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CANADIAN
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AND ENGINEERING JOURNAL

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JULY, 1900

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CANADIAN
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THE IMPERIAL ELECTRIC LIGHT COMPANY.

The origin of the Imperial Electric Light Company, of Montreal, dates from the spring of the year 1892, when Mr. Israel Charbonneau installed a small dynamo in his saw mill. He afterwards accepted Mr. Jos. E.

IMPERIAL ELECTRIC LIGHT CO.—VIEW OF BUILDINGS.

Pare as a partner to assist him in promoting the business of electric lighting in St. Jean Baptist village, then a suburb of Montreal, but at present one of its most promising wards. Later these two gentlemen were joined by three others, Messrs. Jos. Girard, Damien Lalonde and Joseph Lalonde, and the business was extended towards the central part of the city. About the month of March, 1893, a company was organized to take over the assets and liabilities of the above mentioned co-partnership, and the St. Jean Baptiste Electric Company came into existence. On the first of June, 1896, the company was re-organized by the late Hon. Louis Tourville, and letters patent were granted on June 19th, 1896, incorporating "La Compagnie de Lumiere Electrique Imperiale," with a capital of $200,000. Messrs. J. M. Fortier, Arthur Caron, Hon. Louis Tourville, Onesime Marin, N. P., and Rodolphe Tourville were the provisional directors. Since that time some changes have occurred in the board from death and other causes, and the present directorate is comprised of Messrs. Victor Morin, N. P. president; Rodolphe Tourville, vice-president; E. J. Chapleau, treasurer; S. Z. Leboeuf and Dr. E.P. Chagnon, directors. The buildings as shown in Fig. 1, have a frontage of 184 feet and a depth of 94 feet, and are built of brick and stone. Previous to entering the works the attention of the visitor is directed to an inclined alley leading directly in front of the boilers, which is the means of dumping coal to the firemen, and which at the same time enables the company to keep an accurate record of the fuel used, by the employment of a Fairbank's scale. A portion of the space in this alley is occupied by a tank, 40 x 15 x 10 feet, of a capacity of nearly 30,000 gallons of water. This tank is kept well filled by means of an artesian well 235 feet deep. This well, the work of Mr. Wallace Bell, of Montreal, provides a very economical water supply. The Northey pump used in connection, has a capacity of 3000 gallons per hour, this supply of water being sufficient for steam and condensing purposes.

A chimney 134 feet high from the ground level, serves three Heine boilers, two of 250 h. p. and one 150 h. p., making a total capacity of 650 h. p. These boilers were built by the Geo. Brush Boiler Works, of Montreal. Two Worthington steam pumps are used to feed the boilers, and there is a heater also, to be used when running one of the high speed engines. In the engine room is found a Brown Cross Compound engine of 500 h.p., built with an attached direct-jet condenser. This engine was built by the Polson Iron Works Co., of Toronto, its fly wheel is 24⅓ feet in diameter, and its speed is 68 revolutions per minute. The driving shaft operates 320 revolutions per minute, and is connected to the fly wheel by a belt 46 inches wide and 131 feet long, which cost $1,400. To the left of the large engine is seen two small engines, one 135 h. p. Leonard Ball Compound, and the other a 80 h. p. Leonard automatic, the pulley of which travels at 300 revolutions per min-

IMPERIAL ELECTRIC LIGHT CO.—BOILER ROOM.

ute. The main shaft, which was made by Messrs. Miller Bros. & Toms, of Montreal, is connected to the above mentioned three engines, and to three dynamos, and is easily controlled by Hill's friction clutches.

Two Westinghouse dynamos, 150 k. w., 2000 volts, ute, supply single phase current to a large number of 7200 alternations, operating at 730 revolutions per min-

customers. There are two Westinghouse exciters attached to the dynamos, these operate at 2150 revolutions per minute. There is also a third dynamo,

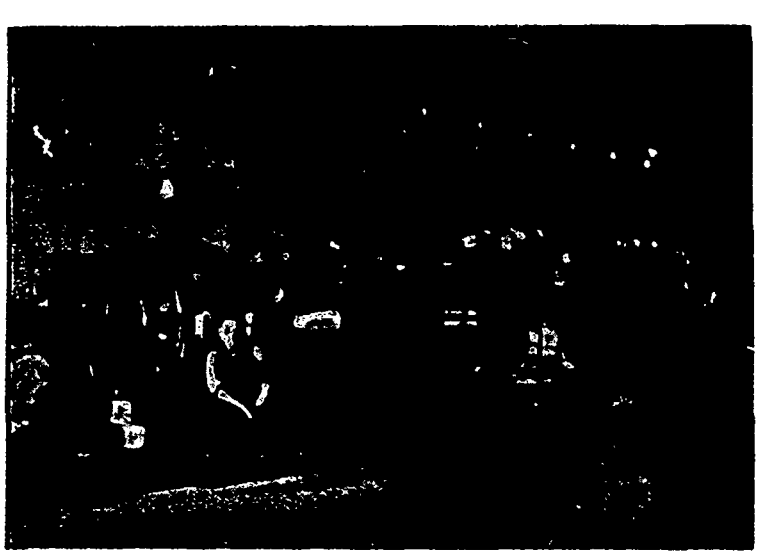
IMPERIAL ELECTRIC LIGHT CO.—500 H.P. BROWN CROSS COMPOUND ENGINE.

with exciter of General Electric Company's make. A squeleton switchboard (Figure 5), containing all the required instruments, including three I. R. regulators made by the Canadian General Electric Company, Peterborough, provides the means of distributing the current, which is by a system of five circuits. A battery of four high voltage transformers serves to reduce from 5000 to 2400 volts the current supplied this company by the Lachine Rapids Hydraulic and Land Company. This set of transformers represents a total capacity of 1000 h.p., three-quarters of which is at present used by the company.

