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CANADIAN ELECTRICAL NEWS AND STEAM ENGINEERING JOURNAL

OLD SERIES, VOL. XV.—No. 6.
NEW SERIES, VOL. VI.—No. 9.

SEPTEMBER, 1896

PRICE 10 CENTS
$1.00 PER YEAR.

CANADIAN

ELECTRICAL NEWS

AND

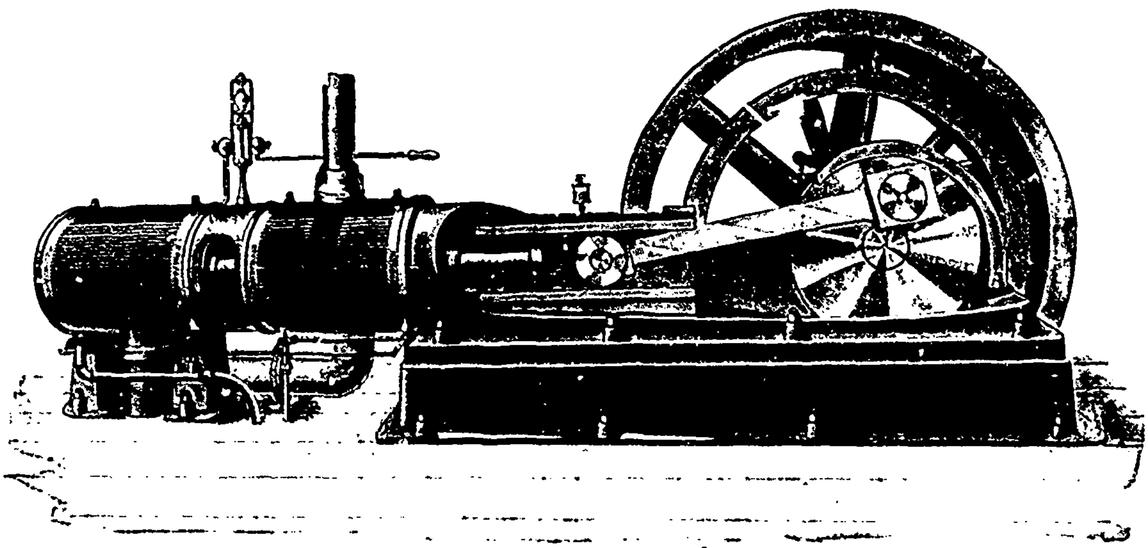
STEAM ENGINEERING JOURNAL.

VOL. VI. SEPTEMBER, 1896 No. 9.

TANDEM COMPOUND STEAM ENGINE.

THOSE who have observed the trend of steam engine designing during the past few years will have noticed that there is a tendency towards a short, compact, heavy built frame, with strong simple parts, suited to the severe and incessant work imposed upon power plants by street railway and other heavy work. Corliss and other types of long stroke engines have been shortened and strengthened in order to meet these conditions and to occupy less room, and there is also a tendency to increase the speed to suit direct driven dynamos and give better regulation. In fact, there seems a tendency for the advocates of high and low speed to meet half way in a type of engine which will embody the best points of each.

As an example of what is being done in this way, we give an illustration of a tandem compound engine, built by the Robb Engineering Co., of Amherst, Nova Scotia. The cut is from one of four engines of 300 h. p. each recently installed for the Halifax Electric Tramway Co. for railway and lighting purposes, and it represents a type of engine designed with a view to combine the best points of long and short stroke engines.



TANDEM COMPOUND STEAM ENGINE.

The design of frame and general proportion of parts is similar to recent types of long and medium stroke engines designed for railway work. The shaft bearings, crank and crosshead pins are much larger than usual, to insure cool running under stress of overloading or irregular work. The guides are cylindrical, allowing the crosshead free alignment. The disc crank contains sufficient metal to permit the crank pin and shaft to be forced in under heavy hydraulic pressure, and is balanced. The main journal has quarter boxes with adjustment at top and sides. The governor, which is of the "Sweet" or "Straight Line" pattern, used in all engines made by the Robb Co., is of the simplest and most sensitive form and directly connected to the valves. The high pressure cylinder is placed next to the frame, low pressure in rear, and so arranged that the cylinder head and pistons may be removed without disturbing the cylinders, valves or other parts. The valves are of the "Porter" type, consisting of a flat plate balanced by a pressure plate, which have proved so successful in the "Porter-Allen," "Straight Line" and other engines, their greatest merit being simplicity and freedom from wear. Both high and low pressure valves are attached to the governor in such a way as to divide the load exactly between the high and low pressure cylinders. This system is new and peculiar to the Robb engines and is found to give better economy with variable loads, such as are found in railway work.

The manufacturers are now building a full line of these engines, in simple, tandem and cross-compounds, up to 700 h. p., having a medium length of stroke, speed from 150 to 200 revolutions per minute; and as the parts are massive, and bearings unusually large, parts simple and strong, they are splendidly adapted for direct connection to electric generators or other variable work.

The extension of the Hamilton, Grimsby and Beamsville railway to Beamsville will shortly be completed.

The number of miles possible to be ridden in the United States on a street car for five cents is said to range from 8¼ miles in Jersey City up to 18 miles in Brooklyn, the average of ten cities being 13 miles. At Chicago a ride of 21 miles can be had for this small sum on an ordinary railroad.

THE HAMILTON ELECTRIC LIGHT AND POWER COMPANY.

One of the best equipped electric light and power plants of Ontario is that of the above company. The plant began operations in April, 1892. It occupies two buildings. The dynamo room was designed and constructed under the direction of Mr. D. Thomson, the late manager. The placing of the machinery was directed by Mr. Dickinson, chief engineer. The dynamo building, on Main St., is 135 x 70 ft. with hip roof, supported by wooden beams covered with corrugated iron; a cupalo surmounts the top. The stone foundation is laid in Portland cement and sharp sand.

Two pair of "Brown" (Polson Works) engines of 700 h. p. each, 78 revolutions per minute, 22 inch cylinder, 50 inch stroke, with fly wheel 16 x 4 ft., and one high speed compound engine of 150 h. p., 250 revolutions per minute, all non-condensing, drive the 120 feet of line shafting, 5½ inches in diameter, and 7 inches at driven pulleys, which runs down the centre of the building between the engines and the machines. A Leonard-Ball engine is also in place, but is not used. These engines are belted to the shafting by 4 foot 3 ply Robin, Sadler & Haworth belting. A Bain & Coville clutch coupling is in the centre of the shafting. The fly wheels are boxed in casings next the passage between them and the wall. At the rear wall are two Northey pumps, 8 inch cylinder, 12 inch stroke, and 5 inch rams, pumping water at 208° into the boilers from a heater built by Bain & Coville from a design by the chief engineer. The different compartments of the heater are full of hay. The hot water passes through this hay, which extracts the lime and magnesia from the water, which forms in a hard lime-stoney substance on top of the hay.

MR. GORDON J. HENDERSON,
Manager Hamilton Electric Light and Power Company.

Entering the rear wall on a level with the cross beams are two 10 inch wrought iron steam mains conveying steam to the several engines. The branch pipes are 6 inches. Where the mains enter the building are three 10-inch valves and a pipe connection between the mains. The valves work so that both mains can supply the engines, or all the engines run from one main.

The floor is concrete except one spot, which is of wood and underneath which is a large tank containing 7,000 gallons of water, to be used in case the water mains give out.

The machines consist of arc and incandescent lighters and electric power generators. There are two "Royal" alternators with exciters, (one of 2,000 lights and the other of 1,250 lights), one "C. G. E." 2,000 lighter and exciter, and one Westinghouse 1,800 lighter and exciter. Fifteen machines of varying power supply arc light, fourteen of which are from the Royal Company; the other, of 35 lights, being a Toronto Electric Light machine. The Royal arcs are as follows: four 35 lighters, eight 50 lighters, and two 12 lighters. An "Edison" 75 K. W. generator and a "Royal" 100 K. W. multipolar generator generate power for motors of from ½ to 15 h. p.

The machines are set on stone foundations, 5 feet deep, and run very smoothly. Mr. Martin, the chief electrician, has his office to the right; behind this is the store room, where are all kinds of supplies and repairs for arc or incandescent lighting and installing of same. They use Packard lamps and Royal arcs, and Ottawa and C. G. E. 5s carbons. The repair shop and lamp testing room is 20 x 25 feet. A full equipment for all repairs is in this shop, except for heavy machines, which are wound by the Toronto Electric Light Co. Along the wall of the store room is the large slate switch board with full complement of instruments for the alternators and generators. On the arc switch board are 14 circuits and on each circuit is an automatic pilot light. In case of the opening of a circuit or trouble at the machine, the pilot light supplied from an incandescent circuit lights up and the operator can see at a glance what circuit or machine is in trouble. This is the invention of Mr. Martin, the chief electrician.

On the arc poles the lamps are hung on hinged arms, no drop ropes being used. Each trimmer is given 90 lamps a day to trim and he covers his circuit with a horse and two wheeled "chariot," which was designed by the chief electrician.

On King street is a three-storey structure in front, combining the offices of the company, and several other offices. The rear is taken up by the boiler room. There are three batteries, the first comprising five 60-inch Osborne-Killey tubulars, 75 h. p. each, and the second two, 66 inch Goldie & McCulloch tubulars, 90 h. p. each; and two Polson water tube boilers, 200 h. p. each. All these boilers are connected to a square brick smoke stack 125 feet high. The tubular boilers are connected to one main and the water tube boilers to the other.

The fuel used under these boilers is hard and soft coal screenings, three-fifths being soft coal. Between the two buildings is a space of about ten feet, and the coal as it passes through is weighed on scales operated from the chief engineer's office, which is in the rear corner of the dynamo room. The engines in the dynamo room exhaust under the floor through a 12-inch pipe, which passes into the rear building 3 feet underground

MR. T. W. MARTIN,
Chief Electrician Hamilton Electric Light and Power Company.

in a box of sawdust. The steam mains carried between the buildings are covered with 12 inches of mineral wool with box castings.

The city use 375 arc lights, and 75 arcs are in commercial service. The capacity is 500 lights. Over 9000 incandescent lamps are installed and on an average 300 new lamps are installed each month.

The directorate of the above company and of the Toronto Electric Light Company being largely the same, Mr. J. J. Wright, manager of the latter company, assumed the management upon the resignation of Mr. Thomson about two years ago. Since the amalgamation of the Toronto Electric Light Company and the Incandescent Light Company in Toronto, however, the duties of Mr. Wright have been so onerous that it has been found necessary to appoint a separate manager for the Hamilton company. The appointment has been given to Mr. Gordon J. Henderson, of Montreal.

Mr. Gordon J. Henderson, who has recently been appointed manager of the company, and whose portrait is herewith presented, was born in the city of Montreal in the year 1872. He is a son of Mr. David H. Henderson, a prominent lumber merchant. For some years he has been connected with his brother, Mr. C. W. Henderson, the well-known electrical contractor of that city. He is quite prominent in Montreal's society, and holds a commission as Captain in the 6th Battalion Fusiliers, having the honor of turning out the best drilled company in his battalion. Mr. Henderson is a business man of considerable ability, and under his supervision the company will no doubt enjoy a marked degree of prosperity.

Mr. T. W. Martin, chief electrician, was born in London, England, 26 years ago. His family came to Canada, and at the age of fourteen years he entered the employ of the Toronto Electric Light Company, under Mr. Wright, in the old Sherbourne street plant. He was removed to Hamilton two years ago. He is a clever electrician and fills his position in a creditable manner.

MR. R. DICKENSON,
Chief Engineer Hamilton Electric Light and Power Company.

Mr. R. Dickenson, chief engineer, was born in Dover, Kent, in 1841. He entered the Royal Navy in 1858, in which he served for some years, leaving it for merchant vessels. In 1874 he came to Canada, filling different positions, and eleven years ago he entered the employ of the Hamilton Electric Light Co.

THE PARAGON OF EXHIBITIONS.

THE major part of the entries having now been made for Toronto's big exhibition, which is to be held from August 31st to September 12th, it is possible to state definitely that the scale of the exhibition will really be greater than ever. Never before did the exhibits cover such a wide range as they will this year. It almost looks as if every province had striven to do its best to make the exhibition worthy of the country. At the forthcoming exhibition in Toronto there will be seen food products of Prince Edward Island; food products, manufactures, fruit and live stock, of Nova Scotia and New Brunswick; an extensive display of horses and cattle, manufactures and minerals, from Quebec; the products of forests, waters, mines, gardens, farms, studs, workshops and art studios of Ontario; the grain, minerals and horses of Manitoba; the grain and minerals of the North-West; and cereals, fish and minerals of British Columbia. The governments of Ontario, the Dominion and British Columbia will make special exhibits of the wealth of the earth, while the Canadian Pacific Railway will supplement these displays by showing cereals, vegetables and minerals from many points on their lines, to the extent of double what the company has shown in other years. In art especially will the exhibition be strong, with the three pictures painted by F. M. Bell-Smith, illustrating incidents connected with the death of Sir John Thompson, at Windsor Castle, for one of which pictures Her Majesty the Queen, Princess Beatrice and members of the Royal household gave special sittings. There will be Edison's wonderful Eidoloscope, an electric theatre; Ontario Trotting Horse Breeders' stake races; Lockhart's performing elephants; the magnificent historical spectacle, entitled the "Feast of Nations" and commemorating the "Taking of the Bastile," and a thousand and one other things; while in consideration of the cattle being on show the first week the railways have agreed to grant one fare for the round trip for the entire exhibition from all points in Canada, and to run a special cheap excursion the first week, on Sept. 3rd, and two the second week.

