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CANADIAN ELECTRICAL ASSOCIATION CONVENTION
Hamilton, Ont.
June 28th, 29th and 30th, 1899

CANADIAN ELECTRICAL NEWS AND ENGINEERING JOURNAL

OLD SERIES, VOL. XV.—No. 8.
NEW SERIES, VOL. IX.—No. 6

JUNE, 1899

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CANADIAN
ELECTRICAL NEWS
AND
ENGINEERING JOURNAL.

VOL. IX. JUNE, 1899 No. 6.

WATER POWER DEVELOPMENT AT CHAMBLY.

By CHARLES W. HAAS.

At the present time, when the development of desirable water powers and the electrical transmission and utilization of the energy thereby obtained is attracting such widespread consideration from both capitalists and manufacturers, the attention of the reader is directed to the original features and subsequent improvement of the power site at Chambly, P.Q., some eighteen miles from Montreal, on the Richelieu river. This stream, as is generally known, is the outlet of Lake Champlain. It has a strong current, and before the building of the big dam at Chambly its course near that point was broken up by a series of rapids. It was to the possibilities of development which were offered at this place that the attention of the Royal Electric Company of Montreal was directed early in 1893, when the rapid increase in their business made it apparent that more power would soon be demanded, and that unless other arrangements were made, an addition to their steam plant would be necessitated. After due consideration, therefore, they secured an option on this water power at Chambly, extending from Chambly Basin for about four miles up the river, and had preliminary plans and estimates made. These first plans contemplated developing 15,000 h.p. by building two dams and two power houses, each for 12-feet head, at a cost, exclusive of the electrical machinery, of about $80 per h.p. Vertical turbine wheels and gears and timber crib dams were proposed.

In the spring of 1894 A. C. Rice, of Dayton, Ohio, a hydraulic engineer of wide experience, was requested to examine the proposed water power and to prepare plans and estimates for its development. He observed that the question of anchor ice (*frazil*) was one that demanded serious consideration in designing a plant, where, as in this case, the development of uninterrupted power was contemplated. This was the more apparent because considerable trouble from this source had been experienced by the cotton mills on the Chambly side of the river, where water power to a limited extent had been utilized for some time. The records showed that the water in the Chambly Basin had been known to rise nearly 8 feet by reason of the accumulation of anchor ice flowing down the river. Engineer Rice concluded, however, that if the power house were properly located, and the power were developed under one head of 28 feet, there would be no anchor ice to interfere with the operation of the plant; and he prepared his plans accordingly.

These plans called for one power house and one dam, the latter built of concrete; and by the use of horizontal wheels and direct connected generators, it was proposed to develop, under the head of 28 feet before mentioned, a total of 20,000 h.p., or 5,000 h.p. more than the plans of 1893, at a cost of about $28 per h.p., exclusive of the electrical machinery. In order to satisfy themselves fully regarding the most practical plan to adopt, still a third engineer was called in, that his views of the feasability of developing the power under one head of 28 feet might be obtained. The preparation of his plans and estimates consumed nearly a year's time, and, when submitted, were found to fully endorse the idea of one dam and one power house, though they called for a timber crib dam filled with stone. It was estimated, however, that the cost of the timber crib dam therein suggested would have been some $40,000 more than the concrete dam called for in the plans of Engineer Rice.

In the meantime the Chambly Manufacturing Company had been organized, the principal stockholders in it being the men who composed the Royal Electric Company. They took over the water power options which had been secured by the Royal Electric Company, and proceeded to carry out the projects of their predecessors. The plans of A. C. Rice were adopted, and in August, 1896, a contract was entered into with the Stilwell-Bierce & Smith-Vaile Company, of Dayton, Ohio, whereby they were to take the river and conditions just as they were at that time, develop the power demanded, and turn the whole plant over to the Chambly Manufacturing Company ready to run, except that they were not to furnish the electrical machinery required.

FIG. 1.—GENERAL VIEW OF THE CHAMBLY POWER PLANT.

Oct. 1, 1896, work was begun on the cofferdams, and during that winter some 10,000 cubic yards of rock were excavated under the power house and in the tail race. The concrete work on the dam and power house was commenced May 1 of the following year, and on Oct. 28, 1897, upon the completion of this portion of the work, the waste gates were closed, and the water began flowing over the crest of the big dam, the length of which, including the waste gate walls, is nearly 1,900 feet. Unfortunately, at the time the water began flowing over the dam, some of the concrete was only two weeks old, and owing to the very low temperature of the water it set very slowly; so that when the ice, some two feet in thickness, went out of the pond in the spring,

it did some damage to the apron of the dam, repairs to which where made after the low water in the fall of 1898.

Having in mind the highest recorded rise in the Chambly Basin due to the accumulation of frazil, the engineer located the power house about 2,000 feet further up the river, and established the tail water level about four feet above the low water level in the basin, making the wheel pits deep enough and the draft tubes long enough so that if, as he anticipated, it was demonstrated that there would be no further trouble from anchor ice after the power was developed, the tail race could be excavated four feet deeper, thereby increasing the power about 2,800 h.p. without any change in the machinery.

The forebay and wheel chambers are built in ten sections, with walls 5 feet thick between the chambers. The wheel pits are built in seventeen sections, with walls 2 feet 6 inches thick to carry the generator floor and power house, and bringing one wall directly under the centre of each generator. Through the arches and over the wheel chambers there are manholes 6 feet in diameter directly over the centre of the wheels, so that any part

supplying the cotton, woolen and grist mills of A. T. Willet & Son with power. On the rear side of the waste gate wall, around the gate openings, is a continuous southern pine timber frame, built into the wall flush with the face, to receive the gate frames. The waste gates and frames are cast iron and each gate is set on sixteen rolls, so that with the operating device on the top of the walls, two men can operate a gate under any condition of water in the river. On the top of this waste gate abutment wall is a pipe protection railing about 4 feet high, extending from the corner of the power house to the end of the abutment at the crest of the dam.

The specifications were carefully drawn up, and called for a high quality of work throughout. Some idea of the amount of labor involved may be gained from the statement that the engineer's estimates included, among other items, over 91,000 cubic yards of rock excavation, 33,763 cubic yards of concrete work, and something like 36 tons of half-inch round iron, this last-named material being built into the dam. All of the electrical work and machinery was furnished and installed by the Royal Electric Com-

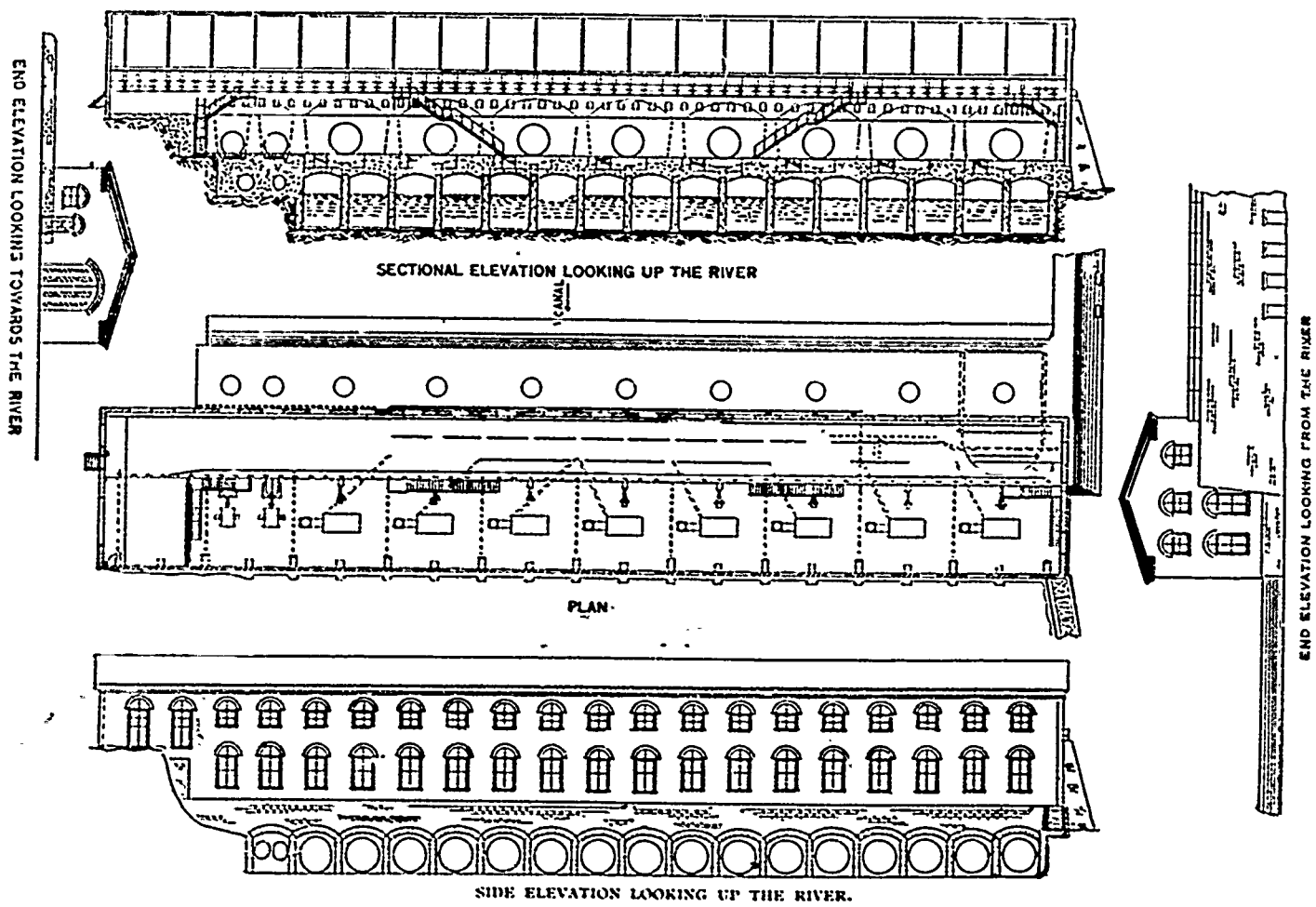


FIG. 2.—PLAN AND ELEVATION OF POWER HOUSE.

of the wheels can be removed from the outside of the generator room. The forebay, wheel pit walls and power house foundations are built of concrete; while the power house above the abutment and gallery floors is a steel and brick structure 75 feet wide, 308 feet long and 30 feet high from the floor to the chord of the roof trusses. The walls are 13 inches and 17 inches thick, with one course of brick outside of the steel structure. The inside of the power house walls is plastered with cement mortar, finished smooth and painted. Fig. 2 shows plan and elevations of the power house, and illustrates clearly the general arrangements.

Joining the river end of the power house and forebay walls is a waste gate abutment wall. This wall is 27 feet wide on the base, 8 feet wide at the top, and is about 33 feet high and 185 feet long. It is provided with 15 waste gates, each having an opening 4 by 6 feet.

The dam is 26 feet wide on the base, 6 feet wide at the crest, and is 18 feet high above the apron; while the total height varies from 20 to 28 feet, with the crest 4 feet below the abutment. The overflow dam extends up the river 1,151 feet, thence across the river 550 feet, where it joins the abutment on the Chambly side. This abutment has three feeder pipes 6 feet in diameter, for

pany, of Montreal. The heavy machine work was done in their shops at Montreal, the lighter work and assembling being done at the power house at Richelieu. This made the progress of this portion of the work very slow and expensive; but, as the power was to be used in the city of Montreal, and the wire line had to cross the St. Lawrence river on the new Victoria bridge, it has been impossible to deliver power in the city until the completion of the bridge. Aside from this, the disrupted ownership of a certain strip of ground lying between the city limits and the abutment of the bridge would still have made it doubtful as to just when the current could be delivered at the sub-station in Montreal, even if the bridge were finished.

The exciter wheels were first started Nov. 18, 1897, and the first power from them was delivered to a saw and grist mill at Richelieu, situated about one mile from the power house, Jan. 27, 1898. The generator wheels were started Feb. 22, and the first generator was connected to the wheels May 26, 1898.

The wisdom of developing the power under one head of 28 feet, with the idea of obviating the trouble previously experienced with frazil, was fully demonstrated during the winters of 1897-98 and 1898-99, when the cotton mills ran continuously without any trouble whatever; while at the same time the exciter wheels were operat-

ing, and the waste gates were discharging more water than the large wheels will ever use.

Twelve inches of the outside face of all the walls and the dam itself is built of concrete composed of one part best Portland cement, two parts good clean sharp sand, and five parts of broken stone that would screen two inches, while the inside portion of the dam is built of large blocks of stone excavated from the tail race and filled solid with concrete.

The full turbine equipment will consist of 16 pairs of 46-inch cylinder gate horizontal wheels, and two single 27-inch cylinder gate horizontal wheels; all of the "Victor" type. The 48-inch wheels are used for driving the generators, each two pairs of turbines constituting one unit, which will develop 2,648 h.p. and 153 revolutions per minute under 28-foot working head. Each unit furnishes the motive power for one of the 2,500 h.p. generators, leaving in the wheels 148 h.p. for regulation. For each two pairs of these wheels there is provided a Giesler electrical governor mounted in front of the wheel chamber, with a suitable hand wheel located near the governor and generator for operating the gates. Fig. 3 shows sectional elevation through the wheels and power house.

The 27-inch wheels, each of which develops 200 h.p. and 260 revolutions per minute under 28-foot working head, are used to drive the exciting generators. Each of these exciting generators requires 175 h.p., leaving 25 h.p. in each wheel for regulation, which is provided by a Snow mechanical governor for each, mounted in front of the wheel chamber. Sectional elevations through the exciter wheels and power house are shown in Fig. 4. At the present time both the exciter wheels are in place, and eight pairs of the generator wheels. The power house, forebay and wheel chambers are, of course, arranged for the reception of the remaining eight pairs of generator wheels as soon as the Chambly Manufacturing Company may call for them.

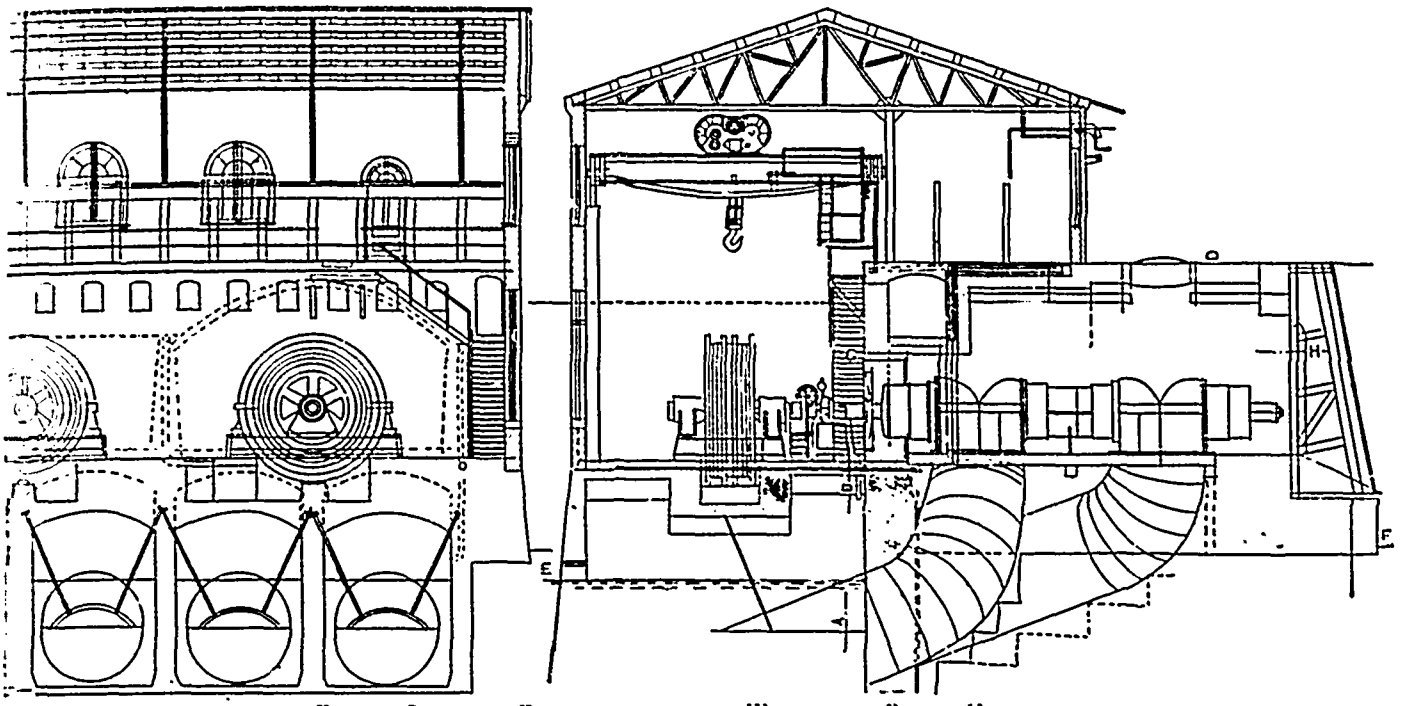


FIG. 3.—SECTIONAL ELEVATIONS THROUGH WHEELS AND POWER HOUSE.

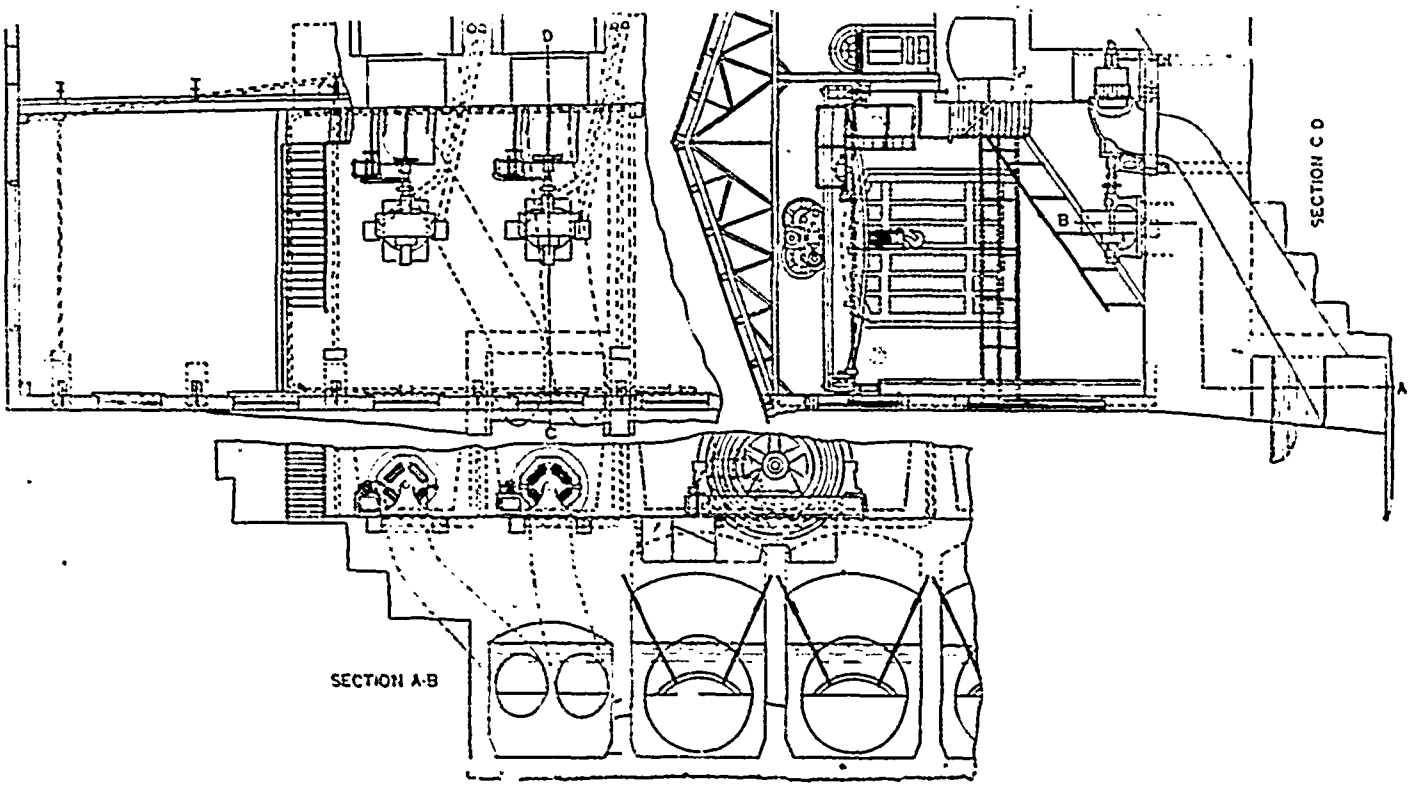


FIG. 4.—SECTIONAL ELEVATIONS THROUGH EXCITER WHEELS AND POWER HOUSE.