There is an alarm gong, a complete tool and testing room, also the finest patrol service wagon in Montreal.

The Imperial Electric Light Company has entered into a contract with the Lachine Rapids Hydraulic and Land Company, by which it will be supplied with current by the latter company for the next eight years, and as means of precaution had their squeleton switchboard built to receive either Lachine Rapids water power current or steam power current. The business of the company is confined almost exclusively to stores, offices and places of business, the company having given no attention to the lighting of residences and public institutions.

The company is under the able management of Mr.



IMPERIAL ELECTRIC LIGHT CO.—WESTINGHOUSE DYNAMOS AND DISTRIBUTING SWITCHBOARD.

Jules Bourbonniere, a portrait and sketch of whom appeared in our last issue, and whose portrait is reproduced on following page. Mr. Bourbonniere holds the dual position of manager and secretary. He is a great student and possesses a remarkable fondness for literature. In his residence will be found an up-to-date library and a scrap-book room of the contents of which he may justly feel proud. In the management of his plant he has a reliable assistant in Mr. Alfred Lepage, superintendent, whose portrait appears herewith.

The company own several tenement houses adjacent to their works, these being occupied by employees.

TREATMENT OF DRIVING BELTS.

THE Werkmeister Zeitung gives directions on the best treatment of driving belts, whose faultless working is of great importance in every factory. The good drawing of a belt increases with the friction between belt and pulley. Hence it is obvious that the belt must surround as large a portion of the pulley as possible. For this reason crossed belts always pull better than open ones. If in any way practicable, open belts should cover at least almost half the pulley. If

IMPERIAL ELECTRIC LIGHT CO.—SWITCHBOARD.

the circumference of one pulley be very small in proportion to the other, thus allowing the belt to cover only a small portion of the smaller pulley, a sliding of the belt frequently takes place, especially if the distance between the two pulleys be slight.

It is plain, continues the Werkmeister Zietung, that a slow running of the engine makes a strong stretching of the belts necessary. For this reason a tightening-pulley is frequently placed midway between the two pulleys, so as to avoid a repeated resewing.

If a large power is to be transmitted at little velocity, a broader belt should be employed than would be necessary with greater velocity, or else two belts are made to run on top of each other. If one does not care to tighten the belts still more or use one of the many belt lubricants, the best makeshift is to cover the pulley with sail cloth. This is done by cutting the sail cloth so exactly that it is difficult to get it on the pulley. By thoroughly moistening the sail cloth on the pulley with warm water it clings more closely to the pulley, as the water causes it to shrink. It is still more practical in the long

run to fix, instead of canvas, a leather strip of corresponding breadth on the middle of the pulley, by having a few holes bored into the rim of the pulley which are tightly filled up with wooden wedges, in order to be able to nail the strip of leather on it. This process is said to have proved useful with ordinary proportion of the size of the belt to the effect of power to be transmitted. If all is unavailing, the belt is too weak and must be replaced

MR. JULES BOURBONNIERE,
Manager Imperial Electric Light Company.

by a broader or double belt. Of great advantage in cases are the wooden belt pulleys, which increase the driving power.

STANDARD RULES.

The committee on standard rules submitted the following report at the recent convention of the National Electric Light Association :-

"Your committee has continued the same line of policy during the past year as heretofore, viz., to discountenance any changes in the National Code of Rules not absolutely necessary ; but with the march of improvement in the electrical field some changes therein and additions thereto have been found necessary since the issue of 1897. Many of the changes made were suggested by the chairman of your commitee, and others received his approval. The policy heretofore pursued by the insurance organizations of sweeping out of existence thousands of dollars' worth of material that had been used previously with the sanction of insurance inspectors has been abandoned, and, while new and better devices and material are substituted, an opportunity is offered the manufacturer, dealer, contractor and station manager to sell and use the material and fixtures on their hands.

"The thickness of interior conduit, lined or unlined, has been established, and commercial gas-pipe taken as the standard.

" 'Weatherproof' wire, so called, is tabooed for interior construction unless covered with a slow-burning material.

"A standard of thickness of insulation on wire, after a conference with the manufacturers, has been established.

"The much-vexed question of the proper distance between fuse terminals has been determined, as well as the distance between fuse metals of opposite polarity. Switches are now being standardized as to the proper breaking distance between poles, etc.

"The rules have been changed so as to permit the running of two more small motors in series multiple or multiple on constant-potential circuits.