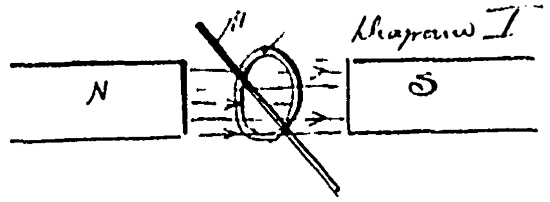
TRANSFORMERS.

By G. W. F.

THE really distinctive feature of an alternating current system is the transformer. Without it the alternating current would possess no advantages over the direct, and the transmission of power for lighting or motor purposes would be impracticable except at the cost of very large conductors. The use of the alternating current in connection with station transformers arose out of the practical limitations imposed on direct current apparatus, and in so far was an improvement in the art. *In direct current working the pressure* generated by the dynamo is maintained throughout the entire system; a 220 volt machine will cause a pressure of 220 volts (less the "drop" of course) between the positive and negative wires at all points; a 500 volt machine gives a pressure of 500 volts everywhere, and so on. In order to distribute current over an extensive area, it is evidently necessary to use either heavy, and therefore expensive, feeders with a 220 volt pressure, or to use a higher pressure and so allow of smaller feeders. *But as it is not at all desirable to introduce a* high pressure into lamps placed in private buildings, where they have to be handled constantly, and where the wires are frequently exposed to risk of grounding, it is evident that a limit of pressure is soon reached, and that any extension of business must be met by an additional expenditure for feeder copper. In a district where there is a large amount of lighting this may be commercially possible, but it is quite easy to imagine conditions where the additional amount of lighting would not actually justify the necessary feeder expense. It is easily seen that any method which permits of the use of a high pressure for transmission, and at the same time of a *low pressure for utilization, meets the conditions of* economical supply and safe use. The static transformer renders possible an advantage beyond the power of the direct current.

It would be strange if a piece of apparatus possessing such great importance were not worth capable study, and in fact the electrical principles governing its action, and the electrical, magnetic, and mechanical features entering into and influencing its design and construction are not merely of great interest, but a thorough comprehension of them is necessary before the constructing or operating electrician can be considered conversant with alternate current working. To the casual observer a *transformer is merely a quantity of insulated* copper wire wound in two separate coils round an iron core; the whole placed inside a box and what goes on *inside that box* when the current is turned on is of no more interest to them than the mechanism of a musical box—you turn the handle and grind out music; you turn on the current and you get light somehow. It is thought by those whose interest in electrical matters leads them no furthur than the study of how to pay the least money for plant—that once a transformer is hung up on a pole and connected into circuit there is the end of it; that the worst thing that can happen to it is to have one of its fuses blow, or lightning get into it and burn it up. *As to its being a source of expense all the time,* as to its capacity for wasting current, the matter not only does not occur to them, but they actually smile when it is suggested to them, How can a transformer be a source of expense? How can it waste current? It isn't doing anything; it isn't moving or revolving; there's no friction about it—it doesn't need oiling—might as well suggest that a glass insulator is a source of expense. A little investigation, however, will show that the transformer is not the simple thing it is popularly supposed to be, and that careful study and educated thought were just as necessary in its evolution as introducing the high class modern dynamo. The basis of *transformer action is the same as that of dynamo action* —induction. If a closed conductor be placed in a magnetic field, the intensity of which is rapidly varying, an E. M. F. is set up in that conductor, the direction of the E. M. F. will depend on whether the intensity is increasing or decreasing its strength on the rate of variation.

N S are two poles, the space between them being a magnetic field as indicated by arrows. C is a closed conducting ring capable of being revolved on A, as axis. It is understood that A is really at right angles to the direction N S, and that the plane of the ring C is perpendicular to the direction of the lines of force from N



to S. Now if the strength of the magnetic field N S is always the same (*as it generally is in a dynamo*) and if the ring C be held stationary in any position, it will be evident that nothing is varying, and consequently there will be no current set up in C. But if we now revolve the axis A (in either direction) and with it the ring C, it will be seen that, although the same amount of lines of force will always flow from N to S, the ring will in some positions hold less of them than it will in others. *In the diagram* No. 1 the ring is *perpendicular* to the field and will contain say X lines of force. In diagram No. 2, having now revolved it through a quarter of a

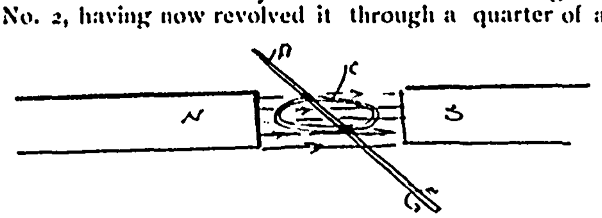
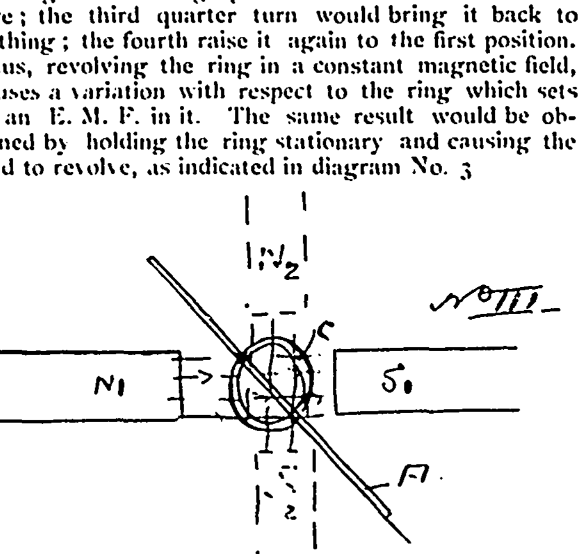


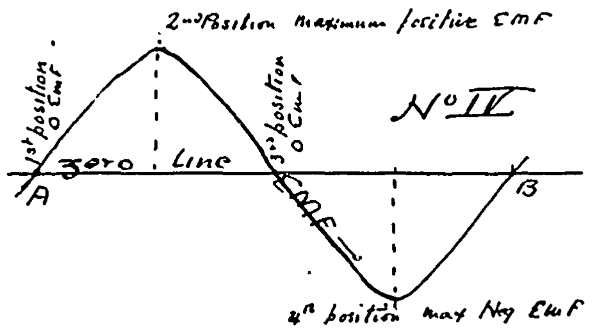
DIAGRAM II.

circle, the plane of the ring is parallel to the lines of force, and contains none of them at all.

So that in the course of a quarter revolution we have varied the lines of force contained by the ring from a certain *maximum* down to nothing, and this is the condition necessary for the setting up in the ring of an electromotive force. Turning C through another quarter circle would again vary the field with respect to the ring from nothing up to the same maximum as before; the third quarter turn would bring it back to nothing; the fourth raise it again to the first position. Thus, revolving the ring in a constant magnetic field, causes a variation with respect to the ring which sets up an E. M. F. in it. The same result would be obtained by holding the ring stationary and causing the field to revolve, as indicated in diagram No. 3

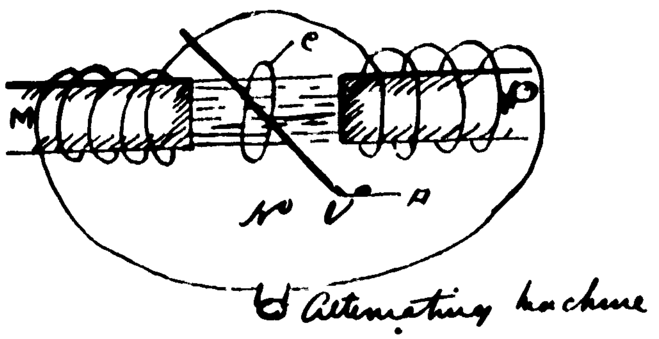


The ring C is perpendicular to field N, S₁, and if these poles be shifted to positions N, S₂, the ring being not moved; the ring will be parallel to the new field N, S₂, hence during the shifting of the positions of the poles an E. M. F. will have been set up in C. It is therefore *evident that so long as there is relative movement, it* does not matter whether the ring be moved or the field. The necessary condition being a varying of the lines of force passing through the ring, a third method is possible which will attain that object without revolving either the ring or the poles. If in the above diagrams the poles N and S are supposed to be electro magnets, (that is iron bars which are made magnets by the passage around *them of a current*), and we have some means of varying the current passing through the wire, either by means of a rheostat or other equivalent means, then, remembering that the strength of an electro-magnet (the strength of its field) varies within certain limits, in the same proportion as the current producing it, it will be evident that the field can be varied up or down by simply turning the rheostat, leaving both poles and ring stationary. And from this last method it is but a step *to the energizing of the poles by an alternating current* which will cause an even greater variation of the field than the rheostat can accomplish with a direct current. This will be plain when it is considered that the current in an alternating circuit begins at nothing, grows rapidly to a certain maximum, diminishes again down to nothing, then actually charges its direction and grows to a negative maximum, and then *decreases again to nothing. Turning to diagram No. 1*, we will suppose ring C to be one of the coils of an alternating dynamo. In the position where C is perpendicular to the lines of force N S, any very slight revolving of A will not vary the amount of them contained by C much; in fact in this position a slight revolving will really generate no E. M. F. at all, but as A is revolved (counter clockwise) ring C will hold less and less lines *of force until it reaches the position in diagram 2, when* the rate at which C is decreasing is greatest, and as the E. M. F. generated depends on the rate of variation, the highest E. M. F. generated in C will be when it is passing through the position in diagram 2, and a proportionate E. M. F. will be generated in C at any intermediate position. So that the E. M. F. will grow during a quarter revolution from 0 to a maximum. When *C has been revolved through a half turn, conditions* will be as they were in diagram No. 1, and at this point no



E. M. F. *will be generated in C, it having decreased* from the position of maximum E. M. F. in diagram 2. If C be revolved through and then quarter turn, then everything will be the same as in diagram No. 2, and the E. M. F. will again be at a maximum, except that the direction of the E. M. F. has reversed, and instead of being from right to left is now from left to right; or, if we call the first direction positive we can call the new *one negative. From the third quarter revolution to the* fourth brings C back to the first position. All these changes can be put into a diagram form as in No. 4, where the curved line shows how the E. M. F. in the ring varies between a positive and a negative maximum. It will be understood that whereas the direction of the E. M. F. is from right to left in the upper part of the diagram, it becomes from left to right in the lower; the *strength of the E. M. F. at any point in the revolution* being indicated by the height of the curve above the zero line and the distance A B representing one revolution of the axis.

Now suppose we have two magnets M, P, energized by an alternating current as above, so that they shall be of opposite polarities and a ring C. From position 1 to position 2 (diagram 4) M will have a north pole, and P a *south pole, constantly increasing in strength, and* from position 2 to position 3 the polarities will be the same, but the strength of the field will diminish constantly back to nothing. At position 3, however, the direction of the E. M. F. changes so that, from 3 to 4, M will become a south pole (instead of a north), and P will now be a north pole (instead of a south), and the strength of this reversed field will constantly increase to *a maximum at 4, and thence down to nothing at posi*tion 1, when the E. M. F. again changes its direction, and the poles consequently again change sign. During these variations and reversals, the ring C will (although stationary) have been placed in a varying field produced by the alternating electromagnets, and consequently an alternating E. M. F. will have been induced in C. This is the simple theory on which is based the action of the transformer, but its application gives rise to phenomena which introduce new and less simple considerations. A transformer could be constructed on the plan shown in the diagrams, but a more convenient, and in every way



better form is adopted in practice. The simplest form may be shown in diagram where A is a ba. of iron, P is an insulated wire wound round and carrying an alternating current from the generator G, S being another insulated wire also wound round A and P, (but insulated from both) and leading to say the lamp L. On passing the alternating current from G round A, the bar is at once made an electromagnet, the poles of which reverse their sign as the direction of the alternating current reverses. The whole space surrounding A becomes a magnetic field, the lines of force radiating in the manner

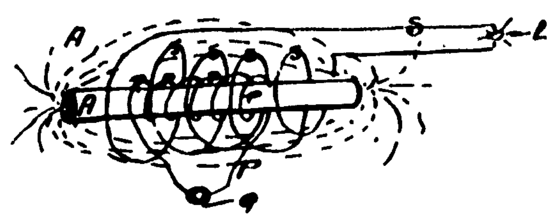


DIAGRAM VI.

indicated from one pole to the other. It is evident that under these conditions the coil S is just as much placed in a varying magnetic field as it was in diagram No. 5; hence a current will be induced in it. All transformers are built in this way: two coils wound together round a magnetic circuit, and insulated both from it and from each other, the one carrying the energizing current called the primary, the other in which current is induced called the secondary. The feature of special importance in this induction is that, no matter what may be the voltage in the primary coil, we can get what voltage we desire in the secondary, so that we can run our alternator at 1,000 or 2,000 or 5,000 volts, and still have only 52, or 104, or any other desired voltage in our secondary coils. This, of course, permits of the use of high voltage for distribution and low voltage at lamps, obtaining both economy and safety. The difference in voltage between primary and secondary wires depends directly on the proportion between the number of primary and secondary coils. If there be ten turns of the primary to each secondary turn, then the secondary voltage will be only one-tenth of the primary, and so on.

