 amperes, only 500 c. p. is produced. This is an item which has been discussed by various Canadian electrical men before this, and Prof. Cahart's researches will in all probability settle some of the disputed points.

SOME time ago the utilization of the power of the Lachine Rapids at Montreal was spoken of. Upon finding the numerous difficulties which would be involved in such an undertaking, not to speak of the fact that the water runs up hill there during a flood at Montreal, the scheme was dropped. Apparently also is the project of the Royal Electric Co., of Montreal, to bring power from the Chambly Rapids on the Richelieu River. The Hurontario Canal which is to supply power for electrical purposes, will probably end up in like manner. This in some measure bears out the statements made by many intelligent electrical engineers that a good economical and well made steam engine, where coal is at a fair price, is more to be depended on and in the long run is probably as cheap as water power.

SINCE the regrettable accident to the Rev. Mr. Botterell in Montreal, the Montreal Street Railway Co. have been running their cars at a decidedly slower rate in response to the clamor of the general public. The accident was certainly one to be regretted, but there is no reason for the clamor to have the car service run at such a speed that it is impossible for business men in Cote St. Antoine having but one hour for dinner to go home there and get it. We venture to state that the old horse car system produced more accidents to the week than the electric system has done per month since its inauguration. When the horse car system was in use, the cry was "rapid transit"; when rapid transit was given, the cry was "too quick," but it is ever thus.

A pump is said to lift water. This phrase often leads to a misconception of the true working of a pump. There are pumps which lift water, but they are not usually found in connection with steam boilers. The ordinary plunger pump "lifts water" by producing a vacuum in the chamber of the pump, and the pressure of the atmosphere then forces water into this space. The man who gets a clear idea of this operation, will know that if the pump is not getting water, he must look out for one or other of four defects: 1st. He will see that the packing of the pump gland is right, so that the plunger may form the vacuum. 2nd. He will see that the valves are in place and free to open and shut. 3rd. He will look out for any air leaks or obstructions in suction pipe. 4th. He will make sure that there is water to lift within lifting distance from the pump.

IT seems strange to us that with the many really good constant potential arc lamps on the market, even for 52 volt alternating current, that there are not more of them used in place of incandescent lights. Taking a current of 10 amperes we only get (on 52 volt alternating circuit) 160 c. p. in all. For the same current expended through an arc and its accompanying rheostat we get about 1200 c. p. This at ¾ cent. rate would cost us 7½ cents per hour to burn. On the other hand to obtain the same candle power from incandescent lights we should require to burn about eighty 16 c. p. lights, which would cost 60 cents per hour. Stations which are heavily loaded and have no room at present for extension, would do well to advocate these lamps, as they would be certain to give satisfaction in many places.

IN the ELECTRICAL NEWS for November there appeared a letter from Mr. D. W. Robb, of Amherst, Nova Scotia, on the relative merits of high versus slow speed engines for electrical purposes. The writer argued the case on behalf of the high speed engine with ability and fairness. A rejoinder to Mr. Robb appears in the present issue from the pen of Mr. W. T. Brown, of Galt. The subject is an interesting one, and might profitably be further discussed, and for this object our columns are at the disposal of readers who may desire to give their experience or express their views. Another subject which is engaging considerable attention at present is the relative advantages of horizontal and vertical compound engines. The Toronto Electric Light Company and the Royal Electric Company have recently installed large new engines of the vertical type, and express the opinion that they are the engine of the future, while on the other hand in the new power station of the Montreal Street Railway Company, horizontal engines are to be employed, and a well-known engineering expert of that city in conversation with the writer gave it as his opinion that the weight of advantage was on the side of the horizontal engine. What do our readers think about it?

AT the annual meeting of the Montreal Street Railway Company, it was announced that the franchises for the construction of electric railways in the suburbs of St. Cunegonde and St. Henri, had been purchased by the Board of Directors for the sum of $50,000. This is an illustration of the means by which a number of speculators in Montreal will achieve wealth without the expenditure of effort which is usually necessary for that purpose. For several years past these speculators have been at work with the object of securing franchises from suburban municipalities for the construction of railways, the supply of water, power, etc. There never was any intention on the part of these men to construct the works, but they foresaw that in a very short time these municipalities would be annexed to the city and then they would be in a position to sell their franchises to the city or city corporations, at handsome prices. The purchase by the Montreal Street Railway Company is the first of the harvest which these speculators will sooner or later reap. The statement was made by one of the directors of the Company, that had the matter been brought before the Legislature, these franchises would have been annulled. There is a lesson here for the City of Toronto in dealing with the the Georgian Bay Canal scheme. It has been clearly shown that the object of the promotors of this scheme is to secure this valuable franchise and sell it to the highest bidder. We have the word of certain parties that they would be willing, in the event of this franchise being secured, to pay $100,000 in cash for it.

THE annual meeting of the Montreal Street Railway Company was held at the Company's offices in Montreal, on the 8th of November. The president, in his address to the stockholders, gave some information regarding the operation of the road, which will doubtless be of interest to railway managers. The receipts of last year show an increase of 30.02 per cent over 1892, and 52.63 per cent over 1891. The number of passengers carried in 1893 was 17,177,952, as compared with 11,631,386, in the previous year, and 9,837,257 in 1891. After paying into the city treasury 4 per cent of the net earnings, amounting to $28,365.96, the company netted a profit of $116,032.86, as against $93,980.21, in 1892. The expenses amounted to 17 cents per car mile, and the management was subjected to criticism on this point. It was, however, pointed out by the president that the high rate of expense this year was due to the disadvantageous conditions under which the system was operated, owing to the changing of the system and improvement of the roadbed and pavements, necessitating the use of both horses and electricity, as well as to the fact that the company, pending the completion of their new power station, were compelled to rent the necessary power at a price considerably higher than it is expected it can be produced by their own plant now being installed. It is estimated that when the conversion of the road is completed and the power station in operation, the expense per mile will be reduced from 17 to 12 cents. Fault was found by some of the shareholders with the action of the managent in giving to Messrs. Ross and Mackenzie, without competition, the contract for the construction work at $30,000 per mile. It was however, pointed out by the president that the work was given in this manner owing to the fact that the company were obliged to have a certain number of miles of road built within 60 days. It was also pointed out that the price at which the work was being done compares favorably with the cost of similar work in other cities, Cleveland and Toronto, for example, where the cost was $35,000 per mile. Mr. Ross, one of the contractors, stated that he had offered to relinquish his contract at any time that the company might desire. These explanations appeared to be satisfactory to those who had objected to this feature of the company's management, and the old board of directors was re-elected. The company was also authorized to make application to the Legislature for amendments to its charter and for power to increase the capital stock to $5,000,000. Mr. H. A. Everett, managing director of the road, has tendered his resignation, on the ground that his connection with the street railways of Cleveland and Toronto demands all his attention. Mr. G. C. Cunningham has been appointed as his successor.

The proposition made to the city Council of Belleville, by the Canadian General Electric Company, for the construction of an electric street railway in that city, is meeting with favorable consideration.

NOTES FOR ENGINEERS.

What makes an engine pound? If the question were put the other way—what will prevent an engine from pounding? it would to some be more reasonable. Pounding however, asserts itself, and speaks out so that a man who is no engineer will know something is wrong, and will be ready to ask what makes that pounding?

Sometimes the cause is in the steam cylinder. Anything loose about the piston or its connection to the piston rod will cause a knock. A little wear of the cylinder when the counter bore has not been made deep enough, and a little ridge forms, upon which the piston strikes as it comes to the end of the cylinder. Sometimes the counter bore is too deep, and the piston rings spring out as they reach it, where the piston is made with narrow rings.

Any of these causes are comparatively easy of discovery by an experienced man. The pounding may all be in the crank shaft bearing. If it is not exactly true and level or square to engine, there will be pounding as it revolves. The crank pin will certainly be affected in that case, and will give trouble from heating or cutting The crosshead connection and slides are sometimes the cause because of not being quite true and fair with the cylinder and motion of the piston. In other cases every bearing may be perfectly true and fair, and yet engine will thump and pound as if trying to break itself up.

If the engineer finds all as true and fair as should be, and yet the pounding continues, he should get engine indicated and have diagrams studied by someone accustomed to the problem of valve setting.

It is necessary for successful running of an engine,that all the bearing surfaces be sufficiently slack to allow oil to flow in between them. When piston is moving forward, the slack is on the opposite side of the bearing from what it is when the dead centre is passed and piston is moving in the opposite direction. If the weight of the moving parts and the counter balances be adjusted to the speed if engine and pressure of steam, there should be no pounding, but in many cases it is necessary to set valve so as to cushion a little either with exhaust steam or with live steam, so as to take up the slack before the dead centre is passed. Each engine has to be studied and valve set so as to give the required amount and no more.

QUESTIONS AND ANSWERS.

M. L. D., Toronto, asks: Can you give me the name of a Canadian firm who manufacture glass insulators?

ANS.- We are unable to give the desired information, and would feel obliged if some of our readers would do so.

"W. N.," Hamilton, Ont., writes:

(1) Will you explain in your next number, the way to put a dynamo right when it has changed its current, that is when the current is reversed? also (2) the best and nearest place to get books treating on electricity and electrical machinery?

ANS.– If the dynamo is an arc machine, and it is necessary to change the current in a hurry owing to the lower carbons in lamps being in danger of burning out too soon, the trouble can be temporarily overcome by reversing the plugs on the switchboard, i. e., if it is a T. & H. plant; turn each plug upside down on switchboard, so that the current enters the line from machine where it ordinarily returns. To make the polarity of machine right, take off brushes from commutator, or you will convert dynamo into a motor, and take a positive and negative wire from another dynamo in operation, and attach the live positive wire to the negative binding post of machine to be changed, and attach the negative live wire to the positive binding post, and allow current to pass through a few moments. The machine will then be found to be right polarity. (2) You may obtain through the ELECTRICAL NEWS any electrical books, by stating what books you require.

"Induction" asks: 1. Would you kindly inform me through your valuable paper where, and at what price I can obtain a book that will give me practical information on transformer construction and winding? 2. What metal would make a good core for a transformer, and where can it be obtained? 3. Is there any duty on burned out incandescent lamps, going into the United States. 4. Have you ever noticed that the customs charges on 1st and 2nd quality carbons, are the same, viz. $2.50 per m.? This is not as it should be, as it means 50 per cent. on the 2nds.

ANS.—1. "Transformers" by Caryl D. Haskins, published by the Bubier Publishing Co., of Lynn, Mass. Sold by electrical supply houses in Montreal at $1.25. 2. The metal must be iron. If a small transformer, annealed iron wire will do, if large enough to warrant it, discs cut or punched out of soft sheet iron with piece of tissue paper pasted on one side. Any hardware merchant can procure you the above. If the iron or iron wire be too hard it can be softened by heating to a bright red and laying it embedded in ashes afterwards to cool slowly. 3. There is no duty on goods sent back to the United States marked "For Repairs". The case, however, must be examined by the appraiser at the Examining Warehouse before export, so that it can be identified when returned. 4. Customs Tariff, Department No. 545, Act No. 207 C, reads. "Electric arc light carbons or carbon points not exceeding 12" long, $2. 50 per 1,000, and in proportion for greater or less length." We should judge by this that the duty is the same for both qualities.