"Rubber insulation is not now insisted on for flexible-cord pendants in dry places, but an elastic slow-burning material may be used.

Rule 40 has been so amended as to permit in dry places the use of a slow-burning insulation similar to what has been known in the past as 'Underwriters.'"

ACCIDENTS TO STEAM BOILERS IN FRANCE.

The British Institute of Civil Engineers gives, in Foreign Abstracts, an interesting tabulated resume, taken from the official reports, of the whole of the accidents occurring to steam boilers in France during the year 1896. The information given comprises the date and situation of the accident, details of each boiler, the circumstances attending the accident, and the consequences and presumed cause of each accident.

In 18 cases defective design and workmanship was the cause of the accident, the principal defects being—1, parts made inaccessible to complete inspection ; 2, tubes of too large diameter and too thin ; 3, copper fire-box above the level of the water, and unprovided with safety appliances ; 4, copper of too thin a gauge ; 5, fire-door opening too weak; 6, supply pipes not provided with expansion joints ; 7, staybolts badly made ; 8, cast iron parts of bad design or subject to unequal expansion ; 9, plates of two low a grade for the strains to which they were submitted.

Defective maintenance was the cause of 14 accidents through—1, corrosion of plates and other parts ; 2, wear and deterioration of brass smoke-tubes ; 3, wear and defective repair of a copper fire-box ; 4, over-straining of a staybolt ; 5, defective making of joints.

Careless working caused 15 accidents, viz., in five cases through shortness of water, and in seven cases

MR. ALFRED LEPAGE,
Superintendent Imperial Electric Light Company.

through want of cleaning ; in one case through an excess of pressure, and in two cases through tightening joints while under steam. In five cases the causes of the explosion were not ascertained.

Further tables classify the accidents according to—1, the class of work for which the boiler was employed ; 2, the type of boiler ; 3, the presumed cause of the accident. The total number of accidents dealt with was 44, which resulted in injuries to 25 men and death to 16.

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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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Cost of Fuel. THE recent increase in the price of soft coal with the consequent proportionate increase in the import duty, has proved a serious item in the expense account of large power users. The Toronto Electric Light Company, who burn something like 60,000 tons of coal per annum, propose to avoid this serious extra expense by importing in their own vessels direct from the mines a species of hard coal or culm, which, when burned with a proportion of soft coal, gives results almost equal to those to be obtained by using soft coal alone. This fuel, besides being cheaper in price, is not subject to the import duty of 25 cents per ton, which of itself is a substantial item.

Recording Wattmeters on Switchboards. IN a paper presented to the North-Western Electrical Association on June 26th, Mr. W. Worth Bean points out the advantages of using recording wattmeters on switchboards. These may be briefly stated thus: 1. Knowing the actual output of his station, the manager can intelligently purchase and test the quality of his fuel. 2. A check is afforded upon the work of the fireman, whose carelessness or inefficiency cannot be laid to the poor quality of the fuel. 3. The given amount of current leaving the switchboard being known, it becomes possible for the station manager to tell if his current is wasted in motors, transformers, lamps or wire connections.

The Dodge Telephone Company. A PARAGRAPH which recently appeared in the daily press stating that a protest had been received by the City Council from Mr. J. A. McMurtry, representing the Dodge Telephone Company, against the renewal of the agreement with the Bell Telephone Company, served as a reminder to the public that the plans of the Dodge Company for the supply of a cheap and efficient telephone service to the citizens of Toronto appear to be materializing very slowly. Mr. McMurtry, in his communication to the Council, states that he will soon be in a position to make a proposition to the city. In common with other citizens we await the early fulfilment of this promise. If the Dodge telephone system is all that its promoters claim it to be its appearance will be welcomed in a more tangible form than it has yet assumed.

Gas Engine Tests. IN view of the rapid development of iron production works in Canada, interest attaches to recent tests in Belgium of a gas engine of the Delaware-Deboutteville type, supplied with gas directly from the blast furnaces. The engine was specially designed to operate in this manner, the cylinder being unaffected by the residuum of dust in the gas after it had been cleansed by being passed through depositing chambrse. Specimens of the gas taken from time to time were submitted to calorimetric test. The speed of the engine during first test varied from 92.48 to 94 r.p.m., and the number of admissions was exactly half the revolutions. Calculation showed that the thermal efficiency was 27.11 per cent.; that is, this figure represented the ratio between the heat turned into work and the heat available for work. The net efficiency or the ratio between the work a e brake and that of the heat in the gas consumed varied from 19.86 to 22 per cent., a figure much higher than it is possible to obtain with the steam engine. At full

load the thermal efficiency was between 25.25 and 27.16 per cent, and the net efficiency between 20.44 and 22 per cent. The mechanical efficiency of the machine was 73 per cent. at half load and 81 per cent. at full load. On the second test, the thermal efficiency was 27.34 and 27 10 and the net efficiency 20.60 and 22.17 per cent. of the total heat supplied 20 per cent. was converted into work, 52 per cent. passed away in circulating water, and 20 per cent. in the exhaust. The consumption of gas varied from 31.13 cubic meters to 31-56 cubic meters per horse-power hour.

Popularity of Horseless Vehicles.

