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CANADIAN
ELECTRICAL NEWS
AND ENGINEERING JOURNAL

OLD SERIES, VOL. XV - No.
NEW SERIES, VOL. X - No 1.

JANUARY, 1900

PRICE 10 CENTS
$1.00 PER YEAR.

CANADIAN

ELECTRICAL NEWS

AND

Engineering Journal

VOL. X

1900:
THE C. H. MORTIMER PUBLISHING COMPANY, OF TORONTO, LIMITED.
TORONTO, CANADA.

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CANADIAN
ELECTRICAL NEWS
AND
ENGINEERING JOURNAL.

VOL. X. JANUARY, 1900 No. 1.

THE CHAMBLY TRANSMISSION PLANT.

BY E. M. ARCHIBALD.

THE long expected day of transmission of electrical power from Chambly to Montreal arrived on Saturday, June 24, 1899, when the lines were finally tested, a lamp being lighted at the Chambly power house from the Montreal station. On Sunday, the following day, on of the huge generators was slowly and noiselessly started, the field excited, switches closed, and power was successfully transmitted into Montreal. The first use of the power was to test the transformers in the sub-station, but at 4 p.m. steam was shut off from the engines in the city plant, and until 5.30 p.m. those using the Royal Electric Company's power were, unknown to them, cut off from the city plant and supplied from Chambly, some 16½ miles distant.

The Royal Electric Company has for many years been supplying the great bulk of the electric light and power service in the city of Montreal, Canada, and this has until the present been utilizing steam power for generating purposes. As early as 1893, however, they secured control of an immense water-power situated at Chambly, on the Richelieu river, about 15 miles from Montreal. It was found after careful calculation that the cost of water and steam power for the size of the plant necessary—8000 h.p.—was almost equal, but that for any increase in size, the water power decreased at a much more rapid rate than did steam. Consequently, the Chambly Manufacturing Company, the principal directors of which are interested in the Royal Electric Company, having been formed, this water power was sold to it, and a contract was drawn up whereby the new company was to supply the Royal Electric Company with a specified amount of power in Montreal, with provision for increase. One of the conditions of the contract is that the steam plant shall remain as at present for two years to provide for possible contingencies.

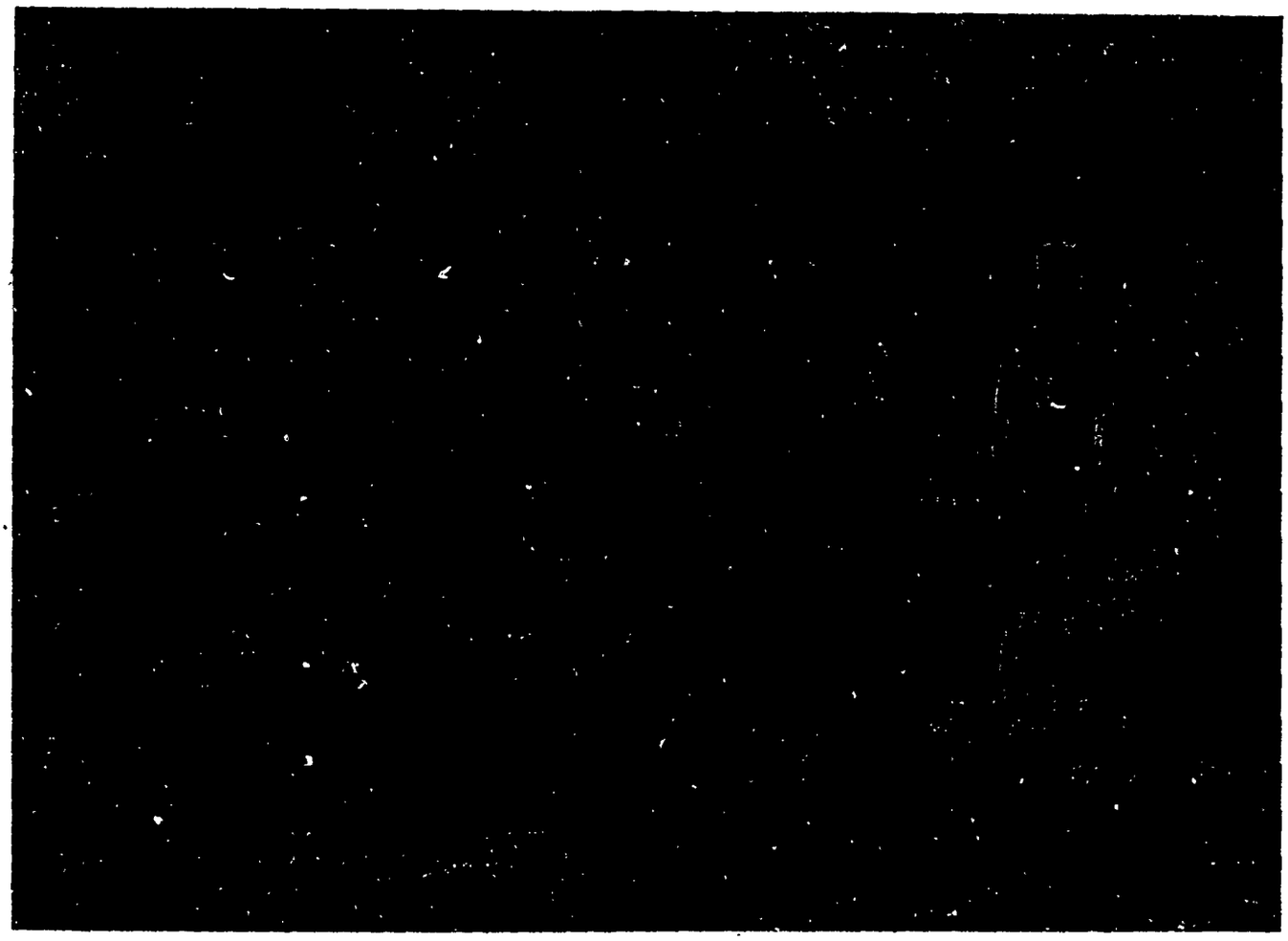

FIG. 1.—GENERATING PLANT AT CHAMBLY.

The hydraulic equipment of this plant has already

General View of the Chambly Power Plant.

been very fully described in these columns (issue of June last), and this article will therefore deal solely with the electrical equipment. This is of special interest in being very complete in all details, and in representing the latest design in high tension apparatus, as all the electrical apparatus, consisting of the large inductor alternators, the exciters, the high tension

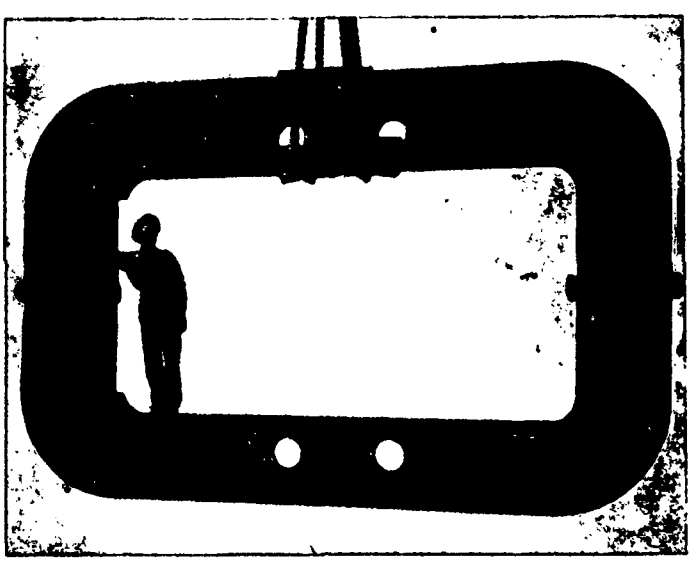

Fig. 2. Base of Generator.

switches, and even the instruments, were specially designed for this plant.

GENERATORS.

The principal machines are, of course, the alternators, of which there are eight, four installed at present, each a 2000 k.w. two-phase inductor machine running at 153 r.p.m., and generating current at 12,000 volts directly at the machine at 8000 alterations per minute, or 66 cycles per second. Generating directly at the line voltage, 12,000, disposes of step-up transformers with the necessary switchboards and transformer house. This is perfectly practicable with the induction type of machine, as there are no moving wires, both armature and field coil remaining stationary, while the huge inductor, consisting wholly of iron, is the only revolving element. Hence, it only becomes necessary to secure sufficient insulation in order to obtain any desired voltage.

All joints in the armature coils are made with the greatest care in order to withstand such a high pressure. The joint, after having been carefully soldered, is covered with several layers of pure rubber tape, over which a composition of rubber and sulphur is placed, and covered all over with several layers of insulating tape. The joint is then soaked in boiling paraffin wax, which vulcanizes the rubber, thus producing a joint such that there is no break in the complete insulation of the wire. Such joints as these are made in connecting the armature coils together, and for all switchboard work.

The base of one of these machines is a hollow rectangular piece of iron, whose outside dimensions are 17' 2" long, by 10' 11" wide, and 25" thick, weighing no less than 100 tons. It is set on a concrete bed. Resting on this base is the armature, built up in two parts, an upper and lower, bolted together in the middle. The lower half penetrates the base and dips into an excavation in the concrete, thus making the height of the machine appear less than it really is. This armature, which is of the well known ribbed frame of the S.K.C. type, is 15' in diameter, 6' 6" wide. The coils are all machine wound, very carefully insulated and intersect each other, the inner curving around the outer so as to be in quadrature or at a phase angle of 90 degrees.

The single field coil, resting on the armature in a slot specially prepared for it, has a slightly smaller diameter than the armature and is wound, not of wire, but of bare copper strip insulated with japan and insulating linen. The joints in this strip are butted together and soldered with a special solder, thus producing a joint no thicker than a copper strip, which possesses a greater tensile strength besides an equal conductivity.

The inductor, built of laminated iron and weighing 30 tons, is the only revolving element in the whole construction, and is built up very solidly, the poles each being securely bolted to the spider.

The air gap between the inductor and armature is ½ inch. The field excitation, as is the case in all S.K.C. machines, is very small, being only ¾ of 1 per cent. of the total output of the machine. The shaft to which the spider containing the inductor is attached is 12 inches in diameter and is coupled directly to the turbines. The pillow blocks are bolted securely to the base

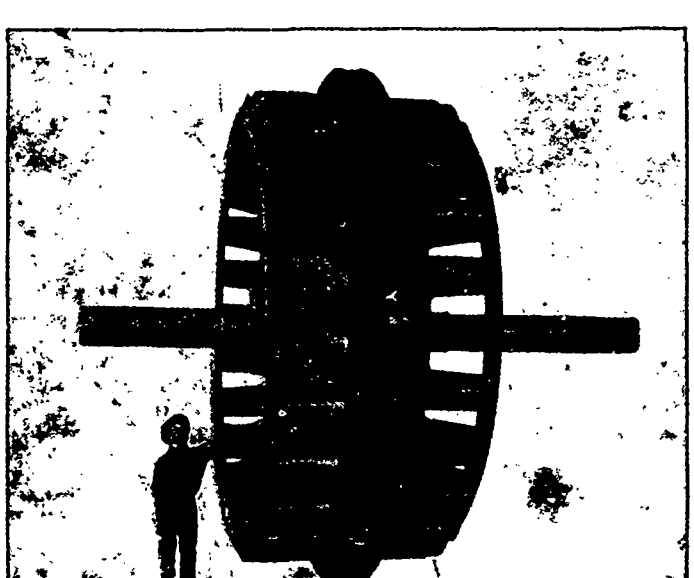

Fig. 3.—Inductor and Field Coil.

and the bearings are of the self-oiling and spherical-seated type.

The governor regulating the gates of each wheel is the Geisler electro-mechanical governor, manufactured and installed by the Stilwell-Bierce & Smith-Vaile Company, of Dayton, Ohio, and is geared directly to the governor shaft.

The two exciters, each of which is capable of fully exciting the complete installation besides running the

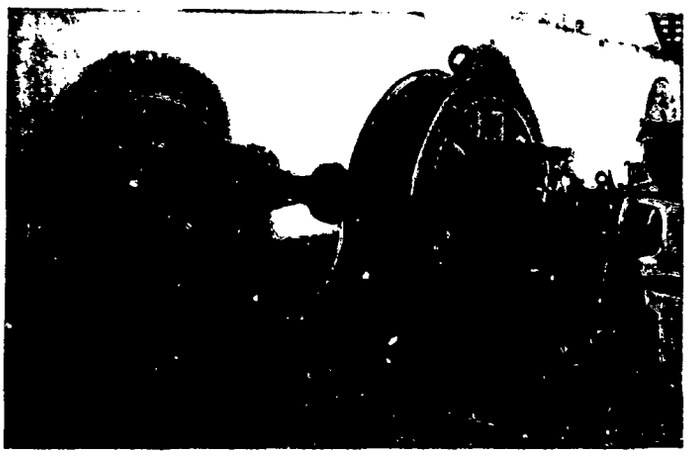

FIG. 4.—ONE OF THE EXCITER UNITS.

crane motor, have each six poles, a capacity of 140 k.w. running at 266 r.p.m., and generating current at 75 volts pressure. They are of the large drum armature type, with large commutator, and are well ventilated. A feature is that they are shunt-wound machines. Regulation is afforded by Snow mechanical governors, belted to the exciter shafts. An electric crane having a capacity of 40 tons, from the works of the Shaw Electric Crane Company, Muskegon, Mich., runs the entire length of the dynamo floor.

From the alternators and exciters the cables pass through ducts in the concrete floor to the cable tunnel situated under the switchboard gallery. This cable tunnel has a vaulted roof, and is of sufficient height and width to allow free passage to several persons walking abreast. It is lighted and ventilated by casements in the concrete wall. These casements may be seen in the view of the dynamo room, directly below the switchboard gallery. The cables, which are all lead-armored from the works of the Washburn & Moen Co., Worcester, Mass., are placed on racks in the cable tunnel and are passed through ducts in the solid concrete to reach their respective places on the switchboard. The exciter cables are connected four in multiple, each of 400,000 circular mils, the four having a capacity of 2,000 amperes. The rubber insulation on all the cables is 5-32" thick, and they are tested to 400,000 volts.

SWITCHBOARD GALLERY.