Jos. Ogle, Brantford, writes: Enclosed you will find a rough sketch of a heating system of our factory, supposed to be heated by exhaust steam from a Wheelock engine 16"x38", developing 81 h.p., cutting off at ¼ stroke, having a 6" exhaust pipe. After exhausting through heater there is a 4" main running through engine room wall, which acts as a header, from which five ¼" pipes are run all around the factory, returning to starting place, with 4 feet of a fall, and having a 2" drip pipe at end. The system is overhead and 12 feet from the floor. I find we cannot do justice to the factory in heating it without having too much back pressure on engine (which I consider very expensive heating) also an abundance of steam escaping through back pressure valve to the open air. Would you recommend any change?

ANS.—In first place his 6" exhaust from engine has an area of 28·27 sq. in. and is reduced to 4" beyond heater which has an area of less than one half the 6 in. pipe; a reduction then takes place again to six ¼" radiating pipes with a combined area of 7·362 s.q. in, and to make matters worse a 2" drip is placed at end of pipes. The back pressure on engine is due to your not having area sufficient in your heating pipes. Then again your exhaust steam has to travel about 446 feet after it leaves the exhaust main, and supposing it has a temperature of 212° when leaving the engine (it should not be higher) it is very likely that it is condensed about the time it gets half way round. To overcome the difficulty, we would suggest that you cut the pipes running round factory in about the center and put in two headers each having a 2" return drip, which you can run to your tank or whereever you like. Then run a 4" pipe from above your present 4" main and attach it to what is now the return end of your coil, thus making two separate coils. Of course it will be necessary to give the pipes the necessary fall to the return end. If an exhaust heating system is properly constructed and has sufficient area there should be no back pressure on engine at all; in fact there should be partial a vacuum.

MOONLIGHT SCHEDULE FOR DECEMBER.

Day of Month.	Light.	Extinguish.	No. of Hours.
	H.M.	H.M.	H.M.
1......	P. M. 50.0	A.M. 2.30	9.30
2......	" 5.00	" 3.30	10.30
3.	" 5.00	" 4.30	11.30
4......	" 5.00	" 5.30	12.30
5......	" 5.00	" 6.10	13.10
6......	" 5.00	" 6.10	13.10
7......	" 5.00	" 6.10	13.10
8	" 5.00	" 6.10	13.10
9......	" 5.00	" 6.10	13.10
10......	" 5.20	" 6.10	12.50
11......	" 6.20	" 6.20	12.00
12......	" 7.20	" 6.20	11.00
13......	" 8.30	" 6.20	9.50
14......	" 9.30	" 6.20	8.50
15......	" 10.40	" 6.20	7.40
16......	" 11.00	" 6.20	7.20
17......	" 11.40	....	6.40
18......	....	" 6.20	
19......	A.M. 12.50	" 6.20	5.30
20	" 2.10	" 6.20	4.10
21......	" 3.20	" 6.20	3.00
22......	No light.	No light.	....
23......	No light.	No light.	....
24......	No light.	No light.	....
25	P. M. 5.10	P. M. 8.50	3.40
26.	" 5.10	" 10.00	4.50
27.	" 5.10	" 11.10	6.00
28	" 5.10	A. M. 12.20	7.10
29......	" 5.10	" 1.20	8.10
30......	" 5.10	" 2.20	9.10
31 ..	" 5.10	" 3.20	10.10
		Total,	247.50
		Grand Total,	2,155.50

The Canadian General Electric Company put in successful operation a few days ago their new incandescent light system at London, Ont.

The Canadian Locomotive and Engine Co., of Kingston have recently manufactured for the School of Practical Science, Toronto, a solid fly wheel 4 feet in diameter and weighing 1650 lbs. This wheel has been placed on a dynamo countershaft which makes 450 revolutions per minute. Thus, the wheel has a periphery velocity of 5,900 revolutions Owing to the irregular working of the gas engine used to operate the laboratory machinery, the speed of the countershaft to which this wheel has been attached was formerly subject to sudden variations up to 20 per cent. rendering the use of the electrical recording instruments by the students impossible. By the use of this fly wheel the difficulty has been almost entirely overcome, the greatest fluctuation in speed at present being 3 per cent., and this occurring less suddenly than formerly.

STEAMBOAT LIGHTING BY ELECTRICITY.

By R. W. Herring.

The lighting of steamboats by electricity is now a very common and ordinary thing, but the time was, and not very long since, when the first steamship fitted with an electric light plant was a great marvel. This was about thirteen years ago, when the steamship Columbia, of the Oregon Railway & Navigation Co., was so lighted. It appears that in 1879 the president of the company, Henry Wellard, conceived the idea of lighting every room on board the steamer Columbia by electricity. By his orders and under suggestions from Mr Edison himself, Mr. J. C. Henderson, then advising engineer of the Oregon Company, wired the new steamship, using No. 11 for mains and No. 32 wire for branches, the wire used being Underwriters double cotton covered, paraffined and painted all over.

The plant consisted of four dynamos, one of which was run as an exciter for the others. All of these machines were driven from a countershaft directly overhead, the countershaft being belted to a pair of vertical engines at a very high angle in order to economise space.

The first lamps used were of the paper carbon variety, and were found to be very irregular in their duration of life and so liable to breakage by heavy shocks that it was found best to suspend them directly from the wires above and do away with sockets entirely. The lamps being surrounded by a ground glass globe the attachment was hidden entirely, the lights being suspended from the ceiling. Later on these lamps were replaced by bamboo carbon lamps—these gave much better satisfaction. It was some of the experiences on board the Columbia that led to the introduction of safety valves.

This plant is described in one of the old Edison bulletins as being the first plant ever put in operation in the hands of strangers.

The only plant that could compete in the art was that built for the unfortunate exploring steamer Jeannette, now lying at the bottom of the Arctic Ocean.

Since the plant was thus put on the S. S. Columbia, hundreds, and I might say thousands, of boats have been equipped with the electric light.

The great advantages to be gained by the electric light are, first, that of economy, inasmuch as it does not require the services of an attendant to trim and light the lamps. There is also much less expense for breakage; besides it is much cheaper than oil. I might here say that the quantity of oil used for lighting purposes only on some of the largest steamers, will average nearly two barrels per week. The next very important point is that of safety from fire, as no matches are required, and all danger of explosion from coal oil lamps is overcome, and there is no necessity to keep the doors and windows closed to keep the lamps from smoking the chimneys or from being blown out. The electric light is also perfectly clean and does not give off any unpleasant odor as is the case with lamps or candles. This alone is a great advantage, especially in rooms where passengers are sea sick.

All this is true, but the incandescent light has so thoroughly gained the day that argument has no longer to be made on these lines; in fact there is no need to make any argument at all for a first class passenger steamer not equipped with electricity is something to be considered far behind the times.

Now, as I am directly interested in this particular branch of electric lighting through my connection with the Richelieu and Ontario Navigation Company, I will endeavor to give you a brief description of a few of the different plants under my charge.

First, I will mention that of the steamer Carolina, which was purchased by the company and brought on here from Baltimore last spring. This plant was installed, I should say, about five or six years ago. It consists of a 250 light Edison dynamo of the type usually built at that time, belted directly to a 30 h. p. Armington & Sims High Speed Engine. The mains which consisted of a pair of No. 2 Okonite wires running direct from the machine to the ceiling and there soldered into two pair of No. 4 wire, one pair running forward and one aft through a bank of branch cut-outs; from these cut-outs branches were run in moulding to all the different parts of the boat, the dynamo room being situated almost midship, it was a very good point of distribution.

There was no switchboard or instruments of any description excepting the Rheostat. The main saloon is lighted by one elegant sixteen light electrolier which is nicely fitted with six oil lamps for use in case of emergency; there are also one four and one six light fixture besides numerous side brackets which give a very fine effect. The saloon forward is also very nicely lighted after the same style. The dining saloon is lighted by a very neat two light combination fixture over each table. The ladies' cabin is also well lighted. There is also a light in each stateroom, in all passages, washrooms, lavatories, etc. The wires running to these single lights are soldered on to the mains in the moulding and coming out one side passing through a single pole fuse block and then down to a vamp switch and up to the light which is on the ceiling, the other wire running direct from the main to the light. The wire used for these small branches was No. 18 Habershaw, and was stapled in grooves cut in the woodwork, which when painted made a very neat job, but hardly in accordance with our wiring rules of to-day. Each socket was attached to the ceiling with a small spiral brass spring, which greatly relieved the lamp from the vibration of the boat. They also used electricity for the mast head and side lights. These were fed by a cable passing through a rubber tube, the wire being attached to a plug which fitted a receptacle which was fitted to a block of hardwood made to fit inside the different lanterns and wired for two lamps, one lamp being wired in series with a relay which, when the current was on opened the circuit connecting lamp 2, so that in case No. 1 should burn out the circuit would be broken and No. 2 be immediately closed, thus doubly insuring a constant light; these lights are governed by a switch in the pilot house.

I will also give you a few particulars of the plant on board the steamer Quebec, which is one of the largest and best equipped passenger boats in Canada, and is fitted especially for night service. The electric light plant consists of a 300 light 110 volt T. & H. dynamo, manufactured by the Royal Electric Co., Montreal. This machine turns 1200 revolutions per minute. It is belted direct to a Robb-Armstrong high speed engine turning 235 revolutions per minute. The steam is supplied by a boiler put in especially for this purpose.

The mains, which are of No. 0 wire, run direct from the machine to the ceiling and then to the busbars on the switchboard, which is made of black walnut and fitted with four single pole knife switches, mounted on slate bases; it is also arranged with a voltmeter and rheostat. The branches are taken off the busbars, which extend across the lower portion of the switch board, the branches passing upwards into a bank of cut-outs immediately above the switchboard, one side of each set passing through a switch; from the cut-outs the branches run in moulding to the different parts of the boat. The main saloon which is about two hundred and fifty feet long, is lighted by four nine light and two four light electroliers, besides a number of side lights on brackets, there is also a light in each stateroom, of which there are about one hundred and fifty. The washrooms, lavatories, passages and promenade deck are also well lighted. The dining room is nicely arranged with lights directly over each table, and is also equipped with revolving electric fans, which have a very pleasant effect. The main deck, engine room, mess-rooms and forecastle are lighted by lamps placed in receptacles attached directly to the ceiling. The circuits and switches are arranged so that only part of the lights on the main deck and saloon can be turned off or on as desired. In all there are about 300 lights on this boat. I might say here in regard to the engine and dynamo which were put on board last spring, that we have not had the least trouble with them in any way, and that they have given perfect satisfaction.