Fig. 5 shows the exterior, and Fig. 6 the interior of the power house. It will be observed that it is light and roomy; the generators on one floor and the switchboards in the gallery above where the operator can have an unobstructed view of the whole generator room.

The entire plant affords an excellent example of modern engineering practice, and great credit is due both to the engineer and the builders of the powerful turbines and generators. Unusual interest has been manifested in the progress of the work by prominent engineers, and the plant has been visited by a number of the leading engineering societies.

The four sets of wheels and generators were started April 10

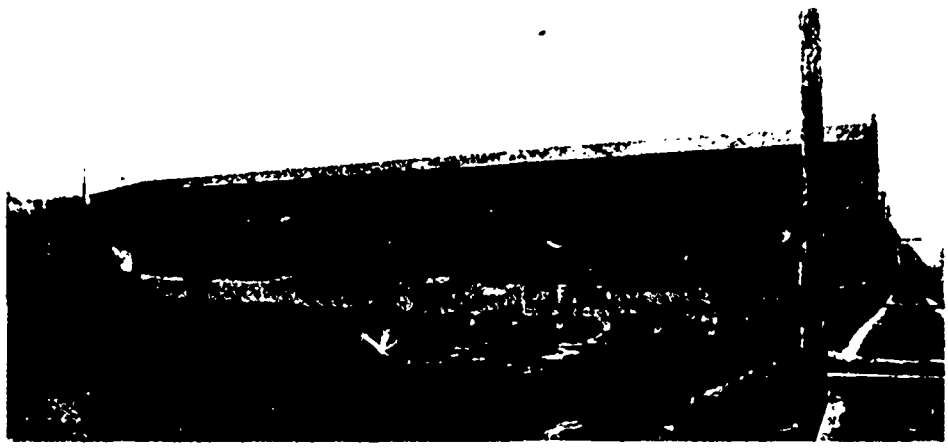


FIG. 5.—EXTERIOR OF POWER HOUSE.—CHAMBLY POWER PLANT.

for a continuous trial run of thirty days, as provided for in the contract between the Chambly Manufacturing Company and the contractors for the water-power equipment. The results have been very satisfactory indeed, and a rheostat test of the generators has shown as high at 3160 h.p. output of one generator with about a 30-foot head of water on the wheels. As soon as the wire line to Montreal can be completed, the abundant supply of electrical power available will prove of immense value to the industrial interests of the city, and will mark the beginning of an era of greatly improved conditions.

All the iron and steel work, including the waste gates, hand rail, rack frame and rack, wheels, draft tubes, steel structural work in building, traveling crane and crane track, was furnished by the Stillwell-Bierce & Smith-Vaile Co., who contracted, as before stated, for the entire hydraulic plant; but sub-let the work of excavation and building to Peter Lyall & Sons, of Montreal. Electrical World.

CANADIAN ASSOCIATION OF STATIONARY ENGINEERS.

Montreal No. 1, C. A. S. E., have decided to hold a picnic and games on Saturday, July 15th, at Cartierville. This picnic is being held for the purpose of assisting the mechanical library of the association.

James Aikins, secetary of Brockville No. 15, furnishes the following list of the officers of that branch: Past president, John Grundy; president, Wm. Robinson; vice-president, Chas. L. Bertrand; recording secretary, Jas. Aikens; treasurer, W. F. Chapman; conductor, Clarence Van-Arnum, doorkeeper, Victor Hannan; trustees, Edward Devine and James McRitchie.

The City Council of Toronto have awarded the contract for electrical apparatus to be used for lighting the new city and county buildings to the Canadian General Electric Company. The plant consists of one 100 kilowatt direct connected unit, together with switchboard and instruments.

PERSONAL.

Mr. Edward Bailey, electrician for the Perth Waterworks Co., has removed to Montreal, where he has obtained a more lucrative position.

In the recent bye-election in North Waterloo, Mr. L. J. Breithaupt, president of the Berlin Gas & Electric Company, was elected to a seat in the Ontario legislature, defeating his opponent by 116 votes.

To Professor Dean Bovey, of the Faculty of Applied Science of McGill University, Montreal, belongs the distinguished honor of being elected a member of the Council of the Institute of Civil Engineers, of England.

The ELECTRICAL NEWS learns with regret that Mr. J. Wilson, superintendent of the C. P. R. telegraphs in British Columbia, has been confined to the hospital at Nelson through serious illness. He is now, we understand, almost recovered.

Mr. Nelson Graburn, assistant superintendent of the Montreal Street Railway, has resigned his position, and will shortly go to Glasgow, Scotland, where he will become superintendent of the Glasgow Corporation tramways. Mr. Graburn, while assistant to Mr. McDonald, had charge of the electrical equipment of the company.

Mr. Wm. W. Grant, of the engineering and sales department of the Westinghouse Electric & Manufacturing Company, has been transferred from the New York office of that company to the office of the Canadian agents of the company, Messrs. Ahearn & Soper, Ottawa. The Westinghouse Company's business in Canada is assuming large proportions.

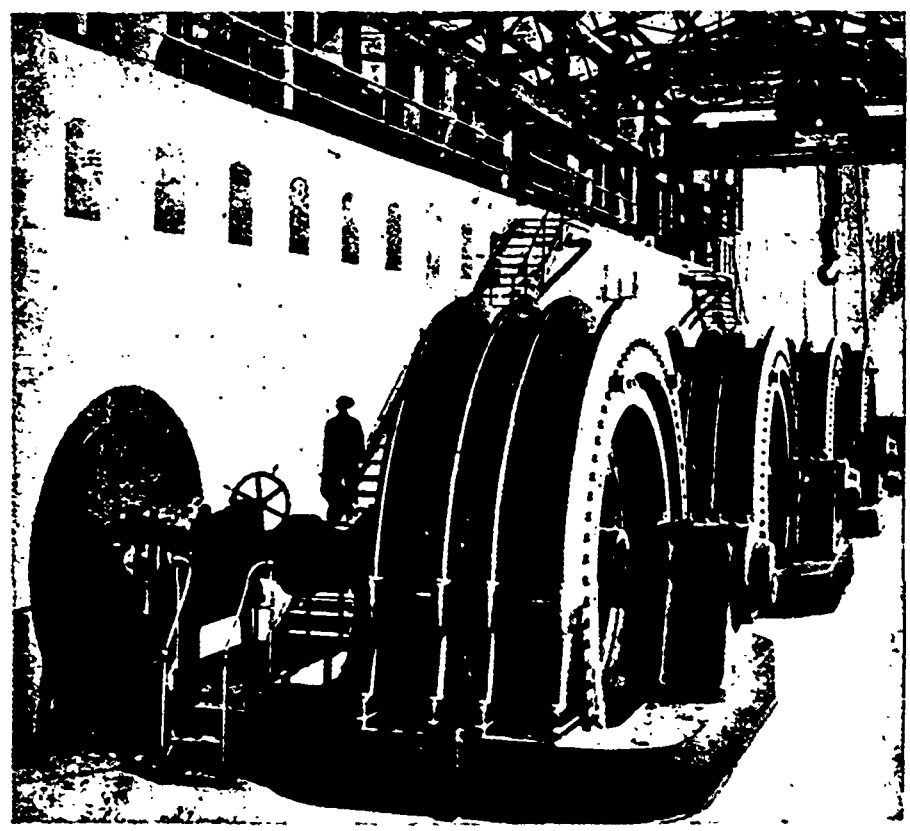


FIG. 6.—INTERIOR OF POWER HOUSE.—CHAMBLY POWER PLANT.

Mr. J. Wm. Morris, a graduate of McGill University, Montreal, has gone to Kingston, Jamaica, having received the appointment of electrical superintendent of the street railway there. Since graduating Mr. Morris has held the position of superintendent of the St. John and Moncton, N. B., railway systems, and has occupied a responsible position with the Royal Electric Company, of Montreal.

CANADIAN ELECTRICAL ASSOCIATION.

CONVENTION PROGRAMME.

CONVENTION HEADQUARTERS NEW ROYAL HOTEL, HAMILTON, ONT.

BUSINESS PROGRAMME.

WEDNESDAY, JUNE 28TH.

11.00 A.M. Meeting of Executive Committee.

2.00 P.M. Opening of first session in Convention Hall, New New Royal Hotel.
President's Address.
Reading Minutes of Last Meeting.
Secretary-Treasurer's Report.
Reports of Committees and General Business.
Presentation of Papers.
Discussion.

THURSDAY, JUNE 29TH.

9.30 A.M. Consideration of Reports of Committees.
Election of Standing Committees.
Selection of Place and Time of next Meeting.
General Business.
Presentation of Papers.
Discussion.

2.30 P.M. Presentation of Papers.
Discussion.

FRIDAY, JUNE 30TH.

9.30 A.M. Election of Officers.
Unfinished Business.

LIST OF PAPERS.

"Meters and Meter Rates." A. A. Dion, Ottawa.

"Cost of Electric Power Produced from a Steam Plant." C. B. Hunt, London, Ont.

"Inspection": Compulsory inspection of installations; Montreal Fire Commissioners' Report as to causes of fire. W. J. Plewes, Montreal

"Long Burning Enclosed Arc Lamps." W. A. Turlayne, Hamilton, Ont.

"The Incandescent Lamp for Central Stations, considering efficiency, candle power, distribution of light, regulation, and whether 220 to 240 volt lamps are likely to come into general use, also a reference to the Nernst lamp. E. E. Cary, St. Catharines, Ont.

"Central Station Accounting from a Business Standpoint." P. H. Hart, Montreal.

"Transformer Economy." F. H. Leonard, Jr., Montreal.

In addition to the papers, there will be a few matters for general discussion, also a "Question Box."

SOCIAL FEATURES.

WEDNESDAY, JUNE 28TH.

7.30 P.M. Trip to Burlington Beach and excursion on the Lake, returning by Hamilton Radial Railway, visiting en route the power stations of the Hamilton Street Railway Company and the Hamilton Radial Railway Company.

THURSDAY, JUNE 29TH.

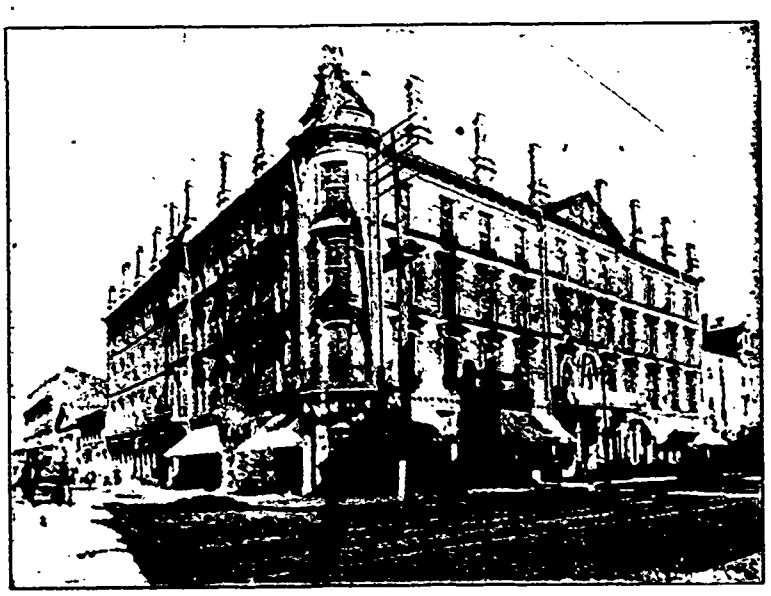
5.00 P.M. Trip to Grimsby over the Hamilton, Grimsby and Beamsville Electric Railway, and on return, visit to the Hamilton Electric Light & Power Company's power station

9.00 P.M. Annual Association Banquet, New Royal Hotel.

FRIDAY, JUNE 30TH.

12.30 P.M.—Take train on Grand Trunk Railway for visit of inspection to the Cataract Power Company's works at DeCew Falls, leaving for Hamilton and points east and west at 5.31 p.m.

ACCOMPANYING the programme of the forthcoming annual convention of the Canadian Electrical Association, printed above, will be found in succeeding pages, particulars and illustrations of some of the electrical and other features of interest in and about the city of Hamilton, where the event will take place.



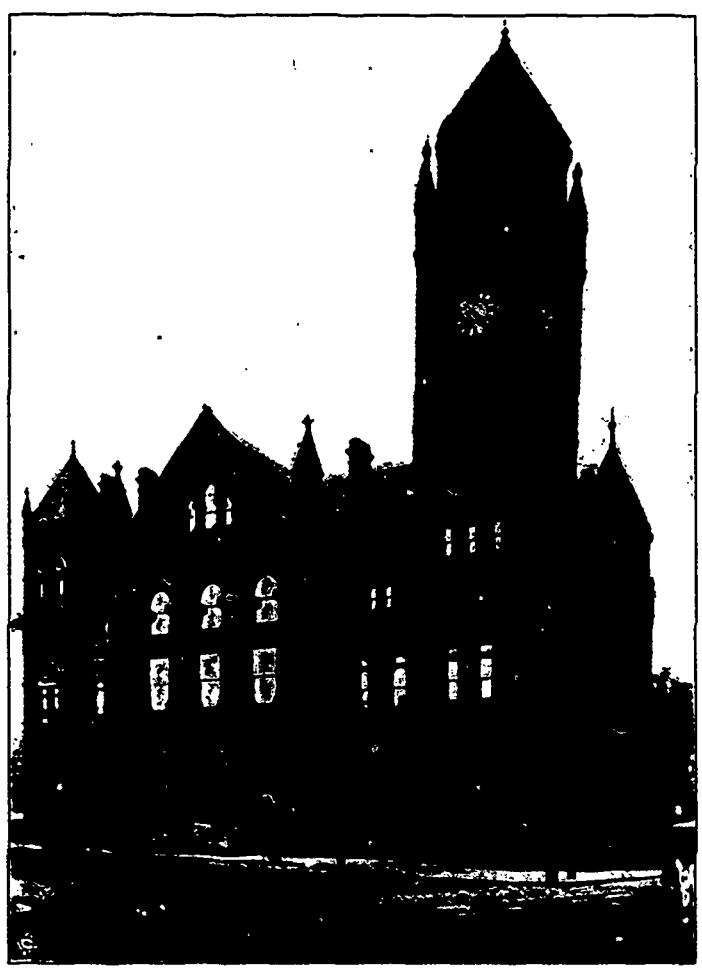
CONVENTION HEADQUARTERS NEW ROYAL HOTEL, HAMILTON.

Some of our readers will recollect that the first convention of the Association, following soon after its organization, took place in Hamilton. The success then achieved was such that the promoters felt encouraged to go forward, and the subsequent history of the Association has been one of steady development. In the proceedings of the first convention held June 14th, 15th and 16th, 1892, are recorded the names of several gentlemen who are still members of the various committees of the Association, and are regarded as being among the most active and successful promoters of its welfare. There should be a reunion of all these at the coming meeting, in addition to an attendance of the majority of those whose membership dates from a later period. Not only so, but it may reasonably be expected that electric lighting companies throughout the province will mark their appreciation of the value of the Association's recent efforts to conserve the rights of the electric lighting industry, by submitting their names for membership at or previous to this meeting.

From an electrical point of view, especially, Hamilton has made wonderful progress since the time when the first convention of the Association met there. Ottawa and Montreal were then the only important electrical centers in Canada. Recent developments have placed in the same rank, Hamilton, Quebec and other cities.

The enterprise of the citizens of Hamilton in this di-

rection is seen in the numerous electric railway systems which now radiate from that centre. By the construction of these railways Hamilton has attracted to itself the trade of a large and prosperous territory, and has thereby greatly increased its commercial importance and prosperity. The Cataract Power Co. represents the greatest and boldest enterprise of the citizens of Hamilton in this direction. By successfully providing for the generation and transmission of at least 8,000 horse power of electrical energy, from a water power situated near St. Catharines, they have, so to speak, taken the wind out of the sails of the electric power companies at Niagara Falls, so far as the market for power between St. Catharines and Toronto is concerned. *Having got their plant in successful operation, the* question of finding a market for all the power which can be developed at their works is understood to be now engaging the attention of the management, and it need cause no surprise if before or shortly following the convention, the rumored consolidation under one management of all the electric light and railway companies having their headquarters in Hamilton, should become an accomplished fact. These electrical developments, combined with the numerous other features of interest set forth by the programme, together with the attractiveness of the city itself, and its central location and accessability by rail and water, should ensure for the coming convention a large attendance and a full measure of success.



City Hall, Hamilton, Ont.

The local committee having charge of the convention arrangements is as follows. Messrs. George Black, superintendent G. N. W. Telegraph Company, chairman; Mark Thomas, manager Hamilton and Dundas Railway; H. R. Leyden, manager Cataract Power Company; Gordon J. Henderson, manager Hamilton Electric Light & Power Company; A. J. Nelles, manager Hamilton, Grimsby & Beamsville Railway; Wilfred Phillips, manager Niagara Falls Park & River Railway; A. B. Smith, G.N.W. Telegraph Co.; E. E. Cary, manager Packard Electric Company; J. B. Griffith, manager Hamilton Street Railway; C. K. Green, manager Hamilton Radial Railway.

THE ELECTRIC RAILWAY SYSTEMS.