The switchboard gallery, situated as it is over the wheel pits, commands a view of the entire power house overlooking the dynamo floor. The switchboard, only half of which is at present constructed, is built of white Vermont marble panels, tested to 20,000 volts, on a frame of hardwood. The frame is seasoned cherry, and for further insulation and protection from fire is well soaked in asbestos paint. This makes it practically fireproof, and, besides, offers the additional advantage of being absolutely free of danger from accidental contact at all times, unlike a steel frame.

There are two sets of bus bars. These bus bars have a 5-32" rubber insulation, with a thick jute outer covering. This was used instead of a lead armored bus on account of their being no possibility of a static charge collecting, as would be liable in the latter case. As it stands at present, the main switchboard contains nine panels, the first for the exciters, four for the generators, and the remainder the line panels.

The exciter panel contains the two double-pole single throw exciter switches and one double-pole double throw switch for connecting the electric crane motor to either exciter; three ammeters, one for each exciter, and the other crane motor, the two exciters, voltmeters and rheostats. The machine panels are exactly similar to each other, so that a description of one applies to all. At the top of the board there are four instruments, two ammeters and voltmeters, the ammeters being placed outside, one set for each phase of the generator; below these are the voltmeters and ammeters for measuring the generator field excitation, while between them is the synchronizing apparatus, consisting of five lamps and a three pole switch, for each phase. The lamps are arranged three in the upper row, connected respectively to the upper bus bars, the three-pole switch being similarly connected, and two synchronizing lamps in the lower row. Then comes the generator field switch, the two main 12,000 volt switches, and lastly the field rheostat. The apparatus on each line panel consists of two ammeters, one for each phase, a static ground detector connected in any circuit as desired, and the two pole-line switches.

The main switches used on the generator and line panels are a new departure and need an explanation. They are special high tension switches for breaking a circuit of 12,000 volts and over, but are only necessary when such a high pressure is generated directly from the machines. As they appear on a switchboard there is

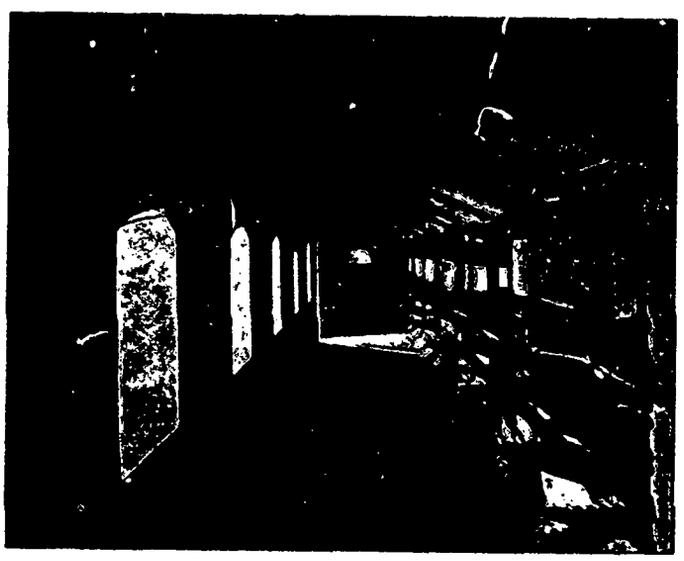

FIG. 5.—THE CABLE TUNNEL.

only a small iron frame in which a long wooden lever may be turned through a 120 degree arc, and a small iron handle placed above. This latter is connected by means of a lever on the back of the switchboard, to two valves, each placed in an air duct into which air is pumped from a fan blower. These air ducts are two wooden boxes running the entire length of the switchboard, and are situated so that when the valve is open a jet of air impinges on the contacts of the high tension switch, thus destroying the arc. The iron handle

directly above the high tension switch cannot be opened until the valve in the air duct is also opened, thus always insuring an air blast on the breaking contacts.

For the switch itself the moving lever on the face of the board is directly connected to a rocking lever which moves too and fro a trolley containing the dead side of the switch. This trolley moves forward and engages with one set of contacts connected to the upper bus bars, or backwards to the lower bus bars, according as the lever is moved to the right or the left of the centre. The contacts of the two sets of bus bars are 9 feet apart, and though the "off" position of the trolley is midway between the two, a break of 6 feet may be produced by moving the lever slightly past the center. There are two of these switches for each generator and line panel. To prevent arcs from jumping from one switch to another, they are separated by marble barriers two feet high.

All the ammeters and voltmeters in use on alternating current are enveloped in a handsome ground glass case to protect the switch-board attendant, should he persist in his habit of tapping the instruments, from receiving the shock he would get from an iron cased instrument should there chance to be a leak.

For supplying the air ducts with air two 45-inch Sturtevant fans are used, each direct-connected to a two-phase 500-volt S.K.C. induction motor, either being capable of keeping up the supply required.

To reduce the line voltage to 500—that required by the induction motors for the fans four single-phase Stanley air-cooled transformers are used, a special switchboard for these, consisting of four white marble panels mounted on a hardwood frame, being installed at one end of the switchboard gallery.

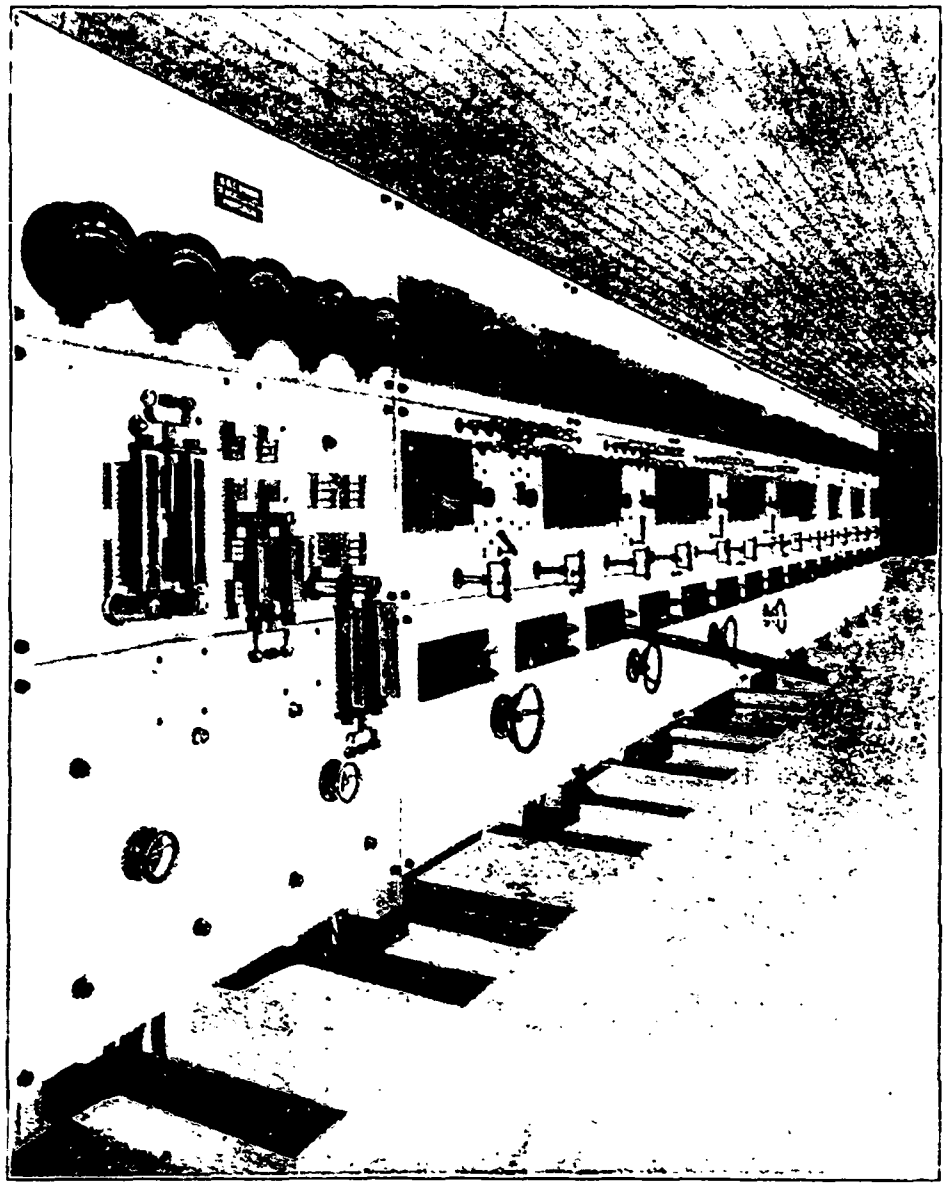

FIG. 6.—SPECIAL SWITCHBOARD FOR HANDLING 10,000 H. P. AT 12,500 VOLTS.

The high-tension switches are of the bayonet stick type, each separated by heavy marble barriers. The low tension switches are the ordinary S.K.C. slide type. D. & W. non-arcing enclosed fuses protect the transformers on both the primary and secondary sides.

For a local circuit, the two 60 k.w. single-phase Stanley air-cooled transformers are also installed. The switchboard for these is similar to the one just described, except that it consists of only two panels.

POLE LINE.

From the front of the power house the line wires, still lead-armored, pass through quarter-turn porcelain tubes to prevent rain from leaking into the power house, through wooden ducts to the terminal house and thence to the pole line. There will be four 4-wire two-phase transmission lines on two separate pole lines, each 16.6 miles in length, although only two lines are as yet completed. No fuses or circuit breakers are used in the line, as the generators, on account of the great inductance of their armatures, will carry a short circuit for a short time without injury.

The pole lines are built very substantially, the poles being of white cedar, 45 feet long, 8 inches in diameter at the top, set 6 feet in the ground and spaced 90 feet apart. In places where it is necessary they are imbedded in concrete.

The transmission wires, four on each cross-arm, are No. 00 medium drawn bare copper, 18 inches apart, securely fastened to triple petticoat porcelain No. 1 Imperial insulators, tested to 40,000 volts. These are screwed to oak pins, which are in turn fastened to the cross-arm by a saddle bolt from below. For protection against lightning, there are three barbed wires grounded at every pole the entire length, one on top of the pole, the other two at the outer ends of the upper cross-arm; all are mounted on glass insulators, these being used on account of the lesser liability of fracturing the barbed wire and thus producing a short circuit than when

secured by ordinary staples. Besides these are two banks of S.K.C. lightning arresters and choke coils at four places on the line where it passes underground, as well as at the power house. At such points there are eight gaps between each line and the ground, each gap being for 2,000 volts.

From the power house the pole line crosses the Richelieu river below the dam, the poles being imbedded in immense concrete piers, along the line of railway to the new Victoria Jubilee bridge, over a mile long, spanning the St. Lawrence. Here it passes into two wooden boxes, each containing one line, situated outside the guard rail. Thence it again takes to the poles on the company's right-of-way to the Lachine Canal, which it crosses in 3¼" steel tubes, two wires each, placed 6 feet below the bottom of the canal, and thence to the sub-station. The line loss is about 10 per cent. at full load.

Fig. 7.—Pole Line Over Richelieu River.

The line tests on June 24th proved perfectly satisfactory, not the slightest indication of a ground showing on the line, the pressure on which, as stated before, is 12,000 volts direct from the machines, without any interposition of transformers.

SUB-STATION.

The sub-station, situated on Prince street in the premises occupied by the Royal Electric Company, is a brick structure, the floor of which is several feet below the surface, for reasons to be developed later. This building has thoroughly water-proof foundations, even several feet above ground, on account of the tendency of the St. Lawrence to overflow its banks in the spring and produce a flood in the lower parts, though protected by dykes as they are.

The lead-armored cables enter from below, pass to a high tension switchboard, the switches, air ducts with their fan blowers and bus bars similar to those used in the power house previously described; thence to the transformers, the voltage being there reduced to 2300, the city pressure; thence back to the switchboard to what is called a transfer board, where the transformers may be coupled in any combination desired without any possible danger of short circuiting the line. The method of doing this is to have the plugs of one polarity slotted and keyed so as to connect with jacks of the same polarity. The needed instruments, ammeters, voltmeters, and ground detectors, all glass encased, are also situated on this switchboard.

There are twenty-four 200 k.w. single phase Stanley transformers immersed in mineral oil and water cooled, in three rows of eight each. Each transformer is enclosed in a rectangular cast iron tank, in which a free circulation is obtained through coils of pipe, the supply being obtained from the Lachine canal not far distant. The Royal Electric Company has a perpetual grant of water from this canal, obtained from the government, and for this reason the sub-station was excavated deep, so that the water would flow from the sub-station to the transformers by gravity. This sub-station is only *one-third of the total output of the water plant, but* permits of enlargement by removing some of the boilers used at present.

Each transformer is given a clear space free from obstruction, while situated directly in front is its switchboard, consisting of high and low tension sides, the switches on the former being of the bayonet-stick type mounted on a white marble panel, and each separated by a heavy marble barrier to prevent arcs from jumping across; the switches on the low tension side are of the S.K.C. slide type. Connected in the secondary of each transformer is a glass case ammeter

indicating the load that each is carrying. The frame work of these switchboards is of white oak well soaked in asbestos paint and then erected and allowed to dry for upwards of a year. It was then given two coats of asbestos paint, after which it is practically fireproof. Each transformer is protected by D. & W. non-arcing enclosed fuses on both primary and secondary sides.

Power and light are supplied from the same circuits, the slight regulation being performed by hand at the distributing board, the machines themselves having an inherent regulation of 10 per cent. between no load and full load. As each phase is the independent in two-phase system, no method is needed to balance the loads on each phase, except that in order to obtain the full capacity of the machine each phase must be fully loaded.