The action of the transformer is, as described above, that when the primary circuit is closed round the bar the alternating current transforms it into an electromagnet, with rapidly reversing polarity, and the varying and reversing field induces an alternating current of the same periodity in the secondary wire. This appears to be so simple a process that the person who does not examine it more closely will not easily believe when told that a transformer wastes coal. As a fact, however, every transformer built—even the very best—necessarily wastes energy; good transformers waste less than second-rate ones. These wastes have been located and can be calculated. They result as follows:

On closing the circuit in the primary the core becomes an electromagnet, whose polarity reverses at the same times as the current reverses. It has been observed that subjecting iron to an alternating magnetomotive force raises the temperature of the iron and this phenomenon has been accounted for by the following theory: Consider a bar of iron M. Pass a current round it from the source K in the direction of the arrow. Instantly the one end becomes a north pole N, and the other a south pole S. Now we may consider the bar to be made up of an infinite number of small atoms of iron pivoted at their centre points, each of which becomes a little atomic magnet, their N poles all pointing to the N end of bar, and their S poles all pointing toward the S end. Now reverse the direction of the current from K. Instantly everything is changed. The old north pole now becomes a south pole; the old south pole is now a north pole. Every little atomic magnet has swung round, and is now pointing in the opposite direction to what it did before. Plainly they cannot have done all

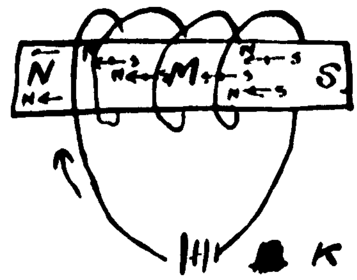


DIAGRAM VII.

this swinging without rubbing against each other and getting warm, and this friction requires a little expenditure of energy to overcome it. We can easily see, therefore, that a certain amount of energy is expended in the iron core of the transformer itself in producing the necessary alternating magnetism; and this energy will be greater in proportion as the number of reversals of the current becomes greater. It is also evident that as the number of atomic magnets increases—that is, as the total mass of the bar increases—a greater power must be expended in overcoming their friction; it will take twice as much power to swing 2,000 atomic magnets as to swing 1,000. Once more, it is evident that as the strength with which each atomic magnet points in one direction increases, i.e., as the strength of the magnet increases so will it take more and more power to force it to point in the opposite direction. Consequently, it is plain that a certain amount of power must necessarily be expended in the transformer itself in producing the alternating magnetism, and the actual amount of power so expended depends first on the number of times the current alternates; next on the number of atomic magnets to be reversed (that is the size of the whole iron bar), and third on the strength of the magnet (the amount of magnetic flux). It depends on the transformer itself whether the total amount of energy expended in this way is greater or smaller, but in any case it has to be supplied by the primary current and hence by the coal pile. It therefore follows that any means of reducing it is an advantage. The amount so expended depends, we have seen, on the number of reversals, the total mass, and the magnetic induction. It would therefore be an advantage to use a lower alternation, but this is limited by considerations outside the purpose of this article. It certainly will be of advantage to use a smaller bar of iron, but as in order to construct a transformer capable of giving a certain secondary voltage, we have to use a proportionate magnetic induction, the only way he can reduce the size of the iron is by using a better class metal whose permeability is higher. It is necessary to remember that bars of different kinds and qualities of iron will not give the same magnetic strength for the same current, but that the poorer the iron the less need be the magnetising current to give a desired strength. Consequently we can only reduce the mass by using a better quality of iron. Better quality means higher price—it is no economy to select the cheapest transformer.

(To be Continued.)

CANADIAN ELECTRICAL NEWS AND STEAM ENGINEERING JOURNAL

PUBLISHED ON THE FIFTH OF EVERY MONTH BY

CHAS. H. MORTIMER,

OFFICE: CONFEDERATION LIFE BUILDING,

Corner Yonge and Richmond Streets,

TORONTO, - - CANADA.

Telephone 2362.

NEW YORK LIFE INSURANCE BUILDING, MONTREAL.

Bell Telephone 2299.

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Advertising rates sent promptly on application. Orders fo advertising should reach the office of publication not later than the 25th 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 2 nd day of the month.

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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 should be remitted by currency, registered letter, or postal order payable to C. H. Mortimer. Please do not send cheques on local banks unless 5 cents is added for cost of discount. Money sent in unregistered letters will 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.

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

The "Canadian Electrical News" has been appointed the official paper of the Canadian Electrical Association.

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The C.A.S.E.

IN the present number will be found a report of the proceedings of the annual convention of the Canadian Association of Stationary Engineers held at Kingston. A perusal of the report leads to the conviction that in point of attendance and also as regards the importance of the discussions and business transacted, this convention suffers by comparison with those of previous years. Our truest friends are those who sometimes call us to account for our shortcomings, as well as commend us for what is meritorious in our conduct. We trust, therefore, that the Association will not take it amiss if we give expression to a few opinions with regard to its policy and work. The avowed object of the Association, viz., to educate its members up to a higher standard of efficiency, thereby fitting them to improve their social and financial standing, is one which must commend itself to everyone. It appears to us, however, that this object is in some degree being lost sight of, as witness the fact that at the recent convention only one paper, and that upon a subject not intimately connected with engineering practice, was presented. There was practically no discussion whatever upon engineering practice—the subject above all others in which members of the Association are interested, and on which they need enlightenment. A large proportion of the time of the delegates was taken up with sight-seeing, and most of the remainder in considering ways and means of raising the revenue, which appears to be on the decline. Might not the energy which is being dissipated on publishing schemes, which are entirely without the province of the Association, and not calculated to enhance the respect in which it should be held by manufacturers and the public generally, be more profitably employed in the collection and dissemination of engineering knowledge of a character which should result in permanently increasing the membership and the finances? However this may be, the ultimate success of the Association will depend on the extent to which the desire for a pleasant outing is subordinated to a determination to promote the education and welfare of every member.

Operating Lamps at High Pressure.

THERE is a growing feeling in favor of operating lamps at a pressure of 220 volts instead of, as heretofore, at 110. Reports from Europe show that this method of distribution is rapidly gaining favor, and in the States there are quite a number of plants adopting the improvement. It will be obvious that the advantages of this are that a very considerably greater area can be served from the same station with the same loss, and that the percentage of variation of voltage will be very much less than it was with the 110 volts. This again reacts on the lamps, so that their average life is greatly increased. The only matter that seems to retard the full development of the 220 volt distribution system seems to be the difficulty of producing good commercial lamps to suit the high pressure, and this seems to be in a fair way to being overcome. We recommend central stations to keep their eyes on this development, with the view of adopting it ultimately.

Designing an Electric Plant.

No part of the designing engineer's duty, when laying out a power house for electric lighting or railway purposes, is more important, or requires greater care and experience, than the general proportioning of the various pieces of apparatus and machinery, so that they may work together with the highest ultimate efficiency. Nothing is more apparent in the large proportion of lighting stations in the Dominion, than the complete absence of any continuous, coherent scheme, binding together and running through the entire plant, and we are sorry to say that nothing could be more unanimous than the complaint from those owning such plants, that electric lighting is not a very lucrative business. And yet very little consideration will show that these unfortunate results are but a necessary consequence of the policy—or rather the lack of policy—adopted by owners. It is too usual to consider a power house as consisting of two separate portions—steam plant and electric plant—and to consider them without much reference to each other. The purchaser is told that, generally speaking, it takes 10 lamps to a horse power, and on this very approximate and unsatisfactory basis he proceeds to make his own arrangements for steam engine, without having any idea as to the efficiency of the dynamo he proposes to try, or as to the most economical voltage drop, whether 5% or 10%, or as to the many other data which would all greatly influence the proper power of the engine. As a matter of fact he places himself entirely in the hands of the engine builders, who certainly cannot be expected to be extremely well posted on electrical matters, and as both he and they are very insufficiently informed as to what power would be actually required, the chances are that between them they decide—"in order to be certain"—on an engine 25% larger than there was any necessity for. Now it is well to be on the safe side, undoubtedly; but then what is enough is enough—any more is a superfluity; and there is great likelihood that had advice been obtained from some independent engineer of competence the saving in the size of the engine would more than pay his fees. If it were only the question of saving a few dollars on the price of the engine, this would be not of sufficient importance to warrant any great extra expense, but such unnecessary extra horse power means a continual yearly extra and unnecessary expense for fuel, over and above what would be necessary with an engine of proper size. This will be perfectly evident when one considers that it takes an appreciable percentage of the power of engine to merely turn itself over without any load. This percentage is frequently placed at 10%; so that a 100 h. p. engine would take 10 h. p. to turn it over. Now on the supposition that an engine has been purchased that is larger than necessary, it is very easily demonstrated that each horse power of such unnecessary extra size will cost the central station, on the average, one-half ton of coal per year more than necessary, assuming such a low coal consumption as 3 lbs. per h. p. h. This may seem a small amount, but then it is unnecessary, and capitalized at 5 per annum, it represents a sum of $40 per h. p. Then there is the further consideration of the less average efficiency of the larger engine working on a load only sufficient for a smaller one. What would be a full load for a 100 h. p. engine is only 80 of a full load for one of 125 h. p., and as the percentage efficiency of steam engines falls off rapidly as the proportion of load decreases, it is plainly seen that a too large engine is by no means a prudent precaution.

Another matter on which a word of caution is in season is the proper size of generators to use. The size selected is too often a matter of purely arbitrary choice on the part of the purchaser, who does not take sufficiently into account such very important factors as population of town, class of inhabitants, number of churches, halls, etc. Here again, it is no economy to base one's ideas on one's own inexperience, instead of calling in professional independent advice, and so profiting by the accumulated experience of the electrical profession. The problems presented are to get enough; to not get too much, and to arrange the generators in units of such size as that such, and as many as may be operating at any moment, may be operating at their maximum efficiency. This efficiency question is one which plays a very much more important part in the operation of electric plants than most of their owners are aware of, and if more attention were paid to it there would be less complaint about the unprofitableness of electric lighting business. The main trouble seems to arise out of the injudicious selection of sizes of generators; they being, as a rule, so selected that for the very large proportion of the time, they are operating at much less than half load. For instance, a machine of 1000 capacity may be installed in a town of 2000 inhabitants; now only for about one hour per night during the depth of winter, will that machine be called on for 1000 lights; at all other times it will be supplying less than that number, and for the greater portion of the time (from about 10 p. m. to 5 a. m.) it will be running on loads of from 900 down to 200, with the smaller number predominating. Now it is quite plain that the machine, under these conditions, will be running at full efficiency for only about 10 per cent. of time, or probably less, and that its average load will be considerably less than half. Consequently it will be running principally on half load efficiency, or even less. To the thinking mind this consideration will at once lead to the inevitable conclusion that the 1000 light generator is too large as a unit, and that one of more like 500 lights would be better to use under the circumstances. Two units of this size operating together, will supply the 1000 lights; their full load efficiency will be nearly equal to that of the 1000 light machine. When the load comes down to 500 lights then one machine will take care of it, at the same efficiency and at the lowest point of the load, viz., 200 lights. The proportion that this load bears to the 500 light full load is just double what it bears to the 1000 light full load machine. Consequently the average efficiency throughout is higher in the latter case than it was in the former, and the economy greater. It cannot be too strongly impressed on central station owners that the division of their generating plant both steam and electric—into economical units is a most important matter.

BOILER FEED PUMPS.

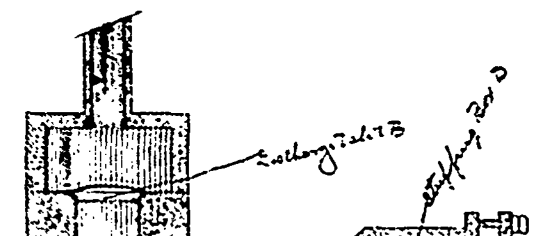
By Wm. Thompson, Montreal West.

A recent visit to a small plant, operated by a somewhat young engineer who was constantly having trouble with his boiler feed pump, owing to want of knowledge as to the principles of construction and operation, must be my excuse for again troubling my fellow engineers. At the outset allow me to say that it is not my intention to discuss the use of feed pumps from an economical standpoint, but as far as my ability will allow me to endeavor to explain the principles of operation of the ordinary feed pump to be found in use in many of our engine rooms at the present day.

In a few instances I have found pumps connected direct to the boiler and pumping direct thereto, delivering the feed water to the boiler at the same temperature as it left the water cylinder of the pump. In some cases no attempt had been made to heat the water, and in others a tank filled with water was heated by means of a jet of steam, taken usually from the exhaust main, and the temperature of the water raised as high as they could get it, or as high as they could get the pump to handle it. Most modern plants are now, however, fitted with some kind of apparatus for heating the water after it leaves the pump and before it enters the boiler. In non-condensing plants this is usually done by means of a tubular heater constructed on the principle of distributing a large amount of heating surface to the cold water, or inversely to the principles of the surface consender. This heater is commonly situated at some point in the exhaust main, and makes at once an admirable means of heating the boiler feed water at the smallest possible cost. In condensing plants a great many means are adopted, but apparently the engineers of to-day prefer the use of "economizers," through which the water is forced, and the waste gases from the furnace are utilized for the purposes of heating, thus enabling the engineer to utilize full value of his fuel to the last possible moment.

There are so many forms of boiler feed pumps working under so many different conditions of service, that I shall not attempt to describe any of them, except to take for an example the simplest form of a pump operated from some part of the engine or its reciprocating parts, and commonly known as a single acting plunger pump.

The principles of action of this pump may be explained from the accompanying diagram, representing a single acting plunger pump shown in section, and with the suction embedded in water, the



pump being empty, valve A being the suction valve, and valve B being the discharge valve, the plunger C being operated from some part of the machinery giving the necessary motion.

The water has the pressure of the atmosphere resting upon its surface, and the pump being also filled with air at atmospherical pressure, the inner face of the valve within the suction pipe is also under atmospherical pressure, and consequently in a state of equilibrium.