The Hamilton Street Railway was the first in Canada to be operated entirely by electricity, the old horse car system being converted to electric power in the year 1892. This system, operating within the city limits, comprises 11 miles of double track. The equipment consists of 35 motor cars, built by Jones, of Troy, N. Y., and 15 trailers. The electrical equipment is Westinghouse excepting one equipment of G. E. 1,200, which is used on a water car for sprinkling the streets, this being done under special contract with the city. The road extends to Dundurn Park, owned by Senator McInnes, which is one of the finest in the Dominion, and also connects with two inclines, one at the head of James street and one at the head of Wentworth street. The power house of the Hamilton Street Railway Co. is a brick and stone structure situated at the foot of Hughson street, on the shore of Hamilton Bay. The motive power consists of wheelock tandem compound condensing engines, six boilers and Westinghouse dynamos. *The officers of the company are as follows:* President, Edward Martin, Q. C.; vice-president, John A. Bruce; secretary-treasurer and manager, J. B. Griffith; electrician, V. H. Waggoner.

Besides the Hamilton Street Railway, *the city* is fast becoming the centre of a magnificent system of radial railways. The longest road is the Hamilton, Grimsby and Beamsville electric railway, which travels east to Grimsby and Beamsville, a distance of 24 miles, passing through a country that for years has been known as the fruit garden of Canada. The power house, a brick and stone structure, is situated at Stoney Creek, about midway between the two terminals of the road. The generating plant consists of two Westinghouse dynamos, 300 h.p. capacity in engines, and two 200 h.p. in tubular boilers. The cars consist of nine motor cars and five trailers. Mr. A. J. Nelles is secretary and manager of the road, and Mr. C. Fraser chief electrician.

The Hamilton Radial electric railway leaves the city by the north-east, skirting the bay shore until the beach is reached, then crossing the beach and passing between handsome villa residences to the village of Burlington, ten miles from the city of Hamilton. Two *C. G. E. generators of 400 k. w., 500 h.p. in engines,* and 300 h.p. in boilers, comprise the equipment of the power house, which is located at Burlington. Six motor cars and two trailers are operated. Mr. C. K. Green is manager and Mr. C. G. French chief electrician.

In the year 1896 the Hamilton and Dundas railway, *then operated by steam, was converted to an electric* system. It extends from Hamilton to Dundas, about 5 miles to the west. Mr. Mark B. Thomas is manager

of the road and Mr. P. McCullough chief electrician.

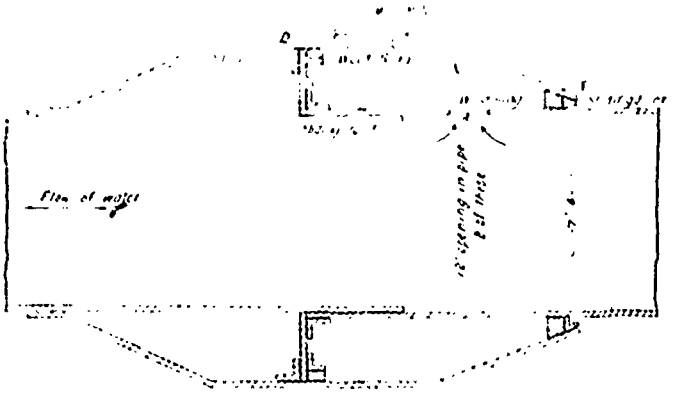
THE CATARACT POWER COMPANY.

The magnificent enterprise of the Cataract Power Company has already been described in the ELECTRICAL NEWS. Power is generated near St. Catharines, Ont., and transmitted, at a pressure of 24,000 volts, to the city of Hamilton, a distance of 35 miles. In a paper by Mr. Wm. Hemphill, read before the Engineering Science of the School of Practical Science, Toronto, we find the following additional particulars regarding the construction of the steel pipe that carries the water from the reservoir at the edge of the mountain to the wheels in the power house: The pipe is 735 feet long, 8 feet 6 inches in diameter at the top, and 7 feet 6 inches at the bottom; it is ¼-inch thick at the top and gradually increases to a thickness of 13-16-inch at the bottom, both tranverse and longitudinal seams being double riveted. This pipe is large enough to supply 6,000 h.p. At the top of the mountain, the stone was dug out to a depth of 8 or 10 feet, the pipe laid in this, and securely fastened by concrete in the mason work, heavy flanges having first been riveted to the pipe. The flanges were necessary as a great part of the weight of the pipe is supported at the top. At the upper end of the pipe, suitable grates are placed, to keep out ice and drift wood. As the current in the canal is very slow, there is not much danger arising from drift ice. At distances of 15 feet down the side of the mountain solid blocks of mason work are built for the pipe to rest on.

COURT HOUSE, HAMILTON, ONT.

About two-thirds of the way down the side there is a ledge on the mountain about 60 feet wide, the pipe follows this, and then runs down at an angle of 20° to the power house, where it turns almost at right angles, and passes under the power house. Near the edge of the ledge in the mountain there is an expansion joint, to take up any elongation or contraction that may occur in the pipe. This joint is constructed so that it supports the remainder of the weight of the pipe. The joint, being larger than the pipe, rests in a hollowed-out portion of the mason work, making it very secure.

The illustration shows a longitudinal cross-section of this expansion joint. At B is shown how two sections of the pipe slide, one inside the other, with a piston and cylinder action, forming a sliding joint. At C is shown an iron ring, fastened with angle iron as shown, and this forms a sliding joint at D. At A is a 12-inch opening in the pipe, through which the water can flow. There are two of these holes. The water fills this portion of the joint, and the pressure of the water against C has a tendency to keep the lower part of the pipe in place. The water presses against E, causing a little spring in the joint. The combined action of the spring in the iron and the pressure of the water against C takes up any elongation or contraction that may occur. It was found necessary to pack the joints with wooden rings, as shown, some six or seven inches thick, and when the wood swelled, it stopped the leakage to a large extent, but this swelling of the wood will not allow the joint to move much. As F is an iron ring around the pipe, this ring is flanged and riveted to part E, as shown, forming another sliding joint.



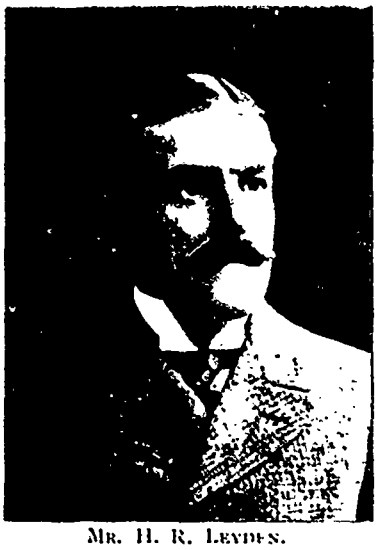
CROSS-SECTION OF EXPANSION JOINT IN PIPE. CATARACT POWER COMPANY.

THE HAMILTON ELECTRIC LIGHT & POWER COMPANY.

Situated on Main street is the dynamo room of the Hamilton Electric Light & Power Co., its dimensions being 135 × 70 feet. The machines consist of arc and incandescent lighters and electric power generators. There are two Royal alternators with exciters, one C.G.E. 2,000 lighter, and one Westinghouse 1,800 lighter. Fifteen machines of varying power are for the supply of arc lights, fourteen being from the Royal Electric Co. There are two pair of Brown engines of 700 h.p. each. On King street is a three-storey structure in front, combining the offices of the company and several other offices. The rear is taken up by the boiler room, where there are three batteries, one consisting of five 60-inch Osborne-Killey tubulars of 75 h.p. each, the second of two 66-inch Goldie & McCulloch tubulars of 90 h.p. each, and the third of two Polson water tubulars of 200 h.p. each. This company now hold the contract for lighting the streets of Hamil-

MR. E. E. CARY.

MR. MARK B. THOMAS.



MR. H. R. LEYDEN.

MR. GEO. BLACK, Chairman.

MR. A. B. SMITH.

MR. C. K. GREEN.

MR. A. J. NELLES.

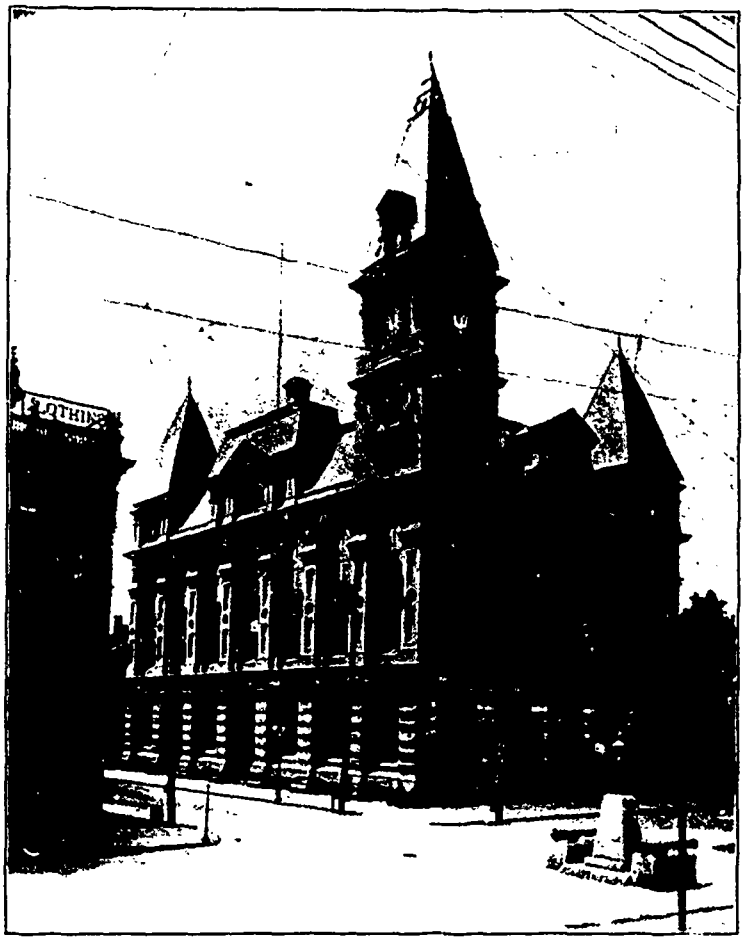
MR. GORDON J. HENDERSON.

SOME MEMBERS OF THE LOCAL COMMITTEE—CANADIAN ELECTRICAL ASSOCIATION CONVENTION, HAMILTON, 1899.

ton. Recently the management decided to take power from the Cataract Power Co.'s system, instead of generating it themselves. Mr. Gordon J. Henderson is manager of the Hamilton Electric Light & Power Co., and Mr. T. W. Martin chief electrician.

G. N. W. TELEGRAPH OFFICE.

About 2 o'clock a. m. on the morning of May 19th, 1898, during a severe thunderstorm and downpour of rain, the office of the Great North-Western Telegraph Company in Hamilton, along with the building in which it was situated, was destroyed by fire. So complete was the destruction that not an instrument or even a printed message blank was saved out of the wreck the books (the current month's business), a portion of the lower office furniture, and some battery cells only being rescued. As early as possible the chief operator and the linemen cut all the wires through, so that by the time of opening for business at 8 a.m. all through circuits were completed, and no stoppage of business except with Hamilton ensued. The only wires incommoded temporarily were those depending upon Hamilton batteries, which were demolished in the basement of the burnt building. The manager in the meantime had secured the only vacant premises in the neighborhood, and at 7 a.m. began moving in the few articles saved



POST OFFICE, HAMILTON, ONT.

The new location was about 60 yards south of the old office, and as no poles could be erected, a 50 wire cable was secured for temporary use ; instrument tables, battery stands, etc., had to be made out of pine boards. The first supplies arrived from Toronto by the 8 o'clock train, wires were rapidly got working, and before dark all necessary circuits were connected with the office. Those not required for local purposes were left cut through in the cable box ; about one hundred wires were in the mix, but few offices were aware that anything unusual had occurred. The temporary quarters being too small, the adjoining office with No. 34 was secured and fitted up for permanent quarters. The premises are 18 by 61 feet, all on the ground floor; front consists of a large plate glass window, and door on each side. The counter running across the office is made of ash, with cherry top, covered with plate glass, a neat brass screen dividing it lengthways, with openings to receive messages through. Inside are the necessary desks, etc., for clerk and manager, and below these desks is the operating department. The switch case and instrument tables are of ash and cherry. The tables provide space for 21 instruments, three sets of repeaters, and space for extension. The switch is Bunnell's latest design, with space for 70 wires. The office presents a neat and handsome appearance, windows at back and front giving perfect light and ventilation, metallic ceiling of neat pattern and light color, walls covered with grey ingrain paper, with 18 feet ceiling.

The wires are led into the office in two 50 wire and one 18 wire Kerite cables, boxed in, and back of switch case opens into a distributing box. This box and its surroundings are covered with asbestos board, and every precaution possible has been taken to avoid fire from electric contacts after leaving the box each wire passes through covered porcelain fuse blocks, which are separated from each other by glass strips, then recabled to the switch-board, and from the switch-board cabled to each instrument table. All wires not in cables are Kerite covered. The sounders are in resonator boxes of neat design, and everything arranged for prompt and efficient handling of business with perfect ease.

The office is admired by all who have seen it. One gentleman connected with the telegraph service who has visited all the principal offices in the United States and Canada, says it is one of the neatest he has came across.

Although the old office took fire during a thunderstorm, there is nothing to connect the fire with lightning coming in on the wires. All reliable evidence indicates that the fire started in the south part of the building, and rapidly spread to the north end. The telegraph operating room floor was not touched, and the business office damaged by water and fire entering from behind. The office is under the management of Mr. George Black. Members of the Canadian Electrical Association are invited to visit the office during their stay in Hamilton.

THE BELL TELEPHONE EXCHANGE.

The Hamilton exchange of the Bell Telephone Company is quite important, inasmuch as it is the central distributing point for long distance messages to the United States and elsewhere. The exchange is under the management of Mr. B. J. Throop, while Mr. H. C. Baker, manager for Ontario, also makes his headquarters in Hamilton. The company intend to lay a

number of underground conduits in the city this summer.

HAMILTON AND BARTON INCLINE RAILWAY.

It is well known that along the south side of the city of Hamilton, and extending for miles in either direction, stretches a bold, steep escarpment, known as the Hamilton mountain. This mountain is from two hundred to four hundred feet higher than the level of the city, and to provide means of access for wagons, electric cars, etc., the Hamilton and Barton incline railway, a view of which is here shown, was constructed in the year 1892. It is a straight cable road of uniform grade, extending from a point at the commencement of the rapidly rising ground to the top of the escarpment. The distance between these two points is 700 feet, and the rise 195 feet. The central portion of the track is at an elevation of about 50 feet above the surface of the ground.

The Hamilton and Barton Incline Railway.

The road has a double track. The lower portion of the road-bed is built upon the ground, partly through a cutting and partly upon an embankment formed by the material taken from the cut. The road-bed at the lower end commences in a pit 13 feet deep that is, 13 feet below the level of the approach to the track. This pit is formed to receive the peculiar-shaped cars of the road, which are built with level platforms and consequently, to suit the steep grade, which is 50.7 per cent., require to be 13 feet high at the one end, the other being as close to the track as possible.

The cutting within a very short distance attains a depth of thirty feet, the width of road-bed being 34 feet. The upper end of the embankment is terminated by a heavy stone abutment, built to receive the lower ends of four girders forming part of a steel trestle viaduct. This abutment is built with large, heavy stone, and provided with wing walls turning back to meet the retaining walls, or rather the retaining walls are extensions of the wings.

The steel trestle extends over about two thirds of the length of the railway, and consists of eleven 30-feet spans and one of 37 feet. Most of the bents, which are of steel, supported by two stone piers or pedestals, are from 30 to 50 feet in height. They carry four parallel track girders two feet in depth and spread eight feet from centre to centre. The whole structure is designed so that a moving load of 60,000 pounds will not produce a greater strain than 10,000 pounds per square inch of section on any member. Across each pair of these inclined girders the ties are placed, and upon them, directly over the centre of the girders, the track rails, which are bolted to the girders. There are then two parallel tracks eight feet from centre to centre of rails and eight feet apart. Upon the bank, below the trestle, the tracks are laid in the ordinary way, except that the ties are supported on the lower side by stout stakes to prevent them from working down hill.

On either track runs a car 36 feet in length by 14 feet in breadth. The cars are constructed with level platforms, being supported by wedge-shaped frameworks, which raise the platforms towards the lower end about 13 feet above the tracks. The cars are combination affairs, being arranged to carry passengers and teams at the same time.

Attached to two heavy timbers, braced by heavy iron knees, in the lower framework of each car, are two steel wire cables, each having a tensile strength of 125,000 pounds by actual test. From the car the

cables are carried up the centre of the tracks on small carrier wheels 14 inches in diameter.

At the head of the plane the cables pass over large cast iron sheave wheels 10 feet in diameter, these being strongly supported by iron girders and columns. Thence the draught cable passes down to a winding drum 10 feet in diameter, about 30 feet below, situated in the basement of the depot at the head of the plane; but the safety cable passes from the sheave wheels onto another large cast iron wheel of about equal size, which is set in a heavy iron framework and securely anchored to the solid rock, so that in case of the possibility of an accident happening to the draught cable the cars would be held securely by the safety. Powerful brakes are atttached to either side of the drum and to the safety wheel, and these may be applied by the engineer from the pilot house. The foundations of the drum, which itself weighs about 10 tons, are strongly anchored down to the solid rock by 16 two-inch iron bolts. The drum is controlled, and from it the road operated, by a pair of Wheelock engines of about 125 indicated horse-power.

The depot, situated at the head of the plane, and which contains all the machinery, is a four-storey stone and brick building. The basement is occupied by the engines and drum, the boilers and fuel room, and also contains a large room to be used as a workshop. The second and third flats are designed to be used as a dwelling for the engineer and his family, and the upper flat, which is only on a level with the top of the hill, contains the driving platform, a waiting room, a board room, and a large covered balcony looking out over the city. In the centre of the driving platform and opposite the centre of the tracks is situated the little 4×8 feet pilot house. This is built with large glass windows on all sides and commands a view of the whole road. Within it stands the engineer, who has within arm's reach the means of controlling every part of the machinery.

At the lower end of the plane there is another small but neat brick depot, and dwelling above it for a caretaker. The entrance to this depot is guarded by sliding gates, which are opened when a car is down. Into the face of the car pit are built four large iron air buffers two for each car to strike against. These consist simply of 18-inch iron cylinders provided with pistons which are drawn out by wire sash-cords hung with weights and working over pulleys.