The entire electrical equipment and machinery of the

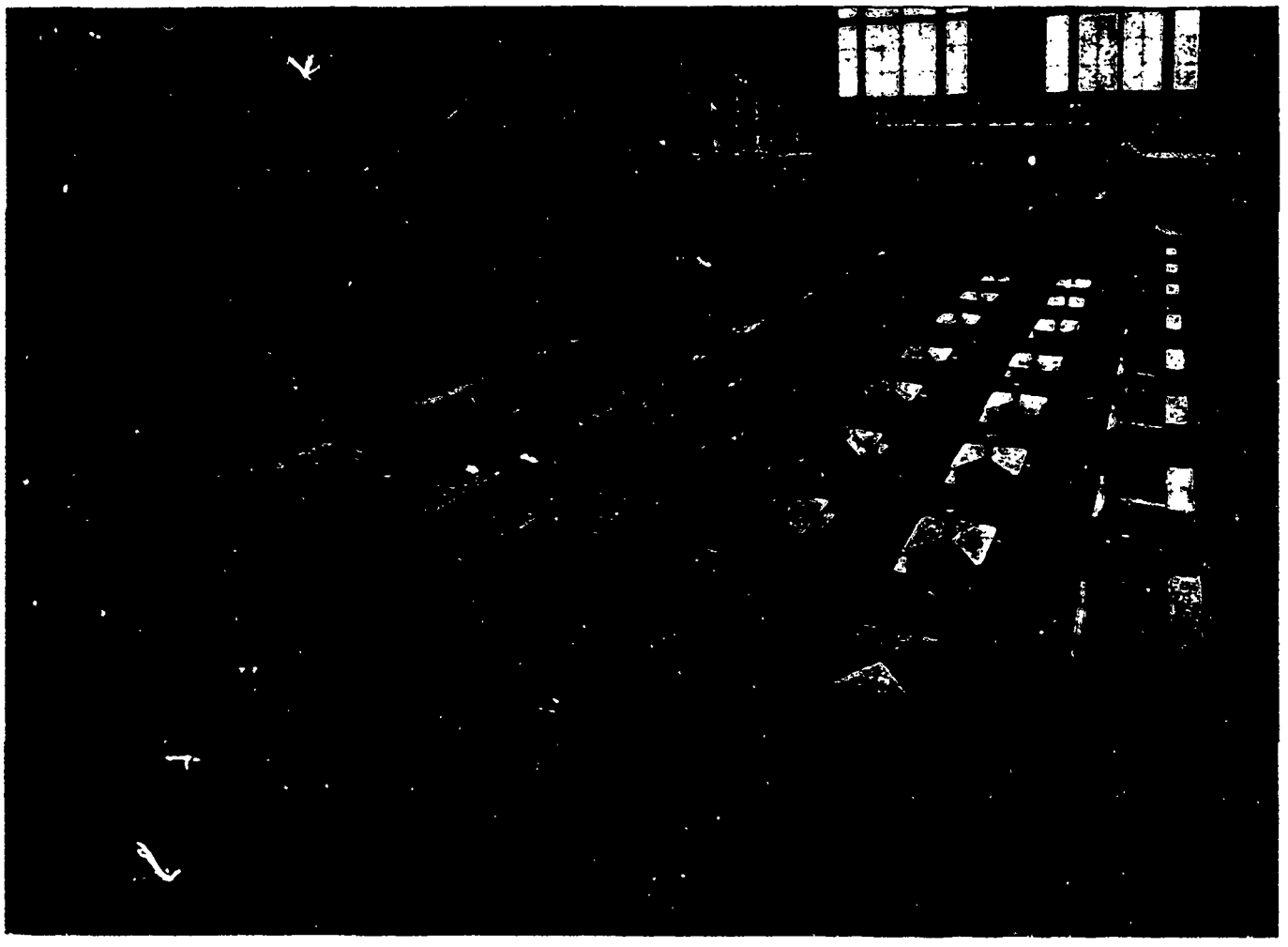

FIG. 8—INTERIOR OF SUB-STATION IN MONTREAL.

above plant was furnished and installed by the Royal Electric Co., of Montreal. The heavy machine work was done in their shops in that city, and the lighter work and assembling at the power house at Richelieu. The work is creditable to the Royal Electric Company.

PERSONAL.

Mr. B. R. Laird, of Amherst N. S., has gone to Cuba, to set up the engines shipped there by the Robb Engineering Company.

Mr. Robert O. Boyd recently spent a short vacation in Toronto, previous to going to Denver, Col., where he has secured a position as manager of a large electrical company.

On December 20th last Mr. Chas. A. Barton, manager at Peterboro' of the Canadian General Electric Co., was married in Toronto to Miss MacDonald, daughter of Mr. Randolph MacDonald.

Mr. E. M. Davies, electrician, recently installed an electric light plant at Montague Bridge, P.E.I., for the Montague Electric Light Co. Before taking his departure he was tendered a complimentary dinner, at which Mr. Geo. Wightman, president of the company, acted as chairman. In replying to the toast, Mr. Davies expressed his regret at the severance of his relationship, and referred to the kindness received at the hands of manager of the company.

Capt. Thos. A. Brown, late of Montreal, but now engineer of the Havana Street Railway, has been a victim of yellow fever, but we are pleased to learn that the crisis has been passed and that he is on the road to recovery.

Mr. D. M. Campbell, who has been for almost a decade foreman of the Ottawa Car Company's works at Ottawa, was on Christmas eve made the receipient of a beautiful case of drafting instruments by the employees under his supervision.

Mr. Alfred Fairbairn, of Montreal, has gone to Kingston, Jamaica, to accept the position of comptroller of the West India Street Railway Co. Before his departure some of his friends in Montreal presented him with a gold watch as a testimonial of esteem.

Mr. J. A. Kammerer, local manager at Toronto for the Royal Electric Co., of Montreal, was presented during the holidays with a handsomely framed group of portraits of the members of his staff, an enlarged photo of himself occupying the place of honor in the centre, and on either side photos of the interior of the Cataract Power Company's generating station at DeCew Falls.

Mr. F.C. Armstrong, well known throughout Canada as the former representative of the Canadian General Electric Co., spent the holidays among his Canadian friends. Mr. Armstrong now occupies the responsible position of manager of the commercial department of the well-known engineering firm of Dick, Kerr & Co., London, England, of which Mr. Rutherford, formerly chief engineer of the Canadian General Electric Co., is now the general manager. Mr. Rutherford is at present in India in connection with some important project in which his firm are interested. It is gratifying to be able thus to record the success achieved by Canadians abroad.

The contract for lighting the streets of Dartmouth, N. S., by electricity expires in June next, and the council will shortly consider the question of renewing the contract or installing a municipal plant.

REGULATIONS CONCERNING ELECTRICAL APPARATUS.

A COMMITTEE of the British House of Commons appointed to enquire into certain dangerous trades made a somewhat comprehensive report regarding the dangers incidental to the operation of electrical generating works. After describing the process of generating and distributing electricity, the committee recommended that the following regulations be adopted for the protection of apparatus in stations where current is generated at a pressure above 700 volts direct or 350 volts alternating :

1. The frames and bed plates of all generating machines shall be efficiently connected to earth.

2. The rails fencing dynamos, or other generating machines, shall be made of wood or other non-conducting material.

3. All terminals, collecting brushes, main connectors, parts of dynamos, motors or other appliances, to which neither regulation No. 6 nor No. 7 applies, shall be so placed, covered or fenced with non-conducting materials, that no person can touch accidentally, either with his body, clothing, or any conducting tool, two parts differing from each other by an amount which constitutes a high pressure. This rule is to be read in connection with No. 4.

4. The floors of all places where it would be possible to make connection with metal at high pressure shall be covered with an insulating mat of suitable material and kept in a state of efficient insulation.

5. The material used for wiping or cleaning the commutator strips or collector rings of dynamos, motors, or rotary converters of any form shall be applied by means of an insulating handle.

6. In switchrooms and on the front of switchboards, the main switches, main fuses, main terminals, omnibus bars, and all other metallic parts shall be insulated or arranged in such manner as to render it impossible for any person by accident or inadvertence to touch them.

7. The backs of all switchboards shall be kept closed, except for the purpose of alterations or repairs. When such work has to be carried on either at the back or at the front of switchboards, the following regulations shall apply :

   a. No person except a skilled electrician, or a workman under his personal and immediate supervision, shall be employed when any part is at high pressure.
   b. No extensive or serious repairs shall be executed upon metal which is at high pressure.
   c. Where the alterations or repairs are not of an extensive or serious character, all metallic parts at high pressure shall be covered with an insulating cap or protected by some form of insulating covering, only one part, or several at the same pressure, to be exposed.

8. All switchboards erected after the application of these rules shall have, at the back, a clear space of at least four feet. This space shall not be utilized as a store room or lumber room, or be obstructed in any manner.

9. Any person at work upon a cable or portion of the mains under high pressure shall wear india rubber gloves on both hands.

10. All aerial high pressure conductors in factories or workshops shall either be insulated over their entire length, and supported at such frequent intervals, that, in the event of breakage, they shall not come within reach at places where persons are liable to pass or to be employed, or shall be so placed and arranged as to comply with the requirements relating to such wires in streets enjoined by the Board of Trade.

11. The gloves shall be supplied by the occupier, and it shall be the duty of the manager to see that they are in a proper state of repair, and are worn by the work-people.

12. No examinations, repairs, or alterations necessitating the handling of mains, wires, machines, or other apparatus shall be carried on except in cases of urgent necessity while such parts are under high pressure, and all such work shall be done under the personal supervision of an electrical engineer or competent manager or foreman.

13. Where operations are being conducted upon mains from which the current has been cut off, the switch shall be locked and precautions taken that it shall not be unlocked except by the person in charge of the station on his being satisfied that the danger is at an end.

14. Every vessel used for lubricating purposes shall be so constructed that it cannot act as a conductor between the hand and anything touched.

15. Metal transformer boxes shall be efficiently connected to earth, and so constructed that in the event of "running to frame" the earth connection will not be broken by the removal of the fuse box or any other part of the box.

16. Transformer cases, iron ladders, and all permanent metallic parts contained within the transformer chamber, and not forming part of the electric circuit, shall be metallically connected together.

17. All holes in transformer cases, through which high pressure conductors pass, shall be lined or bushed with suitable and effective non-conducting material.

18. All high pressure connections within a transformer chamber shall be so protected with insulating material that it shall be impossible to touch them.

19. Switches which can be conveniently operated from the outside for cutting off both the high and low pressure connections of the transformers shall be fitted in all transformer chambers erected after the application of these rules, and in all existing chambers, unless it is proved to the satisfaction of Her Majesty's chief inspector of factories that such an arrangement would be attended by special difficulty.

20. Each post or support where series arc lighting is employed shall be provided with means for completely disconnecting the arc lamps from the mains, without disturbing the action of the other lamps.

DECISION AFFECTING LIGHTING FRANCHISE.

A MOST important judgment has been handed out by the court of appeal at Montreal. The decision was in regard to an action for $20,000 damages brought by the Hull Electric Company against the Ottawa Electric Company. The facts in the case are: The Hull Electric Company got a charter in 1894 based on a by-law of the city of Hull purporting to give to it the exclusive right of supplying electric light, power and heat within the limits of that corporation. At that time the Ottawa Electric Company had been located in Hull, and doing business there, for six or seven years under a privilege that it did not deem as exclusive. The Hull company then set up the claim that the Ottawa company was doing business in that city contrary to its charter, maintaining that it alone had the right to do business in Hull. When no attention was paid to this assumption, the Hull company brought action for damages and to have it declared that it had an exclusive privilege ; also to compel the Ottawa company to take down its electric system and cease to do business in Hull. The Ottawa company pleaded in answer that the charter of the Hull company was not exclusive, that it had a right to continue to do business in Hull, and that it was not responsible in damages. The Ottawa company also ponted out that it was not within the power of the legislature of the province of Quebec, from which the Hull company's franchise had been obtained, to grant an exclusive franchise to any company ; that the Dominion parliament alone had the power, under the B.N.A. act, to grant an exclusive franchise of the kind in question. Judge Lavergne held that the provincial legislature of Quebec had no right to give an exclusive franchise, and that consequently the action of the Hull company was unfounded. The case was dismissed with costs against the Hull company. From this judgment the Hull company appealed to the Court of Revision at Montreal, there being on the bench Sir Melborne Tait, Judge Pagnuelo and Judge Gill. This court reversed the decision of Judge Lavergne. The Ottawa company then in turn appealed to the court of appeal in the same city, and judgment, as has been stated, was rendered restoring Judge Lavergne's decision. Presiding were Sir Alexander Le Coste, Judge Bosse, Judge Blanchet, Judge Hull and Judge Wurtell. There were three parties to the action. The corporation of the city of Hull took sides for the Ottawa company, and appeared, through the medium of its legal representative, to uphold the position that it had not in fact granted an exclusive franchise and never intended that the Hull company should have an exclusive privilege.

It is probable that the latter will now carry the case either to the supreme court or to the privy council. If the court of appeal's judgment is sustained the Hull council will be enabled to establish a civic lighting system, which otherwise it will not have power to do.

The Toronto Rubber Shoe Company, of Port Dalhousie, Ont., are installing in their new factory a 150 k.w. S.K.C. two phase generator, with switchboard, and one 30 h.p. and one 7 h.p. S.K.C. two phase induction motors. The entire factory will be lighted and operated by electricity.

CANADIAN ELECTRICAL NEWS AND ENGINEERING JOURNAL

PUBLISHED ON THE TENTH OF EVERY MONTH BY

THE C. H. MORTIMER PUBLISHING CO'Y
of Toronto, Limited,

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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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 25 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

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Telephone and Phonograph.

A YOUNG man named Paulsen, son of a wealthy lawyer of Copenhagen, Denmark, is said to have invented a phonograph, designed to be operated in conjunction with the telephone, and which will record with a magnetic needle the message delivered to the telephone. If desired the phonograph can be disconnected from the telephone. The method of operation of the new invention is thus briefly described: "A very small magnetic needle, which is influenced by the current of the telephone wire, governs a steel ribbon which in turn runs over two cylinders. These cylinders come in touch with the magnetic needle and the work is done. While the instrument is operating and a person talks into the telephone, the magnetism in the steel ribbon is influenced by the electric needle to such a degree that a perfect message is recorded. At the receiving end it is only necessary to let the steel ribbons pass later before the electric needle and the current will then reproduce the words sent over the wire. Just as soon as the message has been heard, by passing a magnet over the steel ribbon, the speech is wiped off immediately and the instrument is ready to receive messages again." A company has been formed to introduce the invention throughout the world.

Destructive Effects of Earth Currents.

ENGINEERING, of London, in a recent article, refers to the disturbance caused at St. John's College, Oxford, by stray currents emanating from dynamos in the building. Reference is also made to the Toronto Observatory, where the delicate recording mechanism was so seriously affected by the current employed on the street railway lines 700 feet distant, that removal to a new location several miles east of the city became necessary. In the construction of the new building the stone was mechanically tested, blocks showing traces of iron being rejected. In the Cavendish laboratory at Cambridge, even the hot water pipes are made of copper. Notwithstanding every precaution, however, it is stated that several of the prominent observatories, including the national institution at Greenwich, are seriously affected. The most certain remedy, although a costly one, is that adopted by the Toronto Observatory. The purpose of the Toronto Railway Co. to weld together the ends of the rails throughout their entire system, should greatly lessen the escape to earth of return currents and the destructive effects of the same. Engineering suggests that a remedy may also be found in the use of aluminum conductors, but of this we are not sanguine, as aluminum is not well adapted for use in cities, where the injury from earth currents is greatest.