I will also give you a few particulars of our new steamer Columbian which was built two years ago especially for this company by the Deleware River Iron Ship Building Company, of Chester, Pa.

She is fitted up with all modern improvements. She is a twin screw steamer, being driven by two triple expansion engines of the latest type working with a steam pressure of 120 lbs. to the square inch.

The electric light plant consists of a 150 light Edison dynamo of the latest type, belted directly to a Case automatic high speed engine running at 620 rev. per minute, with 120 lbs. steam pressure. The switch-board which is made of black walnut, is fitted with two 50 amp. D. P. switches and four 25 amp. O. P. switches, also a Weston volt meter and ammeter, a ground detector and two 50 amp. branch cut-outs and rheostat. The mains run from the machine into the two 50 amp. cut-outs, one leg passing through the ammeter. From one of these cut-outs two branches are taken to supply the main deck, one running forward and one aft. From the other cut-out a set of mains is run up to the saloon deck midshipt into a tank of four cut-outs, from which run four branches, two for each side of the saloon, one running forward and the other aft. Just below each cut-out there is a switch on each branch, so that the light can be turned on or off in any part of the saloon as required. The cut-outs are nicely arranged in a neat case on the wall, with a glass door which is fastened with lock and key.

The wire used in the installation of this plant is the Grimshaw white core, and is run in a very neat moulding fastened with brass screws and very neatly put up. The saloon is nicely lighted with center electroliers and side brackets. There is a light in each stateroom, each light being controlled by a switch and protected by a small porcelain fuse block set neatly in the moulding with a mica cover and containing 1 amp. fuse link. The fixtures are of very tasteful design and are made of brass with black trimmings.

We have several other steamers lighted by electricity, but the few details I have given you I think will be sufficient to give you some idea of the construction and working of an electric light plant on board ship. I might here say that you will scarcely ever find two steamers equipped just alike as there are a great many things to be taken into consideration before installing an electric light plant on board a steam boat, such as suitable location for plant, steam pressure of main boilers; if it is necessary to put in an extra boiler; to find a suitable place to put it, &c. Then in regard to wirng and switches, some boats running only at night require to be lighted all through from dark till daylight; in others running day and night there are parts which require to be ligeted in the daytime as well as the night; therefore the wiring and switches must be put in, to fill, as far as possible, these requirements. There is no doubt that in the future all these and many other necessary items will be taken into consideration when new boats are built, and thus do away with the many disadvantages we have to contend with in wiring and fitting up boats after they have been completed.

Some steamers also carry search lights, but so far these are mostly used on war vessels for signalling purposes and for locating objects at a distance. On river steamers they are not considered to be of any great advantage and are looked upon more as an expensive luxury than a necessity as it is found that in order to operate a search light properly it is necessary to have a practical man for that purpose, which is quite an extra expense, as the plant is nearly always looked after by one of the engineers and does not require an extra man.

There is another system of wiring which has been used on some steamers, mostly vessels made almost entirely of iron or steel, such as war vessels. We have what is called the two wire system and the three wire system, but the system I allude to should, I think, be called the one wire system, inasmuch as only one wire is used, the iron hull of the vessel being used for the negative or return, one pole of the dynamo being grounded on the ironwork of the vessel and one wire run to each light, the opposite side being also grounded on the ironwork, but as I have had no experience with this style of wiring I would not recommend it, and you must be your own judges of the practicability of the scheme.

I might say in conclusion concerning the wonderful advances and improvements which has taken place within the last few years in all branches of the electrical business, that I believe the time is not far distant when the business will be divided up so that a man in order to be successful will have to give all his time and attention to one particular branch, and will not be expected as he now is, if he calls himself an electrician, to tackle anything from a common door bell to a street car motor or a 5000 light alternator, and I believe that steamboat lighting will be one of the important branches of the electrical business.

* Paper read before the Montreal Electric Club.

SPARKS.

The town of Knowlton, Que., is to be lighted by electricity.

The contract for the electrical machinery required by the Cataract Construction Company, at Niagara, has lately been awarded to the Westinghouse Company, who will employ the Tesla multiphase system. There will be employed 3 generators of 5,000 h. p. each, with corresponding motors and accessories. These machines will generate 2,000 to 2,400 volts. The E. M. F. will be increased or lowered by transformers.

The Royal Electric Company of Montreal, have just completed and successfully tested a 5,000 light machine, for the Standard Electric Company of Ottawa. This is said to be the largest machine yet manufactured in Canada. The company have commenced work on the foundation of a new boiler and engine house adjoining their present station. The size of the boiler house will be 66 feet square, and of the engine house, 53 by 96 feet.

The new power house of the Ottawa Electric Street Railway is being roofed in. There have been placed in position by Messrs. Wm. Kennedy & Sons, Owen Sound, two water wheels, each 160 inches in diameter, and capable of generating 500 h. p. These wheels will be used to operate two 400 h. p. dynamos. Two additional wheels will be installed at a later date. From 900 to 1,000 h. p. will be employed in the operation of the street railway system during the winter.

At St. Anne du Sault, a few days ago, a boiler exploded in a shingle mill, causing the death of three men and injuring several others, besides causing serious damage to property. This boiler had previously been examined in the establishment of a second-hand machinery dealer, and had been pronounced unfit for steam pressure. Notwithstanding, it was sold and put into use, and after having been in use only five days, it exploded with the result stated. If machinery dealers will sell boilers of such character, it is time that the Government should insist upon proper inspection of steam boilers.

CANADIAN ASSOCIATION OF STATIONARY ENGINEERS.

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

ANNUAL DINNER OF TORONTO NO. I.

THE seventh annual dinner of Toronto No. 1 took place at the Avondale Hotel, Toronto, on the evening of Nov. 23rd. The attendance was considerably larger than on any previous occasion. Unfortunately the accommodation provided was not adequate, so that it was found impossible to seat at once all the guests. This contingency will no doubt be provided for in the future.

Among those present were noticed the following:

Toronto—Prof. Galbraith, Principal School of Practical Science; Mr. Cassidy, Editor *Canadian Manufacturer*; Jno. Galt, C. E., M.E.; J. Inglis; A. E. Edkins, Prov. Dep. for Ontario; A. M. Wickens, Dist. Dep; Wm. Sutton, Vice-Pres. Executive; W. G. Blackgrove, Treas. Executive; W. Philip, Pres. Toronto No. 1; W. Butler, Vice-Pres. Toronto No. 1; Ed. Philip, Geo. Gilchrist, John Fox, H. E. Terry, Samuel Thompson, Geo. Fowler, Geo. Mooring, Fin. Sec'y Toronto No. 1; C. Mosley; W. L. Oathwaites; J. Barber; Wm. P. Sutton; Huggett; Ed. Appleton; Alex. Fraser, Secy-Treas. Boiler Inspection and Insurance Co.; John Perkins; Geo. Grant; A. S. Wilson; J. Sanrioll; James Wadge; F. Tushingham; Mr. Crosby, Chief Engineer T. Street Ry. Plant; S. Mathews, Asst. Eng. T. St. Ry. Plant; F. Forster; David McCulloch; Ed. Ash; R. Waterson; F. Smith, Sec'y Marine Engineer's Association; Geo. Gore; Geo. Haworth; Walter Lewis; J. Johnson; John Day; Fred. Day; George Thompson.

Hamilton No. 1.—Robert Mackie, Dist. Deputy; Duncan Robertson; J. Langdon; R. Chillman.

Kingston No. 10.—Jas. Devlin, President.

Galt—W. T. Brown.

Brantford No. 4.—Arthur Ames.

After ample justice had been done at the festive board, the toast list was proceeded with.

Mr. Wilson Phillips, President of Toronto No. 1, occupied the chair, and made some brief remarks expressive of his pleasure at seeing so large a number present. The toast of the "Queen" having been duly honored, the Chairman proposed the toast of "Canada, Our Home," and coupled therewith the names of Mr. Cassidy, of the *Canadian Manufacturer*, and Mr. Burton.

In reply Mr. Cassidy said that only a short time ago Canada was an unknown country, but to-day it was one of the foremost countries of the earth. The cause of the rapid development which had been made was chiefly the enterprise and ability of such men as were here to-night, men who were interested in the industries of the land. The Government had very wisely provided that marine engineers must be licensed, but it was not so in the case of stationary engineers. He thought it would be in the interest of all engineers if the Government would compel the licensing of engineers, in order that only competent men would be allowed to operate steam plants. It should be and no doubt was the desire of steam users to improve the standard of engineers, and they should lend a ready hand withthat end in view.

Mr. Burton was then called upon, but did not respond.

"Toronto, the Queen City of the West" brought a response from Ald. Bell who referred to the benefit derived by citizens from the formation of the C. A. S. E. They had taken a stand to benefit the public as well as themselves. In 1868 the speaker and two or three others tried to start an association but were unsuccessful. However, since the formation of the present organization great strides had been made, and its influence was being felt all over the land. He fully agreed with Mr. Cassidy's remarks regarding the licensing of engineers, and would like to see every stationary engineer a member of this association.

The toast next in order was "Our Educational Interest," which was acknowledged by Prof. Galbraith, of the School of Practical Science, and Mr. John Galt, C. E.

Prof. Galbraith congratulated the members that during the present depression there appeared so few signs of hard times among the engineers. One great cause of trouble in the present age was strikes on the part of employees. The C. A. S. E. was promoted to raise the standard of engineers, and this was the fair way to get their proportion of the profits. The trade unions should not try to force employers to put all employes on equal pay. For wage earners the true principle was for every employee to do his best, not to try to estimate his own wages, for he would be left behind in time of depression. The ambitious man is the man who endeavors to do his best for his employer; the other man has no ambition who measures his services by his pay. Engineers should educate themselves to take a broad view. With regard to educational work he could only say that they had exceeded all expectations both in the School of Science and Toronto Technical School. The speaker also referred to the advancement of electrical engineering, concluding his remarks by inviting all the members to a test of a steam plant to to be held at the School of Science on Friday evening, the 1st of December, from 7 to 11 o'clock.

Mr. Galt could remember well the formation of the C. A. S. E. It had been formed on educational lines, and education was an important and valuable feature of the association. The engineer of the past would be brushed aside if he did not keep pace with the developments in electrical and steam engineering The effects of the C. A. S. E. were being felt all over the Dominion. There was no question that a certificate of this association was a guarantee of a good honest and successful engineer. With regard to a Government license, he thought the stationary engineers' association was fast becoming as important or more so that the Canadian Society of Civil Engineers, of which he was a member. This society was in a similar position regarding a license law but had no fear of the future, and when the time came he thought there would be no difficulty in obtaining it. Regarding steam engines, for a time nothing was talked of but high speed engines, but there seemed to be a growing tendency at present towards the old style of slow speed engines. It was with a view to meet this demand that multipolar dynamos were being constructed. We will now have ordinary slow speed engines running dynamos and generators. Mr. Galt thought that it was only a question of time when the Canadian Association of Stationary Engineers would be recognized as the only body of mechanical engineers of importance in the land.