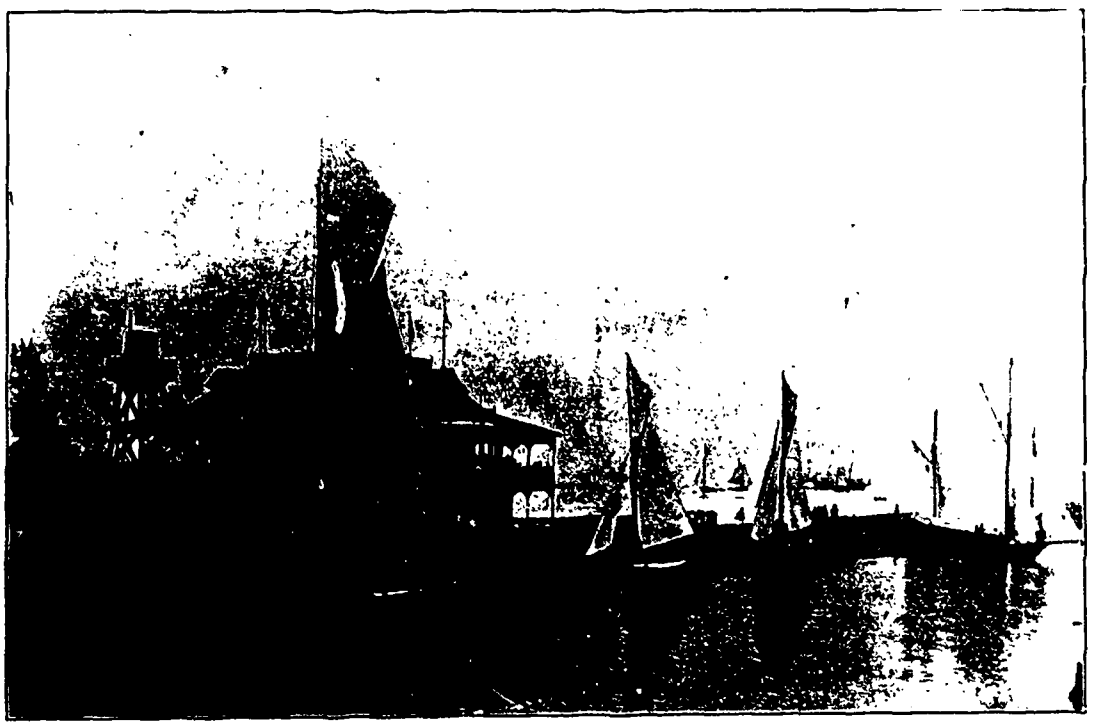
FEATURES OF INTEREST.

The Hamilton water works is owned by the city, the pumping station and filtering basins being at the Beach.

There are nine city parks in Hamilton, containing in all 52 acres. A view of the Gore Park will be found on another page.

Three fire stations are located in the central portion of the city, and four others in the outlying districts. Alarms are sent through a system of electric boxes, and also through the Gamewell police call system.

Authority has been given the Hamilton Electric Light and Power Co., by the city council, to illuminate with incandescent lamps during the C. E. A. convention the Court House and Post-office buildings as well as the central park known as the Gore.



ROYAL CANADIAN YACHT CLUB, HAMILTON.

Places of interest in and around Hamilton include the following: Burlington Beach, Gore, City Hall, Gore Park, Post Office, Court House, Ontario Normal School and Collegiate Institute, City Hospital, and Royal Canadian Yacht Club, an illustration of which appears elsewhere.

Hamilton possesses two hundred and twenty-seven manufacturing establishments, equipped with modern machinery and the latest labor-saving devices, and many of them, including the extensive works of the Gurney-Tilden Company, operated electrically by motors supplied by current by the Cataract Power Company.

The Hamilton Light and Power Company have had made of galvanized iron letters two feet in height the name of the company. A number of incandescent lamps inserted in sockets in holes in each letter will illuminate the sign and enable every passer by to read it. This sign will be put in position and illuminated during the Canadian Electrical Association convention, and on special occasions afterwards.

CANADIAN ELECTRICAL NEWS AND ENGINEERING JOURNAL

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EDITOR'S ANNOUNCEMENTS.

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

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

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The Demand for Electrical Machinery in South Africa.

SOME of the American electrical journals have lately referred to the fact that that during the last fiscal year $50,000 worth of electrical machinery from the United States was sold in Cape Town. Some American manufacturing firms have established resident representatives there, by which means they are regularly kept informed regarding trade demands. The suggestion is now made that the National Association of Manufacturers should establish in Cape Town a warehouse for the display of American goods, as has already been done at Caracas, South America. These pointers as to the doings of our American neighbors should be suggestive and useful to Canadian manufacturers.

Standardizing Direct-Connected Generating Machinery

AT the recent meeting in Washington, D.C., of the American Society of Mechanical Engineers, Mr. J. B. Stanwood, of Cincinnati, presented a paper on "Standards for Direct-Connected Generating Sets." The author defined as the features that need standardization: A series of capacities and speeds, for the use of the outside engineer, and those parts of the engine and generator which have to be connected or fastened together to be standardized for each different set, to facilitate the assembling of the combined machine or "set." As the result of this paper and the discussion thereupon, a committee of the Society was appointed to co-operate with a committee from the American Institute of Electrical Engineers to consider the subject and formulate a method of standardization.

Dangers of Calcium Carbide.

PREPARATIONS have been made to establish two factories for the manufacture of calcium carbide within the limits of the city of Ottawa. This has elicited a protest from the Canadian Fire Underwriters' Association, on the ground that such manufactures should be classed with those of explosives, and therefore prohibited, except in isolated and remote buildings. In a letter to the City Clerk, Mr. Hadrill, Secretary to the Underwriters' Association, points out that the English government has taken action in this direction, owing to the hazard from the finished article. Supposing that the manufactured carbide be not stored on the premises, a large amount of it must necessarily be on hand, as the pigs of carbide take many hours to cool. Regarding the contention that water thrown upon carbide when hot will not generate gas but throw the water off in steam, Mr. Hadrill argues that the surface of the carbide pigs would soon become cooled, and gas generated which water would be powerless to extinguish; in fact, the more water poured on the worse would be the fire.

New Field For Central Stations.

It seems reasonably certain that in the near future the automobile carriage industry will become established on a commercial basis. Of the various kinds of motive power for these carriages, electricity gives promise of being most generally adopted. This almost certain increase in the number of electrical vehicles is likely to result beneficially to the central stations, the charging of the batteries providing a market for current during the day when there is usually a light load on the machines. In the larger cities, where a number of such vehicles would be used, an approximately constant day load could be carried. This question has already re-

THE ROYAL ELECTRIC CO.

MONTREAL — TORONTO

Sole Manufacturers for the Dominion of the

"S K C" SYSTEM

GENERATORS AND TRANSFORMERS

The first "S.K.C." Generator built in Canada was put in service March, 1895, since which the following "S.K.C." Generators have been installed or are in order:

THE ALLISTON ELECTRIC LIGHT CO., Alliston, Ont.	60	K. W.
C. O'DELL ELECTRIC CO., Annapolis, N.S.	60	"
BAIE ST. PAUL ELECTRIC CO., Baie St. Paul, Que.	25	"
BERLIN GAS CO., Berlin, Ont.	60	"
BRANTFORD ELECTRIC & OPERATING CO., Brantford, Ont.	180	"
COCKSHUTT PLOW CO., Brantford, Ont.	20	"
WOOD BROS., Brantford, Ont.	50	"
BRIDGEWATER POWER CO., Bridgewater, N.S.	40	"
G. H. DAVIDSON, Brighton, Ont.	30	"
CORPORATION OF CAMPBELLTON, Campbellton, N.B.	60	"
THE ELECTRIC CO., Chicoutimi, Que.	40	"
" " " " "	40	"
DUNDAS ELECTRIC CO., Dundas, Ont.	60	"
EDMONTON ELECTRIC LIGHT & POWER CO., Edmonton, N.W.T.	75	"
H. E. POULIN, Farnham, Que.	30	"
HAMILTON & PROUT, Forest, Ont.	30	"
CORPORATION OF FORT WILLIAM, Fort William, Ont.	60	"
" " " " " " "	180	"
GLEN WILLIAMS ELECTRIC LIGHT CO., Glen Williams, Ont.	30	"
JOHN PHILIP, Grand Valley, Ont.	20	"
" " "	75	"
GRAVENHURST ELECTRIC LIGHT & POWER CO., Gravenhurst, Ont.	50	"
CATARACT POWER CO., Hamilton, Ont.	1000	"
" " " " " "	1000	"
HAMILTON ELECTRIC LIGHT & POWER CO., Hamilton, Ont.	360	"
" " " " "	240	"
" " " "	240	"
LAKE & BAILEY, Hamilton, Ont.	50	"
CORPORATION OF JOLIETTE, Joliette, Que.	120	"
CORPORATION OF BARRIE, Barrie, Ont.	150	"
KOOTENAY ELECTRIC CO., Kalso, B. C.	75	"
J. T. AYERS, Lachute, Que.	120	"
CORPORATION OF MARKHAM, Markham, Ont.	20	"
CORPORATION OF MONCTON, Moncton, N. B.	60	"
DOMINION COTTON MILLS CO., Montreal, Que.	180	"
THE ROYAL ELECTRIC CO., Montreal, Que.	300	"
" " " "	300	"
" " " "	300	"
" " " "	300	"
" " " "	300	"
" " " "	180	"
" " " "	180	"
" " " "	135	"
" " " "	80	"
MONTREAL WATER & POWER CO., Montreal, Que.	360	"
NAPANEE WATER & ELECTRIC LIGHT CO., Napanee, Ont.	35	"
CORPORATION OF NEWMARKET, Newmarket, Ont.	50	"
EASTERN TOWNSHIPS ELECTRIC LIGHT, POWER & CARBIDE CO., North Hatley, Que.	75	"
OWEN SOUND ELECTRIC ILLUMINATING & MFG. CO., Owen Sound, Ont.	50	K. W.
PENMAN MFG. CO., Paris, Ont.	30	"
CANADIAM ELECTRIC & WATER POWER CO., Perth, Ont.	180	"
" " " " "	56	"
PETERBOROUGH LIGHT & POWER CO., Peterborough, Ont.	180	"
THE MONTMORENCY ELECTRIC POWER CO., Quebec, Que.	600	"
" " " " "	600	"
" " " " "	600	"
" " " " "	600	"
" " " " "	600	"
" " " "	600	"
" " " "	240	"
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CHAMBLY MFG. Co., Richelieu, Que.	2000	"
" "	2000	"
" "	2000	"
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" "	2000	"
A. RIENDAW, Richelieu, Que.	75	"
RICHMOND COUNTY ELECTRIC CO, Richmond, Que.	60	"
" " "	60	"
W. McMASTER, Ridgetown, Ont	60	"
IRON MASK GOLD MINING CO., Rossland, B.C.	75	"
WELLAND VALE MFG. CO., St. Catharines, Ont.	25	"
ST. JEROME POWER & ELECTRIC CO., St. Jerome, Que.	75	"
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SHERBROOKE GAS & WATER CO., Sherbrooke, Que.	240	"
" " "	240	"
" " "	180	"
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" " "	40	"
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NORTH SHORE POWER CO., Three Rivers, Que.	240	"
" " "	240	"
TORONTO ELECTRIC LIGHT CO., Toronto, Ont.	60	"
" " "	180	"
VANKLEEK HILL ELECTRIC CO., Vankleek, Ont.	50	"
A. GAGNON & CO., Victoriaville, Que.	75	"
WINDSOR ELECTRIC LIGHT CO., Windsor, N. S.	50	"
" " "	90	"
RIORDAN PAPER MILLS CO., Hawkesbury, Ont.	30	"

59 COMPANIES, 95 GENERATORS, 30,451 KILOWATT CAPACITY.

0,000 LIGHT CAPACITY OF S.K.C. TRANSFORMERS IN USE IN CANADA.

T.-H. Arc Dynamo and Lamps
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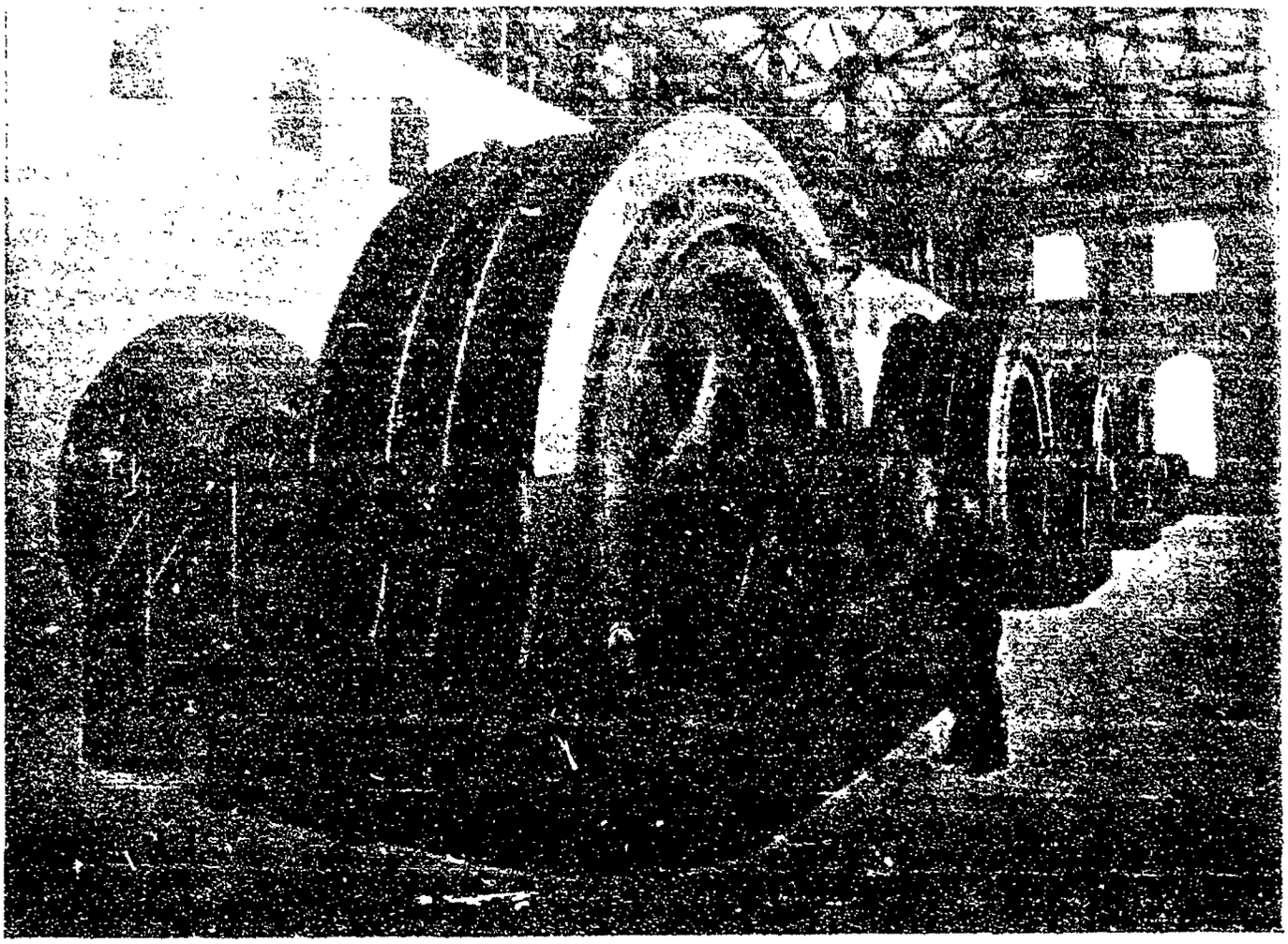
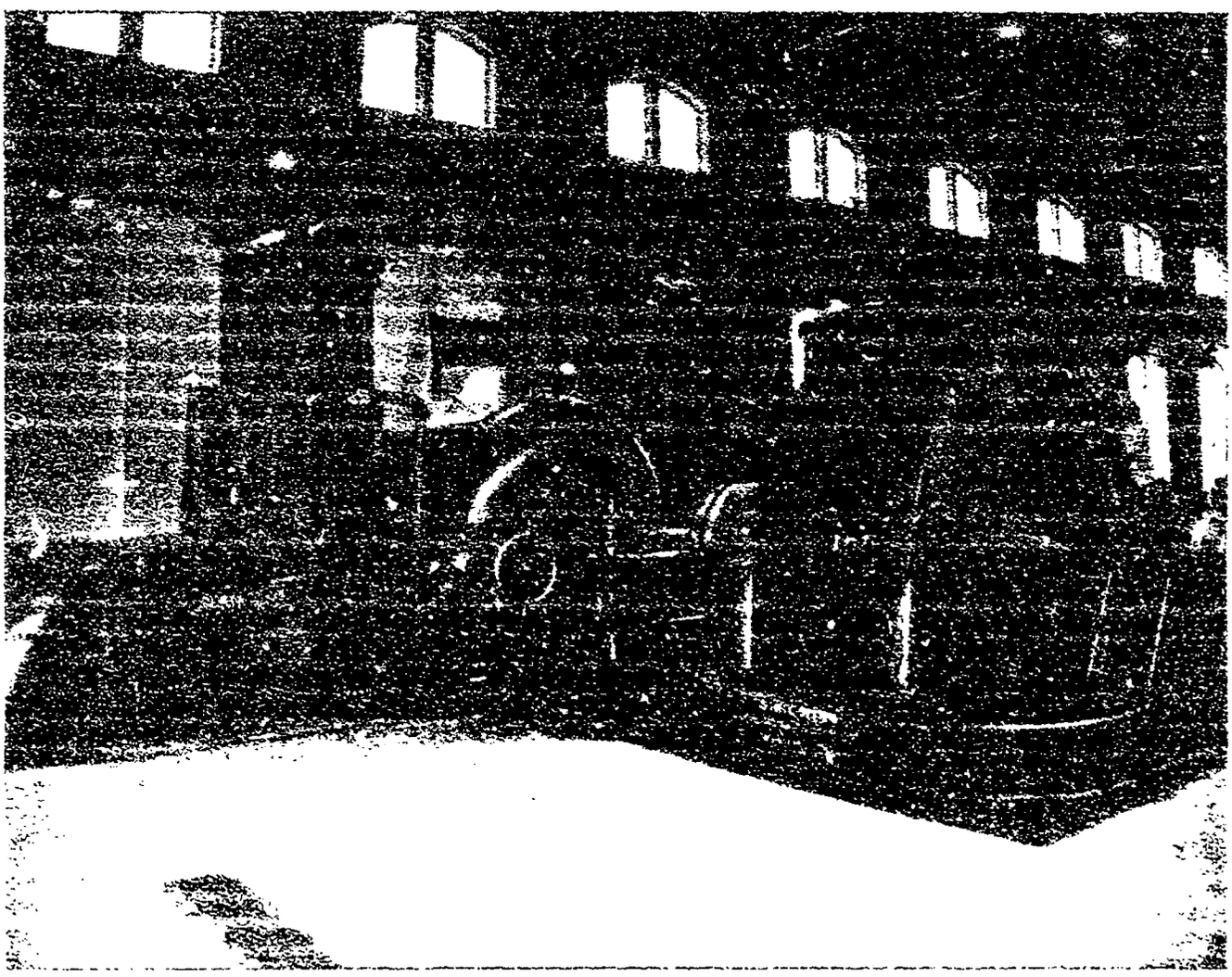


1000 H.P. S.E.C. GENERATORS IN THE POWER HOUSE OF THE CHAMBLY MFG. CO., RICHELIEU, QUE



ceived some attention in the United States, a paper on the subject having recently been presented before the Northwestern Electrical Association by Mr. H. M. Maxim, who sees in the advent of the electric carriage a great advantage to the central station. While automobiles have as yet been introduced only in one or two Canadian cities, it is quite probable that they will become more generally used in the near future, although to what extent is uncertain. The large amount of asphalt and other smooth pavements now being constructed in our cities should encourage the use of electric carriages, as the best storage battery must become impaired by constant jolting over rough roads.