Electrical Progress in 1899.

ENQUIRY reveals the fact that the electrical industry in Canada shared to the full in the prosperity and development which characterized nearly every department of commerce and industry during the year which has just closed. The leading electrical manufacturing and supply companies report that the volume of their business for 1899 exceeded by upwards of 75 per cent. the business done during 1898. More than half of the output of these companies was applied to the extension and improvement of existing plants, the bulk of the machinery sold being for lighting and power purposes. There was but little new railway construction work

done during the year, but considerable apparatus was required for extensions and improvements to the street railways in Toronto, Montreal and Winnipeg. Many electric lighting companies took advantage of the prosperous times to discard old type machinery and replace the same with new apparatus of higher efficiency. In most instances, larger units were installed and the old type machines kept on the premises to be used as a reserve in case of emergency. As a result of the unusually large business done, the stock of the two leading manufacturing companies has risen fifty points during the year, and further advances are predicted. The workshops of the electrical manufacturing companies are said to be crowded with orders to such an extent that no promise of delivery at a specified time can be made and prices are firmly maintained. The outlook for the new year is also very promising. On good authority we learn that during this year nearly 100 miles of electric railway will be built out of the city of Hamilton. Canada can already boast of having in operation the largest generators in the world, and to be the home of some of the largest electrical enterprises in the world, and there is reason for the belief that the limit in this direction has not yet been reached.

Opposition to Electric Railways.

THE construction of electric railways through rural districts has brought into prominence the question of what conditions should govern the operation of these roads. In the discussion of this question, opportunity has been taken by certain public men to criticise rather severely the operating methods adopted by street railway companies. The Toronto Railway Co., for instance, have been condemned for what is claimed to be their neglect in not providing an efficient fender. A criminal action has been taken by the Crown against the officers of the company and the City Engineer, on account of the killing of a person while crossing in a sleigh a street intersection. The verdict of the Coroner's jury states that the fender in use was not the best available, and that the speed of the car was so great as to be inconsistent with safety to life. That it is now possible to obtain a more efficient fender than those in use the company admit, but they claim that the present fender was the best that was available when it was introduced, and that since having adopted it they have been endeavoring to satisfy themselves as to the efficiency of the various fenders on the market. The question as to what fender to adopt has been given much consideration by street railway companies both in Canada and the United States. A deputation of the Montreal Railway Company recently visited many of the leading cities in the Eastern States for the purpose of investigating the merits of the various fenders in use, and subsequently recommended the adoption of the fender invented by Mr. Geo. Sleeman, of Guelph. This fender is now used by the Montreal, Winnipeg and Guelph street railway companies, and has, we believe, been quite effective in the prevention of fatal accidents. It has been suggested that a government commission be appointed to make an investigation and report as to the most efficient fender to be employed. This course would no doubt meet with the approval of street railway companies, who would not likely be slow to act upon the recommendations made. It is being urged in some quarters that a line of policy towards electric railways, covering such points as rights of way on public thoroughfares, duration of franchises, fares, connections with other roads, and similar matters, should be declared by the government, and that a commission or arbitration board should be appointed to decide matters in dispute. No section of the community would welcome such a policy more heartily than the railway companies, as they would then know exactly on what ground they stood. A point to be guarded against, however, is the placing of such restrictions upon the operation of electric railways as would retard their development. In this connection it might not be amiss to point out to the electric railway companies the necessity of organization, to more effectually present their just claims to the public authorities, and to prevent the adoption of legislation based on erroneous assumption.

Death from Electric Shock.

DR. Cunningham contributes to the Electrical World a valuable treatise giving a description of how electric currents induce death in the lower animals, as well as his observations regarding effect of such currents upon the human body. Dr. Cunningham has devoted much study to this subject, and has made exhaustive experiments on dogs, with currents at more than 1,000 volts pressure. To ascertain the effect, currents were passed for various periods of time across the chest, through the brain, and from the brain to the thighs. He found that when the chest was transversed by a current for a sufficient length of time the effect was the immediate cessation of the heart action. The circulation of the blood throughout the body ceased and the nerve cells of the system died rapidly from the lack of indispensable blood. When the circuit included the heart and the brain a combined effect was the result, the heart being thrown into fibrillation and the blood supply to the brain ceasing. Death is thus produced by disorganizing the action of the heart. Dr. Cunningham is of the opinion that artificial respiration, if applied at once, would in the majority of cases restore life, but that if many seconds elapse the co-ordinate heart beat would fail to reappear. He suggests that the required stimulus might possibly be given by a high pressure electric shock. This method of resusitation might be employed on the lower animals, but it would require considerable persuasion to induce the friends of a person injured by an electric shock to apply as a restorative the agent which was responsible for his injured condition. Dr. Cunningham is of the opinion that electric currents act on the human body in the same manner as they do on the canine race. Altogether, his experiments are not favorable to resusitation in the event of a shock from a high pressure current.

Electric Light Inspection.

BY the annual report of the Inland Revenue Department of the Dominion for the year ended June 30th, 1899, we are furnished with some particulars regarding the working of the Electric Light Inspection Act, authorized by Parliament in the spring of 1894 and put into effect in June of the following year. There were registered under the Act during last year 276 companies, who paid in registration fees the sum of $4,170. These companies have in operation 10,960 arc lamps and 546,672 incandescent lamps, or, calculating that one arc is equal to ten incandescents, a total capacity equal to 656,200 incandescent lamps. Comparing these figures with the

number of lamps in use three years ago, they show a substantial growth of the electric lighting industry. During the year ended June 30th last there were presented for inspection 5,762 electric light meters, of which 5,566 were accepted as correct or as coming within the limit of error permitted by law. There were rejected 187 meters, but 134 of these were verified after first rejection. The fees charged for the inspection of meters were $7,228.25, or about $1.35 per meter. It will be observed that the revenue for the year from registration and inspection fees reached a total of $11,398.25. The expenses of inspection are given as $4,007.02, leaving a balance of $7,391.23. There was expended on standard instruments the sum of $2,625.67. These instruments, we presume, are in a measure a permanent asset, and should not be charged against the expenses of any particular year. But, even after allowing a sum to cover the cost of these instruments, it is shown that there was a net revenue derived from the inspection of electric light in the year under review of $4,675.56. Clause 26 of the Electric Light Inspection Act states that the fees shall be regulated so that they will, as nearly as may be, meet the cost of carrying the Act into effect. It apparently was not the intention of the Act that its operation should in any way increase the government revenue. It would seem, therefore, that the time has arrived when a reduction of the fees charged would be in order. It is indeed a strange anomaly that the electric lighting companies should be called upon to carry a portion of the expense of the inspection of gas and weights and measures. We observe that while the fees for the inspection of electric light are more than double the expenses, the revenue obtained from gas companies is between one and two thousand dollars less than the expenditure, while for the inspection of weights and measures the revenue for the year was $48,453.95, against an expenditure of $63,643.31. The comparison is certainly not such as will meet with the approval of the electric lighting companies of Canada.

MR. A. F. NASH.

As previously announced in the ELECTRICAL NEWS, Mr. A. F. Nash, of Windsor, Ont., has been appointed to succeed the late Mr. Williams as electric light and gas inspector for the London district. Mr. Nash was born on June 22, 1853, in the town of Whitby, Ont., securing his first business experience with the firm of Thompson, Smith & Son, lumber dealers, of Toronto. From 1870 to 1876 he was employed in their Oswego office. In January of the latter year he became associated with his brother, Mr. C. H. Nash, who during the previous season had erected the Stratford gas works. He assisted in the construction of the Napanee gas works, and subsequently accepted the management of the Stratford gas works, being appointed secretary-treasurer of the company in July, 1877. Four years later he resigned this position and removed to Windsor, where he held a similar position until February, 1882, when he removed to St. Joseph, Mo., and became secretary-treasurer of the St. Joseph Gas Co. In April, 1887, he returned to Windsor to become manager of the Windsor Gas Co.

During the summer of 1887 Mr. Nash installed an arc light plant in conjunction with the gas works, which he operated until December, 1890, when a municipal plant having been installed by the city, he was compelled to shut down his plant and dispose of it piecemeal as opportunity presented. This was his reward for providing electric lighting for the city when that industry was almost in its experimental stage. Mr. Nash continued as manager of the gas company until March, 1896, when, owing to a change of ownership, he resigned his posltion. His next appointment was as eleatric light and gas inspector for the London district, the duties of which office he is well qualified to discharge in the intetests both of the government and the lighting companies.

QUESTIONS AND ANSWERS.

A SUBSCRIBER writes from a town in Western Ontario as follows :—(1) "I am in charge of the lighting plant here and have worked myself into a small corner with the series street lighting, but yet I believe that I am all right, but to make sure am bothering you. There are installed and burning 56 street lamps, 32 c.p., and what are called 45 volt lamps, on two circuits. One circuit has 27 lamps, the other 29 lamps, with a booster. I want to add 10 more lamps—they are scattered all over the two circuits—and at the same time do away with the booster. The way I figured, also where I made the mistake, was as follows: Assuming my primary voltage at 1,000 volts and the lamps each taking 45 volts, and 56 lamps already burning, with the ten new ones make $56 \times 10 = 66$; then in going over my lines outside, I found that I could divide them up into three circuits with very little labor and expense, which would give me three circuits containing 22 lamps each, $66 \div 3 = 22$, and 1,000 v. $\div$ 22 l. $= 55$, which would allow me to divide that way, and only leave 10 volts over. But upon considering my plan I found that my primary voltage was nearer 1,150 than 1,000, for my secondary voltage is 115 volts. What I want to know is this—can I safely do this yet—put 22 lamps in series, they being only 45 volt lamps, or will it just blow them all out of business? They are the Buckeye lamp, and as they are running give a poor light. I don't think they are developing their full candle power." (2) "I would also like to ask some of your readers what they would consider a fair consumption of coal for a plant consisting of a boiler 60" × 14', well placed, burning mine run coal; boiler feed; a duplex steam pump feeding through a heater capable of raising temperature from 50° to 190° F.; engine 13 × 30, high pressure Wheelock (steam pipe covered), running an alternator (inductor) 10½ hours in two runs—first eight hours fires banked for 5½ hours, then 2½ hours run, and then fires banked again for eight hours; average load 17·5 amperes.

ANSWER.—(1) This is a very simple problem. The 22 lamps would not have quite resistance enough to keep current down to normal. It would be necessary to put sufficient resistance into each circuit to equalize them with the pressure. In practice it will be a simple matter to put one or two extra lamps on to each circuit and cut them out one at a time till the required current was obtained. If there were then left more lamps in each circuit than were required outside, they could be utilized to light the plant. This would be better than wasting the current in a rheostat. (2) From three-quarters to one ton per day, depending on quality of coal and on a somewhat varying load.

A CANADIAN BOILER-MAKER.

Boiler-making, like its sister trade, engine-building, is a branch of industry which has commanded the attention and study of some of the most able men of the nineteenth century. The nature of the duty that a boiler is designed to perform renders it imperative that there should be identified with its construction artizans of recognized ability and skill. As one who has attained renown in this direction we introduce to readers of the ELECTRICAL NEWS Mr. J. J. Main, of Toronto, who is well known in engineering circles.

Born in one of the Channel Islands in the year 1852, Mr. Main came to Canada with his parents when but a boy, obtaining his early education at public schools at Montreal and Barrie. At the age of 13 he was apprenticed to learn the trade of a mechanical engineer, but disliking his position and the hours he was required to work, namely, from 4 o'clock in the morning till 9 at night, he decided to seek other employment. He became apprenticed to the boiler-making in the Northern Railway shops at Toronto, and while thus engaged attended the Mechanics' Institute night school, where he received tuition in drawing and mathematics at the expense of Mr. Cumberland, managing director of the Northern Railway Company, who had recognized him as a diligent and faithful employee. After completing his apprenticeship Mr. Main joined his father in taking contracts for points, crossings, etc., for the narrow gauge railways, their shops being located just on the site where the large chimney of the Toronto Railway Company's power house now stands.

Towards the close of the year 1870 the boiler-making trade began to improve, and Mr. Main engaged as a journeyman with Dickey, Neil & Co., whose works were located on Beverley street, Toronto. The business of this firm was confined largely to the building of boilers for the oil wells in western Ontario and for saw-milling plants, the manufacture of marine boilers being well nigh controlled by Neil Curry, whose works were on the Esplanade. The marine boilers of those days were of the fire-box return tubular, low pressure steam chimney type.

MR. J. J. MAIN.

It is only when we compare the primitive methods then employed with the equipment of a modern boiler-making plant of to-day that we can appreciate to the full extent the difficulties under which the artizan labored in earlier days. Mr. Main states that a boiler which thirty years ago would require one year in which to build could now be completed in two months. The shops of Dickey, Neil & Company were so small that it was frequently found necessary to remove one side of the shop in order to get a boiler out. Any kind of a building was considered as good enough for a boiler shop. Anything but a mud floor was unknown, and in many cases there was little roof, and the workman frequently had to shovel the snow off his work and tools on winter mornings. The drilling of holes in boiler plate was regarded as an impossibility. Whenever they could not be punched with a punching machine they were cut with the hammer and chisel. The chief qualification of a boiler-maker consisted in his ability to cut a large number of holes in a day.

Mr. Main remained with Dickey, Neil & Co. for two years, then went to the United States for a similar period, working as journeyman in Titusville, Oil City and Pittsburg on boilers for oil wells and stills. It was there that he gained valuable experience in doing rapid work. Returning to Toronto in 1874, he engaged with Irwin & Marshall, who conducted boiler and engine works on the Esplanade, between Jarvis and George streets. While thus employed he had the honor of building the first steel boilers built in Toronto, while but comparatively few had previously been built on the Continent. These boilers were 6 feet 4 inches in diameter and 16 feet long, and were then considered exceedingly large. They are still in service at the Toronto Waterworks. While with this firm Mr. Main also built boilers for the Toronto University. These were made of Swedish iron, but investigation proved that it was practically the same class of material as the steel used in the boilers for the Toronto Waterworks, and which was furnished by the Otis Steel Company, of Cleveland, Ohio.