Mr. W. T. Brown was then called upon to respond to the toast, "Our Manufacturing Interests." In a few well chosen remarks, Mr. Brown urged upon those present the advantage to be derived from self education. The best engineers were those who studied all the details, and took an interest in themselves, their employers and their plant. He was glad to see that in small towns where there was no branch of the C. A. S. E., engineers were endeavoring to secure all the information they could, and no doubt the society would soon spread to the smaller towns also.

Mr O. P. St. John, also made a brief reply, contrasting the position of the engineer of to-day with that of the engineer in the past. At one time all that was necessary for an engine to do was to start and to stop the engine, and to keep the plant running as long as possible, but times have changed, and there now exists among engineers a friendly spirit to excel, to obtain information, and to handle their plant with economy and efficiency. Mr. St John also referred to the fact that steam users were gradually coming back to slow speed engines and he was certain there was greater economy with the long stroke engine.

Mr. Perkins, jr., also made some remarks in reply to this toast.

The "Executive Council C. A. S. E.," was responded to by Bro. A. E. Edkins, who thanked those present for the hearty manner in which the toast had been received. He regretted that their Executive President, Bro. George Hunt, was unable to be present in his official capacity, as he certainly would have received a very hearty welcome. He thought the outlook for the coming year was bright for the association. Since their meeting in Montreal an association had been started in Kingston, with a membership of 30. He found it difficult to organize new associations in small towns, which was no doubt due to a great extent to indifference, but some improvement was taking place. Papers on steam engineering had been read and published, and these papers were being read and studied by the engineers throughout the country, and as a consequence more interest was being taken in the C. A. S. E. The demand for engineers for electricity was increasing, and he urged the engineers to study along this line. When we take into consideration the large number of compound and even triple expansion engines which are now being sent out of the shops for stationary purposes, compared with a few years ago, we can more readily see the necessity for such an organization as the C. A. S. E. An organization in which men can exchange views on matters affecting their every-day duties was certainly a great benefit, and was deserving of public support, but more especially of the support of steam users. The association had nothing to be ashamed of, but a great deal to be proud of, as they were not working against employers, but to benefit them.

Mr. Edkins thought that all steam users should be honorary members of the association; they would be gladly welcome as such. It was only a matter of time when there would be a branch of the association in every town where ten or fifteen engineers were employed.

Mr. Grant was then called upon to respond to the toast of the "Amalgamated Engineers." He remarked that this society was different from the C. A. S. E., inasmuch as it was a trades organization, but nevertheless they did not rush into strikes on every occasion. They thoroughly understood the law of supply and demand. In 1851 there were a number of sectional societies in England, but being so scattered they found they had no power to improve their condition. Some of the leading men proposed amalgamation which was consummated in that year, although it met with great opposition by employers, who did their utmost to destroy it. The speaker produced some figures showing the extent to which the society had grown, and referred to the improved position of the steam engineer of to-day.

After the toast of "Old Toronto No. 1" had been drunk with enthusiasm, Mr. A. M. Wickens was asked to say a few words in reply. He referred to the formation of the association, which was commenced by eleven members, and the success which had attended their efforts, notwithstanding the opposition which had been met with. Some steam users seemed to have the idea that any person could operate a steam plant, and incompetent men were engaged who would undertake the work, the result being they got into trouble. With regard to a license law, Mr. Wickens said that after three years of persistent work, the Legislature had granted a permissive law, under which a Board of Examiners had been appointed. This Board had granted hundreds of certificates. Toronto No. 1 had spent $850 for education and legislation. The co-operation of all employers was solicited. Not long ago the speaker was called upon to examine a boiler, the botton of which had been burnt out, and he found that the man in charge had been firing away for seven hours without any water in the boiler. Some figures were then given showing the number of explosions per year and the results thereof.

There was no representative present to respond to the toast, "The Marine and Locomotive Engineers."

"Hamilton Association" was responded to by Messrs. R. Mackie and Jas. Langdon.

When Mr. Devlin rose to respond to "Kingston No. 10," he was greeted with loud applause, this association being the last one to cast in its lot with the C. A. S. E. Mr. Devlin hoped the time would soon come when an engineer would be compelled to hold a certificate in order to operate a steam plant.

After the health of the various branches of the association and of the "Press" had been drunk, the most successful annual dinner of the C. A. S. E. since organization, was brought to a close by the singing of "God Save the Queen."

The Committee who had charge of the dinner, and to whom great praise is due for its success, was composed of Messrs. Samuel Thomson, Chairman; H. E. Terry, Sec-Treasurer; A. E. Edkins, W. G. Blackgrove, J. Harper and George Fowler.

The musical part of the evening's entertainment consisted of songs by Messrs. Grant, Anderson and Blackgrove, and a banjo duett by Messrs. Tuppen and McHenry. The duties of accompanyist were performed in an admirable manner by Mr. A. E. Harding.

TORONTO NO. 1.

AT a meeting of the above Association held on the 10th November, Bro. Charles Heal presented to the association a framed photograph of the delegates to the recent convention in Montreal. The meeting was an open one, the main feature of the programme being a paper by Bro. A. M. Wickens on the "Expansion of Steam." The paper was an able and interesting one, and evoked considerable discussion, and also a vote of thanks to the author. Bro. G. C. Mooring is preparing a paper on "Combustion" to be read at the next open meeting.

OTTAWA NO. 7.

A member of the above Association under the *nom de plume* of "Corn Cracker" writes as follows:—Very seldom you get matter for publication in your columns from Ottawa No. 7. It may appear to other Associations that we are frozen stiff in this "Saw Dust" City, while others would be under impression that our officers are kept too busy attending general business. Anyway there is no reason why we should appear to be fading out of existence for the want of notice in your publication. I have no intention of going too far back in the history of our proceedings, but will say a few words regarding the last regular meeting on Nov. 14th, with the Vice-President, Bro. F. Merrill, in the chair.

One application was received and referred to the proper committee. This makes the fourth member coming in since the last convention, and one of them is a well known Toronto gentleman in the person of Bro. Donaldson, which gives proof that the good work and material in Ottawa No. 7, attracts engineers from all over the country.

Under "Good of the Order" the first question was the piston speed at different points of the stroke. The ball was set rolling by Bro. Thomas Wensley, who gave a minute explanation, accompanied with diagrams, showing the crank at different angles and the position of the piston at each of these points, demonstrating the irregularities in the travel of the piston and crank in one revolution. Several other members took part and it brought out theories, opinions and experiences sufficient to make it very interesting for all present.

The next question of importance was the capacity of pumps when some one asked why a pump would not lift hot water; this brought out once more plenty of opinions to show on what principles a pump lifts water.

As far as I can judge Ottawa No. 7 is progressing very favorably although I will admit that it has been retarded, but we expect soon to be on a level with time. Already some of the engineers have promised something interesting on engineering for the next meeting, and it is my intention to keep "the boys" posted on the ingenuity of our inventors.

KINGSTON NO. 10.

Editor ELECTRICAL NEWS AND STEAM ENGINEERING JOURNAL:

I was in Kingston from Oct. 21st to 24th inclusive, and, having a few hours time to spare, took advantage of it to visit the steam plants and engineers and in conversation with some of them, regarding the C.A.S.E., I suggested the advisability of the Kingston Engineers' Association being made a branch of the C.A.S.E. The result was, that after due consideration, an advertisement was inserted in the two papers calling on all engineers to meet at 7.30 p.m. at No. 1 Fire Hall (on Tuesday, Oct. 24th) to consider the advisability of organizing a branch of the C.A.S.E. in Kingston. I was informed that the Kingston Engineers' Association was composed of thirteen members, and to my surprise and delight, when I arrived at the place of meeting on Tuesday night I found between 25 and 30 engineers in the hall. The president, Mr. J. Campbell, being absent, the secretary appointed Mr. J. Devlin, Chief Engineer of the K. Penetentiary, to take the chair, which he did, and after calling the meeting to order, requested that I should address the meeting on the principles, aims, and objects of the C.A.S.E. and the benefits to be derived from membership.

After some discussion it was resolved, That the Kingston Association of Stationary Engineers be abandoned and that a branch of the C.A.S.E. be formed, and application for a Charter accompanied by the usual fee be handed to Bro. Edkins at once. After some 25 engineers had given in their names for membership, the election of officers was proceeded with, which resulted as follows:—President, James Devlin, Chief Engineer K. Penetentiary; Vice-President, H. Qaulden, Chief Engineer Fire Department; Treasurer, H. Hopkins; Recording and Financial Secretary, Anthony Strong, Chief Engineer Dominion Cotton Mill (residence, corner of Bagott and Charles St.); Conductor, J. Langhrane; Door Keeper, J. Gascoigne.

After the initiatory ceremonies were concluded, it was resolved, That a vote of thanks be tendered to Prov. Deputy Bro. A. E. Edkins, for the interest he had taken and work he had performed in the organization of Association No. 10. It was also resolved, That the thanks of this Association be tendered to Bro. H. Gilmour for his services as secretary of the late Kingston Association of which he was a most devoted member.

This brought Bro. Gilmour to his feet, and in the course of a neat speech, he said that as they were now attached to the C.A. S.E. he was determined to do everything in his power to further the interests of the Association and he trusted that every member would make up his mind to attend regularly and not only learn all he could from others, but be ready to give his experience for the benefit of his Bro. Engineers. From what he knew of the C.A.S.E. and its principles he felt that it was working in the right direction both in the steam user's interest and in the interest of engineers, and from the enthusiasm which had been shown by the members, he predicted a fine healthy and in every sense of the word useful branch in Kingston.

President, Bro. Jas. Devlin, then addressed the meeting asking the officers and members to give him their support in carrying out the work of the Association.

It was decided that the Association should meet every 2nd and 4th Tuesday at 8 p.m. in Engineers' Hall, over No. 1 Fire Hall.

Regret was expressed by several members that Bro. R. King could not be pursuaded to take office, as he is known as a worker and an energetic engineer. Bro. King is Chief Engineer for the Kingston Light, Heat and Power Co., and told the Association that his duties in that capacity would often necessitate his absence from the meetings, and for that reason he could not take office.

Meeting adjourned at 10.30, when light refreshments were served and a pleasant half hour spent in general conversation.

These "Limestone City" Engineers are alive and are determined to make No. 10 outshine everything.

Yours, etc.,

A. E. EDKINS,
Prov. Deputy.

[The above was received too late for insertion in our November issue.—Editor NEWS.]