Now, suppose that the stuffing box D has been securely packed to prevent the admission of air, and that plunger C has been moved to the right, as no more air can get into the pump, that already within it will expand and as a consequence will become lighter, therefore the pressure on the inner face of the suction valve A will have been reduced, and as a result the water will rise up in the pipe, raising suction valve A in its passage and into pump chamber E. Let me here say that this act is very frequently misunderstood by young engineers and is the cause of a great deal of his troubles; he imagining that the moving of the plunger to the right drew or sucked the water into the pump chamber E, while as a matter of fact the water rises in the suction pipe owing to the pressure on the inner face of valve A having been reduced, as a result of the expansion of the air previously mentioned; therefore, the pressure of the atmosphere exerted on the surface of the water forces the water up into the pump chamber. To obtain this result the engineer will notice that it is compulsory that the admission of air to pump chamber must be prevented, or expansion cannot be effected, or in other words a vacuum will not be created, and the respective weights between the two points will not have been in any way changed, and water will as a consequence remain stationery.

The water inside the pipe will rise above that outside in proportion to the amount to which it is relieved of the pressure of the air, and that if the first stroke of the plunger to the right reduces the pressure from 15 pounds per square inch (atmospheric pressure) to 14 lbs., the water will be forced up the suction pipe a distance of about 2¼ feet, because a column of water one square inch in section and 2¼ feet high is equal to one pound in weight.

When the plunger has completed its travel to the right, the suction valve will fall to its seat and enclose the water in the pump chamber; but as soon as the plunger moves back to the left and enters the pump chamber it will compress the water and force it to raise the discharge valve (B), and expell from the pump a volume of water or air equal in volume to the cubical contents of that part of the plunger that enters the pump chamber and displaces water. To prevent the plunger from forcing the water in the pump chamber back to the suction pipe the suction valve must first close and remain closed until the plunger has completed its stroke to the left. And if when the plunger was at the end of its stroke to the right the pump was partly filled with air, this air will be expelled from the pump before any water is; but if the pump was filled with water, then water only will be delivered.

Now let us suppose that the plunger during its first stroke reduced the pressure within the pump chamber from 15 to 14 lbs. per square inch, and that the second and each subsequent stroke of the plunger reduced the pressure in the suction pipe one pound each stroke, the water in the suction pipe will rise 2¼ feet for each stroke of the plunger, until the weight of the column of water within the suction pipe is equal in weight to the pressure of the atmosphere bearing on the surface of the water; and thus to ascertain how far a pump of this kind will cause the water to rise, will be found by calculation to be equal to a column of water nearly 34 feet high. Consequently it must always be borne in mind that no matter how high the pump may be set above the level of the water, it is impossible for the water to rise more than 34 feet up the suction pipe, no matter how perfect a vacuum can be got, because the force that propels the water is a fixed quantity of about 15 lbs. to the square inch, and it cannot raise a column of water greater in weight than itself. It is considered excellent practice when a pump will create a vacuum sufficiently good to raise water 30 feet.

This principle of operation is applied to all feed pumps with, however, many different mechanical appliances, to suit different purposes and conditions of service.

When this pump, or rather this style of pump, is applied to the purpose indicated, it will be observed that the pressure within the pump chamber when the plunger is discharging is at all times equal to the pressure contained in the boiler, and that to secure the proper performance of the pump for feed purposes, the following methods of construction and operation must be observed, viz:

1st: That the vertical distance between the top of the pump chamber E and the surface of the water must not be more than 30 feet, and that all pipes and connections must be perfectly air tight to prevent the admission of air between the valve and the water.

2nd: That the suction valve must weigh less than 15 lbs. per square inch of cross section. It will be borne in mind that the weight of the valve acts directly on, and against the pressure of the atmosphere on the surface of the water, and reduces the height to which the water will rise directly as the pressure required to be exerted per square inch on the valve to raise it off its seat. An instance of this occurs to my mind, where an engineer of my acquaintance purchased at second-hand a duplex steam pump, which my friend set up to pump water from a tank to his boiler. Much to his surprise he found it would not work, although he knew it had been doing excellent service where last in use. On examination he found that the springs on the suction valves had been adjusted at about 30 lbs. per square inch to suit former service, where water was pumped direct from town mains. As soon as proper adjustment had been made the pump performed quite satisfactorily.

3rd: That all air must be excluded from pump cylinder or chamber, and that all flanges and stuffing boxes must be kept tight, not only to prevent the admission of air, but to prevent leakage of water while pump is in operation.

4th: The discharge valve and pipe must also be clear, and all check valves, stop valves, etc., in proper working order, so that the plunger, or piston of the pump, will not be subject to any greater pressure than that within the boiler.

It will be unnecessary for me to add that water sufficiently hot to form steam at atmospherical pressure cannot be pumped owing to the destruction of the vacuum by the vapor. Nor will it be necessary to enumerate the various disorders to which pumps are subjected, as all minor troubles can invariably be traced to some of the causes already discussed.

THE MEASUREMENT OF RESISTANCE.

SINCE the resistance of no two metals is the same, it was necessary to select the resistance of some accurately defined substance as a standard of measurement. The unit adopted by the international electrical congress in 1893 and called the ohm, after the discoverer of what is called Ohm's law, is "the resistance offered to any unvarying electric current by a column of mercury at the temperature of melting ice, 14,4521 grammes in mass of a constant cross sectional area and of a length of 106.3 centimeters." From this is obtained the standard unit of resistance, but for practical purposes wires of known resistance or resistance coils are used.

The resistance coils require great accuracy in their measurement, in the insulation of the wire and in the mounting of tne coils. The wires must be carefully selected and tested. The insulation must be such as will withstand the highest temperature to which it is subjected without change. Silk thread is extensively used for the insulation. The wire is usually wound on spools or in coils so as to occupy as little room as possible, and are mounted in a box, which protects them from injury and places them in a convenient form to be carried. The ends of the coils are connected to plates or binding posts in the cover. This, also, must be carefully constructed so that the resistance at the point of contact will be as low as possible. A single coil is sometimes placed in an ebony case, or any number, according as the work for which it is to be used seems to require. When a large number is placed in one box the ends of the wires are usually connected to metal blocks, placed at such a distance apart that a metal plug will make a good connection between any two.

The resistance coils being uniform in size, the entire resistance or any part may be used. This is one of several styles of resistance boxes which are manufactured by instrument makers, and is the one commonly used. In measuring the resistance of an electric circuit, we cannot take our standard of measurement as we would take a foot measure to obtain the length of a piece of timber, but we can use it in another way, which will be explained with the Wheatstone bridge. If that of which we wish to measure the resistance is carrying a current and we have a voltmeter and ammeter so we may obtain the difference of potential and amount of current, the resistance is easily obtained by means of Ohm's law, the resistance equaling the electromotive force divided by the current.

ELECTRICAL ITEMS WORTH REMEMBERING.

DROPPING a steel magnet, or vibrating it in other ways, diminishes its magnetism.

It is said that steel containing 12 per cent. of manganese cannot be magnetised.

Flames and currents of very hot air are good conductors of electricity. An electrified body placed near a flame soon loses its charge.

In changing a secondary battery, the charging electromotive force should not exceed the electro-motive force of the battery more than 5 per cent.

The resistance of copper rises about 0.21 per cent. for each degree Cent.

A lightning rod is the seat of a continuous current, so long as the earth at its base and the air at its apex are of different potentials.

The rate of transmission on the Atlantic cables is eighteen words of five letters each per minute. With the "duplex" this rate of transmission is nearly doubled.

The effect of age and of strong currents on German silver is to render it brittle. A similar change takes place in an alloy of gold and silver.

To obtain the number of turns of wire in an electromagnet, multiply the thickness of the coils by the length, and divide by the diameter of the wire squared.

A test for the porosity of porous cells consists in filling the cell with clean water and taking the per cent. of leakage. The correct amount of leakage is 15 per cent. in 24 hours.

If the air had been as good a conductor of electricity as copper, says Prof. Alfred Daniell, we would probably never have known anything about electricity, for our attention would never have been directed to any electrical phenomena.

For resistance coils, for moderately heavy currents, hoop iron, bent into zigzag shape, answers very well. One yard of hoop iron ½ inch wide and 1-32 inch thick measures about 1-100 of an ohm.

The voltage of a secondary battery must always be equal to or slightly in excess of the voltage of the lamp to be burned. For example, a 20 volt lamp will require 10 secondary cells, but ten cells will supply more than 20 lamps.

Compression of air increases its dielectric strength. Cailletet found dry air compressed to a pressure of 40 or 50 atmospheres resisted the passage through it of a spark from a powerful induction coil, while the discharge points were only 0.05 centimeter apart.

An accumulator with 17 plates, 10 by 12 inches, is reckoned, in horse-power hours, equal to about one horse-power hour. Taking this as a basis, it will require 6 cells for one horse-power for 6 hours, or 30 cells for 5 horse-power for the same length of time.

To obtain the length of wire on an electro-magnet, add the thickness of the coils to the diameter of the core outside of the insulation, multipy by 3.14, again by the length, and again by the thickness of the coils, and divide by the diameter of the wire squared.

Blotting paper, saturated with a solution of iodide of potassium to which a little starch paste has been added, forms a chemical test paper for testing weak currents. When the paper (slightly damp) is placed between the terminals of a battery, a blue stain appears at the anode, or wire connected with the carbon or positive pole of the battery.—Scientific American.

CANADIAN ASSOCIATION OF STATIONARY ENGINEERS

SEVENTH ANNUAL CONVENTION.

The limestone city of Kingston was honored this year as the seat of the seventh annual convention of the Canadian Association of Stationary Engineers, which was called for the 17th, 18th and 19th of August. The duties of entertainment therefore devolved upon Kingston Branch No. 10, and the manner in which the delegates were received proved conclusively their qualifications in this respect. While the number in attendance was not as large as desired, the convention throughout was extremely interesting and enjoyable.

Mr. Jas. Davis, Kingston, President.

By the kindness of the city authorities the Council chamber was placed at the disposal of the association, and at 10 a. m. the delegates convened in session. The Executive Committee was *fully* represented as follows: W. G. Blackgrove, Toronto, president; J. Devlin, Kingston, vice-president; E. J. Philip, Toronto, secretary; R. C. Pettigrew, Hamilton, treasurer; W. F. Chapman, Brockville, conductor; F. G. Johnston, Ottawa, doorkeeper.

The Executive president, Mr. Blackgrove, occupied the chair, and on his left sat vice-president Devlin.

The delegates and visitors from the various places were as below:

Toronto A. E. Edkins, John Fox, W. Selby, J. Huggett, R. Pink, J. G. Bain, C. Moseley, A. M. Wickens, W. G. Blackgrove, Geo. Grant, Wm. McKay.

Montreal B. A. York, John Murphy, Wilbur Ware, O. E. Grandberg, J. J. York, Frank J. Greene.

Hamilton R. C. Pettigrew, W. Norris.

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Guelph C. J. Jorden.

Wiarton -F. J. Cody.

Brockville W. F. Chapman, J. McCaw.

Carleton Place J. McKay.

Nearly all the members of the local association were present at some time during the session, prominent among whom were Sandford Donnelly, president; John Tandvin, secretary; Charles Selby, treasurer; Daniel Reeves, John McDonald, Charles Asselstine, Thomas Burns, Fred Simmonds.

The president presented the delegates to the Mayor, who gave a brief address of welcome. He expressed himself as being assured that the subjects coming before the convention would receive that consideration which their importance demanded. Being informed that the constitution of the association very properly provides that the organization shall not be used as a means to encourage strikes or interference in any way between its members and their employers, he thought this fact a matter for congratulation. "In coming from all parts of the Dominion to assist in educating the minds of others in your calling," he said, "Your mission is as noble as your calling is responsible. We all must recognize the importance of having responsible and reliable men placed in positions where human lives are placed at their mercy. It is, therefore, a personal pleasure for me to welcome a representative body of brother mechanics to our city; men who thoroughly understand the subjects they discuss and who can practice what they preach; men possessing a thorough and practical knowledge of their calling. I trust your deliberations while in our city will be beneficial to your order and the public in general." During their leisure hours the Mayor requested the delegates to visit the various public buildings and places of interest throughout the city.

The president replied that it was equally pleasant for him to thank His Worship for the kind and hearty welcome. The reception was thoroughly appreciated by the delegates, who had come to the beautiful city for both business and pleasure—business to discuss matters whereby both manufacturer and steam user may profit by their experience. He extended to the Mayor and Council a cordial invitation to visit the convention at any time. The delegates were confident they would be right royally entertained. The association's objects were purely educational, believing it is never too late to learn.

PRESIDENT'S ADDRESS.

In addressing the convention the president stated his gratification at seeing so many familiar faces present, and he felt in good company. He made a touching reference to the late Bro. Duncan Robertson, of Hamilton, whose death occurred shortly after the last convention in Ottawa. A faithful officer, a true friend and kind husband, his death was deeply regretted. He asked the new members to join heartily in the work to be done. The most important question to come up would be the changing of the name of the association, and he hoped the brothers would weigh their thoughts before expressing their views on the matter. Another important question would be the holding of the convention every two years, instead of annually as in the past. The compulsory issuing of certificates of membership and other topics of interest would also be considered. He stated that Stratford No. 3 had been reorganized, and an application had been received from Waterloo, where it was desired to inaugurate a branch association. He called the attention of the members to the programme that was laid before them, and thought it was the best the association had ever had. From the correspondence received from Brothers Tandvin and Devlin he felt perfectly satisfied that the members of Kingston No. 10

Mr. F. J. Pillar, Toronto, Vice-President.

were a whole-souled and hard-working lot of men. Nothing had been left undone in the way of making this meeting both successful and entertaining to the delegates.