In the spring of 1876 the subject of our sketch went to Erie City, Pa., in the capacity of foreman for the Erie City Iron Works. It was there his privilege to operate one of the first flanging machines built in the country. Flanging, it might be explained, is one of the most important branches of boiler-making, and Mr. Main had obtained a reputation for rapidity and efficiency in this direction. In 1877 he returned to Canada, engaging with Inglis & Hunter, machinists and boiler makers, of Guelph, as foreman. There he remained until 1880, when he again returned to Erie City, securing a more lucrative position. After a period of sixteen months he was induced to return to Canada and assume charge of the new works of Inglis & Hunter about to be established in Toronto. While thus acting as superintendent, Mr. Main was also interested in the business, receiving a percentage on sales. He remained with this firm—in the meantime changed to John Inglis & Sons—until 1895. To him the credit is due of constructing the first large Scotch marine type boilers built in Canada. This was in the year 1892. They were 11 feet 2 inches in diameter and 11 feet long. They were first built in the shop, then taken down and removed in pieces to the boat in dry dock at Port Dalhousie, and then put together in place, practically turning the steamboat into a workshop. Mr. Main also enjoys the distinction of building the largest number of marine boilers on the lakes at the present time.

After working incessantly for thirty years, Mr. Main decided to take a holiday trip to Great Britain, but after having secured his passage on the steamer Vancouver, he was prevented from so doing through family illness. Mr. Main was about to engage in the manufacture of boilers on his own account, and had selected tools and site, but before arrangements were finally completed the Polson Iron Works Company, of Toronto, made him such a liberal and satisfactory offer that he engaged with them as superintendent of their boiler works. In the following year, 1896, in conjunction with Mr. James R. Annett, he purchased the right to manufacture in Canada the celebrated Heine patent safety water tube boiler. He now occupies a dual position, being superintendent of the Polson Boiler Works and superintendent and treasurer of the Canadian Heine Safety Boiler Company. The first contract secured by the latter company was for one boiler of 250 h.p. and three of 150 h.p. for the new municipal buildings in Toronto. The favor with which the Heine boiler has been received in Canada may be understood by mentioning some of the contracts secured by the company. In addition to the above contract, the following batteries of boilers have been installed: Temple building, Toronto, two boilers of 120 h.p. each; Toronto Electric Light Co., three of 260 h.p. each and two of 410 h.p. each, the latter being the largest water tube boilers in Canada; T. Eaton Co., Toronto, five of 150 h.p. each; Gutta Percha Rubber Co., Toronto, one of 260 h.p.; Macdonald Rolling Mills Co., for utilizing waste heat from blast furnace, one of 100 h.p.; Asylum for Insane, New Westminster, B.C., three of 60 h.p. each; Massey-Harris Co., Toronto, three of 200 h.p. each; Dominion Radiator Co., Toronto, one of 150 h.p.; Truth Publishing Co., Toronto, one of 150 h.p.; new La Presse building, Montreal, two of 150 h.p. each; Central Prison, Toronto, one of 150 h.p.; Asylum for Idiots, Orillia, two of 150 h.p.; Crow's Nest Coal Co., Fernie, B.C., one of 200 h.p.; Lever Bros., Toronto, two of 260 h.p. each. These contracts represent a consideration of $100,000, a business for three years of which a new firm may justly feel proud.

Since assuming the superintendency of the Polson Boiler Works, Mr. Main has made many improvements in the plant. He was the first to introduce in Canada pneumatic machines for drilling, corking and rivetting boilers, and he has to-day at the Polson works a complete pneumatic as well as hydraulic plant. He was also the first to build in Canada large digestors for sulphite pulp mills, having just completed three for the Riordan Pulp Co., of Hawkesbury, Ont. Each digestor is 13 ft. 6 inches in diameter, 38 feet high, and they are known as eleven ton digestors, being capable of making eleven tons of pulp each charge. They are made of 1⅛" steel plate, with 1¼" butt straps. A special press for forming the ends, which are elliptical in shape, was built by the Polson Company. It has a capacity of 100 tons, and cost about $10,000. One of Mr. Main's ingenious inventions is a furnace for heating the plate. It uses crude oil and compressed air, and is in the form of a large oven about 12 feet square. This press and furnace is also used for flanging and pressing large marine boiler heads.

As a boiler-maker Mr. Main is recognized as having few compeers. It is said of him that during his career he has turned out a greater number of tradesmen qualified to fill the position of foremen than any other boiler-maker in the Dominion. Many of his apprentices are now occupying responsible positions of this character. The secret of his success in this repect probably lies in his willingness and desire to impart information. This characteristic is in striking contrast with the policy pursued generally in earlier days and by some at the present time.

Mr. Main possesses an individuality that commands attention. He is popular with all who have his acquaintance or friendship, and many persons can testify of assistance in their work received at his hands. He is a man of broad mind, sound judgment and keen perception—qualities which go a long way to make a successful business man. In private life he is also much respected.

CHANGING THE TRANSFORMER VOLTAGE.

A CORRESPONDENT of the American Electrician asks the following question: How can I change a 50-vol transformer so that I *can raise the voltage from 50 volts to 100 volts, i.e., so that I can* make a step-up transformer which will raise the voltage from a 50-volt circuit to a 100-volt circuit.

The answer given is as follows: If the transformer you wish to change is fitted with two secondary coils which can be connected either in parallel for 50 volts or in series for 100 volts, it is a very simple matter to use them to transform from 50 volts to 100 volts without rewinding the transformer at all. This can be done by connecting the two secondaries in series for 100 volts and bringing out the middle point or common connection between the two coils; the 50-volt circuit should then be connected between this middle point and one of the outside wires, and the 100-volt circuit can be taken off from the outside wires. The transformer will then be capable of transforming its rated load from 50 to 100 volts, even though half its wiring space, viz., that occupied by the primary, is idle. For instance, if the transformer is rated at 1 kilowatt it will transform 1 k.w. from 50 volts to 100 volts or from 100 volts to 50 volts without overheating. If, however, the transformer is designed to give only one voltage in the secondary, a different means must be adopted. If this voltage is 100 volts, the simplest means is to find if possible the middle turn of the secondary winding and tap this out for a 50-volt terminal, connecting up the instrument as described above. If the transformer is only wound for 50 volts, the primary coils should be removed and another coil, an exact duplicate of the secondary, i.e., with the same number of turns of the same size of wire, should be put on in place of the primary. These two coils should be connected in series and the 50 and 100-volt circuits connected to them, as described above. In this case a transformer rated at 1 k.w. would be able to transform 2 k.w. In all cases the 50-volt and 100-volt circuits should be electrically connected to each other, but this is, as a rule, no disadvantage in such low tensions.

INCANDESCENT ELECTRIC LAMPS.

AN important question in connection with the operation of electric lighting plants is that of the value and efficiency of various forms of incandescent lamps, and a valuable discussion of the relation between power consumed and illumination furnished forms the subject of a paper by Inspector Loch, in a recent issue of Glaser's Annalen.

The ordinary life of an incandescent lamp is placed at 800 to 1,000 hours, but this extreme duration of the filament is by no means the measure of its illuminating usefulness. The real point at issue is the maintenance of uniform illuminating power. In some instances lamps reach a life of 1,000 hours only with a great diminution in brilliancy, while in others a useful life of 3,000 to 4,000 hours has been attained.

As a rule those lamps which yield a brilliant light at first for a given consumption of electrical energy show also a more rapid falling off in brightness than those which start with a weaker light.

With the falling off in illuminating power there appears also an increase in the consumption of electrical energy. An average consumption for a new lamp is from 2 to 4 watts per Hefner candle while this may increase to 9 watts per candle before the lamp fails.

There is, however, a great difference in different lamps, even of the same makers. Lamps rated at 16 candles are found to vary between 10 and 30 candles, while 25 candle lamps may range from 15 to 50 candles. A moderate increase in pressure makes a marked increase in brilliancy, and hence Siemens & Halske stipulate for a variation in pressure of not more than 2 per cent. either way from the normal rating of their lamps, i. e., for a 16 candle lamp at 110 volts the pressure should not exceed 112 volts nor fall below 108 volts.

In order to investigate the subject fully, Herr Loch conducted a series of experiments upon a number of incandescent lamps, noting both the life and duration of brilliancy as well as the consumption of electrical energy, the results being plotted in the form of curves. The lamps for the tests were furnished by the makers in accordance with certain specifications, with the intention of securing, as nearly as possible, articles of normal character. Each lamp was required to be tested, and it stipulated that during the first twenty-four hours the illuminating power should not vary more than 6 per cent. either way from the normal, while each lamp was also obliged to stand a run at pressure 2 per cent. above and below the normal rating without showing injury. The normal consumption of energy was required to fall between the limits 2, 5 and 3.5 watts per candle, and the illuminating power must not fall more than 15 per cent. during the first 480 hours. At the end of this period it was also required that the consumption of electrical energy should not have increased more than 20 per cent. over that required at the beginning.

The records of the tests are given very fully in the article referred to, both graphically and in tabular form, and to the original publication the reader must be referred. The general conclusions, however, were altogether clear, and can readily be summed up.

The tests, as indicated above, were made for twenty-four hours *in order to enable the preliminary measurements to be made, after* which the 480 hour trial followed, and such lamps as survived were then continued on trial until a total 960 hours had been completed.

The general result of the investigation showed that the consumption of electrical energy continued about the same per lamp throughout the entire test, having fallen off but slightly at the termination of 960 hours, but the illuminating power diminished steadily during the same time, so that the power per candle increased materially; in one case the energy per candle increasing from 2.45 watts to 6.75 watts, the candle power having fallen from 24 to 8 during the run of 960 hours.

These evidences of deterioration in incandescent electric lamps correspond to a great extent to those which have been noted in connection with incandescent mantles for gas lamps. A similar falling-off in illuminating power is observed, while the consumption of gas remains the same and hence the efficiency is reduced. It is evidently in the interests of economy to observe the performance of both kinds of lamps and replace them before the waste becomes excessive.—Engineering Magazine.

INVENTION OF COMBINED GAS AND STEAM ENGINE CLAIMED.

THE problem of the transformation of heat into mechanical energy in an economical manner has been a perplexing one since the advent of mechanical power. Professor V. H. Emerson, mechanical and civil engineer, an American citizen at present residing in Ottawa, Ont., who has established a reputation in Canada through his recent discovery of a process for the conversion of sawdust and sawmill refuse into calcium carbide for the production of acetylene gas, claims to have taken very important steps in solving the problem, and he has in operation a powerful and compact machine which he terms a hydro-electric motor, inasmuch as the motor is composed of a number of elements, in which water and electricity form prominent parts. In respect to his new discovery, Professor Emerson, when questioned, said:

"I cannot go into the structural details concerning the motor, as I have not yet secured patents. I have designed the machine for operating my carbonizing machinery, of which I expect to *install plants throughout the country. The motor may be used* for many other purposes, such as operating street cars, boats, supplying electric light or pumping water for private residences, and as a motive power for vehicles; in fact, in any place where a powerful motor of light weight is required. A 10 horse power motor, as constructed for a carriage or boat, would not exceed 125 pounds in weight, and the two horse power machine I now have in operation weighs 46 pounds, but in this I have not attempted to reduce the weight. The motor operates at a moment's notice by connecting a lever with a key, which puts an electric battery in circuit, and it is as easily controlled as a steam engine; in fact, when once started, requires no further attention.

"The principle upon which my motor operates is equivalent to building a fire directly in a vessel of water; the water, taking up the entire heat, becomes expanded into steam, and thus produces mechanical energy by so doing. The hot gases escaping from the smokestack of a steam boiler or the high temperature of the exhaust of a gas engine is entirely obviated by my system of motor, and it will exceed in point of economy more than 50 per cent. of the best steam engine practice.

"In order that the operation may be more thoroughly understood, I may state that atmospheric air is charged with carbonaceous matter. This mixture is ignited by an electric current, producing expansion and a high temperature. At this instant it is brought into contact with water, broken into minute proportions, the water being converted into vapor instantaneously, which reduces the temperature and increases the pressure, which acts upon a piston and is converted into mechanical power. The whole operation is automatic and continuous, and we have practically a steam engine without a boiler or exhaust steam."

MONTREAL

Branch Office of the CANADIAN ELECTRICAL NEWS,
New York Life Building,

MONTREAL, January 5, 1900.

It is rumored that the Bell Telephone Company will enter suit against certain local manufacturers of 'phones on the ground of patent infringements.

The Royal Electric Company have lost the work they were tendering for at the Paris Exhibition, it being given to a Parisian company for some three thousand dollars less.

Ottawa people are discussing the question whether carbide works are or are not dangerous. The burned victims of the explosion the other day would seem to be exhibits of the affirmative side.—Gazette.

To give an alarm when the speed of motor cars is too great a small dynamo is used to generate power, with an armature set to respond at a predetermined speed of the dynamo, ringing an electric bell as soon as the abnormal speed is reached. Exchange.

The Montreal Electric Company report the sale of a 55 k.w. multipolar Crocker-Wheeler generator to the Mechants Cotton Company for lighting purposes. This displaces two small units in old mill. An 18 station Eco Watchman's magneto time detector will be installed in the mill by the above compa[illegible].

Some very nice decorating has been done in this city with electric incandescent lamps, notably at the Royal Victoria Hospital (indoors), where the arrangement was under the supervision of their chief resident engineer, Mr. Bowden, on whom it reflects great credit. This was on the occasion of their usual Xmas festivities.

In the case of the Quebec Railway, Light & Power Company vs. the Jacques Cartier Water Power Company, for $25,000 damages, and the issue of a writ of prohibition, the defence have filed their statement of defence at Quebec, in which they claim that the action is not instituted on good faith, but simply to harass, molest and annoy defendants in their work.

The open winter season so far has been a perfect "picnic" for water power companies. As both the large Montreal concerns are now on that basis (admitted both have steam reserve), the present winter, when it gets properly to work, will have the deciding of a great part of next spring's contracts. The one who has least trouble, or gets out of it the quickest, thus providing the most constant service, will be sure to be the favorite.

A discontinuance has been filed of the suit of the Royal Electric Company against the Chambly Power Company and certain directors thereof. This action arose out of a dispute in which the transfer of certain stock and the legality of acts of the directors of the Chambly Company was called in question. It caused considerable excitement in stock exchange and business circles. Efforts to effect a settlement were eventually brought to an issue.