The National Electric Light Association.

The annual convention of the National Electric Light Association of the United States, held in New York last month, is declared to have been the most largely attended and in many other respects the most successful in the history of that organization. The president in opening the convention gave some statistics showing the wonderful development of the electrical industry within the boundaries of Greater New York. He said: "Within its limits are located thirty-five electric light stations, which furnish more than 1,000,000 incandescent lights, more than 30,000 arc lights, and at least 30,000 h.p. in electric motors. The capital invested for carrying on this great business is nearly $100,000,000. It may interest you to know that in 1897, in the City of Brooklyn alone, there were ten street railway companies having 678 miles of track, and a capitalization of $55,000,000. In that year these railway companies carried 223,180,504 people. To-day, every transit company in the borough of Brooklyn is equipped or about to be equipped with electricity as its motive power, and the capitalization is $150,000,000, and 230,680,010 people were carried by this vast system in 1898. Electricity, together with the inventive genius of honored members of this association, has made this wonderful change possible." A number of excellent papers were presented and discussed. A lecture on liquified air by Mr. Chas. E. Trepler, whose recent experiments have become so widely known; an automobile excursion to Grant's Tomb; and a visit to the General Electric Company's works at Schnectedy, were prominent and highly appreciated features of the occasion. General S. T. Carnes, of Memphis, Tenn., was chosen as president of the association for the ensuing year. It is probable that the next convention will take place in New York or Chicago.

Methods of Generating and Supplying Electricity.

It would appear as though changes are likely to occur in some localities at least in methods of supply of electricity for light and power. In all the provinces of the Dominion, with perhaps the exception of Nova Scotia, New Brunswick and Prince Edward Island, steam users are obliged to import coal from Pennsylvania. In consequence of this fact, their fuel bill becomes one of the most serious items of operating expense. Owners and operators of works for the supply of electricity doubtless realize to the fullest extent the truth of this statement. There is no more important question to them than that of how to keep down the fuel account. The keenness of competition and other causes have in many instances reduced prices for current to unprofitable figures. In the majority of cases any attempt to increase them would probably not be successful, but, on the contrary, would be certain to lead to a disturbance of conditions which have come to be regarded, by the consumer at least, as being permanent, and would in consequence arouse antagonism to the companies. The latter must therefore adopt the alternative plan of trying to lessen, to the greatest extent possible, the cost of generating the current, while at the same time, by the use of the most improved apparatus and the best arrangement of circuits, ensuring the profitable utilization of as high a percentage of the current generated as may be possible. Naturally enough, under such conditions, the attempt is being made to cheapen production by substituting water power for steam wherever by this means a saving can be effected. The relative efficiency and economy of the two methods is one of the live and much discussed questions of the day. Without entering into the pros and cons of the subject, it may be said that weighty arguments can be advanced in favor of both systems also that the relative economy of steam and water power is largely dependent on locality and circumstances. The latest phase of this subject is now in process of development, and is the result of the demonstration at Hamilton, Montreal, Quebec and elsewhere in Canada of the possibility of transmitting current at least over distances of ten to thirty-five miles, and supplying consumers en route and at the terminals at lower prices than could be offered by companies using steam to generate current on the spot. From this quarter has already come threatened competition to central station companies operating by steam in proximity to water powers, and it remains to be seen to what extent the present central stations situated within thirty-five miles of large water powers may find it most profitable to resolve themselves into distributing stations, receiving their supply of current at wholesale rates from an outside source.

Y.M.C.A. ELECTRICAL SOCIETY.

The summer course of the above society, organized by the electrical students in connection with the educational department of the Y.M.C.A., Montreal, opened on May 25th, when Mr. F. B. Horn delivered a lecture entitled "The Theory of the Telephone." The members have prepared quite an interesting syllabus for the summer months, the main feature being a series of lectures by practical men. The second one will be by Mr. J. C. Bray, of Messrs. Ness, McLaren & Bate, entitled "The Telephone in Practice." It is proposed to visit large electrical plants on the first and third Saturday of each month. Following are the officers: Honorary president, Prof. Herdt, McGill College; president, Mr. F. B. Horn; vice-president, Mr. R. B. Macdonald; secretary and treasurer, J. C. Bray, 410 St. James street.

The following gentlemen connected with the electrical industry of Canada attended the recent annual convention of the National Electric Light Association held in New York: Mr. Fred. Nicholls, general manager of the Canadian General Electric Co. (ex-president of the N.E.L.A.); Mr. W. H. Browne, general manager of the Royal Electric Co., Montreal; Mr. C. B. Hunt, manager London Electric Co., London, Ont.

Every person interested in electrical development past, present or future in Canada, is invited to participate in the Annual Convention of the Canadian Electrical Association at Hamilton on the last three days of this month.

TELEGRAPH and TELEPHONE

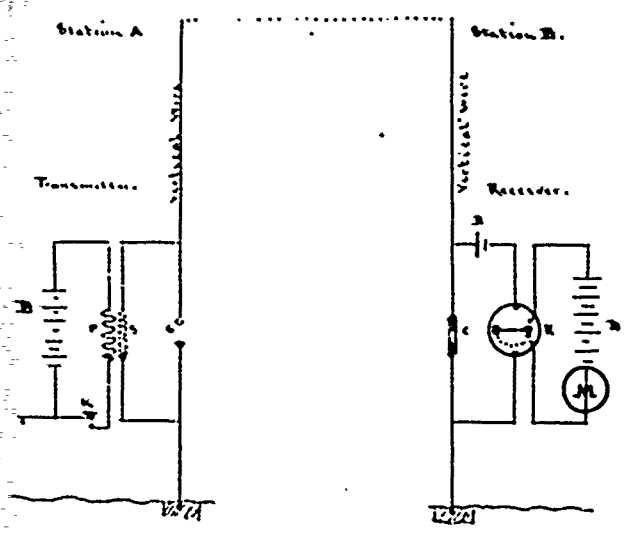
WIRELESS TELEGRAPHY.*

By F. A. Hamilton, M.I.E.E., M.Can.Soc.C.E.

Recent shipping disasters which have occurred, more especially on or near the Atlantic seaboard of Nova Scotia, render the consideration as to the best means to be employed with the object of minimizing such casualties particularly appropriate at the present moment, in view of the fact of marine insurance rates having been raised on vessels bound to and from Canadian ports.

That the subject is one of no inconsiderable importance, as far as Halifax is concerned, will be at once apparent to those whose interests are connected with the maritime enterprises of this city, and as these interests concern, to a very great extent, the whole province, the presentation of the following remarks will need no apology on the part of the writer.

The enumeration of the many accidents to shipping on and near these shores, which have been chronicled during the past twelve months, would here be superfluous. The mere mention of such losses of life and property as those involved in the Burgoyne-Cromartyshire collision, the wreck of the Moravia on Sable Island, and the loss of the Castilian, will suffice as instances. In studying the subject of marine signals, and particularly those placed near the coast for the purpose of guiding the mariner into



B represents an electric battery. K, telegraph key.
P S, primary and secondary of induction coil.
C, spark gap between metal spheres.
C, coherer. R, relay. M, Morse sounder.

The dotted lines indicate the invisible Hertzian waves, produced by the oscillatory discharges from the induction coil when the key K is depressed. The waves are intercepted by the vertical conductor at station B and conveyed to the coherer. The relay circuit is brought into action, in the manner already described, and the local battery and sounder M complete the cycle.

port and warning him in respect to outlying dangers, the writer has recognized the advantage afforded by audible as opposed to visual signals. A system of electric buoys, to be placed at some distance from this harbour, was suggested in sundry communications, published in Halifax papers in 1891, and the general features of the proposed apparatus were fully described. Attention was again called to this subject in a paper read before the Maritime Electrical Association in September last. The proposal was regarded with favor by competent authorities, but as its practical application necessitated some considerable outlay, no encouragement was given to the scheme. But the advent of what is popularly known as "wireless telegraphy" renders the discussion of my proposed system of electric gong buoys, as far as the immediate object of this communication is concerned, for the present at least, unnecessary. The marvellous results now attained by means of the Marconi system of wireless telegraphy are so much in advance of those afforded by any other means that the question of improving the approaches to our coast and to our harbor is a comparatively simple one. The history of the various attempts to telegraph through space without the aid of intervening wires dates back, as far as the United Kingdom is concerned, to the early forties, but it is beyond the scope and objects of this paper to record the labors and achievements of those who have devoted their time and talents in the endeavor to perfect this long dreamt of project.

*Paper read before the Council of the Board of Trade, Halifax, N. S., May 16th, 1899

The natural and practical question is how and by what means is this astonishing annihilation of space now rendered possible. In an admirable work on this subject, Richard Kerr, F. G. S., says: "The great fact to be apprehended in connection, not only with the several systems of telegraphy without wires, but with many other departments of science, may be expressed in the following words: Throughout all the solid materials of the earth, through all the liquids and gases, through ourselves and our atmosphere, through the moon itself, through all the vast distance of ninety-three millions of miles between us and the sun, in fact, throughout all things too small to be seen by the power of the best miscroscope ever constructed, and through all the space ever reached by the largest telescope in the world, there exists a medium known as the Ether. In fact, all interstellar space across which light travels, whether from our sun or from any other star, is filled with this ether. It is through this mysterious medium that light travels. If a stone is thrown into the middle of a pond, a series of ripples or small waves cover the surface of the water

Similar waves are produced in the air whenever a bell is struck, and the ether has its waves also. The ether conveys energy from the sun in the form of waves. These waves vary in length. To one set we give the name of light, and the eye is adapted to the appreciation of these waves. The surface of the body feels the other waves and to these we give the name of heat. Other waves are detected by delicate instruments and to these we give the name of electricity and magnetism. As the eye receives the light, so Lord Kelvin says, the delicate coherer of branly is an electric eye, in that it is sensitive to electric waves. In wireless telegraphy, as in other systems, the use of two pieces of apparatus, the transmitter and the receiver, are necessary.

The Marconi transmitter, by means of which oscillatory vibrations are produced, consists of the following apparatus: A battery, or source of electrical energy, an induction or intensity coil, with terminal brass knobs at the extremities of the secondary coil, and an ordinary telegraph key. The knobs are so adjusted, relatively to one another, that the electricity induced in the secondary coil by the charging of the primary, will bridge the space (the spark-gap) between the knobs, and a succession of oscillatory discharges will take place, and give rise to waves, which travel in all directions. The receiving apparatus consists of the following instruments: The coherer or "electric eye," as Lord Kelvin describes it, a sensative telegraph relay, and an ordinary Morse sounder or writer. The coherer is a sealed glass tube, about two inches long, with wires leading out from each end, in the inner extremities nearly meeting in the middle of the tube, but with a space or gap between them, in which is placed a small the quantity of metal filings. In their normal condition these filings do not perfectly complete the metallic circuit formed by the outer ends of the wires, leading from the extremities of the tube, and the relay to which they are connected. But when electric waves caused by the oscillitory vibrations of the distant transmitter reach the coherer the small particles of filings immediately cling together or cohere, thus completing the circuit of the relay, bringing into action a small battery, when the armature of the relay closes the local circuit and the sounder or Morse writer responds to the signals.

A small tapper, in the local circuit, is caused to agitate the tube and decohere the metal filings, so that they resume their normal position. A vertical wire at each station is an important part of the equipment that in connection with the transmitter imparts to the ether the vibrations set up at the sending station, and that at the receiving station intercepts the waves and conveys them to the coherer. This is by no means a full description of the appliances used, but it may serve to convey a general idea of the method employed to impart vibrations into space and to intercept them at a distant point. But it will be at once apparent that under some circumstances the radiation of signals in every direction would be an objectionable feature, not because a telegram so sent might become common property, but on account of interference or cross-signaling.

It is a perfectly easy and simple matter to read the messages now passing on an ordinary telegraph line, without disconnecting or even touching the wires, but no one ever takes the trouble to endeavor to become acquainted with other people's business by such means, and besides, all telegrams requiring secrecy are coded.

Nevertheless, there are conditions in connection with which the screening of the signals, either by the interposition of some non-absorbing substance, or the focussing of the radiations by means of projectors, or the syntonizing of the instruments, so that they

will respond only to certain vibrations, would appear necessary, and it is extremely interesting to learn that this phase of the problem has been dealt with successfully.

Not that the idea would be here given that finality in this respect has been reached, for much remains to be done in perfecting details in connection with this all important feature, but it is encouraging to read the statement that a development of more than ordinary interest in this regard has been recently announced, viz: that cross-signalling has been eliminated, and that arrangements have been successfully introduced whereby interference has been prevented between three stations which heretofore interrupted or interfered with one another.

So many wild rumors are published by enthusiastic and imaginative persons with regard to the future adaptation of wireless telegraphy, that a word from the lips of Signor Marconi may be of interest in respect to such startling announcements as those lately advanced, to the effect that the next experiment would be between the South Foreland and Paris. In the London Electrician of April 28th, Signor Marconi is reported as stating "that he knew nothing of such an experiment or of any serious attempt being made to establish wireless telegraphy between Ireland and New York."

He expressed his conviction that real progress was only to be made by shorter stages, and that he was determined to undertake no share in any experiment likely to bring the Marconi system into disrepute, through complete, or even partial failure.

He is fully in agreement with Dr. Flemming's view that wireless telegraphy is quite unlikely to take the place of wire telegraphy for long distance commercial work, but for connecting islands or places separated by sea, the system is now available up to distances of 60 or 70 miles.

If the Canadian government contemplates expending $120,000 for a telegraph cable to Sable Island, it is a question whether it would not be wise to consider how far that sum might be advantageously applied in providing the lighthouses on the island and on our coast with the Marconi apparatus, for whilst it is not possible at present to span the distance between Whitehead and Sable Island by means of wireless telegraphy, the establishment of a station on the island would render communication therewith at all times possible to a vessel provided with the necessary instruments, and as the use of such instruments will probably be general in the near future the actual need of a cable to the island will be less imperative than it has been in the past.

Wireless telegraph stations on such headlands as Cape Race, St. Pierre, Miquelon, St. Paul's Island and other lighthouse stations up the Gulf, Louisburg, Whitehead, Egg Island and Sambro, could probably be established at considerable less cost than would be required for a cable to the graveyard of the North Atlantic, indeed it might with reason be argued that one of the best means of averting such disasters as those which have occurred on that dangerous sand bank would be to adopt the suggestion now outlined.

It is gratifying to learn that the Wireless Telegraph and Signal Company, of London, intend giving a practical demonstration of the Marconi system of signalling on this side of the Atlantic, about August next, and it is hoped that Halifax will be one of the places selected for the purpose. The question of providing a steamer for the pilot service for the port of Halifax is one that has been mooted from time to time, and like every other proposed measure for the improvement of the approaches to our harbor, deserves careful consideration.

If Sambro were provided with a Marconi apparatus and the pilot steamer were likewise so fitted, the efficiency of the pilot service would be considerably augmented, for many potent and obvious reasons. With the lighthouses mentioned, and those of Little Hope, Roseway and Seal Island, radiating their signals to a distance of twelve to fifteen miles in the offing, no well equipped vessel need meet the fate of those which have left their bones along these shores and in the deadly sands of Sable Island.

SHORT-CIRCUITS.

The Bell Telephone Co. are laying a number of underground conduits in the city of London, Ont.

The city of Brantford, Ont., has granted the Bell Telephone Co. an exclusive franchise for five years, for the consideration of $450 per annum.

The St. Martins Telephone Co., of St. Martins, N.B., recently held its annual meeting and re-elected directors and officers. They are: John McLeod, M.P.P., president; W. H. Allen, vice-president; A. W. Mackin, secretary-treasurer and manager; C. M. Bostwick, W. E. Skillen and C. D. Trudnen, additional directors.

The Carman Telephone Exchange Co., of Carman, Man., is applying for incorporation. The applicants include J. E. Campbell and F. D. Stewart.

E. W. Crane, of Brantford, has issued a writ against the city and the Bell Telephone Co. for $5,000 damages. While working as a lineman, he came in contact with a wire which was not properly insulated, receiving injuries for which he claims damages.

It is stated that the Dominion government intends to complete the telegraph service between Quebec and Belle Isle within the next two years. The line has already been built to a point 160 miles below Quebec, and an additional 200 miles will be strung this year.

A charter has been issued to the Victoria Telephone Co., to operate in the town of Lindsay and throughout the county of Victoria, with head office at Woodville, Ont. The directors are J. G. Eyres and C. E. Weeks, Woodville; Arch. Campbell, Lindsay; J. J. Cave, Beaverton; W. H. Johnston, Pefferlaw.

Mr. Timothy Howard, telegraph engineer of the Australian post and telegraph department at Melbourne, Australia, is making a tour of inspection of the telegraph and telephone systems and other electrical developments in the principal countries of the world. He started from Melbourne last January, coming direct to San Francisco. He is travelling eastward and expects to get back home about Christmas time. He has visited the principal cities in the United States and Canada, and will stop at the principal centres in England and Europe. Mr. Howard sailed for England a few weeks ago.

Mr. T. A. Smith, district superintendent of the Bell Telephone Company at Kingston, has invented special instruments of unique design for communication between the attendants on the surface and the divers at the bottom of the river, while they are engaged in the work of raising the Cornwall bridge. The ordinary diving apparatus has been dispensed with, and supplemented by special diving bells, so constructed as to withstand the pressure of the current. They are also protected by heavy metal shields. The telephone is put inside the bell, and electric alarms give the signal when either party desires to converse. Anybody can operate the ingenius mechanism.

MOONLIGHT SCHEDULE FOR JUNE.

Day of Month.	Light.	Extinguish.	No. of Hours
	H.M.	H.M.	H.M.
1	P.M. 7.50	A.M. 1.20	5.30
2	" 7.50	" 1.50	6.00
3	" 7.50	" 2.20	6.30
4	" 7.50	" 2.50	7.00
5	" 7.50	" 3.20	7.30
6	" 7.50	" 3.30	7.40
7	" 7.50	" 3.30	7.40
8	" 7.50	" 3.30	7.40
9	" 7.50	" 3.30	7.40
10	" 7.50	" 3.30	7.40
11	" 8.50	" 3.30	6.40
12	" 9.30	" 3.30	6.00
13	" 9.50	" 3.30	5.40
14	" 10.20	" 3.30	5.10
15	" 10.40	" 3.30	4.50
16	" 11.00	" 3.30	4.30
17	" 11.00	" 3.30	4.30
18	" 11.30	" 3.30	4.00
19	. . . . .	" 3.30	3.30
20	A.M. 12.00	. . . . .	
21	No Light.	No Light.	. . . . .
22	No Light.	No Light.	. . .
23	No Light.	No Light.	.
24	No Light.	No Light.	.
25	P.M. 8.00	P.M. 10.30	2.30
26	" 8.00	" 11.00	3.00
27	" 8.00	" 11.20	3.20
28	" 8.00	" 11.50	3.50
29	" 8.00	A.M. 12.20	4.20
30	" 8.00	" 12.50	4.50
. . . . .	. . . . .	. . . . .	. .
		Total	137.30

Without the least reflecting upon Montreal, Ottawa, Toronto or Niagara Falls, it can be stated that the Committee in charge of the local arrangements for the entertainment of those who may attend the C. E. A. Convention at Hamilton, will prove themselves to be past masters in the art of hospitality.