TRADE NOTES.

The Peterboro' Electric Railway Co. has placed an order with Ahearn & Soper, Ottawa, for one vestibule car and one rotary snow-sweeper, both equipped with Westinghouse motors.

The old-established business of Messrs. F. E. Dixon & Co., leather belting manufacturers, of Toronto, has recently been converted into a joint stock company. Mr. F. E. Dixon will continue in the management of the business.

We call attention to the first appearance in this issue of the advertisement of the Steam Boiler and Plate Glass Insurance Company, of London, Ont. The company will assist in educating the owners of steam boilers to the necessity for regular and competent inspection of steam plants.

Messrs. Wm. Kennedy & Sons, manufacturers of water wheels, etc., of Owen Sound, have recently added to their works a gear dressing machine capable of dressing the iron or wooden teeth of spur or bevel gears up to 20½ inches face. The machine works automatically, and will dress teeth of any shape. There are said to be only four machines of this kind on the continent.

The Reliance Electric Mfg. Co., of Waterford, have made the following sales: Prescott Electric Light Co., 900 light alternating current incandescent plant; The Ontario Government, for Central Prison, Toronto, 35 light dynamo, 35 arc lamps, 200 light direct current incandescent plant; The Parkhill Electric Light Co., 30 light arc dynamo, The New Hamburg Electric Light Co., 15 light arc dynamo; The Canadian Oiled Clothing Co., Port Hope, 50 light incandescent plant; Wiarton Electric Light Co. 60 light arc dynamo, Watford Electric Light Co., 40 light arc dynamo; The Sutton Electric Light Co., Simcoe, Ont., 750 light alternating current incandescent plant; The Slingsby Mfg. Co., Brantford, Ont., 200 light direct current incandescent plant. In addition to the above the Company have recently sold a large number of stationary motors.

The Ottawa Street Railway Company propose to double track their Rockliffe, Elgin and Catherine streets' lines.

The Nanaimo, B. C., Telephone Company has just paid a dividend of 10 per cent. The retiring directors, Messrs. W. F. Salsbury, Pimberry Norris, and Praeger were all re-elected.

ELECTRIC RAILWAY DEPARTMENT.

THE TORONTO RAILWAY COMPANY.

The following particulars of the power plant and equipment of the Toronto Street Railway is abstracted from a recent number of the *Street Railway Journal* from which also the accompanying illustrations are reproduced.

The power station (Fig 1) is 137 x 122 ft., and was originally a stable, as may be inferred from the many windows. It is located at the junction of Frederick and Front Streets, and is of red brick and stone trimmings. Geo. F. Hammond, of Cleveland, was the architect, and the iron work was provided by the Dominion Bridge Company.

The boiler room has a trussed roof, leaving it free from posts or pillars of any kind. The roof, which is fifty-two feet from the floor, has in it two large ventilators, giving plenty of fresh air. Doors, which are raised with weights, are situated along the front of the building, permitting the removal of ashes and cinders with the least possible amount of handling. The steam equipment consists of twelve 72 in. x 18 ft. boilers, made by the Polson Iron Works, of Toronto, and containing seventy-two four inch tubes each. The smoke breeching for the boilers is of one-quarter inch plate steel, and is connected to each boiler and to the stack at its center. Each boiler has a seven inch steam branch to the fifteen inch steam header, the latter being made of fifteen inch, lap welded tubing, with steel flanges at the ends and steel nozzles along the shell, these all being riveted and caulked. Feed water is taken from the hot well at the condensers to each of the three feed pumps, and from there to either of the two Morse heaters, and from the heaters to either of the two feed mains. One feed, which is operated by hand, delivers into the bottom of the boiler through the blow-off. The upper feed discharges, through Hartford style of piping, in the upper portion of the boiler, and is controlled by an automatic feed regulator. The pumps are five in number, three being of the Davidson type, and two automatic, and are also controlled by a pressure regulator. The feed water is heated by steam that passes through the pumps, the pumps being run with sufficient back pressure to supply the heater with the required steam. In case the steam from the pumps is not sufficient for the heaters, regulating valves will admit of enough more to bring up the pressure. The pumps are so arranged that they can exhaust into the atmosphere, if desired, the steam for the heaters, in that case, coming directly from the steam main. The steam header pump suctions and dischargers are all so arranged as to divide the station into two distinct halves, permitting either half to be run independently of the other. At each header there is an automatic pump which delivers all the condensation from the heaters and header back to the boilers. Schaffer & Budenburg gauges are used.

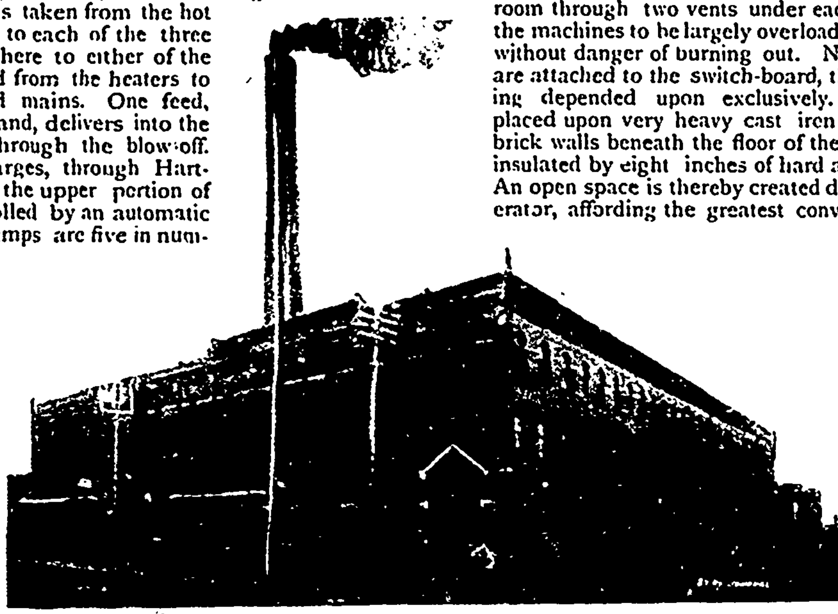


FIG. 1—POWER HOUSE, TORONTO RAILWAY COMPANY.

The engine room has a trussed roof, with ceiling fourty-four feet high. The flooring is of 6 inch hemlock scantling laid on edge on steel joists, and this is covered with one and a quarter inch hard wood flooring. The room presents a handsome appearance, as the engines and belts are protected with iron railings fitted with polished brass trimmings, and the building is lighted with incandescent and arc lamps run from the railway circuit. A large traveling crane, with a capacity of twenty tons, stretches entirely across the room.

The power equipment consists of five Armington & Sims 600 h. p. engines. Four of these were specially manufactured for this plant, and have each two driving wheels, 25 ins. x 9 ft., placed between the high and the low pressure cylinders, each half engine being on a separate base, with a crossover steam pipe below the floor. All the engines have Corliss valves for the low pressure cylinder, with a new design of valve motion, so arranged as to give a quick cut off, and make a card similar to a Corliss. Each engine is connected to independent Davidson condensers; there are also branches to the automatic relief valves, and thence through the roof. The engines are so piped that they can be run non-condensing, and while in this condition with the load on, can be connected with the condensers without stopping or throwing off any load. Should the condensers drop their vacuum the relief valves will open instantly and permit the engines to run non-condensing till the vacuum is restored. The condensers take water through a 30 inch steel pipe from the lake, a distance of 620 feet., being under the water line for the entire distance. Each condenser discharges through a ten inch pipe into a discharge main which empties into a 30 inch brick sewer. The condensers are placed below the floor in front of the engines, and are easily accessible by a flight of stairs.

These engines are connected directly with ten 200k. w. Edison standard generators. All cabling and wiring is taken down through the floor, and carried separately to the station board. The latter is 27 feet in length, and has an ornamental front. The frame is of wrought-iron, and the facing of enamelled slate slabs finished in polished cherry. The amperemeters are of the Edison type, and the volt-meters and circuit breakers of the Westinghouse type. Each feeder has an ampere circuit breaker, and a two-way switch used for high and low pressure in cases of emergency. *Below the switch-board in the basement,* is a Wurts tank lightning arrester. Each of the eleven feeders at the point of entrance to the building is also protected with a Wason four-fuse lightning arrester.

The belts employed were all made from hemlock tanned leather, and were supplied by the Howarth Belting Company of Toronto.

The generators are protected from overheating by a forced draft of air taken from outside the building and transmitted in pipes under the floor by electric power, and entering the engine room through two vents under each armature, enabling the machines to be largely overloaded in cases of necessity without danger of burning out. No fuse wires whatever are attached to the switch-board, the circuit breakers being depended upon exclusively. The generators are placed upon very heavy cast iron arches supported on brick walls beneath the floor of the power house, and are insulated by eight inches of hard and soft wood flooring. An open space is thereby created directly under each generator, affording the greatest convenience for inspection. The basement is fitted with wash rooms, sleeping apartments, store room, etc.

The company's new motor house, which is of red brick and stone, is nearly complete, and measures 140 x 105 ft. It is situated on the northeast corner of Frederick and Esplanade Streets, and extends back to the power house lot. There are large entrances at either end, permitting cars to loop round. *Six tracks run through and are fitted with the* necessary pits, etc., their entire length. Two of these are used exclusively for the inspection of cars, while the other four pits are fitted with hydraulic lifts, etc., necessary for motor equipments and repairs. One side of the building is arranged for the receiving and storage of equipments and spare parts.

All the buildings are fitted up with incandescent lamps run in series of five from the railway circuit.

The company has four large car barns. One is situated on King Street East, near the River Don, and is of red brick and stone. This building is 194 x 164 ft. and will hold 136 cars on the ground floor. It was used as a stable before the adoption of of the electric system and has recently been remodeled to adapt *it for the purposes for which it is now used. Another new,* handsome car barn, built last season, is situated on Yorkville Avenue and extends through to Scollard Street. This is of brick and stone, and is 242 ft. long by 100 ft. in width. Three large entrances are at either end, with tracks extending entirely through the building, permitting the cars to loop round. The entrances are far enough apart to allow of turnouts at either side of the main tracks, thus making nine tracks the entire length of the barn. The main tracks running through are fitted with the necessary pits for inspection of cars. All cars from the Bloor, Yonge and belt line routes are stored in this barn.

Two other barns are located on the junction of Front and Frederick streets, one being on the northwest and the other on the south east corner. The latter is shown in Fig. 1, at the left of the power house. Both of these buildings are of brick and stone, and are three stories in height. The Queen, Brocton, Dovercourt, Church, Bathurst, Winchester and Parliament line of cars are stored here.

The building on the southeast corner measures 137 x 60 ft. The first floor is used as a machine shop, and contains lathes, saws, drills, hammers, presses, etc., necessary in the building and repair of cars. Another portion of this floor serves as a temporary motor shop pending the completion of the company's new motor house, described above. The second floor is used as an armature room, where the company does all its own repairs, such as rewinding of armatures and fields. Several new motors of the company's own make, which have given excellent satisfaction, have been turned out here.