The various correspondence schools in the neighboring republic have been actively canvassing in Montreal of late, and have done good business, one in particular reaping a regular harvest of students. If some of these would so arrange their electrical course as to eliminate the dry mathematics and preliminaries and get right at electricity, they would capture a lot of former college students now in employment. It is to be remembered that when these went through college they had not in their time the practical course provided to-day, and were thoroughly "grounded" in mathematics, etc., "ad nauseam," for over three years of a probable four year course, consequently they look with awe at having to digest these over again before getting the food for which they hunger.

The McCarthy Brewery Company, of Prescott, Ont., are installing a lighting system in their brewery at Prescott, using the Canadian General Electric Company's apparatus.

The British Columbia Electric Railway Company have just installed in their new power house a new engine manufactured by the Laurie Engine Company, of Montreal. The diameter of the high pressure cylinders is 20 inches and that of the low pressure 40 inches, the stroke being 42 inches. The company are also installing one 500 k.w. generator of the direct connected type for street railway work, furnished by the Canadian General Electric Company, as well as a lighting machine from the Westinghouse Company, of Pittsburg.

TELEGRAPH and TELEPHONE

THE INVENTOR OF WIRELESS TELEGRAPHY.

A LECTURE was recently delivered at the Canadian Institute, in Toronto, by Mr. C. A. Chant, lecturer on Physics at the University of Toronto, the subject being "Wireless Telegraphy." Mr. Chant claimed that Marconi is not entitled to, and, indeed, has never claimed the glory which has accrued to him in popular report. Long before Marconi's time the ideas which he has since worked out were well known among investigators. Farraday was the first to direct scientific thought along the path which has led to present results. After him came Lodge, Maxwell, and a number of others, each contributing his quota to the sum of knowledge on the subject. Mr. Chant illustrated the various steps in the progress of knowledge by a number of interesting electrical experiments. The chief merit of Marconi, he says, lies in the idea of stringing a wire to a high mast, thus greatly increasing the distance over which the system can be operated. Previously the great difficulty in using it over long distances was that where the current encountered any obstacle, such as was presented by the curvature of the earth, it was sure to be dissipated. The high mast, with the attached wire, obviates this to some extent.

In making the wireless current of practical value, Marconi has been greatly aided by Mr. Preece, superintendent of the telegraph system in England, without whose energy the whole thing might still have remained in the theoretical stage. Mr. Chant expressed doubts as to whether it would ever be possible to send messages in this way across the ocean, although, as he pointed out, it is necessary to speak with much caution of anything relating to the advance of electrical science.

As to its use in war, he explained that one great difficulty is that no method has yet been devised of keeping messages secret. The current radiates in all directions, and can be read by anybody who is provided with suitable instruments.

THE G.N.W. TELEGRAPH CO.

AN unusual amount of construction work was done during 1899 by the Great North-Western Telegraph Company. A considerable portion of this work was made necessary by the great sleet storm of January, 1899. The systems in Hamilton, St. Catharines, Stratford, St. Marys, and other towns in western Ontario have been re-constructed, also 85 miles of line between Windsor and Glencoe. Considerable extensions were constructed in Manitoba following extensions of the Northern Pacific Railway, and, in addition, existing lines have been greatly improved. Upwards of 80 miles of new line have been built during the year on the line of the Great Northern Railway now in process of construction between Hawkesbury, Ont., and the city of Quebec. There remains about an equal amount of construction to be carried out. The volume of business done by the company during the year was largely in excess of any previous years in recent times, and the outlook is regarded as most satisfactory.

The New Brunswick Telephone Company will run a wire from Chatham to Fredericton.

ENGINEERING and MECHANICS

HAMILTON STATIONARY ENGINEERS.

The Hamilton branch of the Canadian Association of Stationary Engineers held its monthly educational meeting on Tuesday, December 19th. Another of the series of papers on mathematics was read by Mr. C. R. T. Fessenden, the subject being "Signs and Symbols Used in Formulas."

In opening, it was stated that the modern engineer found it necessary to be almost constantly using rules in connection with his work. He said: A formula is merely a short way of expressing a rule by means of letters or signs, and arranges the rule in such a way that by merely writing the quantities, represented in the formula by letters, in place of these letters, we have only to perform the indicated operations to obtain our answer. In working out these rules we add, subtract, multiply and divide, find power and roots, and in the formula we indicate the operations by the following signs: The plus sign shows that the expressions between which it is placed are to be added, as $4 + 2$, meaning the sum of 4 and 2, and A + B would mean the sum of the quantities for which A and B stand. The minus sign between two expressions indicates that the second is to be taken away or subtracted from the first; in A - B the quantity for which B stands is subtracted from that for which A stands. The multiplication sign shows that the quantities are to be multiplied together, $A \times B$ or A B meaning that the quanities represented by the letters are to be multiplied. Letters written together as above, A B, with no sign between them, are to be multiplied, the sign being omitted for convenience. The dividing sign indicates the first quantity divided by the second, as $4 \div 2$ means 4 divided by 2; 4/2 and $\frac{4}{2}$ also read 4 divided by 2, the quantity to the left or above being divided by that to the right or below. $A \div B$, A/B and $\frac{A}{B}$ all mean quantity represented by A divided by that represented by B.

The power to which a number or quantity is to be raised is shown by placing a small number above and to the right of that number or quantity; thus 5^3 means 5 cubed, and means the product of 5 taken three times as a factor, $5 \times 5 \times 5$. A^2 means the value of A multiplied by itself; thus $A \times A$. The radix shows the root of a number used alone, and means the square root. Any other root is shown by the number placed in the V of the sign.

These signs have also further use in particular cases; the signs (+) and (-) separate expressions, and all quantities and operations between these lines, should be performed before the value of the expression is added or subtracted. The signs (×) and (÷) connect only the quantities on each side of them.

There are also other symbols used to shorten work by indicating the same operation on a number of quantities. These are generally called brackets, and all quantities and operations enclosed in them must be simplified or performed before proceeding. A number is sometimes written against the outside of a bracket, in which case the sign of multiplication is always understood. We have also the sign =, meaning equal to, and shows that the two quantities have the same value.

Formulas are generally given in the shape of an equation; that is, certain letters and operations equal some other letter. Below the formula is written that for which each letter stands; so, in order to work a formula, we take the quantity represented by a letter and place it in that letter's position in the formula, then perform the operation indicated, and the result obtained represents the other side of the equation or formula. Example:—

H.P. formula $\frac{P\,L\,A\,N}{33{,}000} = H/P$ — Take a 14" × 40", running 75 rev. per minute. Mean effective pressure is average pressure throughout stroke as found by planimeter, 50 lbs.

A - Area of piston.
P - Mean effective pressure.
L - Stroke in feet.
N - Number of stroke = 2 revolutions per minute.

$$\text{Substitute } \frac{50 \times 154 \times 3\frac{1}{3} \times 150}{33{,}000} = 116.6 \text{ H/P.}$$

A - $14^2 \times 7.854$ = 154 sq. nearly.
L - $3\frac{1}{3}$ feet.
N - $75 \times 2 = 150$.

Before the meeting closed a hearty vote of thanks was tendered Mr. Fessenden for the excellence of his paper and for the intelligent and satisfactory manner in which he had explained the subject to the members.

It was announced that the subject for next month's meeting would be a paper on friction.

PUMPING MACHINERY.*

By C. E. Morgan.

Perhaps the engineer in his varied experience with machinery has given but little thought to the important work that a steam pump is called upon to perform in connection with his boiler plant. I would commence by stating that although it is possible to feed a boiler with other appliances, the steam pump undoubtedly is the best, all round, commercial article.

I do not propose to enter into the question of economy of the steam pump as compared with other means of feeding boilers, such as injectors and power pumps; these no doubt have their uses as auxiliaries, and perhaps in some cases it is advantageous to use a power pump where the engine or prime mover is constantly running, as by so doing the water is pumped practically with the economy of the engine. A boiler feed pump is called upon frequently to handle water at various degrees of temperature, and this being the case, certain mechanical features in connection with its construction have to be considered. For instance, in handling water at normal temperature, say 70 degrees, the ordinary inside plunger type of pump is perhaps all that is desired, whereas should the water reach a temperature of 212 degrees the conditions are different, inasmuch as the temperature of the feed water expands all working parts of the pump and it becomes necessary to have the machine so arranged that the water piston can be adjusted to meet these conditions. This feature is easily taken care of by using a special boiler feed pump, so constructed that its plungers are externally packed. This enables the engineer to immediately discern any leak which may have taken place and to satisfy himself that the pump is fully efficient at every stroke.

Some engineers have raised the objection to a certain amount of friction which is set up by the external adjustment of the plungers, but if the machine is properly made with deep well fitting neck bushes and glands, this feature is not of very much consideration, as under absolute test the friction set up is a very small percentage.

Difficulty is often experienced when pumps are working on very hot water, but in cases that have come under my own notice, I have usually found that the trouble has arisen by the machine being placed in a position where it would practically have to raise the water by suction, while, in place of this, it should gravitate, as the formation of a vacuum in pump would be immediately filled by the vapor from the hot water and would consequently interfere with the proper working of the machine. It is also very important to have valves of proper materials for handling water at high temperatures. Machines are frequently condemned when really the working parts are at fault.

In steam plants it sometimes happens that in feeding boilers the pumps used are much too small for the work required. In making a choice of a steam pump for feeding boilers it is well to have it of sufficient size so that it will do its work easily. For pumps having 4" stroke it is possible to run them to 150 strokes per minute; 6" stroke, 130; 8" stroke, 120; 12" stroke, 100; 16" stroke, 85; 18" stroke, 80. You will note that these are maximum speeds, and for boiler feeding purposes the machine should operate at about one-fourth of the above speeds. In estimating the capacity of the boiler feed pump the following formula is used:

$$\frac{\text{H. P} \times 30 \times 28}{\text{Speed in inches} \times 60} = \text{Area of single cylinder.}$$

This is for a single cylinder piston pump. Of course for a duplex it would be one half this and for a triplex so much.

In very large steam plants the compounding of boiler feed pumps is possibly a move in the right direction, resulting in a considerably more economical consumption of steam. It is very probable that a compound steam boiler feed pump will shortly be introduced which will not be very much more expensive than the ordinary high pressure machine and would certainly be well worth the difference in cost. We have machines of this class operating to-day, with very good

* Paper read by C. E. Morgan, of the Northey Mfg. Co., before Toronto No. 1 Canadian Association of Stationary Engineers.

results. These compound pumps are made of either the single or duplex type; some engineers preferring the duplex machine and others favoring the single. So far as economy is concerned, possibly the single pump is most economical, as there are less clearance spaces to be filled and consequently a more economical use of steam.

Another feature which the single pump possesses over the duplex is that in its length of stroke it is uniform, while the duplex pump invariably short strokes on either side, which further increases waste in the use of steam. The duplex pump, however, is perfectly positive in its steam end, while the single pump has been known to give some trouble in this respect. But this is usually due to the inferior construction of the automatic valve gear. There is no good reason why a steam thrown piston valve should not be equally as positive in its operation as the positively moved one if the ports, both steam and exhaust, are properly proportioned and made strictly to templates.

I think the field of boiler feed pumps has been pretty well covered, and I will, for a few minutes, take up the condenser question.

The question of economy is being studied more closely to-day than was the case some few years ago, and manufacturers are asking for the most economical steam plant that can be installed. In order to achieve these results, condensing engines of different styles are being called for, and independent condensers of many types are being made to-day—the horizontal single and duplex form, and the vertical single and double acting duplex or twin type, or the rotative type. The choice of any one of these condensers is regulated by the size of the plant, and for ordinary small plants possibly the horizontal single type of condenser is the cheapest. When large units, however, have to be considered the most efficient and economical type of air pump and condenser should be installed.

Undoubtedly the most efficient type of air pump to-day is the single acting vertical, its high efficiency being due to the fact that all clearance spaces can be practically dispensed with, and being of the single acting type, the velocity of flow is not checked by diversion. Being provided with foot and bucket valves, and these valves always covered with water, there is very little clearance space.

The lack of efficiency in the double acting horizontal or vertical type of pump is largely due to the reverse of some of the above conditions, as, by the failure of the valves in closing and also a large space between the suction and delivery valves. The speed at which air pumps can be operated depends upon the valve area which they contain. This, in a great many cases, is very much contracted, and accounts for the unpleasant noise which air pumps are sometimes known to make on board steamers. If this valve area could be increased the pump would work somewhat quieter.

Beyond doubt the most economical style of air pump is the rotative vertical type, as it enables you to use steam expansively. Its first cost, however, is very much greater than the direct acting vertical type, and on account of its rotative action it is considerably more expensive to maintain. I think it is possible to construct an air pump of a design which will allow of the valve area being very largely increased and consequently a higher speed made practicable. This experiment is at present under test, and we have every reason to believe it will prove of great commercial value.

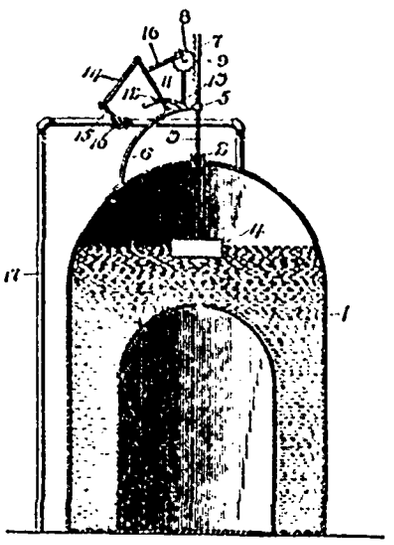
For the practical engineer, perhaps a rule which is used for the proportioning of an independent air pump and condenser for certain sized engines would be well to remember. The data which is required before being able to estimate, is the class of engine which is being used, the pressure of steam supplied the engine, point of cut-off, and the number of revolutions, or piston feet travel, per minute. By referring to our list on page 69 of our catalogue, you will find the maximum steam that certain sized air pumps are capable of condensing per hour. This, of course, is based on an assumption that the injection water is supplied at a temperature of from 60 to 70 degrees.

I have not thought it well to occupy your time with any other class of pumping machinery but what we are familiar with, and may say that the pumps which are used for mining, pumps that are used in pulp and paper mills, and the triplex power pump, and special pumps for special purposes, have not been touched upon in this paper.