The secretary then read the minutes of the last convention, which were adopted.

Standing committees were appointed as follows:—

Auditing Committee—Bros. F. G. Johnston, W. Selby, J. G. Bain.

Constitution and By-Laws—Bros. J. J. York, chairman; A. M. Wickens, W. Norris, C. J. Jorden, S. Donnelly.

Educational and Good of Order—Bros. A. M. Wickens, chairman; J. J. York, J. Devlin.

Mr. W. F. Chapman, Brockville, Secretary.

Mileage — R. C. Pettigrew, chairman; C. Moseley, J. Murphy, J. F. Cody, F. J. Merrill.

Credentials—Bros. O. E. Granberg, chairman; J. Huggett, W. F. Chapman.

Bro. Devlin asked what had been done in connection with securing reduced rates from the Correspondence School of Scranton, Pa., to which the Secretary replied that he did not understand their terms, as a scholarship would cost a member of the association the same as an outsider. Mr. H. S. Robertson, who represented the school, gave a statement of the facts, which showed that the Canadian association could obtain the same privileges as the International association. By these privileges members were not compelled to take their educational course in full, but could take up any branch desired.

The secretary was asked what had been done towards securing a reduced insurance rate for members of the association. He stated that several insurance companies had promised to give the association reduced rates by deducting the agents' commission. In his opinion the death rate had been increased by the encroachment of scientific inventions.

The convention then adjourned, to meet again in business session in the evening.

At 2 o'clock in the afternoon about four hundred delegates and their friends boarded the steamer Hero for a sail on the St. Lawrence among the Thousand Islands. Although attended with occasional showers of rain, the trip was thoroughly enjoyed, and to many was quite a revelation. On the return trip the city was reached about nine o'clock.

EVENING SESSION.

Reassembling in convention, Bro. John Fox, chief engineer at O'Keefe's brewery, Toronto, read the following interesting paper:—

ICE MAKING MACHINERY.

For some time I have looked forward to the preparation of a short paper on cold storage and refrigeration, and in presenting it I will endeavor to be as practical in my few remarks as the subject will admit. I will therefore dwell principally on that system of refrigeration which is now under my charge at the O'Keefe Brewing Co.'s works, namely, the "Delevergne," or direct expansion system. The substance used in this system is anhydrous ammonia. We are told that ammonia is a combination of nitrogen and hydrogen, expressed by the formula NH^3, which means that an atom of nitrogen (representing 14 parts by weight) is combined with three atoms of hydrogen (representing 3 parts by weight), at ordinary temperatures. The ammonia, or anhydrous ammonia, as it is called in its natural condition, is a gas or vapor, at the temperature of 30° F. It becomes a liquid at the ordinary pressure of the atmosphere, and at higher temperatures also, if higher pressures are employed. The anhydrous ammonia dissolves in water in different proportions, forming what is known as ammonia water, liquid ammonia, aqua ammonia, etc. At a temperature of 900° F. ammonia dissociates, that is, it is decomposed into its constituents, nitrogen and hydrogen. The latter being a combustible gas, it appears that partial decomposition takes place at lower temperatures, but probably not to the extent frequently supposed.

Ammonia is not combustible at the ordinary temperatures, and a flame is extinguished if plunged into the gas, but if ammonia be mixed with oxygen, the mixed gases may be ignited and will burn with a pale yellow flame. Such mixtures may be termed explosive in a sense. If a flame sufficiently hot is applied to a jet of ammonia, it (or rather the hydrogen of the same) burns as long as the flame is applied, furnishing the heat for the decomposition of the ammonia.

Ammonia is not explosive, but when stored in drums with insufficient space left for it to expand, with a high temperature, the drums will burst, as has happened in hot seasons.

Ammonia vapor is highly suffocating and for that reason persons employed in rooms charged with ammonia gas must protect their respiration properly.

With the direct expansion system, the liquid ammonia is directly conducted to the place where heat shall be absorbed, or, we might say, into the rooms which are to be cooled. The gas is then drawn back to the machines or compressors, where it is again compressed and discharged into a pressure tank, and from there to the condenser, where it is again liquefied. In liquefying the gas, cold water is allowed to trickle over the condenser, or we might call it the condensing coils, thereby cooling the ammonia. The liquid then passes on to the separating tank and if any oil should get into the liquid it is caught there. The ammonia then goes on through expansion valves into cold storage rooms where the heat of room is absorbed, thereby cooling or lowering the temperature of same, completing its work thus to repeat its circulation over and over again.

Now let us see what we have to consider in the shape of mechanical work performed. As you may know the equivalent of a ton of ice is 284,000 heat units, or the amount of heat that is required to convert a ton of ice at 32° F. into a ton of water at 32° F.; or conversely, it is the amount of heat that must be extracted from a ton of water at 32° F. in order to convert it into a ton of ice at 32° F.

Mr. R. C. Pettigrew, Hamilton, Treas.

Let us take, for instance, a 50 ton plant. The latent heat of one pound of ice is 142 heat units; multiplying this by 2,000 gives us the number of heat units in one ton. Now, as we are considering a 50 ton plant, this will be 14,200,000 heat units in 24 hours of time, or in other words, a 50 ton plant in 24 hours will absorb this amount of heat units. I might say here that in speaking of a plant of so many tons capacity, it is always understood to mean for 24 hours of time.

The temperature of expanding ammonia would have to be about 10° F. lower than the temperature of a cold storage room, which we will take as 35° F., consequently by using latent heat of vaporization at that temperature, which is 35° F. 10° F. = 25° F, we find it to be 540.03, which is refrigerating effect of 1 lb. of ammonia when the temperature of refrigeration is 25 deg. F., and that of condenser 70 deg., specific heat of the ammonia being 1 deg. F. The amount of ammonia to be evaporated, therefore, per minute of our 50 ton plant is (540.03 - (70 - 25)) = 495.03 latent heat of ammonia at 25 deg. F. Omitting the decimals and taking this in round numbers, 495 × 60 = 29,700. This divided into 59165S.33 = 19.92, which is the number of pounds of ammonia we require per minute for our 50 ton plant. We require about 20 lbs., and the volume of 1 lb. of ammonia vapor at 25 deg. F. is equal to 5.26

cubic feet, consequently compressor capacity per minute will have to be 105.20 cubic feet. If we add to this 20%, which is a fair allowance for losses by radiation, etc., we require an actual compressor capacity of 126.24 cubic feet per minute.

Let us see how the plant I operate compares with this theoretical cal culation just made. The compressor cylinders are 11" × 22", which is equal to about 1 1/5 cubic feet capacity of each cylinder. Our engine makes 40 revolutions per minute and each is double acting. Diameter 11" × 11" = 121 × .7854 = 95.0334 × 22 ÷ 1728 = 1.2099. Consequently at each revolution of crank shaft each compressor discharges its contents twice, which gives us a total discharge of about 192 cubic feet per minute. If we deduct 20% from this for clearance, losses, etc., we get 154 cubic feet, or about 27 feet more than required by our theoretical calculation, which would be the amount allowed to come and go on, which I think close enough for all practical purposes.

Now comes the question of piping required for cold storage rooms. In piping cold storage rooms, from what information I can gather on this subject, it is usual to allow about one square foot of pipe surface for every 3,000 heat units to be absorbed. This is equal to about 1.6 running feet of 2 inch pipe. For a 50 ton plant, according to this rule, we will require a sufficient amount to absorb 14,200,000 heat units in 24 hours, which in round numbers will be 14,200,000 × 1.6 ÷ 3,000 = 7,573 running feet of 2 in. pipe. Of course you understand this estimate is approximate. If we were using 1 in. pipe instead of 2 in. pipe, and the same factor, namely, 3,000 heat units, to be absorbed in 24 hours per each square foot of pipe surface exposed, it would require about 2,833 running feet of pipe. The condensers are a system of pipes or coils into which the ammonia, after being compressed in compressors, is forced, where it is cooled by cold water trickling over the pipes. These are called atmospheric or surface condensers. The ammonia in passing through the condensers yields to the cooling water the heat which it has acquired in doing refrigerating duty by its evaporation and the heat it has acquired during compression, superheating being prevented by a liberal supply of oil in our case.

The mechanical work done during compression is converted into its equivalent of heat. This amount of heat is also equal to the latent heat of volatilization of the ammonia at the temperature of the condenser. The efficiency of the condenser determines in a great measure the economical working of the machine, and for this reason it is good policy to have as much condenser surface as practical consideration may permit. It is said for average conditions (incoming water 65 deg. F., outgoing 85 deg. F.) it will require 20 square feet of surface per ton, or for a 50 ton machine it will take 1,600 linear feet of 2 inch pipe. The main difference of outgoing and incoming water is 20 deg., 485.42 × 20 × 60 ÷ 20 ÷ 8.33 = 3496, which is amount of water in gallons per hour.

GREDIRKWORKS FOR ECONOMIZING COOLING WATER.—Where cooling water is very scarce, and especially where atmospheric conditions—dryness of air, etc.—are favorable, the cooling water may be re-used by subjecting the spent water to an artificial cooling process by running the same over large surfaces exposed to the air in a fine spray. A device of this kind is described as being a chimney-like structure, built of boards. Its height is 25 feet, the other dimensions being 8' × 8'. Inside this structure are placed a number of partitions of thin boards, spaced 4 inches apart, extending to within 1 foot of the bottom of the structure; but the lower halves of these partitions are placed at right angles to the upper halves. This arrangement gives better results than unbroken partitions. The water to be cooled enters the structure at the top, where, by the use of a galvanized iron overflow gutter, it is spread evenly over the partitions and walls and flows downward in thin sheets. At the base of the structure air is introduced in such quantity that the upward current has a velocity of about 20 feet per second. The air meeting the downward flow of water absorbs the heat by contact and also by vaporizing during the passage, 20 deg. F.

The oil used for lubricating the compressors differs from ordinary lubricating oil in that it must not congeal at low temperatures, and must be free from vegetable or animal oil. For this reason only mineral oils can be used, and of these only such oils as will stand a low temperature without freezing, such as the best paraffin oil will do.

Bro. Edkins wished to know what a 50 ton ice plant was.

Bro. Fox replied that it absorbed the heat in a cold storage room with the same power as would 50 tons of ice kept at 32° F.

Bro. J. J. York said that only the previous week the Board of Trade of Montreal had met to consider the introduction of ice-making machinery on the steamships. It was a subject which the intelligent engineer would have to grapple with sooner or later.

A hearty vote of thanks was tendered to Bro. Fox for his paper.

Mr. J. M. Campbell, of Kingston, promised a paper on "Electrical Appliances," but was unavoidably absent from the city.

A visit was then paid to the electric light and gas works, under the direction of Mr. Simmons, the superintendent, who showed the delegates some experiments with acetylene gas.

SECOND DAY.

The convention resumed at 10 a.m., the president in the chair.

Bro. E. J. Philip, Executive Secretary, presented his report, which showed that the total receipts for the year were $607.22 and the expenditure $505.65, leaving a balance of $101.57. The strength of the association had not been up to that of former years, neither numerically nor financially, but a large amount of good had been done by the association taking up the matters of education, insurance and certificates, and while none of these had been as successful as was anticipated, the probability was that during the following year they would be got into better shape. He suggested that the cost of certificates be lessened to the members and that they be made compulsory. He again reported at length on insurance and the Correspondence School, as also on a scheme that would make the Executive more of an educator, by establishing a Bureau of Information.

The Committee on Constitution and By-laws presented a report, which recommended that it be made compulsory to secure membership certificates, and that a reduction be made in the number of officers. This was necessary in order to meet expenses. The movement met with much opposition, some proposing raising the per capita tax, while others suggested meeting in convention every two years. The committee was requested to report again the following day.

The report of the Treasurer was then presented, in which it was stated that the Association had felt the effects of the commercial depression. There was a balance on hand of $101.57.

The report, which was certified correct by the auditors, was adopted, and the meeting adjourned for lunch.

At 2 o'clock, by the courtesy of Mr. B. W. Folger, manager of the street railway, a special car took the delegates and friends to the penitentiary. Mr. Devlin, chief engineer, escorted the visitors through the institution. They were shown a small hand engine built by the famous Percy, of Montreal, forty years ago, for the penitentiary, which cost $1,100. Over the door of the engine room was the lettering "Welcome C.A.S.E." surrounding the British coat of arms. On the wall was a crown of colored incandescent lights. Rockwood asylum was also visited, and in the evening the members had an outing at Lake Ontario Park.

THIRD DAY.

At 9 a.m. on Thursday the business of the convention was again taken up.

The report of the Committee on Constitution and By-laws was adopted. It recommended the granting of a free certificate to every member of the association in good standing and the raising of the per capita tax 25c.

The report of the Committee on Education and Good of the Order recommended that members should take a course in the International Correspondence School. This report was also adopted.

Bro. Edkins suggested the advisability of taking steps to secure Dominion legislation compelling all engineers to hold certificates, instead of as at present, through the provincial government.

Bro. Granberg said Quebec would give every assistance. If there was a compulsory law passed by the Dominion government, the certificate holders of the Ontario association would readily join the Canadian association, and allow the former to lapse. This would bring in a membership of from 700 to 800.

Bro. Wickens said he had been through five legislative fights, and advised them to ask for enough, so that they would be able to get something.

It was moved by Bro. Edkins, and seconded by Bro. Philip, that a committee be appointed to co-operate with the executive board of the Ontario association with a view to securing Dominion legislation for the compulsory examination of stationary engineers. Carried.

It was resolved to publish a hand-book, giving a list of all the engineers in Canada, which number about 12,000.