THE constantly increasing number of automobiles and locomobiles to be seen on the streets of Toronto may we presume be taken as tangible evidence of the growing popularity of horseless vehicles. The opening out of two large showrooms on the principal thoroughfares also witnesses to the oncoming of the horseless age. Still another indication in this direction is the adoption by the post office department of automobiles for the delivery and collection of mail matter from the trains and branch post offices to the general post office. Electricity, gasoline and steam are all in evidence as the propelling power for these vehicles, and it remains to be seen which method will ultimately gain the ascendency. It will probably be found that each has advantages for particular duties and circumstances.

The Canadian Exhibit at the Imperial Institute.

The resources of Canada, and particularly of the province of Ontario, are by no means properly or creditably represented by the exhibit at the Imperial Institute in London. The visitor would be much more favorably impressed if the exhibits of the various provinces were placed side by side, instead of on different floors. The present arrangement does not convey the idea that Canada is one Dominion, but rather that it consists of a number of separate provinces having little or no connection with one another. The exhibit should be arranged in compact form like that of Australia. As to the character of the exhibit, and more particularly that of the province of Ontario, the richest and most important of of the provinces, there is good ground for complaint. One would suppose from the numerous views of Niagara Falls placed about the walls, that this great natural phenomenon was the one distinguishing characteristic of the province of Ontario, while the specimens of Indian work are well calculated to confirm the idea, already to prevalent in the minds of some of the people of Great Britain, that Canada is a wild and uncivilized country. Ontario is known on this side of the Atlantic as a fruit-growing province, and the quality of its production in this line is not excelled by those of any other country. In view of this fact, it is extremely humiliating to a Canadian to observe that the jars containing samples of Canadian fruit shown in this exhibit have apparently not been refilled during the last decade. What was once fruit might now, judging from appearance, be almost any other substance under the sun. There is also displayed a view of the Toronto Industrial Exhibition of date the year 1885, which, of course, conveys a totally inadequate idea of the character and extent of the Exhibition of to-day. We would suggest that all relics such as this and the photograph of the ruins of Fort Erie, might well be thrown out of the exhibit, and modern views of our principal cities and industries substituted, so that visitors would be given an approximately fair idea of the kind of country Canada is, the extent of its development, and its advantages as a place of residence and business enterprise. The Canadian Pacific Railway show some excellent views of harvesting in Manitoba. These are well calculated to make a favorable impression upon intending emigrants. There is also an excellent geological map of Ontario containing a large amount of information with regard to the population and resources of the province. There is a fairly good exhibit of building stones and marbles, also of hardwoods. Other features equally valuable might be added, so as to convey to visitors a proper idea of the country and its resources. The entire exhibit should either be rearranged, improved, and brought up-to-date, or entirely done away with.

The Proposed Dominion Exhibition.

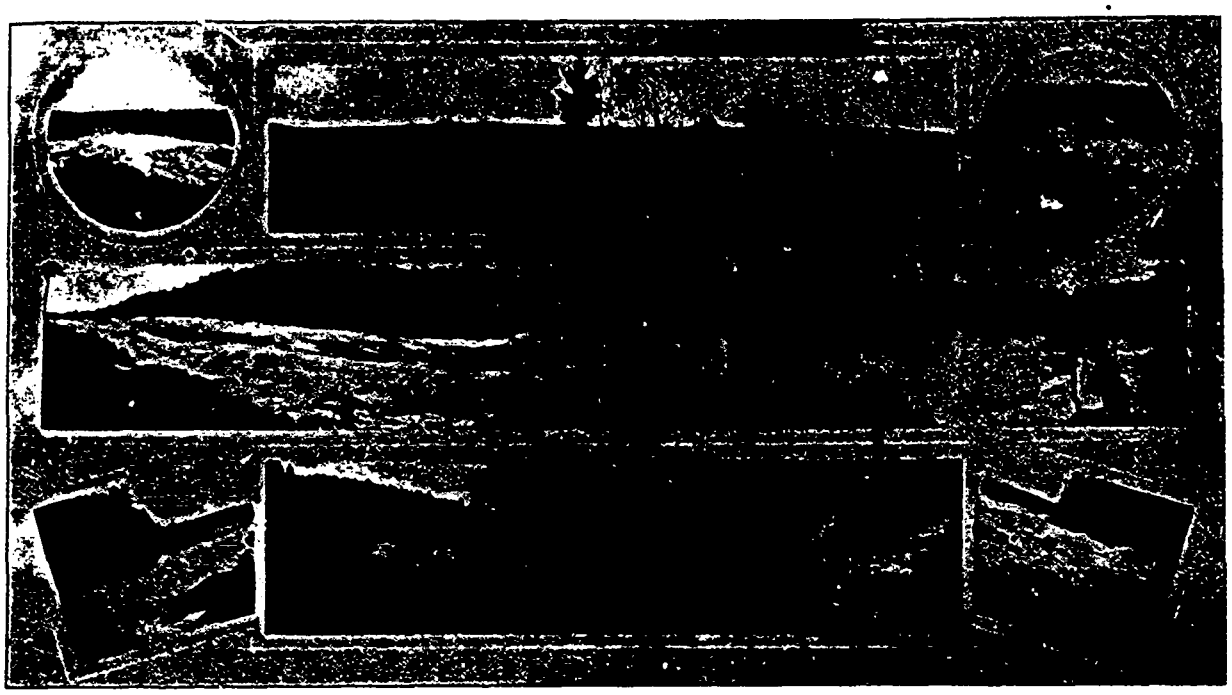
THE Executive of the Canadian Manufacturers' Association have been considering the question of the advisability of holding a Dominion Exhibition in Toronto next year. The opinion of the members of the Association has been asked as to whether the Association should go beyond this and make an exhibit at the Pan-American exhibition to be held in Buffalo. The consensus of opinion seems to be that, if the project for a Dominion Exhibition is gone on with, no attempt should be made to exhibit at Buffalo. This opinion seems well founded. If a Dominion exhibition is undertaken and carried out on a creditable scale, it will sufficiently tax the energies of the Association. It must also be borne in mind that the possibility of finding a market in the United States for Canadian manufactures is extremely small, seeing that the United have now an over-production in almost all lines of manufacture, and are looking for outlets in foreign markets for their surplus goods. We have felt for several years past that the holding of an Exhibition in Toronto, on such a scale as to attract visitors from all parts of the Dominion should be productive of much good, and if the attempt is to be made it might as well be next year as any other time. The Exhibition at Buffalo would not be likely to interfere with its success, but on the contrary might add to it, as some of the visitors to the larger exhibition might be disposed to visit Toronto also. Speaking generally, it would seem as though the Exhibition idea is likely to be carried to an extent which will eventually deprive it of any novelty or usefulness. We observe that on the heels of the Buffalo Exhibition is to come another one at St. Louis, preparations for which are already in progress. There is also to be one held next year in Glasgow. If Canada is to have an Exhibition on a national scale, it would be as well to launch the enterprise at once, so that we may not come in at the tail of the procession.