We shall, however, at a future date, be glad to take up this matter and refer to some of the uses which pumps are put to in the many manufacturing industries throughout the country.

WATER FEED REGULATOR FOR BOILERS.

Mr. W. H. Tobey, of Tupperville, Ont., has been granted a patent in Canada for a water feed regulator for boilers, as shown in the accompanying illustration, for which he makes the following claim: The combination with a boiler, having a water inlet supply pipe and a valve located in said supply pipe to regulate the passage of water into said boiler, of a float mounted to have a vertical

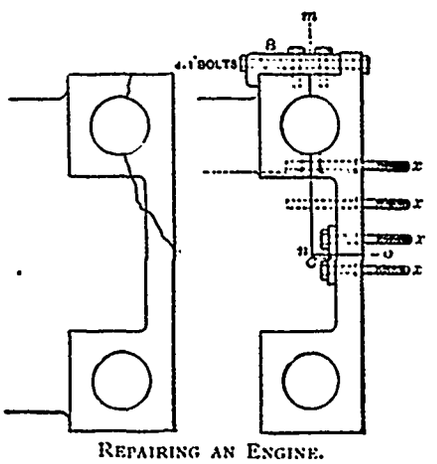


Water Feed Regulator for Boilers.

movement within said boiler, a pinion mounted to have an operative connection with said float, whereby a vertical movement of said float will impart a rotary movement to said pinion, and connections operatively connected to said pinion and the handle of said valve, whereby the movement of said pinion will serve to impart an oscillatory movement to said handle, substantially as described.

REPAIRING AN ENGINE.

An interesting repair job undertaken at the Corliss shops at Providence is shown in the accompanying illustration from Power. An engine, probably from an overdose of water, had knocked out the cylinder head, carrying with it a portion of the flange and of the steam valve bonnet as shown in the left-hand sketch. The broken metal was planed away along the central lines (nn no) of the valves and cylinder bores and a casting made to replace the



Repairing an Engine.

missing section now regular in shape. Fourteen collar studs were put in the end as shown (x), four of which passed through the port. The joint was made of copper. After the patch was in place the cap (B) was put on and the valve chamber rebored. Links were shrunk on C to make the joint on the plane (n o). The engine is now running regularly and giving no trouble.

The Toronto offices of The Royal Electric Company have been removed from No. 36 and 38 York street to No. 76 King street west. This move was rendered necessary owing to the buildings occupied on York street being sold to the W. L. Johnson Company, who purpose erecting a large building on the site for the manufacture of clothing. The new offices of the Royal Electric Company at 76 King street west are commodious and a decided improvement over the old location.

ELECTRIC RAILWAY DEPARTMENT.

STREET CAR CONTROLLING DEVICE.

MR. Duncan McDonald, superintendent of the Montreal Steeet Railway, has invented a device by which he hopes to prevent the too sudden starting of street cars. On the top of the controller is a series of eight stops placed at stated intervals and in a circle. Attached to the handle is a spring arrangement which connects with these stops. The handle runs around freely until the first stop is encountered. Then in order to put on more power a pressure on the handle is necessary. A pressure on the handle top allows the power to be applied to the next stop, and so on until the entire circle has been negotiated. In order to go from a stand-still to full power ahead a lapse of from eight to ten seconds is necessary. By the old method one sweep of the handle would do it all. Of course there is nothing to interfere with the rapid turning off of the power; this can be done with one sweep of the handle as formerly. Mr. McDonald explains that no matter how carefully a motorman was trained, there were times when he would send on the power more quickly than he should. Perhaps it might be his anxiety to make up lost time and get up with his schedule, or a dozen other complications; the result was the same.

MANHATTAN ELEVATED ELECTRICAL EQUIPMENT.

THE Manhattan Railway Co., of New York, last month awarded to the Westinghouse Electric Co., of Pittsburg, Pa., one of the largest contracts for electrical equipment that has ever been placed, it being in connection with the conversion of their system to electricity. It includes the heavy generating machinery for the new power house and apparatus for sub-stations, which, with the contracts already given for engines, boilers, etc., practically completes the apparatus required for the stationary installation of the electrical equipment of the system. The contract is understood to represent a consideration of about $1,500,000, and, in capacity, about 163,000 horse power. There will be eight three-phase alternating current generators of 5,000 k.w. each, seventy-eight 550 k.w. step-down transformers, and twenty-six 1,500 k.w. rotary converters. The generators will be the largest ever designed or constructed, their external dimensions being something over 40 feet, while the rotating element, which includes in itself the rotating field of the generator and the necessary fly-wheel for the engine, has a diameter of 32 feet. The weight of each machine and engine complete will be nearly 1,000 tons. The generators will have stationary armature and revolving fields. The armature winding will be of the bar type, using three bars per slot and four slots per phase per pole. The installation of the armature conductors is guaranteed by the manufacturers to withstand a puncture test of 25,000 volts alternating applied between copper and iron for thirty minutes.

The rotary converters will have 18 poles, and will, therefore, make a little less than 170 r.p.m. Their fields will be compound wound, to provide a certain amount of automatic regulation of the direct current potential, which will range from 575 to 625 volts. The step-down transformers will be cooled by air. They will be connected in groups of three to each rotary converter.

The Westinghouse Company are to be congratulated upon this order, as it is understood that the Manhattan Railway Co. have been actively studying the problem for over two years with a view of securing an equipment of the highest efficiency and of the most modern construction. Messrs. Ahearn & Soper, of Ottawa, are Canadian agents for the Westinghouse Company.

SPARKS.

The Mount Royal Park Incline Railway Co., of Montreal, have appointed a committee, consisting of Messrs. Mann, Vallance and Turner, to report on the conversion of the power plant from steam to electricity. Last year this road carried 325,000 passengers.

The promoters of the proposed electric street railway at Sarnia, Ont., are rapidly completing the preliminary arrangements. According to the franchise granted by the council, the company agree to have a portion of the road in operation by July 1st, 1900, and the balance within twelve months from that date.

It is understood that Mr. Clyde K. Green, manager of the Hamilton Radial Railway, has been appointed traffic manager of the Cataract Power Company's electric railways, and that Mr. J. B. Griffith, late manager of the Hamilton Street Railway, is to be chief of the purchasing department of the consolidated lines.

Mr. J. S. Campbell, of St. Catharines, has made application for the incorporation of the Niagara and South-Western Electric Railway Company, with power to construct an electric railway from Niagara-on-the-Lake, through St. Catharines and Smithville, to Hagersville, with branches to Dunnville, Cayuga and Queenston.

The Berlin & Waterloo Electric Street Railway Company have given a contract to the Volta Electric Storage Company, of Hamilton, for 16 storage batteries. These will be used to supplement the power furnished by the generators and to overcome the difficulties frequently experienced by heavy loads. The system is now being installed.

The application of the Demerara Electric Company for a franchise to construct electric railways in the city of Georgetown, Demerara, has been granted on terms satisfactory to the company. The capital stock of the company is $850,000, and the directors include Sir Wm. Van Horne, Senator Drummond and W. B. Chapman, of Montreal, and B. F. Pearson, of Halifax.

Mr. Chas. Cadmus, representing Hamilton and Toronto capitalists, is endeavoring to organize the Huntsville and Lake of Bays Railway Company, for the purpose of constructing a steam or electric railway over the portage between the Lake of Bays and Peninsula Lake, in Muskoka district. The cost is estimated at $20,000, but as it is proposed to engage in mining also, the capital has been placed at $100,000.

At a meeting held in New York city a fortnight ago, all the street railway interests in the city of Havana, Cuba, were consolidated. Under the terms of the arrangement the Havana *Electric Railway Company acquires the rights and stock of the* Havana Traction Company. It is now expected that a complete system of electric traction will be in operation by the first of June next. Sir William Van Horne and William Mackenzie are interested in this enterprise.

By a new time table inaugarated by the Toronto Railway Company, an increase of 4,000 miles per day run by the cars was effected. On the day on which the figures were taken, 232 cars were in use, which ran 25,520 miles and carried 115,791 passengers, whose fares amounted to $4,026.67. On the same date last year there were 210 cars in use, which ran 21,547 miles, and carried 82,292 passengers, whose fares amounted to $3,784.80, showing an increase of 3,673 miles traveled, 22,400 passengers, and $987.07 in receipts. Thus the Toronto street cars every day run a distance equal to the circumference of the globe, and carry more than half of the whole population of the city.

SPARKS.

The Herald Publishing Company, of Montreal, have ordered a 30 h.p. 250-volt motor from the Canadian General Electric Co.

An engineer is wanted to take charge of the steam heating and electric lighting plant in St. Francis Xavier college at Antigonish, N.S.

The growth of the demand for electric light at Beeton, Ont. has been so rapid that additional machinery will shortly be required.

After sustaining the struggle for seven months, the Trades and Labor Council has given up the strike against the London Street Railway Company.

The Merchants Cotton Company, of Montreal, are installing a 60 k.w. generator of Canadian General make, directly connected to 13" x 12" Ideal engine.

The power house of the Exeter Electric Light Company, at Exeter, Ont., was totally destroyed by fire on December 10th, together with all machinery.

The Toronto Carpet Mfg. Company have increased their original order to the Canadian General Electric Co., and are now putting in a 55 k.w. generator.

The Drayton Electric Light Company, of Drayton, Ont., are revamping their station equipment, and have placed an order for a 30 k.w. S.K.C. two phase machine with the Royal Electric Co., of Montreal.

The Manhattan General Construction Company, of Newark, N.J., have sold through their Toronto office a thirty-five lamp alternating current series arc lighting plant, including regulator, to the corporation of Campbellford, Ont.

The corporation of Bothwell, Ont., are increasing their plant by the installation of two 20 k.w. generators to replace those originally purchased. The order, as in the first case, has been placed with the Canadian General Electric Company.

The St. Thomas Gas & Electric Company are increasing their lighting capacity, and in doing so have decided to change their lighting system from single phase to two phase, having ordered from the Royal Electric Company a 50 k.w. S.K.C. two-phase machine, with marble switchboard and instruments.

The corporation of Picton, Ont., have awarded their meter and supply orders to the Canadian General Electric Company.

Mr. A. Gagnon proposes to connect Victoriaville and Arthabaskaville by an electric railway, provided the ratepayers of these places grant the necessary bonus.

The St. Francis Xavier College, Antigonish, N. S., have placed an order with the Canadian General Electric Company for a storage battery plant, to consist of fifty-five cells, and one multipolar 4-17½ k.w. direct current generator.

The Kingsville Electric Light Company, Kingsville, Ont., are increasing the capacity of their incandescent plant by the addition of a 75 k.w. alternator, the order for which has been placed with the Royal Electric Company.

Mr. Joseph V. Ward has recently constructed for Doctors Law and Dunn, of Beeton, Ont., a telephone line connecting Beeton with the villages of Newton Robinson and Pennville. There are three telephones on the line. The telephones are free to the doctors' patients, a charge being made to other users. On arrival at Beeton messages are transferred to the local system of the Bell Telephone Company. The extension of the private lines six miles in the opposite direction is under consideration.

The Orangeville Electric Light & Power Company are improving and extending their plant to meet a constantly increasing business and a demand for an improved and economical street lighting circuit. For their incandescent requirement they have ordered another standard 60 k.w. alternator, with a complete new panel board for both machines. For the street lighting the present open arc direct current plant will be abandoned, and in place will be installed a constant current alternating system. This will consist of a 50-light series transformer, with switchboard for same, together with 30 improved constant current lamps for operation from the same. This company has recently discarded the old 52-volt individual transformer system, substituting therefor large size type "H" transformers, feeding into a complete system of 3-wire secondary mains designed in accordance with modern practice. The single phase system will be adhered to as being the simplest and most flexible for lighting purposes, as demonstrated by its past satisfactory operation. The Canadian General Electric Company have the entire contract.

THE CONMEE ACT.

In the article headed "A Warning," printed in our December issue, referring to certain provisions of the Conmee Bill designed to protect the interests of lighting companies, the sub-section to which the article was intended to refer was inadvertently replaced by a sub-section which had no bearing on the point under consideration. The error was not discovered until after the article was printed. Under these circumstances we deem it advisable to print herewith the sub-section of the Act to which our previous article was intended to refer, and which is as follows :

(a) In case there is any gas, electric light or water company incorporated for or in the municipality, the council shall not levy any such special rate, or construct works for lighting the public streets, until such council has, by by-law, fixed a price to offer for the works and property of the company or companies, nor until after thirty days have elapsed after notice of such price has been communicated to the company or companies without the company or companies having accepted the same, or without the company or companies having, under the provisions of this Act, as to arbitrations, named and given notice of an arbitrator to determine the price, nor until the price accepted or awarded has been paid, or has been secured to the satisfaction of the company or companies, and in case the company or companies and the municipality do not agree, the said price shall be determined by arbitration under this Act ; and where there is more than one such company in the municipality, the arbitrators shall determine the share or proportion of the price to be paid to each company. This clause (a) shall only apply to a gas or electric light company that has supplied or shall supply gas or electric light for street lighting in the municipality, or to a water company that has supplied or shall supply water for street hydrants in the municipality.

SPARKS.

By a majority of over 700 votes the ratepayers of Ottawa have decided in favor of civic control of electric lighting.

Sir Wm. Van Horne and Mr. H. S. Holt, the latter president of the Montreal Gas Company, have been elected to the directorate of the Canadian General Electric Company.

At the municipal elections the ratepayers of Prescott, Ont., voted in favor of handing over the management of the electric light plant now operated by the town to the water commssioners.

When all the improvements now under way are completed, the electrical plant in the Montreal Cotton Company's mills at Valleyfield, Que., will be the largest in capacity of any plant similarly employed on this continent.

Mr. Roderick J. Parke, E.E., of Toronto, has been engaged as consulting engineer by the Arnprior Electric Light & Power Company, to advise on the reconstruction of their plant, considerable additions to which are contemplated.

A company has been formed at Windsor Mills, Que., to install an electric light plant for lighting the streets, stores and residences. The council has granted a franchise to the company, and it is understood that work will be commenced early in the spring.

The city council of Ottawa has passed a by-law extending the franchise of the Metropolitan Electric Company to twenty-one years. The Deschenes Electric Company have also made an application to the city for a franchise to supply electricity.

The St. Thomas Gas & Electric Company are making extensive changes in and additions to their plant to meet increasing demands For arc lighting purposes they are installing a Brush arc dynamo with capacity for 125 lamps, manufactured by the Canadian General Electric Company. This company has also been operating the St. Thomas street railway for some time past from their power house, using two 100 k.w. generators of the General Electric standard type.