The mileage report was then adopted.

Bro. Norris moved that a quarterly report from the Executive Secretary be sent to each branch giving its standing. Carried.

ELECTION OF OFFICERS.

The next order of business was the election of officers. The president appointed Bro. Edkins returning officer and Bros. Robert and Tandvin scrutineers.

For president Bro. James Devlin, of Kingston, was elected by acclamation.

For vice-president four nominations were made, Bros. Philip, Pettigrew, Granberg and Chapman. Bro. E. J. Philip, of Toronto, was elected.

The contest for secretary was between Bros. W. F. Chapman, Brockville, and R. C. Pettigrew, Hamilton, the former being successful.

Bros. Pettigrew, B. A. York and Granberg were in the field for treasurer. Bro. Pettigrew was elected.

For conductor there were eight nominees, Bros. Huggett, Murphy, Bain, Wickens, B. A. York, Moseley, Johnson and Jorden. Bro. J. Murphy, of Montreal, was successful.

Bro. F. J. Merrill, of Ottawa, was elected doorkeeper. The other candidates were Bros. Huggett, Fox, Jorden, McKay, Johnston and Norris.

Past-president York installed the newly-elected officers, and the retiring president, Bro. Blackgrove, was presented with the customary jewel.

The officers elected thanked the convention for the honor conferred upon them and promised to endeavor to further the best interests of the C. A. S. E.

A vote of thanks was tendered the returning officers and scrutineers.

Votes of thanks were also tendered the Kingston Street Railway Company, the International Correspondence School, the Mayor and city council, the local association and the press.

Brockville and Hamilton both tendered for next year's convention, with the result that Brockville was chosen.

The president-elect appointed Bro. Granberg district-deputy for Quebec and Bro. Cody district-deputy for Ontario.

Bros. Wickens, Edkins and Norris were appointed a Committee on Legislation.

After conclusive remarks the convention closed by singing "God Save the Queen."

At 3 p. m. the members took carriages for a drive to Kingston Mills and Fort Henry, lunching at the former place.

THE BANQUET.

A banquet at the British American Hotel on Thursday evening fittingly closed the convention. The chair was occupied by President S. Donnelly, of Kingston No. 10. On his right sat the Mayor, Aldermen Skinner, Ryan and Tait. On his left was Executive President Devlin, Past President Blackgrove and Past President Wickens.

The first toast on the list was "The Queen," which was honored by singing the National Anthem.

The Mayor and Ald. Skinner, Ryan and Tait responded to the toast of the "City of Kingston."

"The C.A.S.E., its Aims and Objects," brought replies from Bros. Wickens, J. J. York, Granberg and Norris. Bro. Wickens said that the C.A.S.E. was bound to succeed, for it was founded on the rock of knowledge. Intelligent engineers did not believe in accidents; explosions were due to carelessness or ignorance.

MR. S. DONNELLY, President, Kingston No. 10.

Bro. York said that if all the engineers were as proud as he was to be a member of the C. A. S. E. the membership would increase ten fold. Steam users contemplating remodelling their plants or installing new machines should consult the C.A.S.E.

Bros. Granberg and Norris spoke briefly of the advantages afforded by the association.

"Our Manufacturers" was acknowledged by Mr. Anderson, of the Imperial Oil Company. He spoke of the practical emigration policy required in Canada, and advocated the further extension of foreign trade.

Mr. Robertson, of the Correspondence School at Scranton, responded to the toast "Our Technical Educators."

"Our Visitors and Kindred Societies" brought replies from Bros. Blackgrove and Edkins. Bro. Edkins said that many thought that the O.A.S.E. was an antagonist to the C.A.S.E., which was not the case. As soon as Dominion legislation compelled qualified licensed engineers the O.A.S.E., with its 700 members, would amalgamate with the C.A.S.E. He showed how dangerous it was to place boilers in the care of incompetent men, by giving the relative explosive forces of steam and dynamite.

"Kingston No. 10" was acknowledged by Bros. S. Donnelly and J. Devlin.

"The Executive Council" was replied to by Bros. Devlin, Philip, Pettigrew and Chapman; "The Ladies" by Bro. Granberg and Ald. Tait, and "The Press" by representatives of the Kingston Whig and News, and the Canadian Engineer and ELECTRICAL NEWS, of Toronto.

The entertainment was interersed with songs by Messrs. Grant, Blackgrove, Cochrane, Skinner, Murphy and Rubert.

MR. JAMES DEVLIN.

Mr. Devlin, president-elect of the C. A. S. E., was born in Kingston, and is the eldest son of the late P. Devlin, a veteran fireman. After serving his apprenticeship with the Canadian Locomotive and Engine Company, he worked for a time with D. Ewen & Sons, and in 1873 was appointed engineer of the Government waterworks. Two years after he was transferred to the penitentiary at St. Vincent de Paul, near Montreal, as chief engineer. In 1885 he received the appointment of chief engineer of Kingston penitentiary, which position he still occupies. His connection with the C.A.S.E. dates from the year 1892, and since that time he has been an active worker. He was largely instrumental in securing the formation of the Kingston branch, and at the annual convention at Ottawa last year he was unanimously elected to the Executive Committee as vice-president, and filled the position with such credit that his qualifications for the duties of president are unquestioned. He is also a member of the Board of Examiners of the Ontario Association of Stationary Engineers, and a strong advocate of compulsory examination of engineers.

SPARKS.

An electric light plant will probably be installed in the asylum at Brockville, Ont.

The Sherbrooke Telephone Co., of Sherbrooke, Que., is building 100 miles of new lines.

A by-law has been carried by the ratepayers of Listowel, Ont., in favor of electric lighting.

The Prescott Electric Light Co., of Prescott, Ont., contemplate making additions to their plant.

Local parties will probably install an electric light plant for street lighting at Winchester, Ont.

The Ottawa Electric Light Co. intend putting in a 7,000 candle power machine in No. 2 power house.

It is said to be the intention of Mr. Comstock, of Brockville, to place an electric light plant in his yacht.

On the 17th of August the ratepayers of Huntsville, Ont., sanctioned a by-law providing for an electric light plant.

It is announced that a gentleman from Halifax proposes establishing an electric light plant at Shubenacadie, N. S.

The plant of the Owen Sound Electric Light Co. is being enlarged to supply incandescent as well as arc lights.

The Galt, Preston & Hespeler electric railway carried 35,000 passengers and 930 tons of freight during the month of July.

The Auer Light Co., with a capital of $30,000 has been organized in Ottawa. Mr. C. S. Taggart has been appointed manager.

The Listowel Gas Co., of Listowel, Ont., purpose installing an electric plant when the present contract for lighting the town expires.

The Trojan Car Coupler Co.'s branch at Smith's Falls, Ont. are supplying the Quebec and St. John electric road with car couplers.

Incorporation is being sought by the Amherstburg Electric Light, Heat & Power Co., of Amherstburg, Ont., with a capital stock of $20,000.

It is reported that Michael & Becker, owners of a patent telephone system, are prepared to make an offer for the telephone franchise of Toronto.

The city council of Windsor, Ont., have purchased the machinery in the electric lighting station from E. Leonard & Sons, of London, at the price of $2,685.

Mrs. R. McLaughlin, of Summerville, has entered a suit against the Toronto & Mimico Electric Railway Co., to recover $20,000 damages for the death of her husband, who was killed by one of the company's cars.

Owing to the destruction of the power house of the Montreal Park & Island Railway Co., two new power houses are being erected, one at Lachine and the other at St. Laurent.

The Electric Railway Co. at Sherbrooke, Que., is said to be negotiating for water power at Brompton Falls, and if successful will commence the construction of the road at an early date.

Dr. Harrison Chamberlain has presented to the city council of Buffalo a petition asking for permission to construct and maintain a telephone system in that city. It is proposed to organize a new company.

The Hamilton, Chedoke & Ancaster Electric Railway Co. have secured almost all the right of way necessary for their proposed line, and steps are now being taken to organize the company. It is the intention to have the road in operation early next summer.

In the decision of the Privy Council in the case of the Toronto Street Railway Co. re the duty on steel rails, several other railway companies are interested, as follows: London Street Railway Co., $12,000 to $15,000; Hamilton Street Railway Co., $18,000; Windsor Street Railway Co., $6,000. The Winnipeg Street Railway Co. is also said to be interested.

Incorporation has been granted to the Callendar Telephone Exchange Co., with head office in Toronto. The object of the company is to deal in telephone patents, and to build and operate telephone lines throughout Canada. The promoters are: Romaine Callander and Edward H. Hart, of Brantford, and J. Enoch Thompson, of Toronto. The capital stock is $100,000.

The corporation of the town of Markham, Ont., have leased their lighting plant to the Markham Electric Light Company, who have extended and improved the system. They have installed a 20 K.W. alternating plant furnished them by the Royal Electric Company, and about 350 lamps. The street lighting has also been changed from arc to incandescent lights, which are giving every satisfaction.

At the annual meeting of the Ottawa Car Co., held recently, it was stated that a dividend of 8 per cent. had been paid to the shareholders and a sum equal to 4 per cent. placed to the reserve account of the company. Directors were elected as follows: Thomas Ahearn, president and managing director; James D. Fraser, secretary-treasurer; W. W. Wiley, J. W. McRae, W. Y. Soper and Wm. Scott.

The addition to the power house of the Montreal Street Railway Co. is nearing completion. A new boiler house with chimney 250 feet in height is being constructed, in which will be placed three Babcock & Wilcox water tube steam boilers and a direct-connected engine of nearly three thousand horse power. This addition has been rendered necessary in order to cope with the increasing passenger traffic.

R. Anderson, Ottawa, is applying for a patent on an electric switch to turn on one, two or three lights, or any number, in rotation. It is useful in high chandeliers on occasions where only one or two lights are required. He is also applying for a patent for an invalid's push hanging switch. One push lights the lamp and the next puts it out. This is a very simple and useful contrivance. It will be made of porcelain.

The Richmond County Electric Co. have decided to entirely remodel their plant outside the station. All their old type transformers will be discarded and be replaced by Stanley type in large units, and all their primary circuits will be transformed to 2,000 volts. By these changes they will secure twenty per cent. increase in capacity and be able to take care of their increased business without changing their present dynamos. The order for transformers and supplies has been placed with the Royal Electric Company.

At the recent carnival at Halifax, N. S., an attraction of much interest was the electrical illuminations of the war-ships and the illuminated procession of steamers, yachts and boats. The flag-ship "Crescent" was decorated with incandescent lamps, while the English and French war-ships and the cable ships "Mackay Bennett" were beautifully displayed with search lights and blue fire. On the steamer "Annie" was placed a special engine and dynamo, with strings of incandescent lamps covered with fancy shades and Wheeler reflectors. This installation was the work of John Starr, Son & Co., of Halifax, and reflected credit upon the firm.

TO AVOID FIRES FROM ELECTRICAL APPLIANCES.

The National Board of Fire Underwriters of the United States has promulgated a series of rules referring to electrical appliances for light and power. It publishes the following cautions for the information of the public.

1. Have your wiring done by responsible parties, and make contract subject to the underwriter's rules. Cheap work and dangerous work usually go hand in hand.

2. Switch bases and cut-off blocks should be non-combustible (porcelain or glass).

3. Incandescent lamps get hot; therefore all inflammable material should be kept away from them. Many fires have been caused by inflammable goods being placed in contact with incandescent lamp globes and sockets.

4. The use of flexible cord should be restricted to straight pendant drops, and should not be used in show windows.

5. Wires should be supported on glass or porcelain, and never on wooden cleats; or else they should run in approved conduits.

6. Wires should not approach each other nearer than eight inches in arc, and two and one-half inches in incandescent lighting.

7. Wires should not come into contact with metal pipes.

8. Metal staples to fasten wires should not be used.

9. Wires should not come into contact with other substances than their designed insulating supports.

10. All joints and splices should be thoroughly soldered and carefully wrapped with tape.

11. Wires should be always protected with tubes of glass or porcelain where passing through wall, partitions, timbers, etc. Soft rubber tubes are especially dangerous.

12. All combination fixtures, such as gas fixtures with electric lamps and wires attached, should have approved insulating joints. The use of soft rubber or any material in such joints that will shrink or crack by variation of temperature is dangerous.

13. Electric gas lighting and electric lights on the same fixture always increase the hazard of fire, and should be avoided.

14. An electric arc light gives off sparks and embers. All arc lamps in vicinity of inflammable material should have wire nets surrounding the globe, and such spark-arresters reaching from globe to body of lamp as will prevent the escape of sparks, melted copper, and particals of carbon.

15. Arc light wires should never be concealed.

16. Current from street railway wires should never be used for lighting or power in any building, as it is extremely dangerous.

17. When possible, the current should be shut off by a switch where the wires enter the building, when the light and power are not in use.

18. Remember that "resistance boxes," "regulators," "rheostats," "reducers," and all such things, are sources of heat and should be treated like stoves. Any resistance introduced in an electric circuit, transforms electric energy into heat. Electric heaters are constructed on this principle. Do not use wooden cases made for these stoves nor mount them on wood work.

AUTOMATIC COAL WEIGHING MACHINES FOR POWER STATIONS.

The late Hon. Eckley B. Coxe, who strongly advocated the substitution of a continuous record of actual boiler performance for the prevailing system of occasional tests, once stated the matter very tersely, saying:

"I am not so much interested in knowing what some expert may be able to do with my boilers as to know what work my firemen are actually getting from them every day."