At the last regular meeting of the Engineers' Club of Toronto, a discussion took place, led by Mr. James McDougall, C. E., on "Freight Traffic on City and Suburban Tramways.

The only tender received by the city of Toronto for electric lighting was that of the present contractors, the Toronto Electric Light Company. The company offer, in the event of the present contract being renewed for five years, to provide the service at $71.90 per lamp, per year, and for a ten years' contract at $65.70 per lamp, per year, using enclosed arc lamps. A tender was also submitted by the Kitson Incandescent Company for the Kitson incandescent light at $90 per year. The council have employed Mr. G. R. Rosebrugh, of the Electrical Department of the School of Practical Science, to test and report upon the comparative illuminating power of the Kitson light as compared with that of the electric lamps now in use.

THE SHAWINIGAN WATER AND POWER COMPANY.

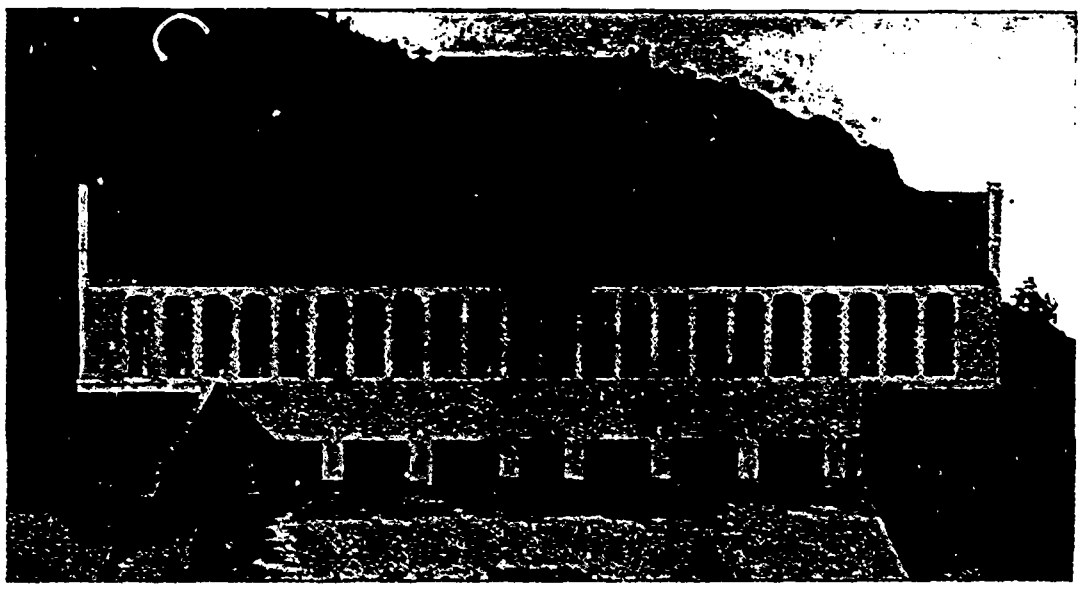
The following description of the extent of the proposed operations of the above company and of the hydraulic work in connection with the extensive plant which they propose to install at Shawinigan Falls, is abstracted from a recent issue of the Engineering Record.



VIEW OF THE SHAWINIGAN FALLS.