The War Eagle Consolidated Mining Company is said to have issued a writ against the James Cooper Manufacturing Company, of Montreal, and associated companies, claiming damages on account of certain machinery supplied working unsatisfactorily.

The New York Journal of Commerce states that the American Air Power Company, of New York, are likely to establish a branch of their works in Canada. They make a specialty of manufacturing apparatus for the propulsion of street cars by compressed air.

The Electrical Maintainence & Construction Company, of Toronto, report that in addition to a number of contracts for house wiring and extensions throughout the city, they are installing 600 lights at the Government House, 250 lights for the Macdonald Mfg. Co., 100 lights for the General Hospital in Toronto, and 1,000 lights for the Canadian Colored Cotton Co., Hamilton.

The electric light by-law of the city of Greenwood, B.C., having finally passed, Messrs. George C. Hinton & Co., of Victoria and Vancouver, have added the contract for the equipment of this Kootenay town to the many others they have completed, or are attending to in that part of the world—for many of the Kootenay towns have been provided with electric light and power by this same hustling firm. The present contract is for one 150 k. w. 2:000 volt two phase S.K.C. inductor type generator of 3,000 light capacity, complete with all equipments, material, insulators and supplies. The generator, switchboard, etc., will be of the very latest and most approved pattern. The entire plant will cost in the neighborhood of $20,000, and will be fully installed during the ensuing ninety days.

The attention of our readers is directed to the announcement in this issue of the American School of Correspondence, offering thorough technical training by mail. This institution claims to be the only correspondence school in the country making a specialty of steam, electrical and mechanical engineering. A careful inspection of the school's attractive instruction papers convinces one of the painstaking thoroughness and accuracy which distinguishes the work of this New England institution. The school is chartered by the commonwealth of Massachusetts and enjoys the respect and confidence of thousands of earnest students throughout the United States. The instructors are all graduates of leading scientific schools, and have had valuable experience along engineering lines. The benefit to the student of this expert supervision cannot be over-estimated. The courses have been carefully laid out by prominent educators and engineering experts. They embrace every subject required by the up-to-date engineer and mechanic in order to have complete mastery over the theoretical details of his daily work. The school was founded to give high grade instruction to those men who have been compelled by adverse circumstances to leave school at an early age in order to make a living. With this idea in view, the tuition has been purposely placed very low, so that no wage earner shall be debarred from receiving the benefit of such a course. By taking advantage of this school's generous offer, the ambitious mechanic can receive a thorough technical education in his profession by merely devoting his spare moments to systematic home study. Almost every man has, at some time, felt the need of a better knowledge of the theoretical details connected with his work, and this school has been founded to supply this much needed education. The school will be glad to furnish a catalogue on request, describing its methods, and letters from graduates giving results of their experience.

TRADE NOTES.

Mr. H. Corby, Belleville, Ont., has placed an order with the Royal Electric Co. for a 100 light direct current generator.

The Clappison Pipe & Boiler Covering Co., of Hamilton, have been awarded the contract for pipes and boiler covering for the Longue Pointe Asylum, near Montreal.

Messrs. Gilmour & Co., of Trenton, Ont., have lately installed in their mills a 100 light direct current generator from the Royal Electric Co.

The Granby Consolidated Mining & Smelting Co., Grand Forks, B.C., have installed a 50 light direct current generator of the Royal Electric Co.'s manufacture.

The Toronto Electric Light Co. have equipped their new Heine boilers with Jubilee shaking grate bars, manufactured by the Jubilee Grate Bar Company, of Toronto.

The Merchants' Cotton Co. has placed an order for all the belting in its new extension, to contain 500 looms and 20,000 spindles, with D. K. McLaren, Montreal. The order includes 155 feet 50 inch, 3 ply; 160 feet 14 inch, 3 ply; 500 feet 10 inch, 2 ply; 800 feet 6 inch, 2 ply.

The Grant-Hamilton Oil Co., of Toronto, Limited, has been granted a charter, with a capital of $40,000. The company will do a general business in oils and engineers' supplies. The provisional directors are G. W. Grant, T. H. Hamilton, John M. White, Andrew Dods and Wm. Irwin.

The Toronto Rubber Shoe Manufacturing Co., who have recently been awarded the contract to supply electric light and power to the town of Port Dalhousie, have retained the services of Mr. R. J. Parke, E.E., of Toronto, to provide plans and specifications for the necessary plant, which will include a 150 polyphase generator and approximately 100 h.p. in motors. This plant will also provide light for the company's factory, for which about 800 incandescent lights are required.

The iron flume built by Mr. G. K. Nesbitt, owner of the electric light plant at Cowansville, Que., burst on December 20th, depriving the inhabitants of electric light for a few days.

The Montreal Street Railway Company will likely put into use a new invention for removing a heavy fall of snow from the tracks. The device has been invented by Mr. Wm. Pont, foreman of the Hochelaga car sheds, and consists of a large wing, 12 feet long, attached to one side of the sweeper near the rear. After the brushes on front of the sweeper throw the snow up off the track, the wing comes along and throws it back to near the sidewalk, so that it is not again thrown on the tracks by sleighs in crossing.

The ratepeyers of Bedford, Que., have petitioned the council to have the streets lighted by electricity.

Pratt, Patching & Company, of Tweed, Ont., have purchased a new engine for their electric light plant.

The death is announced of Mr. Frank Gormley, of Montreal, who in early life was employed by the Montreal Telegraph Company.

The electric lighting plant at the Soulanges canal was tested on December 18th, under the direction of Mr. Thos. Monroe, chief engineer. The light was found very satisfactory. The plant was installed by the Canadian General Electric Company.

SPARKS.

The Columbia Telephone & Telegraph Company have acquired the lines of the Spokane Falls and British Columbia Telephone Company.

The Dominion Iron & Steel Company, of Sydney, Cape Breton, have added another 40 h.p. 250-volt motor to the order already given for electric plant. The Canadian General Electric Co. have the entire contract.

Mr. C. D. Dyke, inspector for the Bell Telephone Co., while repairing wires at Peterborough last month, slipped from the top of a forty foot pole and fell to the pavement, breaking his left leg and otherwise injuring himself.

Mr. J. M. Deagle, of Cataract, Ont., has placed his order for a complete electric light plant for the town of Erin, with the Royal Electric Company. The order includes a 30 k.w. alternator and 300 light capacity in transformers.

The Ogilvie Milling Co., of Winnipeg, Man., have purchased from the Canadian General Electric Co. a 50 k.w. direct current generator of their standard multipolar slow-speed type, and marble generator and feeder panels.

Within the past year the Ottawa Car Works Company expended nearly $18,000 in buying additional land, building an extension to the car construction room, erecting a boiler house and dry kiln, and installing the latest system of heating and ventilation.

Napoleon Savard, a telegraph lineman, was killed in Montreal by coming in contact with a live wire. He and his brother were replacing and coupling wires at the top of a pole, and while in the act of splicing two ends he grasped the wires with both hands.

The Grand Valley Railway Company will make application at next session of the Dominion parliament for power to construct a steam or electric railway from Goderich through Berlin, Galt, Brantford and Simcoe to Port Dover, with branches to Listowel, Elora and Stratford.

The Westport & Digby Telephone Company's cable in Petit Passage, the channel connecting Long island and Digby neck, was repaired on Dec. 15th by Mr. F. A. Hamilton. This cable was interrupted in November by a vessel dragging her anchor through it during a heavy gale.

The Toronto Rubber Shoe Manufacturing Company have purchased a thirty-five lamp alternating current series arc lighting plant, including regulator, for their factory and the street illumination of Port Dalhousie. The Manhattan General Construction Company, of Newark, N.J., are furnishing the equipment.

The Bell Telephone Company's new directory for Western Ontario shows a marked increase in the use of the telephone. In Stratford there are now over 230 instruments, while London's subscribers number nearly 1,400. There are 221 telephones in Woodstock, 224 in Galt, 282 in Guelph, and 359 in Brantford.

The Pennfield & St. George Telephone Company held their first meeting at Beaver Harbor, N. B., on December 7th, the President, Mr. S. L. Dakin, in the chair. The company, incorporated last October, has constructed lines connecting St. George, Black Harbor, Pennfield and Pennfield Centre. In the spring a line will be built to Lepreaux and Bay Bay.

The Montreal Cotton Company, of Valleyfield, Que., are pushing the extension to their new power house, and expect that by May 1st next it will be complete and the new 1,200 k.w. generator in operation. An interesting feature of this installation, which will be the largest industrial electric plant in the world, is the switchboard arrangement. This will consist of a series of blue Vermont marble panels 36" wide by 88" high, upon which will be mounted the necessary switches for controlling the motor circuits, and all instruments for controlling the generators and exciters. There will be used for present equipment 12 feeder panels and 6 generator panels. The entire board, as covered by present orders, will be 54 feet long, and when complete will present an imposing appearance, and will meet all requirements necessitated by the peculiar conditions under which this plant operates. The entire work will no doubt reflect credit upon the Canadian General Electric Co., to whom the contract has been awarded.

PUBLICATIONS.

A Christmas number of the British Columbia Mining Record to hand. Its contents are devoted largely to the early history of British Columbia, in connection with which most interesting illustrations are presented. Sir Charles Hibbert Tupper contributes to the number an able article on "The Alaskan Question".

Catalogue No. 75 has been received from Messrs. Jack & Robertson, of Montreal, sole agents for Canada for the Sprague Electric Co., of New York. This catalogue is devoted to interior conduit. In it special attention is called to the Greenfield flexible metallic conduit, which, owing to its low price and saving of labor in installing, is claimed to have reduced the cost of modern conduit work even more than did the introduction of uninsulated planed iron pipe. The Sprague Company is the pioneer in this department of the electrical field, and all its manufactures are approved by the National Board of Fire Underwriters.

The average Canadian has not been afforded the opportunity of studying the history of South Africa and the causes which have led to the present Boer war. A knowledge of this fact induced Mr. E. B. Biggar, of Toronto, to publish a little booklet entitled "The Boer War, Its Causes and Its Interest to Canadians." So well was the first issue received that three subsequent editions have been published. The author resided in South Africa for five years, and is therefore conversant with the conditions existing in that country. The price is ten cents, and copies may be obtained through the Toronto News Co. or the Montreal News Co.

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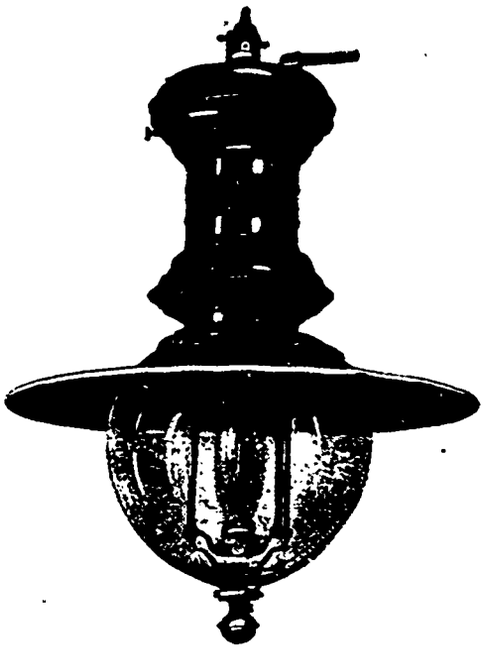

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SPARKS.

The streets of Liverpool, N. S., were lighted by electricity for the first time on December 20th, 1899.

The contract for wiring for electric lighting the Mount Allison residence at Sackville, N. B., has been secured by John Starr, Son & Co., of Halifax.

Mr. L. Smith, of Blenheim, Ont., is said to be considering the putting in of an electric light plant at Little Current, Ont., for street and commercial purposes.

The demand for incandescent lighting has been so great in Newmarket, Ont., that the extension of the plant will be considered by the council at an early meeting.

The Department of Justice, Ottawa, has engaged Mr. R. J. Parke, E.E., of Toronto, to act as consulting engineer in connection with the installation of a 150 k.w. electric lighting and power system for Kingston Penitentiary.

The Coaticook Electric Light & Power Co. are increasing their plant by the installation of another 2,000 light alternator, with switchboard, and a 100 k.w. 500 volt power generator. Both are being supplied by the Canadian General Electric Co.

The Cataract Power Co. are building a brick addition to their transformer station on Victoria avenue, Hamilton. It is understood to be the intention of the company to duplicate their transmission line from the power house near St. Catharines to Hamilton.

A friend of Professor Owens, chief of the electrical department of McGill University, Montreal, has donated the sum of $10,000 to establish a research scholarship in electrical engineering at McGill. The gift is highly appreciated by the university authorities.

A public meeting of the ratepayers of Yarmouth, N.S., will be held on the 15th inst. to consider the question of raising $13,000 for enlarging the pumping station and installing the necessary pumps, steam engines, boilers and other appliances for operating the waterworks system.

The American Alkali Co., of Sault Ste. Marie, have ordered the switchboard panels, with instruments, for their new works from the Canadian General Electric Co. We understand that the 3 150 k.w. electrolytic generators which this company is building also will soon be started.

Scientific American, Oct. 14, 1899.

THE AUTOMOBILE MAGAZINE has at last come to hand and is the most thoroughly satisfactory periodical which we have seen in any language on the subject. It is of regular magazine size and has 111 pages. The quality of the articles is very high and the illustrations are of the best. Everyone who is at all interested in the automobile will find something in the new magazine which will interest him. Even the social side is far from being neglected, as there is an article on the recent floral parade at Newport and on the Automobile Club of France. The Automobile Index, which occupies some nine pages, is exactly what has been needed. On the whole the magazine is a most satisfactory one.

N. Y. Evening Post, Oct. 9. 1899.

The new illustrated AUTOMOBILE MAGAZINE (New York: U. S. Industrial Publishing Co.) has a very attractive appearance, and is so varied in contents, without undue padding, that one wonders how the editor can fill his pages hereafter. Still, the list on page 101 shows that there is a considerable "foreign automobile press;" and what foreigners can do in the way of furnishing "copy" to the printer, Americans can. The society feature of the new vehicle is brought to the front with news from the Newport festival—the driver, by the way, not always sitting on the left. There are competent-seeming book reviews, and some concessions are made to the general reader in comicalities of pencil and verse. The magazine seems free from bias.