CHARGING CARRIAGE BATTERIES.

ELECTRIC carriages are coming into general use in the cities and towns where there are electric power stations, from the wires of which the storage batteries of such electric carriages can be readily charged. Some other method of charging such batteries is greatly needed. Could a simple and practical method of charging such batteries be used anywhere it would enable residents of country districts to use electric carriages. The writer has devised two methods. The first method consists in the use of an endless tread power to drive the motor of the electric carriage as a dynamo to charge the storage battery on the electric carriage while the latter is stationary and at or near the home of the user, or wherever such a tread power can be used. If the owner of the electric carriage has no horse to operate the tread power, either a donkey, a mule, an ox or a cow can be pressed into service to operate the tread power and drive the motor of the carriage as a dynamo to charge the storage battery on the electric carriage. In rural districts where engines are not available the tread power could also be used to thresh, clean grain, saw wood, cut straw, hay and roots, pump and churn without the intervention of the carriage motor used as a dynamo, and without the intervention of the storage battery.

The farmer could make one of his horses charge the storage battery in the manner outlined, and he could still keep the horse at home to do necessary work on the farm while the members of his family might drive a dozen miles and return by means of the electric energy which might be stored by the exertion of the horse, mule, donkey, ox or cow during the previous evening. Of course, absolutely no harness whatever would be required by the horse, donkey, mule, ox or cow while driving the endless tread power. No time need be spent in grooming the animal, and he need not be shod. A fractious animal might store his energy in the storage battery, and no runaways need be feared by the user of the electric carriage. When the carriage is not needed at night the electric energy stored in the carriage battery by the work of the animal at any time during the day might supply light for the house at night by means of incandescent electric lamps. Should it be preferred, the animal may operate the motor of the carriage as a dynamo at night, and so illuminate the house during the night without the intervention of the storage battery. But if the carriage is to be used at night a storage battery for the purpose of illumination may be installed in the house.

It is well known that the endless tread power is the best contrivance for utilizing the energy of animals. The animal while at work simply walks up an incline plane made of a belt of heavy slats which passes under him as he walks, and turns a wheel connected with the motor used as a dynamo by simple belting. The economy of the endless tread power is due to several causes. In the first place, the animal has to carry no load of harness; in the second place, he always walks on a good road, and in the third place he may walk at a uniform rate of motion.

Really, in the present age it seems absurd when a person wishes to drive a dozen miles away in order to remain a day or two, to hitch a huge beast, loaded with harness, to the carriage, and to use him but a small fraction of the time while absent from home. A horse is used to draw the carriage even though often not more than one-quarter of a horse power is really needed for the work. The horse while absent from home must be unharnessed, fed, watered, groomed and provided with a stable; all this causes considerable trouble, anxiety and annoyance. The horse, while drawing the carriage, may shy and run away because of rustling paper or other trivial cause, and endanger the lives of the occupants of the carriage. The roughest and most unsightly and ungovernable beast may store his energy in the carriage battery in the method outlined.

The user of the electric carriage, when on the road, may drive the same at either a high or a low speed; there is no danger of runaways; on arriving at his destination the electric carriage requires neither food, water nor care. He may let the vehicle stand still out of the way until it is again required for use.

The second method consists in using either small kerosene or gasoline engines, in the rural districts, to drive the motor of the electric carriage as a dynamo to charge the battery. Such engines are now sold at low prices and they are very economical in the use of fuel. In some cases steam engines already in use for other work may be used to charge the battery. These engines may also work the carriage motor as a dynamo to store electric energy for lighting houses, and they may also be used in threshing, cleaning grain, cutting feed, sawing wood, pumping and churning.

It will now be thoroughly understood that nothing need now prevent the extensive use of electric vehicles of every description, either in the country districts or in small villages and towns where there are no electric power stations. The country roads may soon be everywhere traversed by horseless carriages. The advantage of cleanliness, speed and convenience of such electric carriages are very great indeed.

The principle novelty in the methods outlined in this article consists in the use of the carriage motor as a dynamo for charging the storage battery of the electric carriage, instead of incurring the expense of installing a dynamo on purpose for such use.

JAMES ASHER,
174 Germain St., Buffalo, N.Y.

May 23, 1891.

GORE PARK, HAMILTON.

THE POSSIBILITIES OF LIQUID AIR.*

By Elihu Thomson.

The object of the present article will be to suggest rather than predict directions in which, under certain conditions, liquid air may possibly become a factor in engineering. And in the absence of favorable conditions need it be said that such possibilities will not be capable of realization.

Let us assume the availability of some innocuous gas liquefiable at about one hundred atmospheres pressure, at temperatures easily and cheaply attained, and at no cost for the gas itself. In such a case there can be no doubt of its soon finding enormous application in the storage and recovery of energy. Cheap power would be used to compress and liquefy it, after which it would be stored in quantity, either at atmospheric pressure or at some selected higher pressure. Such a liquefied gas would be stable, or remain in the liquid state, if heat were prevented from reaching it. This could be done, not perfectly, of course, by surrounding the containing vessel with a liberal thickness of some good non-conductor of heat. That part of the gas which would inevitably escape on account of the lack of perfect heat insulation would be cold and would be made to traverse the non-conducting covering in successive layers from within outward, and thus assist in cooling the covering and in preventing access of heat to the liquid; or, the escaping gas might even be made available for power in an engine, if the liquid were kept under a proper working-pressure. In this case further heating of the gas, analogous to superheating of steam, could be employed before sending it to the engine. But little of the energy of the heat so added would be lost, and a considerable part of it could be supplied by the surrounding air or by water.

With such a liquefied gas produced at one place by cheap power and carried to another for evaporation and recovery of power, ice could be made as a by-product.

In many plants used for the development of power on a large scale, a twenty-four hours' output is not called for, but could be attained at slight additional expense. The excess power from such a plant needs some means of utilization. This excess power, as during periods of otherwise light load, could be employed to liquefy the assumed gas. On a large scale this procedure would not be costly, supposing the use of highly developed machinery. The liquid product could then be transported in tanks provided with heavy lagging and special arrangements to prevent access of heat from the outside. Perhaps it could be distributed by a well-covered pipe-line. The unavoidable evaporation which would be involved in the pipe-line transportation might not be altogether a loss, for if the line be under a pressure suitable for engines the escaping gas might possibly be tapped out at intervals, heated, and used for power along the line of way.

But the foregoing considerations are based upon the existence of a gas at no cost, with desirable properties rendering its liquefaction easy. Such a gas does not in fact exist. There then arises the question whether we can render available any of the gases known to us. Carbonic acid gas is cheap, but still far too costly for use in the way proposed. It would not pay to send it back long distances for recompression and reliquefaction. It costs too much to be thrown away after it has been once used. The air itself meets the condition of no cost for material in the case.

In culmination, Professor Dewar has lately succeeded in reducing even hydrogen to a liquid and in collecting quantities of it. Temperatures not far removed from absolute zero (-273 C.) are obtained by the evaporation of liquid hydrogen. But the absolute zero, like the dynamo of 100 per cent. efficiency, may by each advance be more and more closely approximated but never reached. This low temperature research has shown that at temperatures as low as 200° C., attainable by evaporation of liquid air, conducting-metals, as copper, platinum, silver, etc., when in a very pure state, have their conductivities so much enhanced that electric currents flow with but a fraction of the resistance experienced at ordinary temperatures. Research has shown that at absolute zero they would become perfect conductors. Professors Dewar and Fleming laso found that liquid air is a very perfect insulator, and that ice and many frozen electrolytes even become excellent insulators at the temperatures of liquid air; and in general that intense cold in insulators improves the insulation, just as it improves the conductivity of conducting-metals when they are pure.

Unfortunately, however, the liquefaction of air requires rather extreme conditions, and in the early work of Dewar was an exceedingly costly process.

The discovery of the fact that air compressed, cooled, and collected in a reservoir at from 100 to 150 atmospheres might be made to liquefy a portion of its own volume, rendered possible the procuring of liquid air by a more direct and simple means. This discovery is claimed by several persons, the merits of whose claims will not be here discussed. When highly compressed air escapes from a suitable orifice it is cooled by its own expansion. If the cooled air be now caused to circulate around a long coiled pipe, which brings the compressed air to the jet in such a way that the portion of pipe nearest the jet is the first to be met by the cooled air, and so back progressively from the jet; further, if the whole be thoroughly jacketed by a non-conducting covering the temperature at the jet soon falls sufficiently low to cause liquefaction of a portion of the air even at ordinary atmospheric pressure. The operation itself is cumulative or self-intensifying, since the cooling due to expansion is employed, on the regenerator principle, to cool most effectively the compressed gas on its way to the jet and ready to expand.

If air be compressed to about 800 atmospheres it may be made to occupy the same space as it does when liquefied, but even at higher pressures it would remain gaseous. Ordinary temperatures of the surrounding air are far above the critical temperatures of the gases composing it. In order that it may liquefy, it must lose kinetic energy or be cooled; the velocity of the moving molecules must be brought down. The removal of heat is essential, and the process of liquefaction can only be carried on by cooling the gas during or after compression. Conversely, liquid air confined in a closed and filled receptacle, when allowed to regain the heat lost in being liquefied, would become gaseous and exert a pressure of about 6 tons per square inch.

That the processes for producing liquid air will be developed so as to reduce the cost to an extent such as to render it available in place of a more ideal gas would be a vain prediction to make at present.

The fact that a three-gallon milk-can of liquid air

* Abstract from contribution in the Engineering Magazine

was brought by Mr. Tripler, of New York, from that city to Lynn, Mass., a journey occupying nine hours, and that not more than one-third of the liquefied gas was lost, although the only covering for heat insulation was about 2½ inches of ordinary steam-pipe felting, goes far forward indicating the possibility of transportation. With a tank of 20 times the linear dimensions of the milk-can referred to, the surface for loss of heat would rise to 400 times, while the capacity would have increased to 8,000 times, and with no better lagging it is easily seen that the daily loss would then not be over 5 per cent. Doubtless, however, improved means for heat insulation would make the loss but a fraction of this amount. If the tank were kept under a pressure of, say, 200 pounds to the square inch, a suitable safety-valve being provided to prevent excess of pressure, the evaporated gas or air could be made to do work, especially if superheated. If the tank were in a train the motive power might, at least in part, be derived from the normal evaporation from the tanks. Further, let us imagine a pipe-line well insulated for heat, and it is easy to see that if the velocity of flow equalled the train-speed in the journey of the milk-can from New York to Lynn, the percentage loss in a pipe of the diameter of the milk-can with no better lagging than it possessed would be the same or even less. Here again perfection of heat-insulation might make quite a saving, and the evaporated gas might, if the line were under pressure, be made available for power along the line of way.

Whether the liquefied gases of the air can be employed in this way will, however, depend upon the development of efficient methods of extracting the heat and effecting condensation of the air.

Liquid air represents air compressed to about 800 atmospheres, but existing without pressure. No heavy and excessively strong tanks are needed for storing it. If it be pumped into a closed receptacle under regulated pressure, it may be evaporated by the heat of the air, or that of surrounding objects, or it may receive heat from bodies undergoing refrigeration, as water being converted into ice; after which heating operation it may be further heated to the melting point of lead by heat of combustion, and be finally used in a suitable engine where its expansion may develop power. During its expansion and delivery of power to the pistons of the engine it may become so cooled as to be discharged from the exhaust at nearly normal atmospheric temperature and pressure.

The power expended in compressing and liquefying air is, of course, converted into heat and thrown away. The product, liquid air, has no inherent power of energy in itself. It represents negativity, bearing somewhat the same relation that an exhausted globe does to the surrounding air. It may become the means for rendering the normal energy in the surrounding air available. Liquid air has capacity for taking up the ordinary heat of surrounding objects and thus acquiring pressure. It can be superheated very efficiently, and so used in the form of compressed air in an engine. The superheating will, of course, tend to raise greatly the total efficiency. The inevitable losses in the compressing and liquefying processes would in part be made up in the added heat, the amount of which is small and efficiently employed. We have no reliable data of large scale operations, and can as yet reach no certainty as to the efficiency attainable in compression and liquefaction or in recovery of power. It is possible that the seperation of oxygen, which would probably possess a value in metallurgy, might tend to diminish the cost of condensation. So also the refrigeration which is obtained during evaporation might help the recovery end. Where so much is "in the air" we must be content with suggestions only, and they may never be realized in practice. The power required to be expended in liquefying a given amount of air can be approximately estimated, and an assumed efficiency of plant may be made to do duty in place of exact figures where none are to be had, and if the conclusions based thereon are understood as tentative and subject to extensive modification in view of further advances in our knowledge, no harm is done.

In making an estimate of the cost of liquid air as produced on the large scale, the factors of plant efficiency, maintenance, etc., come in to a greater or less extent. Assuming that air be compressed as nearly isothermally as possible, and that in a large plant a possible total efficiency of seventy per cent. might probably be realized, each horse power hour might thus be expected to compress nearly 10 pounds of air to a pressure of 2,000 pounds to the square inch. If such compressed air, on being expanded in a very carefully arranged self-intensifying apparatus, should condense 25 per cent. of the air admitted, we would have about 2½ pounds of liquid air per horse power hour. The assumed proportion, 25 per cent., seems not improbable in view of all the data—meagre enough, it is true—which have come to the writer's knowledge.

If the power cost be taken at $20 per year in large units and an additional charge of $10 be allowed for each horse power of the compressing and condensing plant, its interest, maintenance, and operating expenses, the cost per pound of liquid air would be about one-sixth of a cent, assuming the plant to run 7,200 hours per year. This estimate, subject to modification from the very nature of the problem, would make the liquid air cost for production about 8 cents per cubic foot. If oxygen separated by fractional distillation possessed a value for equal amounts in excess of the cost of the air, the remaining nitrogen would, of course, be producible at a lower figure.

It is probably within the possibilities that a cubic foot of liquid air or nitrogen, if allowed to heat from its surroundings and then be further heated to 200 C., could, in a high pressure engine, yield about five horse power hours. If at the same time the vaporization of the air were attended by useful refrigeration, as in making ice, the cost of recovery would diminish. Need it be said here, however, that even if the cost of horse power of recovered energy much exceeded that which is indicated in the foregoing estimates or assumptions, a demand may still exist for a source of power having great compactness, freedom from nuisance, no heated nor noxious exhaust, and of unequalled controllability? The horseless vehicle problem certainly presents us with an instance in point.

The great feature of the application of such a power as liquid air would be its emergency value. By this is meant the ability to obtain at will a sudden output far beyond the normal. Animal power notably possesses this emergency value, and the success of electric trolley systems largely depends upon the fact that, when needed, the station can be called upon for a temporary delivery to any single car or train of a power greatly in excess of the rated output of the motors.

Suggestions have already been made of the use of

liquid air or oxygen, mixed with combustibles as a high explosive. Such an explosive can be made at the time of use, and if left unexploded, either by accident or design, soon loses its dangerous character by evaporation of the liquid gas.

A fascinating speculation for the electrical engineer is the possibility of so cooling the conductors of electric lines or apparatus as to improve the conductivity many times, and so diminish the losses in any given length of conductor, and at the same time greatly improve the insulation. Professors Dewar and Fleming have shown, however, that it is a condition of this enormous improvement in conductivity that the metals be very pure, a very small percentage of impurity greatly lessening the result. As regards the insulation, they have shown that dielectrics and electrolytes become insulators of excellent character when cooled to the temperature of liquid air. What effect such a lowering of temperature would have upon the dielectric strength or striking distance between conductors at great differences of potential is not as yet determined, so far as the writer is aware. The result to be expected from a consideration of the effect of heating upon dielectric strength or striking distance is, that very low temperature will make it far more difficult to break down insulation by sparking through it.

That the electrical engineer covets just such agencies as will thus extend the range of possibilities in his art needs no proof. He would be apt to choose a pipe line conveying liquid air as the very best location for his conductors, assumed to be made of as pure metal as possible, the high insulation probably attainable being the chief object. Whether his conductors were placed outside such a pipe or within the same, he could no doubt adapt himself to the conditions, provided he could get the benefit of the low temperature insulation, and possibly, to a certain extent, a gain in conduction.

It is indeed very questionable whether a pipe line will ever be laid and kept filled with liquid air solely for its electrical benefits, but if such a line were also used to supply liquid air to a distant point and the normal evaporation utilized, the case would be somewhat modified, though the improbability of such a combination being put into service, at least within any reasonable period, still remains.

It will be the proper attitude for the conservative and at the same time progressive engineer to await the possession of full and accurate data before drawing any conclusions as to future practice. Suggestions of possibilities are, of course, useful, even if only a fraction of them prove realizable, and no attempt is here made to do otherwise than call attention to matters which must from their nature possess more or less of interest. Engineering Magazine.

Mr. R. A. L. Gray, electrical contractor, Toronto, has removed to 42 York street, having secured the agency of the Electrical Construction Company, of London, Ont.

A by-law will be submitted to the ratepayers of Nelson, B.C., authorizing the council to grant a charter for a tramway system in Nelson to the British Electric Traction Co., of London, Eng. The company's solicitor is Mr. W. A. Macdonald.

The United Electric Company, Toronto, have recently sold 2 h.p. motors to the following: Brereton & Manning, Langmuir & Co., T. H. Patriarche, A. R. Williams Co., and Imperial Cap Co., Toronto: Brock Engraving Co., London; R. B. Dobson, Beaverton; R. E. T. Pringle, Montreal. They have also sold to Mr. Dobson one 4 h.p. motor and one 6 h.p. generator, and to R. E. T. Pringle one 6 and one 8 h.p. motors.

SPARKS.

The town council of Barrie, Ont., are taking steps looking to the construction of a municipal telephone service.

Mr. J. L. Kitchen has removed from Wiarton to Acton, Ont., to take charge of the municipal lighting plant in that town.

The Bell Telepone Co. are now constructing a long distance copper line between Ottawa and Brockville. The line will require about 75 miles of poles and cross-arms and 200 miles of copper wire.

Robert Hunter, Joseph Murchey and associates have been incorperated as the Gasoline Engine Co., of Toronto Junction, to manufacture gasoline and gas engines, steam engines, electric motors, etc.

The council of Wallaceburg, Ont., have refused to grant an electric light franchise to Mr. M. Martin, and have entered into an agreement for street lighting with the Wallaceburg Electric Light Company.

The ratepayers of the village of Thurso, Que., have approved of the by-law to raise $18,000 to purchase and complete the waterworks and electric light plant started last year by the Stadacona Electric & Water Co.

The town of Renfrew, Ont., has given a contract to A. A. Wright & Co. for six arc lights, at 25 cents per light per night, and to W. A. Mackay for 15 incandescent lights, at $20 per light per year, both contracts to be for one year from May 3rd, 1899.