The car house on the northwest corner is 140 x 80 ft. On the first floor are located the car building shops, while the second floor is used by the extensive paint department of the company.

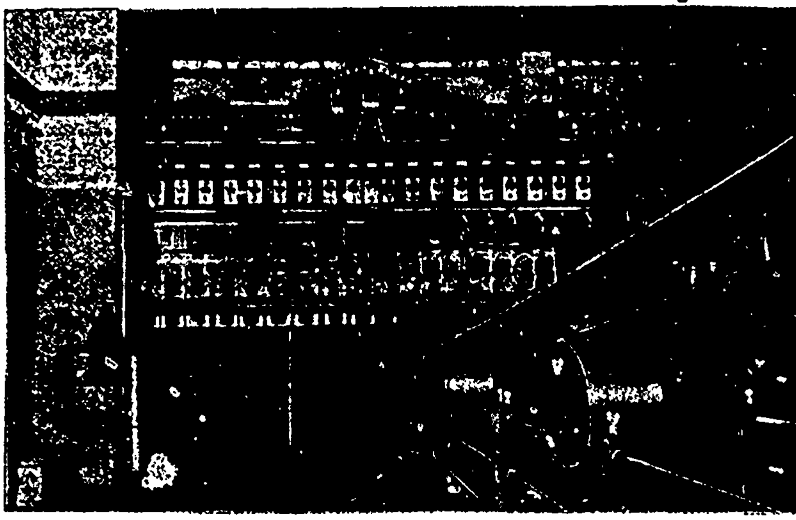


FIG. 2—SWITCHBOARD IN POWER HOUSE, TORONTO RAILWAY COMPANY.

All the car barns are fitted up with wash rooms, waiting rooms, offices, elevators, and all conveniences for the employes.

The company also owns a large, three story, brick and stone building at the corner of George and Front streets, known as the George street stables. All the horses, numbering about 650, now in use on the system, are concentrated at this point. On the second floor of this building is the stores department with all the necessary receiving rooms, etc., for the storage of supplies. On the ground floor is the harness room where all the harness used is made and repaired.

The new track is laid with seventy-three pound grooved girder rails, laid directly on cedar ties. The switches are of steel, and, with the crossings, curves and special track, were provided by the Canada Switch Company, of Montreal. The bonds are thirty-six inches long, of No. 0 copper wire, connected to rails by seven-sixteenths of an inch special rivets. Cross connections are made every 250 ft. with No. 1 wire, and the rails are also connected at intervals with the water mains by means of No. 1 insulated wires. The maximum grade is 5 per cent. extending for a distance of 80 feet, and all curves are of forty-five and fifty feet radius, the maximum allowed by the city engineer. The rails were supplied by Dick, Kerr & Co., of London, England.

The company owns 95 motor cars, 193 box cars and 83 open cars. All the cars of the company were manufactured at its own shops at the corner of Front and Frederick Streets. They are unlike any other make, and were built from designs supplied by the company's shop foreman, Mr. Powers. They are all of a standard size of eighteen feet in length, with extended platforms, making the car twenty-eight feet over all by seven feet ten inches in width. They are quite high and light inside, and have six large windows on either side, with a corresponding number of ventilators in the roof. All the cars have, front and back, large, plain lights which have painted in black upon them the name of the route. These lights are easily removable and can be replaced by others when the car is changed from one route to another. The doors are of quartered white oak, with drop sash and cherry panels. The inside of the cars is finished in quartered oak and cherry panels, and has two large, bevel, English plate mirrors, one at either end. One standard color is in use, the top panels being Harrison's new Tuscan red, while the bottom panels are of Broadway cadmium. The inside of all the cars is finished in oil, with a very little, delicate, ornamental beading along the borders. The seats are beautifully upholstered in Wilton, with the company's monogram woven in the backs. Coil springs of the latest improved type are used. The cars are lighted with a series of five incandescent lamps. The horse cars are lighted with an oil lamp at either end.

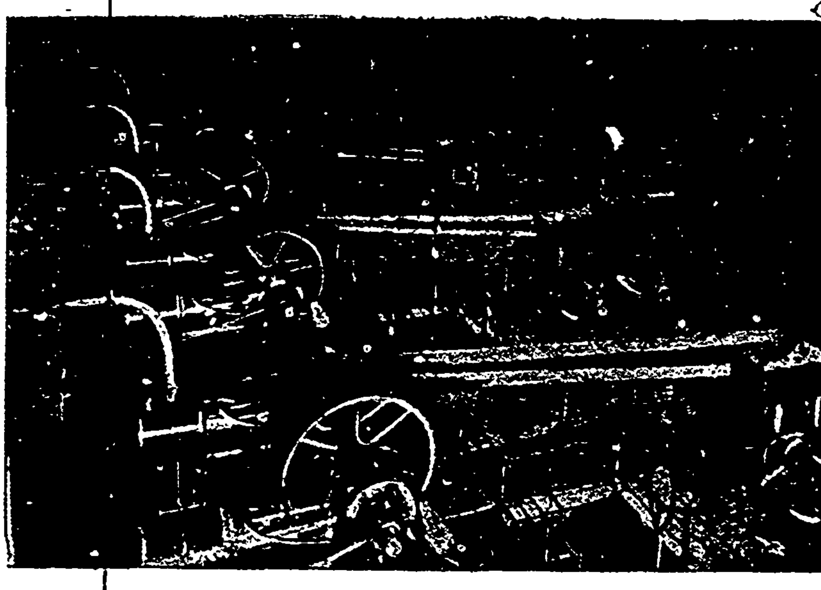


FIG. 3.—INTERIOR OF ENGINE ROOM, TORONTO RAILWAY COMPANY.

Thirty-seven motors were supplied by the Westinghouse Electric & Manufacturing Company, and are of the thirty horse power, single reduction type. All the others are of the Edison type, with the exception of five Thomson-Houston and three Sprague motors. Six McGuire, one Brill and one Taylor trucks are used. The remainder were built by the company, and are of wood. The truck springs are elliptic in the case of the motor cars, and straight in that of the trail cars, and Jones and Bemis gears are used. Electric heaters have been adopted for the motor cars, and Royal stoves for the trail cars. Some of the heaters were manufactured by the company, others are of the Dewey type. Lappin brake shoes and the old type of "coffee pot" fare receivers are employed, though the latter are to be retired for later appliances.

The company owns one electric and ten Walkaway snow plows.

The longest line in the city is the King street line, which is over seventeen and a half miles for the round trip. This line connects the extreme west and east ends of the city, and is very popular during the summer months in conveying people from High Park to Victoria Park, one at either end of the route.

The number of passengers per car mile run during the last fiscal year was 3.9. The average watts per car, when only motor cars are used, is 10,640; when motor and trailers are used, per car, 7,980.

The authorized capital stock is $6,000,000.

RECENT PATENTS.

CANADIAN.

43,759.—Hugh Webster Williams, Victoria, B. C., explosive engine.

43,824.—George H. Waring, St. John, N. B., steam engine.

43,895.—The Bell Telephone Company of Canada, Boston, Mass., telephone.

AMERICAN.

John D. McEachren, Galt, Ont., steam boiler cleaner, No. 507,030.

Herman H. Brown, Montreal, Que., insulated wire, No. 507,257.

Cyrus S. Dean, Fort Erie, Ont., boiler flue cleaner, No. 507,421.

PUBLICATIONS.

"Standard Tables for Electric Wiremen, with instructions for Wiremen and Linemen, Underwriters' Rules and useful Formulae and Data, by Chas. M. Davis, fourth edition, thoroughly revised and edited by W. D. Weaver, flexible morocco, 128 pages, price $1.00. The new edition of this work contains the latest revisions of the Insurance Rules of the Underwriters' International Electric Association, now almost exclusively used in the United States. In addition to the above rules there has been added to this edition an important section on the calculation of alternating current wiring, which for the first time brings this subject within the reach of practical men. The W. F. Johnston Co., New York, are the publishers.

The November *Arena* closes the eighth volume of this popular Review, which, by the conspicuous ability of its contributors, its unequalled, fearless, and healthy reformation impulses, has become a power in the land.

ELECTRIC MOTORS.*

SOME men are born great, some acquire greatness, and some have greatness thrust upon them. As one of the latter I must be counted, and if my remarks are not as interesting as I could wish them to be, please remember that the honor you have conferred upon me was as unsolicited as it was undeserved by me.

The subject I have chosen, "Electric Motors," may appear about as appropriate to deliver before a society of engineers as if I were to go to the Club Canadienne and attempt to advocate certain peculiar advantages which the German language has over the French; but I know I am talking to a body of intelligent, thinking men, whose principal tools must necessarily be "brains," and I do not fear a verdict such as was given in Scotland years ago when a lecturer, who ventured to remark that hand-looms would be superseded by machinery, was told by the operatives that "the sooner his friends looked after him the better"; but, just as the words of the man who was then looked upon as insane have come literally true, there are significant signs that the mighty monarch "Steam," who has so long held absolute sway, must sooner or later give place in many instances to its rival "Electricity."

Numerous hydraulic, compressed air and similar devices have been in the market for supplying power, but, I think it is safe to say, have not come anywhere as near to supplying the general demand for small powers as the electric motor, which is steadily gaining ground and is apparently "come to stay."

Do not for a moment imagine that I claim the extinction of the steam engine; but what I do claim is that fewer will be used, and those which remain will be larger units. Waterfalls are being harnessed rapidly and converted into electric power to be conveyed in an easy manner considerable distances, windmills in conjunction with accumulators have been advocated, and in a small way have had fair success, but what is earnestly sought for and is being experimented on by many is the production of electricity from heat direct. This, as can readily be seen, would cause quite a revolution in electric power production.

The economical limit of the electric motor must be judged primarily on cost of power, and secondarily, by circumstances, such as space, fire insurance risk, capital, etc., so no fixed rule will apply, as both factors vary in different places.

Let us see the advantage to be gained by the electric motor:—We save space, attendance, coal, water, heat, etc., the latter an important item in a Canadian summer. The cost of the electric power, of course, balances some of these items. You may say that you are at the mercy of a wire, which may be broken or cut through many causes. This is very true, especially with the primitive overhead construction system at present in vogue by many companies: but will be lessened to a great extent where underground systems are used, as for instance, in New York, Toronto, etc.; and even admitting the risk, it is no greater than being at the mercy of your own engine, boiler, or engineer. Repairs, in any case, should be more promptly done to the electric motor, as it is easier knocked down for handling.

Central stations supplying the power have generally reserve engines and generators on hand, which can be switched on in an instant when any breakdown occurs.