At a later date particulars will also be given of the electrical plant.

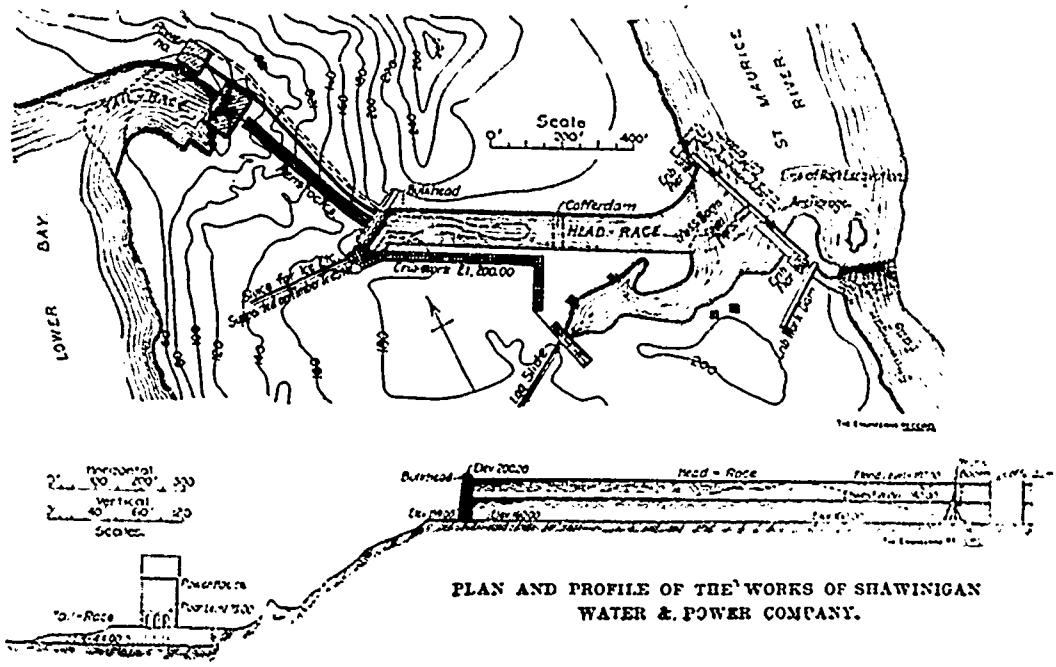
The St. Maurice River is a stream draining 18,000 square miles of heavily timbered country on the north side of the St. Lawrence River, into which it empties at the city of Three Rivers, situated about half-way between Quebec and Montreal, the distance to either of these cities being 90 miles. About 15 miles back from the St. Lawrence, this river, in breaking through the Laurentian hills, forms in a distance of 15 miles a number of falls and rapids, which with the heavy flow of water obtainable, are capable of development into power at a very low capital cost. A minimum of 200,000 horse-power can be developed here at the lowest known water, even after allowing a liberal proportion of the flow for the carrying away of frazil or anchor ice during the winter. As the low water in this region unfortunately occurs in the winter some allowance of this kind has to be made. Owing to the lack of railroad communication, these desirable properties have lain fallow, but the opening of the Great Northern Railway of Canada, which will give the best of them direct communication with Quebec, Montreal and Ottawa, and thus open them to the world, has made their commercial development feasible. The city of Three Rivers is open to ocean navigation for eight months in the year, and it is not improbable that at no other seaport in the world is there a power of such magnitude within a radius of 30 miles. A portion of this power has already been developed at Grand Mere, distant 30 miles from Three Rivers, where it is utilized under a head of 40 feet in the operation of a pulp and paper mill, having a capacity of 100 tons of paper and 50 tons of pulp daily.



VIEW OF THE POWER HOUSE.