To know this, however, means the measuring of the intake and the output—means accounting for the entire supply and production, so that the necessary comparisons may be made for formulating the result. The automatic weighing machine supplies this requirement, automatically handling coal and water, much after the manner of an ordinary water meter, say, interposed in a water pipe, or a gas meter for that matter, giving a continuous and reliable record of what has passed through it.

In another way, too, may the automatic weighing machine serve a good purpose. Daniel Webster has been quoted for the way in which, in one of his speeches, he emphasized "the tremendous power of six per cent." Certainly the investor of to-day looks sharply enough to the difference of one per cent. in the rate of interest chargeable against him. But does he look as closely to the other components of the "cost?" For instance, recent experiments indicate that the anthracite coal generally used for steam making will hold about four per cent. of water without much dripping; and much of that coal is "watered" to this extent before delivery. If, now, the coal pile be replenished twice a year with wet coal, it is evident that the the buyer pays the interest rate plus eight per cent. of the purchase price as the cost of the capital employed in "carrying" the fuel account.

Although the coal cannot, for obvious reasons, always be obtained dry, the drying may be readily effected in nearly all power stations before the coal reaches the bins by using heated air drawn from the upper part of the boiler rooms. Then, by weighing in through an automatic weigher and reweighing in the same way, first to the bins, next directly to the furnaces, all of the required facts are obtained. The first weighings, by showing the amounts taken and delivered to the bins indicate the evaporation, and a comparison of the records of the second and third readings will show, at any time, the amount held in storage in each bin, besides giving the amount chargeable to each set of boilers.—Francis H. Richards in Cassier's Magazine for August.

ERRATA.

Mr. John Patterson, of the Power Company, Hamilton, writes: "Will you kindly correct a couple of errors in your article on the Cataract Power Co., of Hamilton, in the August issue of your paper. The water flowing over the fall is more than 6 inches by 48 feet, instead of 5 inches by 18 feet, and the head is about 210 feet instead of 270. The flow of water is over eight thousand cubic feet per minute, which at this head gives something over the 2500 horse power."

Mr. P. G. Gossler, engineer for the Royal Electric Co., Montreal, is at present engaged on the reconstruction of the Montreal station. They are replacing 17 alternators by five 300 kilowatt generators, directly connected to three engines. They are also building an entirely new switch board for light and power from the two phase circuits. Their present system of 1000 volts is being changed to a 2000 volt system and their transformers are being replaced by more modern ones. Power will be obtained from Chambly Falls, fifteen miles distant.

CORRESPONDENCE

To the Editor of the CANADIAN ELECTRICAL NEWS.

SIR:—I clipped the following letter from the August issue of Power, and with your permission will reproduce it here, as the writer evidently has discovered some new element of danger in our already dangerous but interesting occupation.

WHERE QUICK ACTION WAS NECESSARY.

Several years ago a gentleman who is now chief in a large water works in New York had charge of an engine in a saw mill in the then wild woods of Michigan. One morning he came to the mill, and found no steam. The watchman told him that he had been firing very heavy for several hours with dry fuel. An examination showed that the boiler, dome, and steam pipes were full of water, also that the boiler and arch were excessively hot. Here was a case of danger that required a superior knowledge of engineering, philosophy, good judgment, and prompt action. What would you do?

J. W. POWER.

Will my fellow Canadian professional brethren enlighten me as to what this writer intends to explain, whether the boiler in question had become so overheated as to have become dangerous from this cause, or simply whether the engineer was fearful of detaining the sawmill hand until such time as he could reduce his water level and make the steam, the watchman had been so long trying to get?

After reading the letter I am of the opinion that the writer intends to state that the boiler was overheated and in danger of collapse from this cause. He tells us that the boiler, dome and steam pipes were full of water, but does not say how they happened to be full; quite evidently the water had fed into the boiler from some source after the engineer had shut down the previous night—a not altogether unknown occurrence, as most engineers can verify, especially when there happens to be a cold water pressure on the feed main. No matter how the thing happened, however, we are told that the apparatus in question was full, that the watchman had been firing for several hours, (apparently on this particular morning the watchman got at the fires earlier than usual); that he had no steam, that the boiler as a consequence of the untiring energy of the watchman was excessively hot, that immediate danger was so great that this model up-to-date engineer had to know so much and act so quickly under those trying circumstances that Mr. Power thinks it worthy of record as a brilliant engineering feat and wants to know what other engineers would have done under the circumstances.

Well, Mr. Power, for my part under such circumstances as these I should have kept exceedingly quiet and taken off my coat and made steam. In the first place, if, as Mr. Power tells us, the boiler, etc., was full of water, how was it that the almost incessant firing of the watchman did not impart some heat to this same water, particularly when the boiler shell was so overheated? Mr. Power no doubt knows that the circulation within the boiler was just the same under circumstances stated as it would be with dome full of steam, under equal pressure, and also as heat was imparted to the water it would in course of events follow the natural law and expand. But we are told everything was full and therefore water could not expand or increase in bulk, and increase of pressure on the boiler would follow as a natural consequence and would be recorded on the steam guage just the same as though the boiler was making steam in the usual course of events. We are told, however, that when the engineer arrived there was no steam, or in other words no pressure was indicated on the gauge. If so, then it is quite evident that the heat from the fires had never reached the water within the boiler, and that overheating of boiler plates was caused rather from want of water than there being too much water in the boiler.

After reading Mr. Power's letter I am very much inclined to believe that a very large amount of danger was imaginary and that a great many of the circumstances are the result of an imaginative brain rather than an actual occurrence.

"ENGINEER."

The Lozier Manufacturing Co., of Toronto, have applied for incorporation to build motor vehicles, etc. The capital stock is $500,000.

Mr. Higman, head of the Government Electric Light Inspection Department, recently made a test of the electric light service supplied to the city of Toronto by the Toronto Electric Light Co. In his report to the City Board of Control he states that "voltage readings were made at 12 different lamps, which show an average pressure of 51 volts. If an average of the whole ampere readings is made we have 10.6 amperes as the current strength; this multiplied by the mean voltage gives an average of 541 watts, or 25 per cent. in excess of what the contract called for." The report concludes with the statement that "not only is the company fulfilling its obligations, but is doing so generously, and the operation of the whole plant is decidedly creditable."

BEARDSHAW'S "PROFILE" TOOL STEEL.

ON another page of this journal will be found an advertisement by Messrs. Winn & Holland, of Montreal, who have secured the sole agency for Canada for the sale of Beardshaw's Profile Tool Steel, which is now being largely introduced in Montreal. In introducing to the engineers and allied trades tool steel in a new form, little need be said, other than to point out its various applications, (which is done in the catalogues supplied by the agents) for to say, that the steel comes to the user in such form or profiles as to enable tools to be made by grinding only, is to indicate that a long-felt want has been met.

This steel is now rolled in six different sections or profiles, most required by engineers and machinists, and other profiles will be made as required. Tools for the lathe, planer, shaping, slotting and drilling machines, also chisels, rimers, taps, bits, broaches, gravers, etc., are made from this steel without forging, and there is, therefore, no wasting in the fire. The steel as it comes from the rolls is ready to cut to lengths and grind into tools, which is a great saving in time. There is also a saving over 50% in the weight of steel used.

The manufacturers claim that the quality of this steel is much finer than any ordinary tool steel put upon the market. Owing to it not being necessary to forge it, it is possible to supply a very much more durable steel, which if forged, would be liable to be spoiled by the blacksmith.

The adoption of this Profile Steel amongst the most up-to-date engineers is now an assured fact. An undoubted success of this steel has been made in Europe, and it is now being introduced in the colonies. The Profile Steel is also being produced in self-hard quality, so that no heating is necessary.

PERSONAL.

Mr. A. A. Dion, superintendent of the Ottawa Electric Light & Power Co., returned a fortnight ago from a trip to New York.

Mr. George C. Peters, manager of the New Brunswick Telegraph Co., at Moncton, N. B., recently had the misfortune to break one of his arms.

Mr. J. C. Mullen, formerly with the Ottawa Electric Railway Co., is at present engaged on the construction of a government electric line in Durban, South Africa.

It is stated that Mr. James Devlin, chief engineer of the penitentiary at Kingston, is an applicant for the position of Superintendent of Public Works for the Dominion.

Mr. A. Porter, superintendent of the Cornwall Electric Street Railway, has resigned, to accept a position in Montreal. The employees of the company presented him with a gold watch on the eve of his departure.

Mr. Angus Grant, for many years superintendent of the Great Northwestern Telegraph Co., at Montreal, died at his home in Prescott on the 15th ult. Some time ago, owing to ill health, he was obliged to resign his position.

The death occurred in Toronto early in August of Mr. Thomas Northey, father of Mr. J. P. Northey, of the Northey Mfg. Co. Deceased was well known throughout Canada, and was in his 80th year. Fifty years ago he established a foundry in Hamilton, removing to Toronto in 1880.

Mr. W. E. Davis, formerly of the Toronto Street Railway Co., and latterly electrical engineer and purchasing agent of the Detroit Railway, has resigned his position and removed to Saginaw, where he becomes manager of the Bearinger Electric Railway between that city and Bay City.

Mr. J. J. Ashworth, for several years attached to the engineering department and latterly to the agency staff of the Canadian General Electric Co., has severed his connection with the company and will engage in the future in independent engineering and construction work. The termination of Mr. Ashworth's connection with the company was made the occasion of a pleasant expression of good will on part of the Toronto staff it the form of an address accompanying the presentation of a locket with monogram suitably engraved.

It is with deepest regret that we announce the death of Mr. A. W. Congdon, of the engineering staff of the Canadian General Electric Co., to whose illness reference was made in these columns recently. The hope then expressed that he would probably recover was unfortunately not well founded, the disease having taken deeper hold upon his system than had been supposed. It is believed that in the trip which Mr. Congdon made several years ago to Japan, his constitution was undermined.

TRADE NOTES.

The Canadian General Electric Co. are installing a 500-light incandescent plant in the Winnipeg general hospital.

The Dodge Wood Split Pulley Company have removed their Toronto office from 86 King street to 74 York street.

W. A. Johnson, of Dresden, has ordered a 500 light single phase alternating plant from the Canadian General Electric Co

The Vancouver Consolidated Ry. Co. have ordered a 150 k. w. "Monocyclic" generator from the Canadian General Electric Co.

The Niagara Falls Light & Power Co. recently started up the second of the 2,000-light single phase generators purchased from the Canadian General Electric Co.

The Hull Electric Co. have ordered a parlor car from the Canadian General Electric Co. to meet the demand for such a service on part of excursion parties from the capital city.

The Robb Engineering Co., of Amherst, N. S., are placing a 100 horse power engine and a 125 horse power Monarch boiler in the power house of the Moncton Street Railway Co.

Messrs. Hooper & Starr, who are constructing the Cornwall St. Ry., owing to the increasing traffic, have ordered additional C. G. E. 800 motors from the Canadian General Electric Co.

The Dominion Oil & Supply Co., of Montreal, is applying for incorporation, to manufacture engine and boiler supplies, etc. Among the applicants are Tancrede Hout and Paul Gailbart.

The Goldie & McCulloch Co., of Galt, have been given an order by the Galt Waterworks Department for a compound steam pump capable of pumping 1,000,000 imperial gallons per 24 hours.

The Paxton, Tait Co., of Port Perry, Ont., are seeking incorporation, with a capital stock of $99,000. The first directors are Hon. John Dryden, George William Dryden and William McGill.

Messrs. B. Bell & Sons, agricultural implement manufacturers, of St. George, Ont., are having their large works lighted throughout by electricity. The Royal Electric Company are installing the plant.

The Montreal Park and Island Railway Company have recently placed an order with the Royal Electric Company for ten (two 30 h. p. motor) car equipments, and one 250 k. w. railway generator. These are to replace their plant recently destroyed by fire.

The Berlin & Waterloo Electric St. Ry. Co. have placed an order for two closed motor car bodies with the Canadian General Electric Co. These cars will be of the company's standard vestibule type, somewhat modified to meet the views of the president of the road, Mr. E. Carl Breithaupt, and are intended to be models both in design and construction.

La Compagnie Electrique has recently purchased a 30 h. p. S. K. C. two-phase motor from the Royal Electric Co. This motor will be used to operate a woollen mill. This installation is of special importance as showing the development of multiphase motor work in small plants, and how small plants can increase their earning capacity by operating in the day time as well as the short time of load at night.

The Corporation of the town of Newmarket have closed a contract with the Royal Electric Co. for one of their "S. K. C." alternating current dynamos, having a capacity of 1,000 16 candle power lamps; and also have ordered 800 light capacity in "S. K. C." transformers. They are re-building the old plant and are also installing a new arc machine and lamps, purchased from the Canadian General Electric Co.

The Royal Electric Company are installing for McMaster Bros., of Ridgetown, Ont., one of their 75 k.w. "S. K. C." transformers of 500 light capacity. The generator is direct belted to a 100 h.p. high speed Leonard Ball engine, making a very compact and modern plant. Their new brick power house is a model of neatness, and when their plant is completed they will have a fine modern and complete electric lighting plant.

Mr. Geo. E. Matthews, manager of the Electric Repair and Contracting Co., of Montreal, states that the results of the company's first year's business are very satisfactory, and they are entering upon the second year with fair prospects. The company are prepared to execute any class of new or repair work. The fact that Mr. Matthews was for ten years foreman of the repair department of the Royal Electric Co. should be a sufficient guarantee of competency.

The Montreal Cotton Co. are installing electrical power apparatus in their mill at Valleyfield. Mr. Louis Simpson, the general manager of the company, after examining the operation of similar plants in the cotton mills in the United States, has placed an order with the Canadian General Electric Co. for a 600 h. p. three phase generator, and for 350 h. p. capacity in induction motors. Some of the latter will be of the inverted type attached to the ceiling and direct coupled to the line shafts which they are to run.