One of the faults, if not *the* greatest, lies with the customer in wanting to purchase too small a motor to perform the work; and, in the majority of cases, the very cheapest motor on the market is what is most in demand.

Electricity is not alone in this; steam engine manufacturers have unfortunately to combat this serious difficulty also, but what is in favor of the steam plant is that generally it is rated low, and an engine of a rated horse-power will do a certain per cent. more than that work if called upon to do so. In any case, if I understand steam principles aright, an excessive overload will simply stall the engine. Not so with the electric motor, however; the so-called "safety" cut out with its fusible plug has shown itself time and again to be unreliable, and burnt out armatures are of common occurrence. A better protection would be an "electro magnetic" cut-out, which would open the line as soon as more current attempted to pass than it was set for, but these are not yet in common use.

A few words as to the measurement of electric power may be of use to members of the society who wish to test a motor at any time.

"Voltage" is the term used to denote electrical pressure, and is synonymous with "pounds per square inch" as used by engineers.

"Amperes" is a term to denote the quantity of electricity, and may be likened to "cubic feet of steam."

A "Voltmeter" for measuring the pressure of the current is bridged across (or placed "in shunt" as it is termed) the feed wires which run to the motor.

One of the wires is cut and an "Ampere Meter" let in—placed in "series" as it is termed.

The motor is now started up and the readings of both meters are taken.

When volts are multiplied by amperes the product is termed "Watts," 746 of said watts being the electrical equivalent of 1 horse power.

Now we will suppose our voltmeter shows 250 volts and the ampere meter 3 amperes, the product we see is 750 watts, or just about 1 horse power, which our motor is developing. This is not absolutely correct, as the efficiency of the motor itself is not taken into account, but is the way that such tests are usually made.

A few words may not be out of place explaining why an electric motor runs at all. A magnet, as you know, has two poles, north and south, now, if the opposite poles of two magnets are brought together, they will attract each other, but if similar poles are brought together a repelling action takes place. Steel holds this magnetic effect; soft iron, however, is only magnetic when surrounded with convolutions of wire bearing an electric current. These latter magnets are called "electro magnets" and are the principal factors in both motors and dynamos.

Now as we know electricity has two poles also, it follows thus that we may make the poles of our electro-magnet either north or south at will, according to which direction we allow the current to flow through the wire. This changing of direction of the current is accomplished by the devices known as commutator and brushes. We thus see that it is simply a matter of attraction and repulsion of two magnets, one termed the "field," which is as a rule stationary, and the other termed "armature," which revolves.

The uses of the motors are many, and probably most of them well known to the members here, so we will only touch on such uses as may be novel and interesting.

The Crocker Wheeler Co. has made direct applications of their motors, without the aid of any shafting or belting, to operating the Gatling gun, cloth-cutting machines for clothing factories, engine lathes with motor concealed in head-stock, screwing machines, pipe cutters, punch presses, etc. The Crocker Wheeler Co. claim higher efficiency in factories by this method, as belting and shafting are done away with and each machine is under individual control.

A thirty-ton locomotive for handling freight at the rate of thirty miles per hour was turned out at Schenectady, N. Y., lately, and showed up well in the test being coupled back to back with its steam competitor.

I had intended going a little into accumulator work to show how reserve power might be had at will for stationary motors, not, mark me for street railway work, in which case I can cite many reasons why the accumulator car would not be a success either financially or otherwise here; but this would take some time, I fear, and I have occupied too much already, so will therefore make way for those who are to follow with other papers on subjects more in your line and more ably handled. If, however, my rambling remarks have awakened an interest in a subject which has such fascination for me, I shall feel repaid for any little time spent on what has been a labor of pleasure.

*Paper read by W. B. Shaw before the Canadian Association Stationary Engineers.

ENGINES FOR ELECTRIC WORK.

GALT, ONT., Nov. 15, 1893.

Editor CANADIAN ELECTRICAL NEWS.

DEAR SIR,—I have read with considerable interest an article on the style of engine best suited for electric power stations, in the July number of the ELECTRICAL NEWS, also a letter in the November number from a correspondent in reply to the article mentioned. Before saying anything concerning the letter I might just state that my experience has been such as to lead me to the same conclusions as the writer of the above named article, for every conclusion arrived at by him is correct so far as I am able to judge; at the same time it must be admitted that the letter in reply is an able production from the writer's side of the question, but are all the conclusions at which he arrives correct in every point? I think not. It is true that the high speed engine has more opportunities to correct the difference of speed caused by variation of load, and it needs them all on account of the lightness of its parts. The writer of the reply will find if he makes proper inquiries that there are slow speed engines which have very sensitive governor attachments, regulating very closely, in spite of what he may say to the contrary. He is of the opinion that the difference in economy between the two styles of engines has never been accurately determined, but admits that under favourable conditions the long stroke slow speed engine will develop a horse power with less steam than the short stroke high speed working under the same conditions. By taking a trip through the principal cities of the United States, he will find that in a great many cases the high speed engines have been removed to make room for the low speed ones; it is not uncommon to find electric light and power stations where they removed two and even three high speed engines to put in one slow speed, and by doing so have saved nearly one-half of their boiler capacity; there is, therefore, but one conclusion to come to as to why they made the change—it was that they would have better economy and fewer repairs. If an engineer will consider the question with an unbiassed mind, he will soon realize that it is impossible for a high speed engine to give as good economical results as the slow speed. It is a well established fact that the clearance is the cause of considerable loss and might be termed a necessary evil even when reduced to all that it possibly can be, consistent with a proper and sufficient port area. We shall suppose the clearance space as small as possible in an engine 16" dia. x 48" stroke, and the space the same in an engine 16" dia. x 16" stroke; while this space might in the 48" stroke only be equal to 3 or 4 per cent.—say 4 per cent.—in the 16" stroke it would amount to 12 per cent. Then in most of the high speed engines this loss is still increased from the fact of using a single valve, which necessitates ports with larger area, and besides, in nearly every case it is necessary to have an excessive amount of compression to insure a quiet running engine. For the foregoing reasons, the high speed engine has never given as good economical results as the slow speed, and it is safe to say that it is impossible for it to do so in the future.

When using the term high speed and low speed in connection with the engine, it is not meant that there is any difference in speed of piston—this may be the same in both make of engines —but in order that the short stroke engine make the same piston speed, it is necessary that the speed of the reciprocating parts be greatly increased over what is necessary in the case of the longer stroke engine.

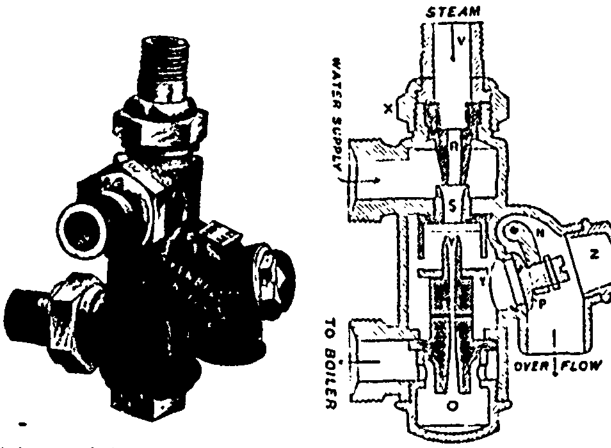
Regarding the repairs on the high speed engine, the fast motion of the reciprocating parts must of necessity cause much more wear than there is on the same parts of the slow speed, and for this reason the shutting down for repairs would be more frequent with the one than the other. It might be well to quote from a paper lately written by Chas. T. Porter, the father of the high speed engine, in which he says: "I would ask builders in their own interests to resist the temptation to get the utmost out of a given engine and set their faces like flint against the demand for short stroked engines which will occupy but little room." As this is quoted from a paper read by Mr. Porter at the Engineers' Convention lately held at Chicago, it must of necessity be considered a matured opinion of one of the ablest consulting engineers of the present day; as it was given after a great many years of experience, besides being himself a builder of engines, he must have had good and sufficient reasons for placing the foregoing remark on record. These are points which are so well understood by the majority of engineers that it is not necessary on this occasion to occupy any more space.

W. T. BROWN.

A by-law has received its first reading in the London City Council to raise $65,000 for the purchase of an electric light plant. The proposal of the Street Car Company to introduce electric power will also be considered at the next meeting of Council.

THE PENBERTHY INJECTOR.

We illustrate herewith one of the most popular boiler-feeders that has ever been introduced to the steam using public. The Penberthy automatic injector was first placed on the market in the spring of 1887. At that time there were no thoroughly successful automatic injectors manufactured, almost the only boiler feeder in use, aside from the steam pump, being



injectors of what is known as the positive class, which require constant attention and considerable manipulation of valves in order too restart them if the current of water to the boiler is broken for any reason. This injector, therefore, had great opposition to encounter and great incredulity to overcome before it could make for itself a successful place with the trade. From that time to the present it has been the constant aim of the manufacturers of this injector to make such improvements and changes as should increase its working qualities. In this they have succeeded admirably, having to-day a machine which is recognized throughout the country as the standard among automatic injectors.

It works at from 20 to 25 pounds low steam, according to size of the injector, and from this point up to 145 or 150 lbs., its best working point being, of course, about midway of its range, or at 65 to 80 lbs. On these pressures it will lift water from 22 to 24 feet, and it is claimed to be the only injector manufactured which will work equally well through hot or cold suction pipe. This is a very great advantage, as frequently the steam valve will not close perfectly tight, and when an injector is shut off, the steam leaking through the valve will heat the body of the injector and also the suction pipe, so that with other machines except the "Penberthy" it is necessary to cool this pipe before the water can be lifted.

During the six and a half years that this injector has been in the market, nearly 75,000 of them have been sold and almost without exception they have given satisfaction from the start. The manufacturers write us that while they received calls at their exhibit in Machinery Hall at the World's Columbian Exposition from nearly all their extensive trade throughout the United States and Canada and from many thousands of engineers who have used and are using their goods, they only received two complaints from any cause whatever, and these were of such a nature that a few words of explanation and instruction set the matter right with the parties who made them. An examination of the sectional cut will show the simplicity of this injector, the inside parts being very easy to get at for purpose of cleaning or examination. The steam jet "R" can be removed by simply loosening the nut on the top of the injector, while the delivery jet "Y" which is the one most liable to stoppage by dirt, can be taken out without disturbing the connections to the boiler, by simply unscrewing the plug "O" in which this jet rests.

This popular injector is manufactured by the Penberthy Injector Co., of Detroit, Mich., who will be pleased to send their catalogue to any steam user who desires it, on application. They issue monthly an 8 page paper, called the "Penberthy Bulletin," which they will send to any engineer who will send them his address.

SPARKS.

The construction of an electric railway at Edmonton, N. W. T., is under consideration.

The formation of associations of stationary engineers at Sherbrooke and Three Rivers, Quebec, is in contemplation.