The most important power location, however, is that

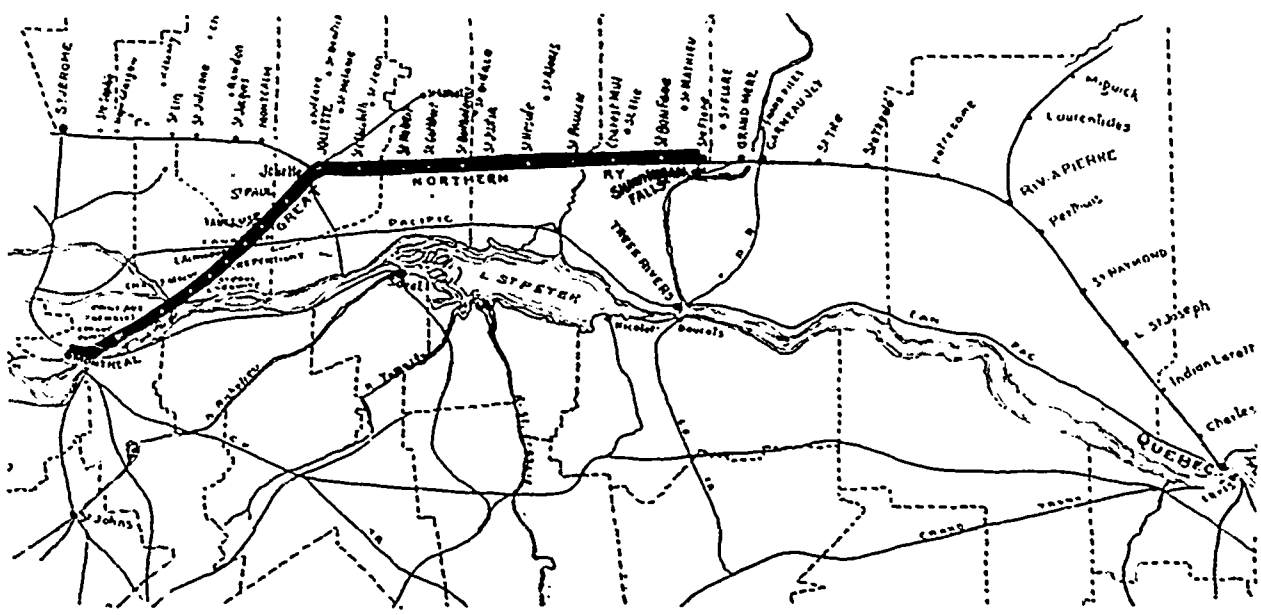
at Shawinigan Falls, a cascade having a fall of 140 feet in a very short distance. The normal flow of the river at this point is 24,000 cubic feet per second, and 100,000 horse-power can be developed and utilized at the very lowest water. The Shawinigan Water & Power Company has acquired the whole of this power from the Government, and is developing it on a large scale.



PLAN AND PROFILE OF THE WORKS OF SHAWINIGAN WATER & POWER COMPANY.

It has acquired large tracts of land in the vicinity, built a standard guage branch 4½ miles long through rough country to the Great Northern Railway, with sidings, turntable and terminal facilities, and has been working throughout the past winter on an initial development of 30,000 horse-power with a head-race and intake of sufficient capacity for extension to 60,000 horse-power. A town site has been laid out, and its improvements projected, and the population now numbers over 2,500.

The natural conformation of the ground in the vicinity of the Falls is somewhat remarkable. A narrow ridge or hogback of clay formation extends out as a peninsula separating two bays of the river forming the upper and lower levels of the Falls, between which there is a drop of 140 feet. A small stream, called the Shawinigan River, falling into the lower bay, carries this peninsula still further back, making it nearly a mile in length, with a width from 600 to 1,000 feet. This ridge, along which the railway is carried, was originally only 5 or 6 feet wide on top in places, falling away with slopes of 1½ to 1 on each side, and although formed of nothing but blue clay has withstood the pressure of water coming within 20 feet of the crest at high whter, the distance through the section of the ridge from water to air being not over 60 feet. Borings taken for a depth of 80 feet below water during the past winter show nothing but blue clay. This bank was, however, being carried away slowly by erosion, and must at some future date have broken through. After building the railway along the ridge the bank has been thoroughly rip-rapped with loose stone from the excavation in the head-race, thus obviating all danger of this kind.



PROPOSED ROUTE FOR TRANSMISSION LINE TO MONTREAL.

Toward the upper corner of the bay the water is of considerable depth, affording facilities for the development of an independent water power for a paper mill or other large industry. At the end of the bay towards the falls the water is shallow, with large sand bars which would render any development at that end exceedingly expensive and troublesome to maintain.

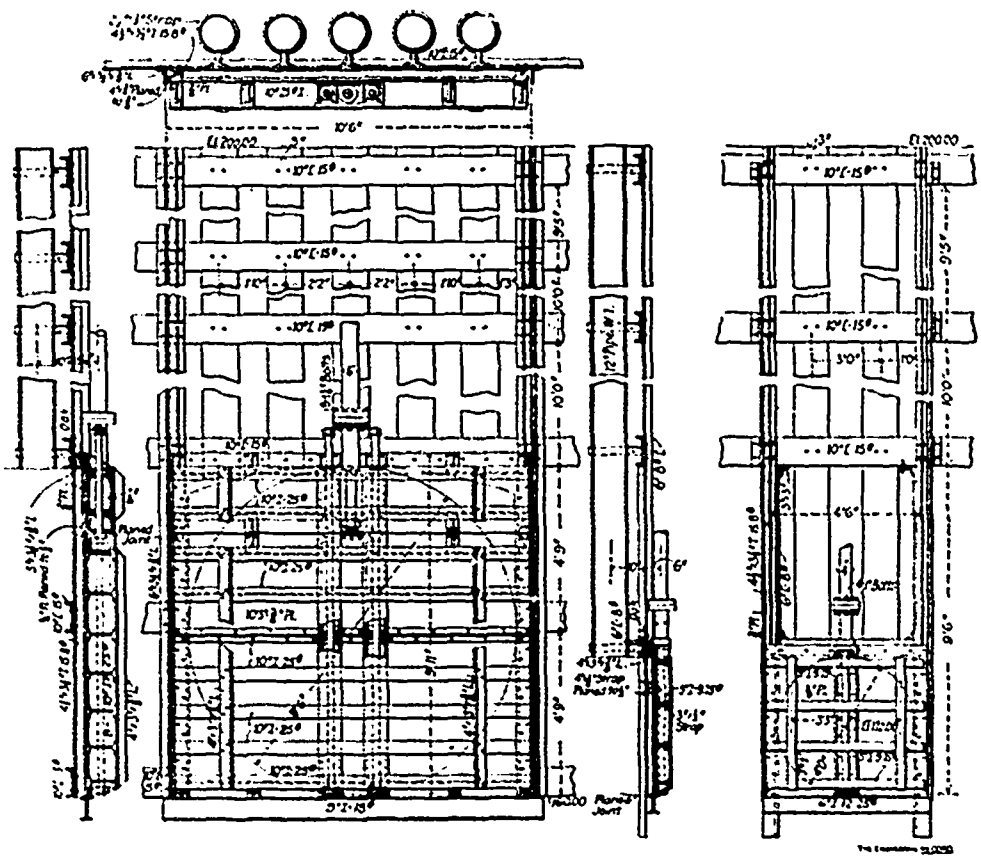
Just above the Falls the river is divided, by a large island, into two channels, both of which converge half