The Bear River Electric Light & Power Company have decided to extend their system to Digby, and to light intermediate points. The capital has been increased to $75,000, and it is understood they will take over the plant at Digby owned by Major Daley.

A syndicate of Toronto gentlemen are said to have purchased the franchises and property of the St. Hyacinthe Power and Electric Light Company and the St. Hyacinthe Gas Company, of St. Hyacinthe, Que. It is given out as the intention of the syndicate to rebuild a portion of the dam at the power house and to remodel the electric system.

The Hull Electric Company has entered suit in the Superior Court against the Ottawa Electric Company, claiming $10,000 damages for non-compliance with their request to cease selling light in Hull. This sum is alleged to have accrued since the last action for $20,000 on the same grounds was issued. The latter is still pending before the Court of Appeal in Montreal.

Oliver Perks, an electrician, of Montreal, was recently killed at the power house of the Chambly Manufacturing Company at Chambly. Perks and some other employees were laying the current on a new machine. Perks wanted to find out for himself the progress being made on the machine. He leaned over it, putting the tips of his fingers on the frame and stretching his other hand down. In the act his hand came in contact with some wire, thereby establishing a circuit and causing a current of 3,000 volts to pass through his body. Death was almost instantaneous.

Recent sales made by the United Electric Company, Toronto, include the following: 3½ h.p. motors to J. T. Rowan, Ottawa, and Telegraph Printing Co., Waterloo; 4 h.p. motors to Merchants Mantle Manufacturing Co., Toronto; 5 and 6 h.p. motors to Citizens' Telephone & Electric Co., Rat Portage; 7 h.p. motor to James Sparrow & Co., Toronto; 8 h.p. motors to Federal Printing Co., Ottawa, Toronto Lithographing Co., Northway & Sons, and Elliott Paper Box Co., Toronto, Clark Creamery Co., Smith's Falls, and Darling Bros., Montreal; 10 h.p. motors to Brown & Hussey, Toronto, Rogers Coal Co., Hamilton, and W. J. Babcock, Brantford; 12 h.p. motors to Elias Rogers & Co. and A. R. Williams Machinery Co., Toronto; 20 h.p. motor to Rice Lewis & Son, Toronto.

The Cataract Power Company have made a proposition to light the streets of the city of Hamilton, the contract to apply to the unexpired term of the existing contract with the Hamilton Electric Light & Power Company, viz., September 1, 1900, and for a further period of ten years. They offer to furnish 325 arc lamps of 2,000 nominal candle power, burning from dusk till dawn of every night of the year, at the rate of $85 per lamp per year, and additional lamps at the rate of $82.50. Should the city require 500 lamps or over at any time during the term of the contract, the price would be $82.50 for the first 500 lamps and $80 for each additional lamp. A rebate of 2 cents per lamp hour to be made for such time as the lamps may not be burning. The company announce their intention, should the proposition be accepted, of thoroughly remodelling the present arc lighting system.

ELECTROLYSIS.*

By F. Walter Thorold.

The great damage done to gas mains, water mains and the cables of the various electric and telephone companies by the return current of the electric railway systems, is now assuming such large dimensions that something must be done to overcome it. If this trouble is left to take its own course, there will, no doubt, be numerous law-suits in which the railway companies will be the losers. They will have to pay for damages done to these pipes and cables, and will also have to so equip their outside plant that this trouble will not occur again.

There may be a doubt in the minds of some people as to whether the electric railway companies can be held responsible for the damage done by their heavy return currents. The argument amounts to this: Certain companies have capital invested in metal, which is placed underground. Another company comes along and destroys this metal. The question then is, is this last company responsible for the damage they have done and are still doing? They may not be doing this damage intentionally, but they are doing it knowingly.

It is a well-known fact that electricity will choose the path for itself which offers the least resistance, but that it is impossible to confine the current to one conductor when there is another open for it, no matter what the resistance of the other may be. Still, it is the duty of the electric railway companies to provide a conductor on their return circuit over which the greater part of the current will flow, and that conductor must offer so little resistance that all the current which does not return over it will not be enough to cause any damage to the underground pipes and cables.

Electrolysis may result to a small extent from the leakage of overhead wires, but as this leakage takes place to such a very small extent, it is not worth considering. Of course, any large leakage of this kind, or a "ground," as it is called in practice, would soon be known at the power house and taken off at once.

The circuit of the ordinary trolley system is very simple. The current comes along the trolley wire from the dynamo in the power house, thence through the car to the rail, and along the rail and underground pipes, etc., back to the dynamo in the power house. If the current all returned along the rails there would be no damage done by electrolysis, excepting perhaps at a few bad joints between the rail and its connections.

A few words might be said as to the connections between the rails now generally used. The rails are bolted together by means of ordinary fish-plates; but to make a better electrical connection they are bonded together by heavy copper wire. This bonding is supposed to so connect the rails that the current will flow on unmolested to the power house. The method of bonding now used is to take a piece of No. 0 or No. 00 bare copper wire, as short as possible, but generally about eighteen inches in length, to each end of which a rivet, called a channel pin, is soldered. There is a small hole drilled in the end of each rail, into which the channel pin is put, and the end is then flattened out, thus connecting the rails together. However, it has been found that this is not enough, as some of the current leaves the rail, on account of the resistance between the joints, and follows along the underground mains and cables to the power house. If the current, while travelling along these pipes, was not increased or diminished on the way, or in other words, if the potential between the pipes and the rails was always the same, there would be comparatively little harm done. The trouble is that the current takes jumps to and from the pipes as the resistance of the rail increases or diminishes, and at every point in the pipe where this takes place—and the points are many—electrolysis sets in.

The method of bonding before mentioned does not make a true electrical connection. The connection between the pin and the wire may be all right, but it is the connection between the pin and the rail which causes the trouble. By continual pounding of the cars on the rail the joint is loosened, and the result is that an oxide of the metal is formed, thus increasing the resistance of the joint, and ultimately of the whole circuit, and thereby causing more of the current to return through the pipes, etc.

One system which is used is to connect the rails every short distance with an overhead insulated copper wire, which carries the current back to the power house. Of course, the system of bonding mentioned is also used, or otherwise it would be necessary to connect every rail with the overhead wire. It will be readily seen that with so little resistance offered, very little of the current would seek any other path.

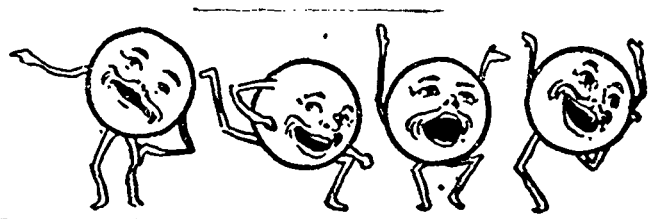
A sixty-pound rail is said to be electrically equivalent in carrying capacity to one square inch of copper, and therefore, in a double-track road, the rails offer a combined carrying capacity for the current equal to four square inches of copper. If the bonding between the rails is made perfect, and the overhead return wire is used, then I think the trouble of electrolysis would be a minimum.

In several cities the rails have been casted together at the joints by placing a mould about the rail ends and pouring molten iron in, which on solidifying formed a solid joint. A first-class electrical connection may thus be obtained, but it has been found to be almost impossible to have an easy running road with joints of this kind, and as this is an expensive connection, it is not very largely used.

The effect of electrolysis is first noticed near the power house, as it is near this point that the current, which has been collecting on the pipes, jumps up to the rail to return to the dynamo, thus causing the oxidation of the pipes at this point. This oxidation, it must be remembered, has been and is going on at many other points of the pipes, although not to such a great extent, but it is only a matter of time when the same trouble will be located on these other sections of the pipe, throughout the city or town.

Outside of all damage done to other property, the electric railway companies are wasting money. To decompose a metal some force must act, and in this case the force is supplied by the railway company. They are, therefore, spending money to decompose these metals, as well as spending money to operate their cars. Why not put in good return wires and save this money? The saving just now would be a negative quantity, but in the end they would probably be the gainers.

* Abstract from pamphlet of Engineering Society of School of Practical Science, Toronto. Published by permission.



The joys of Anticipation—The Realization can be had by attending the Electrical Convention at Hamilton.

THE LATE DONALD GIBSON.

THE late Donald Gibson, city electrician of Toronto, whose portrait appears on this page, was one of the best known of the older citizens. His connection with the fire brigade as superintendent of the fire alarm system extended over the long period of twenty-seven years. Mr. Gibson was a native of Glasgow, Scotland, and came to Toronto in 1854, to enter the service of the Consumers' Gas Company. He was foreman there

THE LATE DONALD GIBSON.

until he entered the city's service. He was an ardent volunteer. As a lieutenant in the Highland Company of the Q.O.R., he was present at the Ridgeway fight. Afterwards he became captain of the Garrison Artillery. He was a first-rate rifle shot, and was a member of the first Wimbleton team sent from Canada. Mr. Gibson was one of the founders of the Caledonian Society, a strong Reformer in politics, and a member of Old St. Andrew's church.

SPARKS.

The United Electric Company, Toronto, have sold a 1½ k. dynamo to Toronto University.

Tenders have been invited for wiring for electric light the municipal buildings at Winnipeg.

Ed. Plante and Z. Plante have formed a partnership in Montreal as electricians, under the firm name of Plante & Co.

Some improvements have recently been made to the electric light plant at Huntsville, Ont., under the superintendence of Geo. Ralstan, electrician.

Mr. Champagne, boiler inspector, Montreal, in a report to the Water Committee, recommends the addition of a pump of 5,000,000 gallons capacity, either worked by steam or electricity.

Steps have recently been taken to form a trust of the manufacturers of rubber covered wire in the United States. Options have been obtained on the purchase of the business of the leading firms.

The authorities of the town of Goderich, Ont., will probably make an addition to the electric light plant. The Light Committee have recommended that the council purchase 1,900 feet of No. 6 insulated wire.

The Lunenburg Gas Co., of Lunenburg, N.S., have changed their lighting system from direct current by steam to alternating current by water power, and are offering for sale their entire direct current plant.

The London Electric Company are still engaged in the work of remodelling their power house, and have placed an order with the Canadian General Electric Company for a complete marble panel switchboard, consisting of sixteen panels.

The Quebec government will offer for sale on June 8th the water power of the river Ottawa, opposite the township of Onslow, comprising the rapids and falls of Les Chutes des Chats. The purchaser must agree to spend $300,000 within three years in developing the power.

It is estimated that in the United States nearly 1,000,000 h. p. produced by electricity is used annually for the driving of pulp machinery. Such an extensive application reiterates the necessity for electrical engineers to become acquainted with the laws and practice of hydraulic engineering.

The Canada Tool Company, of Dundas, Ont., are in receipt of a large order from the Dominion Bridge Company, of Montreal, for special machinery. The large punches are to be operated electrically by motors directly attached to the machines, and for this purpose an order has been placed with the Canadian General Electric Company for four of their latest enclosed slow speed C.E. motors.

The city of Winnipeg, Man., have invited tenders for the supply of one 100 h.p. high speed engine for electric light plant, together with shafting, pulleys, belting, etc.

Mr. J. P. Graves, manager of the Granby Consolidated Mining & Smelting Company, states that it is the intention of the company to build a large smelter at Grand Forks, B. C. The smelter will be located on the Kettle river, power to be obtained by damming the river at a narrow canyon one mile above.

The British Columbia Electric Railways Company, of Vancouver, B. C., have declared their first dividend of 5 per cent. per annum on preference stock and 4 per cent. on ordinary stock. During last year the company made profits of $81,000, half of which was devoted to paying the dividend and the balance placed in reserve.

The Still Motor Company, Limited, of Toronto, has been granted provincial incorporation, with a capital of $75,000, to manufacture batteries and other appliances for propelling carriages, street cars, etc. The provisional directors are W. J. Still, Thos. Bengough, L. W. Doran, C. W. Chadwick and Joseph Heighton.

Messrs. Thos. Ahearn, John Murphy and W. Wylie, of Ottawa, visited the Electrical Exhibition in New York last month. Mr. Ahearn states that there was a splendid exhibition of horseless carriages, from automobile hose wagons to broughams. It is probable that the Ottawa Car Works may manufacture automobiles at an early date.

The Trenton Electric Company, of Trenton, Ont., expect to have their transmission lines at Belleville, Ont., completed very shortly, when they will be in a position to furnish power to the various manufacturers of that place. Mr. R. J. Graham is one of the first to avail himself of this power, and has already contracted for about 50 h.p. He has also placed an order with the Canadian General Electric Company for one 30 h.p. and one 10 h.p. three phase induction motors for operating refrigerating machinery, hoists and fans in his cold storage establishment.

The Montreal Cotton Company, of Valleyfield, P.Q., are making some very extensive additions to their electric plant. They have at present installed four 600 h.p. three phase generators manufactured by the Canadian General Electric Company, and have just placed an order with the same company for a large 2,000 h.p. generator of the revolving field type, together with switchboard panels complete. They have also ordered two 85 k.w. exciters, these having sufficient capacity for furnishing exciting current to the full equipment of generators. Upon the completion of this additional installation this company will have the largest and most up-to-date isolated power plant on the American continent.

Mr. W. H. Whiting, of Boston, Mass., has patented an electrical fire engine, mounted on wheels like a steamer and consisting of a rotary pump and electric motor. It is 25 per cent. lighter than the average steam engine and the motor has double the power. The current for running the motor is obtained by erecting a post about ten feet from the hydrant, and connecting this with the nearest source of electrical supply. The current is transferred from the switch-box on a post to the engine by two flexible conductors, which can be attached instantly and the engine be ready for use before the hose is laid.

The Canadian General Electric Company are introducing a series alternating arc lighting system to their patrons, which permits of the operation of arc lamps in series from an alternating current generator of any standard periodicity. This will undoubtedly fill a long felt want and will tend to revolutionize the systems now in use for street lighting. Appreciating the advantages to be obtained, the Sherbrooke Gas & Water Company, of Sherbrooke, Que., have placed an order with the Canadian General Electric Company for a complete equipment of one hundred of these lamps, with transformers.

The Railway & Engineering Review states that the North-Western Elevated Railway Company, of Chicago, has entered into a contract for 150,000 pounds of aluminum feeders. Three sizes of bare cables will be used, viz., 780,000, 1,000,000 and 1,300,000 circular mils in area respectively. The largest feeder will be about 1½ inches in diameter. Of the two larger sizes there will be two cables of more than 10 miles in each. The feeders will be placed in a wooden box or trough covered by a board walk, between the tracks, and they will be supported on unglazed clay rocks of umbrella shape, placed 9 feet apart. The contract was made on the basis that 47 pounds of aluminum are equal in conductivity to 100 pounds of copper. Experiments carried out by the electrical engineering department of the road have demonstrated that 157 circular mils of aluminum are equivalent in carrying capacity to 100 circular mils of copper.

For some months past it has been reported that the water power at Fenelon Falls, Ont., was to be developed for the purpose of transmitting electric power to Lindsay, Ont., a distance of 14 miles. We are informed that the undertaking has been definitely decided upon by the Light, Heat & Power Company, of Lindsay, who expect to have the new plant in operation by the 1st of October. They have commenced the work of construction and are arranging plans for the development of about 1,200 horse power. The electric plant will eventually consist of two 500 k.w. three phase generators direct coupled to turbines. They have placed an order with the Canadian General Electric Company for one 400 k.w. generator, together with switchboards, step up and step down transformers, and all the apparatus required to complete the electrical installation. We expect to give a detailed account of this enterprise in our next issue.

ELECTRIC RAILWAY DEPARTMENT.

ELECTRIC RAILWAY IN JAMAICA.

The following account of the electric railway at Kingston, Jamaica, of which Mr. H. Holgate, late of Montreal, is manager, is given by the United States consul there :

For some years there has been a mule railway in Kingston, but an electric road covering the lines of the old cars and other thoroughfares as well has just been completed. This new line has about 25 miles of track in and around Kingston, divided into three districts, viz., the lines north of the city, those east of the city, and those in the city. It is a private enterprise, started by Canadian capital, and is called the West India Electric Company. The Government license is for a period of 30 years, renewable for further periods at the pleasure of the governor. The company pays four per cent. of its gross earnings to the government, and assumes the maintenance of the roads and streets occupied by it to the extent of 18 inches on each side of the tracks.

The rates of fare are 4 cents for each passenger from any point within a district to another point in the same district by most direct route; that is, the fare is practically 4 cents for each section of the line, and from the end of the line to the east, through the city to the end of the line north, would be three fares, or 12 cents. In addition, the company reserves three front benches on each car, on which a first-class fare 6 cents is charged. The tickets are sold as follows: Seven 4-cent tickets for 24 cents, five 6-cent tickets for 24 cents, and ten children's tickets, for under 12 years, for 24 cents.

Passengers are allowed to stand. There are no restrictions as to number of passengers carried, and the same complaints of overcrowding are heard. Cars run every 15 minutes in the city. In addition to regular motors, this company runs market cars before 9 a. m. and after 5 p. m. for country people who carry produce. Those cars are trailers, and the fare on them is 3 cents.

STREET CAR FENDERS.

Mr. Duncan McDonald, superintendent of the Montreal street railway system, recently spent a couple of weeks in the United States, on a tour of inspection of the various railways in the principal eastern cities, with a view, particularly, of investigating the merits of the different fenders in use. He found that most every class of fender that has been invented was used. It had been proved, however, in actual operation, that if a person lay down on the track in front of the car or fell sideways, it was impossible to save him. This had been the verdict on all fenders now in use. While one of the best advertised fenders in the United States was on trial recently in Cincinnati, a fatal accident resulted, and this was the very first day of its use. These facts had driven railway men to the opinion that the old reliable maxim of "stop, look and listen when crossing a street car track," was the most reliable life saver up to date.

Mr. McDonald is now preparing a report on the subject, giving all the details at his command, and his opinion is that a combination fender, which will unite the best points of the various ones now in use, will eventually be adopted.

Concerning street car systems, Mr. McDonald says that Montreal can justly claim to have one of the best in existence. Nowhere did he find a two-minute service as is given in Montreal. The nearest approach to it is in Boston, where they are running a two and one-half minute service on one route from 5 to 7 p.m. For the balance of the day in Boston nothing is closer than five minutes.

In every place Mr. McDonald visited, he found interesting and instructive details of maintenance and operating that might be profitably applied. The Boston subway is not only admirable as a well-planned monument of engineering skill, but it is also one of the greatest achievements in the science of operating cars and handling large crowds with safety and despatch. The arrangement of traffic on Brooklyn bridge was another example of the time that could be saved by proper facilities and a little hustling on the part of the people. The absence of grades in most large American cities afforded much more economical maintenance than could be shown with the heavy hills as in Montreal.

CANADIAN CAPITAL IN NEWFOUNDLAND.