The capital stock of the Citizens Light and Power Company, of Ottawa has been increased from $100,000 to $200,000.

The proposed electric railway to connect the City of Brantford with Selkirk on Lake Erie, is estimated to cost $200,000.

A 125 h. p Robb-Armstrong engine has been ordered for the Intercolonial Railway's electric light station, at Moncton, N. B.

A new 1,000 light dynamo and also a new engine have lately been purchased by the St. Johns, Que., Electric Light Company.

Mr. Edison, father of the celebrated inventor, is still living. He is said to have been born in Nova Scotia, on the 7th of August, 1803.

A long distance telephone line, connecting Fredericton, St. John, Halifax and intermediate points, is being constructed by the Moncton, N. B., Telephone Company.

The contracts for ties, trolley poles, fencing and the erection of a power house for the Hamilton, Grimsby and Beamsville Electric Railway Company will shortly be awarded.

The town at Waterloo, Que., is to be lighted by electricity. There will be employed for this purpose forty 32 c. p. incandescent lamps; the cost will be $400 per year.

An offer is said to have been made to the town of Richmond, Quebec, by the Richmond County Electric Company, to light the town for 99 years for the sum of $11,000 cash.

The fly wheels for the engines in connection with the Montreal Street Railway Company's new power station each weigh 40 tons, are 28 feet in diameter, and will run at a speed of 68 revolutions per minute.

The Montreal Board of Trade are installing an incandescent lighting plant. Two engines of 80 h. p. each, of the Robb-Armstrong Company's manufacture, will furnish the power for 1,200 incandescent lights.

The Thousand Island Railway Company, of Gananoque, are considering a proposition submitted by the Kingston Electric Light Company, for the conversion of the road, which is now operated by steam, to the trolley system.

The new power station of the Selkirk Electric Light Company is about to go into operation. It is said that the company will have sufficient surplus power to be able to furnish part of the power necessary for the electric railway between Selkirk and Winnipeg.

Mr. Bremner, one of the electrical engineers of the Montreal street railway, has invented an electric brake which it is reported has been successfully tested. A car furnished with one of these brakes was brought to a stop within the space of four car lengths, while running at a speed of 20 miles an hour.

An electric railway is projected to run from Cote des Neiges across the summit of the mountain at Montreal. Mr. David Yuile is the promotor of the enterprise, for which a charter has been obtained. The length of the road will be about 2½ miles, and it is expected to be in operation by the first of the new year.

The City Council of Halifax have accepted the tender of the Halifax Illuminating and Motor Company for street lighting for a term of three years as follows: 150 2 000-c. p. arc lights at $78.75; 50 1,200 c. p. incandescent at $23.87; 50 32-c. p. incandescent at $17.52, the city reserving the right to increase the number of arc or incandescent lights as they may desire at the contract price per light.

The Toronto and Richmond Hill Street Railway Company are being sued for $20 000 damages by Thomas Armstrong, real estate agent, on the ground of damages to his property by the use by the company of the Forest Hill road. The plaintiff also asks for an injunction to restrain the company from further using the road, and for the disallowance of the township by-law granting the company a bonus of $20,000.

Mr. R. R. Dobell, president of the Canadian Atlantic Cable Company, has received an offer for laying the company's cable from a point at the Strait of Belle Isle to a point on the west coast of Ireland. A meeting of the Canadian directors is to be held shortly to consider the offer, and the Dominion Parliament will be asked to subsidize a direct cable connection between Canada and Great Britain. It is believed that the British Government will also assist the project.

Application has been made to the courts by the creditors to have the Consolidated Electric Co., of Fredericton, N. B., put into liquidation. The solicitor for the company applies to have the application set aside on the ground that the court had not jurisdiction to make the order for the winding up of the company under the Winding Up Act, by reason of its being a railway company and exempt from the operation of the statute. The matter has been sent up for argument.

Incorporation is being asked for by the Preston and Berlin Street Railway Company, Ltd., to operate a line from Preston to Berlin, and connecting at Preston with the Galt and Preston road, and at Berlin with the Berlin and Waterloo Street Railway. The proposed capital stock is $100,000. The provisional directors are: Thomas Todd, Daniel Spiers, Wm. H. Sutz, of Galt; R. Gregory Cox, St. Catharines; T. M. Burt, Waterloo; Fred. Clare, Preston; John Fennell, Berlin, and R. G. Dickson, Niagara.

SPARKS.

The Canadian Pacific Telegraph Company announce the opening of a telegraph line from Halifax to Sydeny, C. B.

The Fredericton Gas and Electric Light Co. have contracted to light the streets of the city for ten years at $55 per light per year.

The largest electric power generator in Canada is now being placed in the power house of the Ottawa Electric Street Railway Company. It is a 700 h. p. Westinghouse multipolar machine and weighs 37 tons.

The Vancouver *News* announces the arrival in that city of Mr. H. Pim, of Toronto, to succeed Mr. E. Maxwell as manager of the General Electric Co.'s business. Mr. Maxwell has gone to Portland, Oregon.

The Westminster and Burrard Inlet Telephone Company propose to extend their line to the American boundary, and thus afford wire connection with Seattle, Tacoma, Spokane, Portland and San Francisco.

Bell Telephone stock is reported to be very strong, and little or none is obtainable in Montreal under 150. This stock which pays 2 per cent. quarterly, is said to be gradually passing into the hands of small investors.

It is stated by the manager that the Niagara Falls Park and River Railroad carried without accident last season, 354,000 passengers. The work of double tracking the line was commenced in September and is being rapidly pushed forward.

The Western Union Telegraph Company has been granted permission by the Canadian Customs Department to land, free of duty, at Canso, a part of cable to be used in repairing the Anglo-American cable, nine miles from Nova Scotia shore.

Mr. D. H Keeley, Acting Superintendent Government Telegraphs, has just returned from the Gulf of St. Lawrence, having seen to the repair of the cables to the Magdalen Island and St. Paul's Island, as well as the laying of a new short line to Anticosti.

A 500 light plant has lately been installed by the Canadian General Electric Company at Lethbridge, N. W. T.

It is reported that an American Company is prospecting with a view to establishing an electric railway in Charlottetown, P. E. I.

The Hamilton City Council have adopted a by-law granting a bonus and right of way to the Hamilton, Grimsby and Beamsville Electric Railway. The promoters of the railway have secured the necessary right of way over almost the entire route, and have started men to work on the grading of the lines.

On the Montreal Park and Island Railway Company's lines, which are about completed, Mr. Roy, the Company's engineer, has caused to be used broken stone for the road beds. Cars of American pattern, 23 feet in length are to be used on this line. The following gentlemen were lately elected as the officers of the Company. Hon. Louis Beaubien, president; Hon. J. R. Thibaudeau, vice-president, Robt. L. Gault, treasurer, Maurice Perrault, secretary and assistant treasurer. David Morrice, Henry Hogan and M. S. Lonergan, directors.

The City Council of Ottawa refused to allow the North American Telegraph and Telephone Company to bring its wires into the city except by means of conduits, and then only on condition that the Company would pay to the city 6 per cent. of its gross receipts. The Company did not fall in with this proposition, but it is alleged, secured an entrance to the city by utilizing the poles of the Bell Telephone Company, the Standard Electric Company, and fire alarm poles. The City Engineer was instructed to at once remove the poles and wires attached to Corporation property, and that official carried out his instructions by cutting the Company's wires. The City Solicitor of Ottawa has given it as his opinion that the Bell Telephone Company have the right to allow other companies to string wires upon their poles and that the action of the North American Telegraph and Telephone Company in thus stringing their wires was legal.

SPARKS.

The Winnipeg Electric Railway Company has recently reduced the wages of its employees by 20 per cent.

The Legal and Commercial Exchange reports the assignment of Messrs. Quintard & Packard, dealers in electrical supplies at Victoria, B. C.

The Toronto Railway Company have purchased a 250 h. p. Robb-Armstrong high speed engine, to be used as an auxiliary, during the winter, to their present power station.

An all night service has been inaugurated by the Bell Telephone Co. at Owen Sound, and negotiations are proceeding with the object of furnishing the town with an electric fire alarm system.

Parliament will be asked to grant incorporation to the Niagara Falls Electric Railway Bridge Company, to build a bridge across the Niagara River between the Falls and the Whirlpool rapids.

A 140 h. p condensing engine and steel boiler, have been purchased by the Penetanguishene and Midland Light and Power Company, of Penetanguishene, for their power station, now in course of erection.

The first electric plant of the Waddell-Entz Company's manufacture has been installed in the *Gazette* Building at Montreal, by the Company's Canadian agents, Messrs. John Langton & Company, of Toronto. The plant comprises a 30 Kilowatt incandescent dynamo of the slow speed type, and a slate switch-board provided with volt meter and ammeter.

The London West Electric Railway went into operation on the 4th of November. The event was celebrated as a public holiday. The road is owned by the company which operates the horse car system in the city proper. There has been opposition on the part of some of the citizens and their representatives in the city council, to the granting of a franchise to the company for the city and the conversion of the city lines to electricity. It is expected that the new electric road in London West will serve to show the citizens the superiority of electricity, and aid the company in securing the city franchise.

When permission was granted the Merchants' Telephone Company, of Montreal, to erect poles on the streets of that city, it was supposed by the council that the resolution granting the privilege called for the work to be done under the supervision and control of the city engineer. It has turned out however that the wording of the resolution does not cover this point, and the telephone company are erecting poles in a manner to please themselves, and in some cases much to the dissatisfaction of the citizens. This privilege granted to the Merchants' Company, will incidentally work to the advantage of the Bell Telephone Company also, as so long as one company is allowed to run its wires overhead, the other company will also escape the expense which would be entailed by putting their wires underground.

We learn from the annual report of Mr. Grenville C. Cunningham, chief engineer of the Montreal Street Railway, that the total mileage of the road when completed will be about 85 miles. 54½ miles of new track have already been laid, and it is expected that when winter sets in the whole system will have been laid with rails. 43 miles of overhead trolley have been constructed, and some 400 poles put up. There are in use at present 71 motor cars, each car being fitted with two 25 h. p. motors. By the time the winter sets in this equipment will have been increased to 100 motors and 4 snow sweepers. 2200 h. p. is at present being used, 1,000 h. p. being supplied by the Royal Electric Company, 1,000 h. p. by a temporary power station erected by the company, and 200 h. p. from the Montreal Exposition Company's engines. The new power station which the company are erecting on William street will afford a total of 3,200 h. p. It is expected that power from two engines from this station will be available before the end of the year. The engine house in connection with this new station is 235 feet long by 187 feet wide, and will contain six engines, each having a capacity of 600 h. p., and driving two kilowatt Edison generators. Sufficient space will be allowed in the building for two more engines. Water for condensing purposes will be obtained from the canal. A chimney 186 feet high by 9 feet interior diameter has been erected.