The Chateauguay & Northern Ry. Co. are proceeding rapidly with the equipment of their road, which is really a branch of the Montreal Island Belt Line system. The contract for the entire electrical equipment and for the car bodies has been awarded to the Canadian General Electric Co. and consists initially of one 200 k. w. multipolar railway generator, and two open and four closed cars equipped with C. G. E. 800 motors, and type "K" controllers. The road is expected to be ready for operation not later than September 15th.

UNSOLVED PROBLEMS IN THE MANUFACTURE OF LIGHT.

Prof. John Cox, in a recent lecture on the above-named theme, before the Royal Society of Canada, presented, in a very striking way the enormous percentage loss of energy in all attempts heretofore made to manufacture light through the agency of the steam engine.

To begin with he points out that in practice not more than from 7 to 16 per cent. of the energy of the fuel used can be realized through the engine, and theoretical considerations establish a limit at about 30 per cent., beyond which it would seem to be hopeless to expect to pass in any form of heat engine. This he terms one of the unsolved problems.

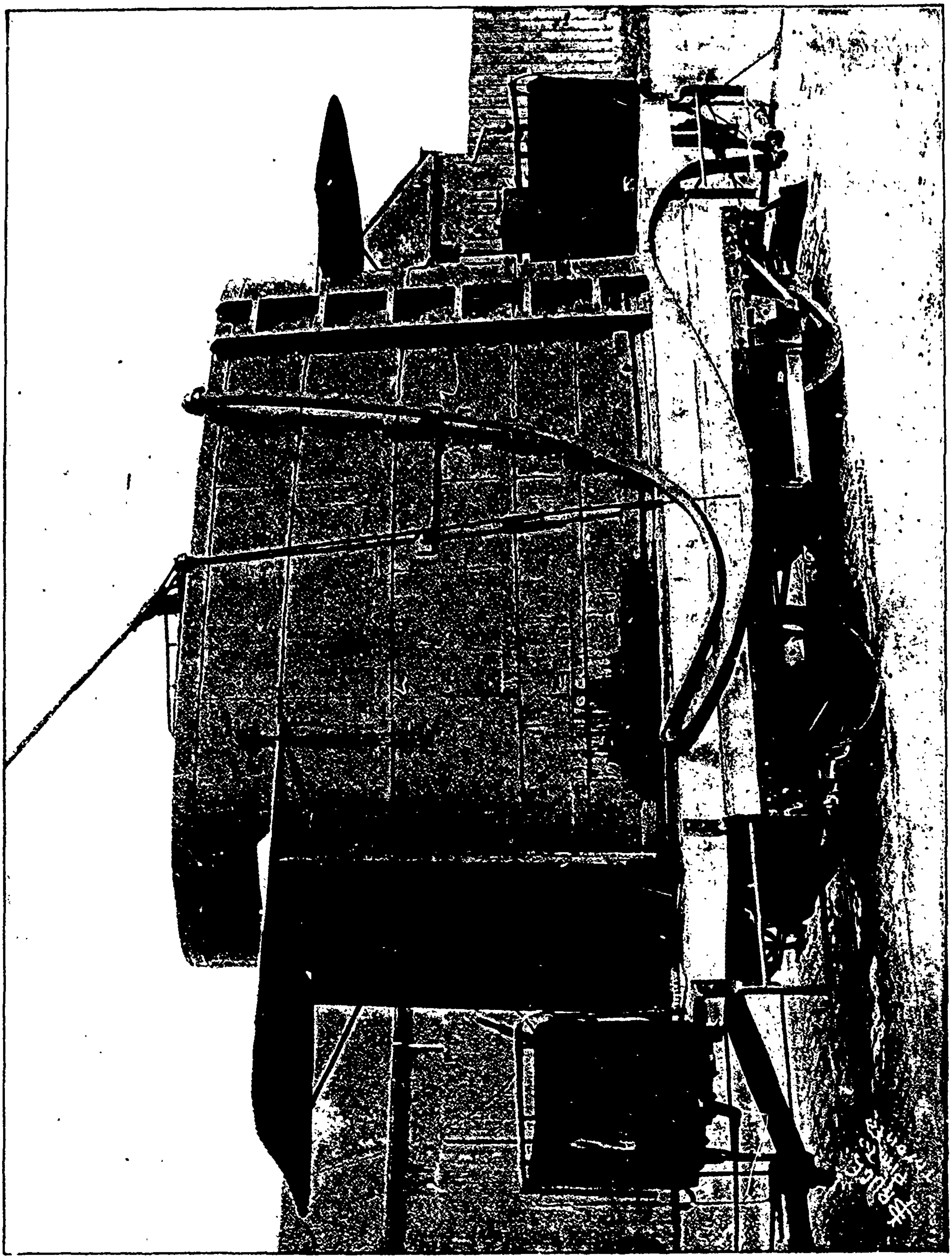
It is, however, not unsolvable if we can devise some means of extracting the energy of coal otherwise than by heat—say in some such manner as that in burning zinc in a voltaic battery. That this is not beyond the scope of our present scientific knowledge the recent experiments of Borchers and others bear strong evidence.

In the second stage of the operation of producing the electric light, the dynamo is already so nearly perfect that hardly any heat is lost in its conversion into current.

The third stage brings us to the lamp, with some 7 per cent. of the original energy still available. The only means thus far available for producing luminous energy is to heat the molecules of some substance, and in this operation we are compelled to waste the greater portion of our available energy in producing heat before we obtain the light rays.

"Here, then, is the second unsolved problem, since even in the incandescent lamp and the arc lamp not more than from 3 to 5 per cent. of the energy supplied is converted into light. Thus, of the original store in the coal less than three parts in a thousand ultimately become useful. In the last six years, however, some hint of means to overcome the difficulty has been obtained fromthe proof by Maxwell and Hertz that light is only an electric radiation. Could we produce electric oscillations of a sufficient rapidity, we might discard the molecules of matter, and directly manufacture light without their intervention. To do this we must be able to produce oscillations at the rate of 400,000,000,000 per second. Tesla has produced them in thousands and millions per second, and Crookes has shown how, by means of high vacua, to raise many bodies to brilliant fluorescence at a small expense of energy. . . These are hints toward a solution of the problem, but give no solution as yet. Prof. Langley states that the Cuban firefly spends the whole of its energy upon the visual rays without wasting any upon heat, and is some four hundred times more efficient as a light producer than the electric arc, and even ten times more efficient than the sun in this respect. Thus, while at present we have no solution of these important problems, we have reason to hope that in the not distant future one may be obtained, and the human inventor may not be put to shame by his humble insect rival."

ELECTRIC RAILWAY DEPARTMENT.



TROLLEY SPRINKLER IN USE BY THE TORONTO STREET RAILWAY COMPANY.

A MONTREAL ELECTRIC LINE.

An electric railway is nearing completion which will connect the city of Montreal with Bout de l'Isle, the extreme east end of the island of Montreal, about twelve miles from the city. The promoters of the road are the Chateauguay and Northern Electric Railway Company, which commenced construction in June last. It will extend from the Montreal Street Railway Company's line on Ontario street through Point Aux Trembles and Longue Point to the east end of the island opposite Charlemagne, connecting with that place by a steam ferry. The road is of the ordinary standard gauge, the right of way secured measuring eighty feet. When the line leaves Maissoneuve the route is perfectly straight for a distance of six miles, the sharpest curve on the road being one of two degrees, while it is practically level the entire distance. The 'rolley poles are of cedar and of the ordinary size.

The rolling stock is being furnished by the Canadian General Electric Company. Eight cars are now nearing completion, which are finished inside and out in mahogany. They will have a seating capacity of from 60 to 100 persons and will be lighted by means of electric globes.

The power house is being constructed at Point Aux Trembles, is 85x46 ft., with 18 ft. walls, in which will be placed a full complement of machinery. The engines, four in number, are being furnished by the Goldie & McCulloch Company, of Galt. The company have acquired a fine hardwood grove of twenty acres, at the end of the island, and where Riviere des Prairies empties into the St. Lawrence, and this in due time will be converted into a park. The return trip from the city to Bout de l'Isle will be made inside of an hour.

HULL & AYLMER ROAD.

The starting up of the Hull Electric Co.'s new system between Hull and Aylmer on July 1, was a marked success, both in point of the patronage which it seems likely to secure, and in the operation of the electric plant. We hope to be in a position in our next issue to place before our readers the detailed description of the various interesting features presented by this important addition to the electric railways of the Dominion.

The twenty-seventh annual general meeting of the shareholders of the Dominion Telegraph Co. was held in Toronto on the 14th of August. The report of the directors showed that the liabilities of the company were $1,015,972.70, and the assets $1,313,905.24. The report of the directors was unanimously adopted, and the following were elected directors for the ensuing year: Thos. Swinyard, president; Sir Frank Smith, vice-president; General—Thos. Eckert, Charles A. Tinker, A. G. Ramsay, Henry Pellatt, Hector MacKenzie, Thomas S. Clark and Thos. R. Wood. In recognition of his services, a presentation of a handsome service of silver plate was made to Mr. Swinyard, president.

SPARKS.

Arrangements have not yet been completed for the conversion of the Hamilton and Dundas Railway into an electric road.

The time for beginning the construction of the Perth and Lanark electric railway has been extended for one year by the Perth town council, provided satisfactory guarantees of bona fides be furnished.

The city of Victoria, B. C., and the Consolidated Electric Railway Company have been made joint defendants in an action to recover $50,000 damages for the death of Mrs. Prevost, who was one of the victims of the Point Ellice bridge accident.

Frank Stevens, of Hamilton, who was injured by a fall from a pole while repairing the Hamilton, Grimsby and Beamsville railway has entered an action against the company for damages, alleging that the fall was due to an electric shock received as the result of a defective bell.

The Gravenhurst Electric Light and Power Co., of which Mr. E. F. G. Fletcher is manager, are re-modelling and re-building their plant. They are erecting a brick power house 30 x 40 on the shore of Gull lake where they have an abundance of water for condensing purposes and are easy of access to the Grand Trunk Ry. for their fuel. The order for an 80 h. p. Wheelock engine with condenser, boiler and shafting, was secured by the Goldie & McCulloch Company, Ltd., of Galt, Ont. This will give them ample power. They have also purchased from the Royal Electric Company a 50 k.w. "S. K. C." alternating generator and switchboard, and an 18-light 6½ ampere "T. H." Royal arc dynamo with lamps, which are now being installed. When completed, this will be one of the finest electric lighting plants in Canada, and speaks well for the enterprise and push of the new company.

Vankleek Hill 25th April 1896
Robert Anderson Esqr
Electrician
Ottawa

Dear Sir,

I have much pleasure in stating that the work done by you on the Vankleek Hill Electric Light plant last summer has given entire satisfaction in every respect, as promised by you

Yours Truly
Wm Higginson

This is to certify that **MR. ROBERT ANDERSON,** of the City of Ottawa, installed an Electric Light Plant in the village of Eganville for me. I am pleased to say that the work was done in a most satisfactory manner. Any person requiring his services will find him reliable and trustworthy.

JOHN D. McRAE.

Eganville, May 4, 1896.

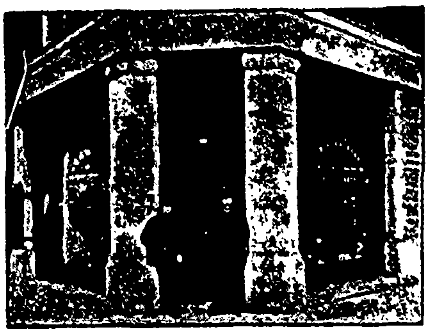
SPARKS.

A syndicate of capitalists is reported to be in course of formation in Quebec to purchase the Lower Town street railway and Mr. Beemer's electric railway franchise.

The electric street railway at Moncton, N. B., was put in operation on the 12th of August. The road is over two miles in length, and construction occupied less than fifty days.

A description of a new electric telegraph has recently been received at the Department of State, Washington. The apparatus, it is said, makes it possible to communicate with a ship at a certain anchor ground without any direct line from land. An electric battery is placed on the shore with one pole in contact with water or moist earth, while the current from the other pole, through a telegraph key and a revolution interrupter, is conducted to a cable which is laid out to the anchor ground and placed around the latter in a coil having a diameter of 1,000 to 1,200 feet. On board the ship is a small solenoid with which a telephone is connected. When a message is sent from the land a bell sounds on the ship and the communication is sent by the telegraph key through the telephone instrument.

There is an absolute necessity for advertising; there is great eagernese to compete for attention, and no one gets it unless it is by giving, as it were, so many strokes of the hammer, one after the other, to compel the people to notice what is going on. W. E. Gladstone.



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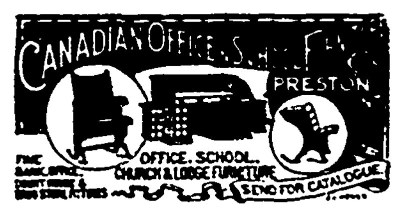

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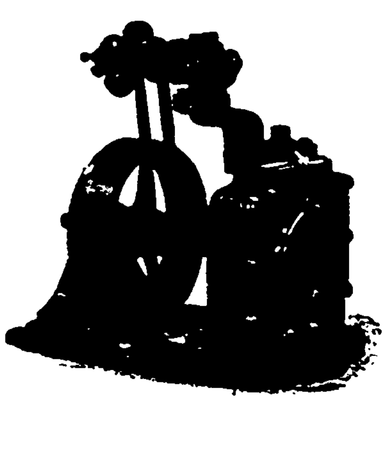

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