Mr. R. G. Reid, of Montreal, who holds extensive franchises from the government of Newfoundland, has concluded arrangements for the immediate construction of an electric railway and lighting system in the city of St. Johns. The contract for all the electrical apparatus for the street railway, power and lighting plant has been awarded to Messrs. John Starr, Son & Co., of Halifax, who are agents in the Maritime provinces and Newfoundland for the Westinghouse Company. The generating station will have a capacity of 1,500 h.p., which will be transmitted eight miles to St. Johns, and there distributed from a sub-station. Step-up and step-down transformers will be used, the current being transmitted at 15,000 volts. The 500-volt direct current for the street railway will be derived from rotary converters. The contract for cars has been placed with Messrs. Lariviere, of Montreal, that for trucks with the Canada Switch Co., of same city, while the Stillwell-Bierce & Smith-Vaile Co., of Dayton, Ohio, will supply the hydraulic machinery. The first cars are to be delivered by August 1st.

SPARKS.

The Board of Trade of Three Rivers, Que., has set in motion a project for the building of an electric railway from that city to Grand Mere.

Berlin citizens are agitating for an extension of the present Berlin and Waterloo electric railway through German Mills, Doon and Blair to Galt.

At the annual meeting of the Hamilton, Ancaster & Brantford Electric Railway Company, held last month, the directors were re-elected. The company still requires $20,000 to make up the necessary capital of $60,000.

The employees of the London Street Railway Company are again on strike. It is probable that the question in dispute will be submitted to arbitration, the employees and the company having agreed to this course.

A bill to incorporate the Ontario & Quebec Bridge Company was thrown out by the Railway Committee of the Dominion Parliament. This was a bill to build a bridge from Bank street, Ottawa, to the city of Hull, so that the Hull Electric Railway Co. might carry passengers into Ottawa. The bill was opposed by the Ottawa Electric Company, which has a thirty year monopoly for an electric street railway in Ottawa.

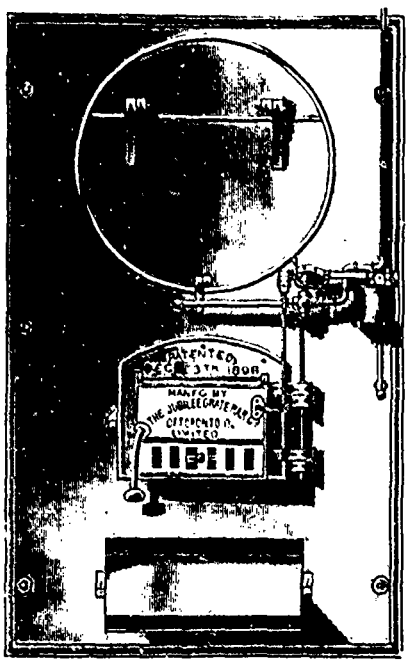
The Peterboro and Ashburnham Street Railway Co. have made a proposition that the corporation take possession of the railway, extend and improve it, and operate the road for a term of five years, without any allowance to the company, the understanding being that all capital expenditure shall be made with the concurrence of the owners, who shall have the right at any time within the period named to resume possession on repayment to the town of the sum expended on capital account, together with interest.

The Montreal Belt Line Railway Co. recently applied to the Railway Committee of the Dominion Government and to the Montreal council for permission to run its line from the north side of Duquette street to the Dominion Cotton Mills, within the limits of the city of Montreal. The Montreal Street Railway Co. protested on the ground that it had a right of preference over every other company, or in other words, that it held an exclusive franchise. The matter was referred to the city attorney, who has ruled that the corporation of Montreal, in giving the Montreal Street Railway rights and licenses, did not grant a monopoly for exclusive privileges. The city, he states, can grant the Montreal Belt Line Railway permission to run its line on Division street without violating the contract with the Montreal Street Railway Co.

Are you a member of the Canadian Electrical Association? If not, send in your application at once and take a hand in the forthcoming Convention at Hamilton.

THE REDPATH-REID AUTOMATIC SMOKE BURNER.

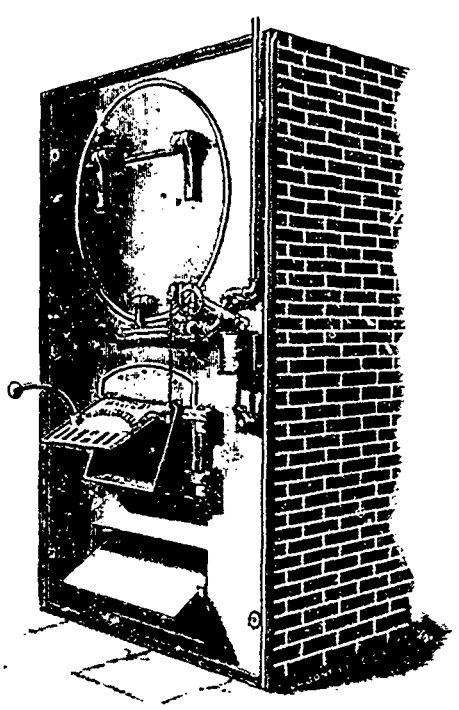
For a number of years engineers and mechanics in all parts of the world have been working diligently with a view to perfecting apparatus for consuming the smoke of boilers, and their efforts have in some instances been rewarded by a degree of success. This question has been given much attention by the patentees of the Redpath-Reid automatic smoke burner, who now claim to have perfected a machine which embodies all the elements which go to make up a high-grade invention, viz., efficiency, simplicity,



THE REDPATH-REID AUTOMATIC SMOKE BURNER.

and durability. Their smoke consumer is not a new system, but an old one improved and modernized.

Many persons will admit that the apparatus burns the smoke perfectly, but express a doubt when told that there is a saving in fuel of from 10 to 20 per cent. through the use of these consumers, contending that all the smoke that passes from the chimney would not warrant a tenth of this claim. The manufacturers of the Redpath-Reid burner offer the following facts to prove that the saving in fuel is effected: First, that it has always been impossible to otherwise get perfect combustion in burning coal. Second, that when there is perfect combustion, each pound of coal gives off 14,500 heat units, whereas with imperfect combustion not more



THE REDPATH-REID AUTOMATIC SMOKE BURNER IN OPERATION.

than 4,000 heat units are likely to be obtained. Third, if all the smoke in the fire box is burned, the heat does not have to penetrate through from 1/32 to ¼ inch of non-conducting substance. Fourth, that invariably the greatest heat in the coal is near the grate bars, the top of the coal being coaked over and presenting a dull red glow until broken up. Fifth, some days the draught, owing to the state of the atmosphere or direction of the wind, may be very sluggish, and here again economy is sacrificed.

In using smoke consumers, it is possible to attain nearer to perfect combustion than in any other way, and a perfectly white blaze instead of unconsumed carbon passes through the flues. The hottest fire is on top of the coal instead of under the surface, and the draught is always strong and cannot be effected in any way by the wind or atmosphere. A better understanding of the Redpath-Reid automatic smoke burner will be obtained by reference to the accompanying illustrations. The manufacturers are the Jubilee Grate Bar Co., of Toronto, who have already disposed of some provincial rights, and have others to sell for Quebec, New Brunswick and Nova Scotia.

THE IMPROVED SAMSON BATTERY.

The steadily growing demand for storage batteries is causing manufacturers to give much attention to perfecting improvements tending to increase their efficiency. We are advised by Messrs. John Starr, Son & Company that they have just made a change in the style of the well known Samson battery.

The improvement consists mainly in joining the carbon, zinc and cover in such a way that it is impossible, they claim, for a short circuit to occur between the elements when inside the jar. The cover is made of a hard dense material, into which is locked the carbon. The cylinder zinc is firmly held to the cover by a nut, and the result is, mechanically speaking, a one-piece battery which can be handled as such, thus dispensing with the rubber rings, etc., previously used. The carbon is held half an inch away from the bottom of the jar, and the zinc is a trifle shorter than the carbon. This is to save possible bridging of salts. The battery is shipped, set up, and to use same it is only necessary to remove the packing. The great advantage of this method, especially in the case of inexperienced persons using battery, will be recognized. It also facilitates the handling of same. The shape of the jar has also been altered, so that the whole appearance of the battery is very much improved.

Concerning the "Sampson" carbon the manufacturers say: It is manufactured in France and is composed of two parts, a fluted lower portion and a flat top carrying the binding post, which are baked into one piece in the kiln. The lower portion is a thin-walled, fluted, hollow cylinder, made from special materials, and by a special process, resulting in a quality of battery carbon which, as is the case with some natural products, cannot be obtained in this country. The top portion is composed of an entirely different kind of carbon from that used in the lower portion, which, after being subjected to enormous pressure, is treated when the carbon is complete in a way which renders it impervious to the creeping tendency of the solution and action of the ammonia gas.

The upper and lower portions, after being formed, are properly baked in the kiln, after which the top of the carbon is heated red hot and plunged into hot parafine, so that it enters into the minutest pore instead of simply collecting on the outside.

A combination of manganese and pea carbon is placed inside the fluted portion and held in position by a specially prepared plug which will not fall out. It is this depolarizer and its close proximity to the exceptionally porous carbon which imparts to the battery its remarkable recuperative qualities.

The result of the thorough and necessarily expensive mode of manufacture is the production of a battery carbon which has a larger surface, longer life and greater recuperative power than any other carbon element ever manufactured.

An improvement has also been made in the carbon binding post connections, which are bolted on across the top of the carbon, and is held in place by a safety check nut.

Messrs. John Starr, Son & Co. have recently appointed Mr. John Forman, of Montreal, agent for the provinces of Ontario and Quebec. Mr. Forman will carry a large stock of these batteries, and will be prepared to supply the trade promptly.

SPARKS.

The Bell Telephone Company is installing a municipal fire alarm system at Cowansville, Que.

A number of Peterboro' gentlemen are endeavoring to form a company to establish an automobile carriage service between Peterboro' and Chemong.

Mr. P. Alexander, electrician, of Peterboro', has recently completed the wiring for electric light of Geo. Matthews & Co.'s extensive establishment in that town.

The Town Council of Orillia, Ont., have submitted an offer for supplying light and power for the Asylum for Idiots, agreeing to put in a 750 light transformer and a 30 h.p. transformer for the sum of $1,400 per annum, on a five or ten years' contract.

Sales of small motors have lately been made by the United Electric Company, Toronto, as follows: 1 h.p. motor to E. S. Stephenson, St. John, N. B.; ½ h.p. motor to Brock Engraving Co., London; 3 h. p. motor to Lindsay Light, Heat & Power Co.

The Empire Heat and Light Co., of Westfield, N.B., is seeking incorporation, to deal in smoothing irons and all kinds of gas, electricity, and forces for power and heating purposes. The capital is $30,000, and the promoters are St. John citizens, including J. J. Porter and F. Calkin.

TRADE NOTES.

The Land Security Company of Toronto have ordered a motor for hoisting purposes from the Canadian General Electric Co.

The Canadian General Electric Company are installing a 100-light plant for the Beaver Portland Cement Company, of Montreal.

We regret to learn that the Ottawa Porcelain and Carbon Co. have decided to permanently close down their factories and liquidate their affairs, owing to the unprofitable results of the enterprise.

The Dominion Bridge Company, of Montreal, have placed an order with the Canadian General Electric Company for a G. E. 1,000 motor equipment, with special resistances, to be used for operating their heavy plate rolling machinery.

The Sprague Electric Company, of New York, have appointed Messrs. Jack & Robertson, of Montreal, Canadian sales agents for their well known electrical apparatus and supplies, including Lundell motors, generators, Greenfield interior conduits, etc.

Mr. F. S. Pearson, of New York, consulting engineer for the Cuban Electric Co., has awarded the contract for two 230 horse power engines to the Robb Engineering Co., of Amherst, N.S. They are for an electric railway from Regla, on the opposite side of the harbor from Havana, to Guamacoa, about eight miles distant.

Mr. Henry F. Duck, who for several years represented the Rathbun Company, of Deseronto, has been appointed Canadian agent for the Engineering Contract Company, of New York, and has opened offices in the Temple Building, Toronto. The company make a specialty of the construction of water power dams, foundations, canals, caissons, etc. Attention is directed to their announcement in our advertisement pages.

The United Electric Company, of Toronto, report the sale of 25 h.p. motors to the Schofield Woollen Company, Oshawa, and the Rat Portage Lumber Company, of Rat Portage. They have also sold an 80 h.p. generator to the Dominion Bridge Company, Lachine, Que., a 25 h.p. generator to John Bertram & Sons, Dundas, and a 60 light dynamo to the Journal Printing Company, Ottawa.

The Smart-Eby Machine Company, Limited, is the name of a new enterprise recently established at 191 Barton St. east, Hamilton. This company are engaged in the manufacture and sale of pumping machinery, steam, gas and gasoline engines, boilers, etc. Mr. Smart, who was a former resident of Hamilton, was recently connected with the Goldie & McCulloch Company, of Galt, and the Jenckes Machine Company, of Sherbrooke, and has therefore a practical knowledge of this business.

A very attractive catalogue has reached us from the Goldie & McCulloch Company, of Galt, Ont., descriptive of their "Model" gas and gasoline engine. A number of excellent illustrations are given, illustrative of the appearance and construction of the machine, accompanied by sketches showing the old fashioned method of obtaining power by means of windmills and such like antiquated devices. The catalogue is well designed to interest readers in modern methods of power development, and particularly in the advantages of the special engine to which the catalogue refers.

The Gasoline Engine Company has recently been incorporated and commenced business at Toronto Junction. The company have secured the right to manufacture in Canada the Olds gas and gasoline engines, which have been successfully manufactured and operated for some years in the United States. One of the members of the Canadian company was formerly connected with Olds Gas Engine Works Company, at Lansing, Mich., where these engines have, for some time past, been manufactured. The new company have therefore the benefit of practical experience in this line of manufacture.

The attention of young men who may be desirous of obtaining a knowledge of electricity and mechanical engineering is directed to the announcement in our advertisement pages of the Electrical Engineer Institute of Correspondence Instruction, of New York. This institute is designed to impart instruction in the above mentioned subjects by the correspondence method, which has been found to be a satisfactory substitute for attendance at engineering schools. Full information as to method, fees, etc., will be forwarded to any of our readers who may make request for the same, referring to the advertisement in the pages of this paper.

In a suit instituted by The Penberthy Injector Co., to restrain the Lee-Penberthy Manufacturing Co., of Detroit, from using the name Penberty, the Supreme Court of Michigan has decided in favor of the complainant, and ordered the latter company to discontinue the use of the name Penberthy in their corporate name and on their Lee injector. In compliance with this order, the defendants in the above suit advise us that in future they will carry on business as the Lee Injector Manufacturing Company. The decision will not interfere with any parties who have purchased Lee injectors in the past, the decree of the courts being that the word Penberthy must not be used in any form in the future.

LONG DISTANCE ELECTRICAL TRANSMISSION IN EGYPT.

Mr. Francis Fox, a member of the celebrated English engineering firm of which Sir Douglas Fox is the head, and whose offices are at No. 26 Victoria St., Westminster, London, is at present on a visit to Canada and the United States, accompanied by his nephew, Mr. Bertram Fox, a young electrical engineer connected with the firm of Siemens Bros. The object of Mr. Fox's visit is to obtain information with regard to electric traction development and methods on this continent, and the methods of utilizing water powers for the transmission of electricity.

In company with Mr. C. J. Crowley, of Toronto, the Messrs. Fox inspected the power station of the Toronto Electric Light Company, the Toronto Street Railway Company, the works of the Cataract Power Company at Hamilton, and the generating stations at Buffalo and Niagara Falls. They also made a trip over the railway at Lockport, and had an opportunity of inspecting the operation of the two 45 horse power electric locomotives in use on that road. They afterwards visited the works of the principal electrical companies in Montreal, together with those of the General Electric Company at Schnectady, New York. From thence they go to New York, where they will embark for Great Britain.

The information acquired on this visit is intended to be used in connection with the proposal to utilize the Zambesi Falls to generate electricity for the operation of the railway to the city of Cairo, in Egypt. It will be remembered that Mr. Duncan Forbes, who was consulting engineer for the Cataract Construction Company at Niagara Falls, recently made mention of this proposal. The firm with which Mr. Fox is connected are interested in the project. The Zambesi Falls are described as being 450 feet high, the river leading to them broadening out immediately before reaching the precipice over which the water falls perpendicularly into a narrow gorge shaped like the letter "S." The form of this gorge, with its projecting points of land, renders it possible to place a power station in close proximity to the Falls, and obtain the benefit of the full force of the water. The electricity generated at this spot would have to be transmitted a distance of 200 miles, which Mr. Forbes has declared to be feasible. The further progress of this enterprise will be watched with the greatest interest throughout the world.

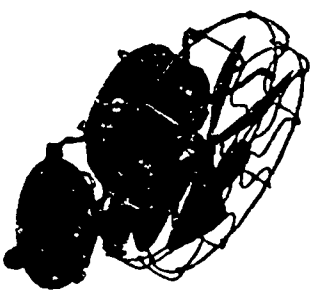
Mr. A. J. Coriveau, of Montreal, is said to have interested United States capitalists in his Lake Champlain and railway enterprises.

The Canadian General Electric Company have just received an order from Mr. E. Keefe, of Halifax, for one of their standard 25 kilowatt direct driven units for the lighting of the new elevators which he is erecting for the Intercolonial Railway.

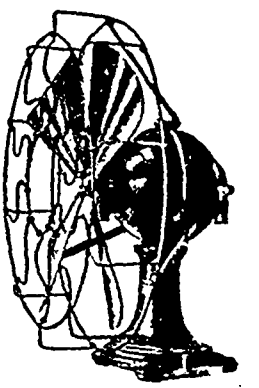
The Canadian General Electric Company are in receipt of an order from the Canadian Pacific Railway Company for two of their standard 40 kilowatt direct connected generators, with Ideal engines. These are to be used for the lighting of their new passenger depot at Vancouver, B. C.

THE CANADIAN GENERAL ELECTRIC COMPANY'S

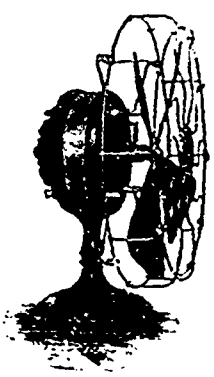
1899 FAN MOTORS



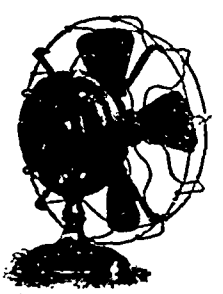
Are constructed to give the highest efficiency with the smallest consumption of current.

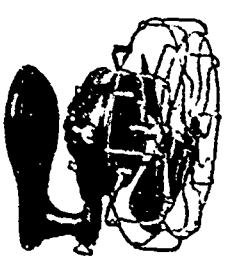


Fans are kept in stock to suit either direct or alternating current for any standard voltage or periodicity, and with either solid or trunnion bases.



For description and prices of our Ceiling and Desk Fans see our illustrated pamphlet. If a copy has not reached you, please drop us a card and we will take pleasure in mailing you another.





Canadian General Electric Company

Limited

HEAD OFFICE : **TORONTO**

FACTORIES : **PETERBORO'**

BRANCHES :

MONTREAL, P.Q. HALIFAX, N. S.

VANCOUVER, B. C. WINNIPEG, MAN.

ROSSLAND, B. C.