way down the Falls. The united waters strike directly into the face of a rock cliff and turn at an angle of about 110 degrees to their course, forcing their way through a narrow gorge, in which there is a drop of 25 feet, into the lower bay.

The present development consists of an intake canal or head-race about 1,200 feet long cut through rock from a point just at the head of the Falls and running back at an angle of 135 degrees with the course of the river, with a glance boom to deflect floating debris and ice over the Falls, terminating with a heavy masonry bulkhead from which the water is carried in large steel penstocks to the power-house below.

This canal is funnel shaped for about 500 feet of its length at the entrance and beyond this has a width of 100 feet by a depth sufficient to give 20 feet of water at the lowest known level.

The sides are formed by the natural rock, above



GATE AT HEAD OF PENSTOCK.

which they are carried up to a height of 40 feet by a dry-stone wall on the right hand side, on which the natural ground is high, and by a timber crib-work wing dam on the left hand side. The dry wall is built of heavy stone with vertical stepped back, the face being battered 2 inches to a foot. This wall is from 6 to 20 feet high, and is filled in behind with loose stone and gravel as as to form a road along the bank of the head-race.

The cribwork dam, 15 feet and 20 feet wide and from 10 to 23 feet high, is built of 12 x 12-inch pine face timbers, laid 2 inches apart, with 10-inch round pine cross-ties 10 feet apart in each course and staggered in alternate courses so as to form 5-foot pockets, and with 6-inch flattening longtitudinal stringers running through the center. This dam is faced with two layers of dressed pine plank, 2 inches thick. Both the face timbers and sheetings are closely scribed to the rock, and the dovetailing of the ties into the face timbers and general fitting is of a superior character. The crib is filled with stone very closely packed and is backed with stone for about half its height. A talus of gravel is to be laid along the outstream side extending over to the edge of the excavation. All bolting was done with ⅞-inch round spikes driven into ¾-inch holes, bored by a pneumatic boring machine.

At the end of this crib, next the bulkhead, is placed an ice chute to carry off drift ice and trash from the racks, and the crib being 40 feet high at this point, is 30 feet wide. Cribwork was used along this side of the canal so as to be easily removed when the canal is widened and the bulkhead extended for additional penstocks required to develop 60,000 horse-power.

The entrance to the head-race is protected by a heavy glance boom in two sections, each 220 feet long, supported by two heavy crib piers at the ends and by a steel structure at the center. The cribwork piers are 30 x 30 feet square by 26 feet high, and are built of 12 x 12-inch pine face timbers, laid to 2-inch spaces, with 6-inch flattened cross-ties 10 feet apart in each course, staggered in alternate courses. They are faced with 6-inch oak on the outstream and upstream sides, and each of them has two elm mooring posts 20 inches in diameter, capped with cast iron. The bottom timbers are bolted down with 24 fox-bolts 1½ inches in diameter running 5 feet into the rock.

The steel bottom pier consists of a bent of two vertical posts, each made of a pair of 15-inch channels 38 feet two inches long. These uprights are 22 feet apart in the line of the boom, and are braced with horizontal and diagonal struts, and sway bracing in every direction, particularly, of course, in the direction of pressure at right angles to the line of the boom, the connections being made with gusset plates riveted between the webs of the channels. The bases of the bents are each formed by two pairs of angles set up on concrete piers. These bases are anchored down with 1½-inch fox-bolts 10 feet long, running 6 feet into the rock and having a cross piece to set into the concrete base

piers. Half-round rubbing pieces are provided to allow the boom to slide smoothly up and down, and heavy shackles are provided to which the boom chains will be secured.

The boom is made in the form of a Howe truss, there being two sections each 220 feet long, 4 feet deep and 10 feet wide. The face timbers are three courses of 12 x 12-inch timbers with 3-inch plank laid solid between, diagonally, forming the main bracing, the counter-bracing being formed by 4 x 12-inch timbers on edge spiked to the main bracing. The truss is divided into 10-foot panels and bolted with iron bolts 1¼ inches to 1¾ inches in diameter with plate washers. On the outstream side the boom is faced with 3-inch tamarack plank laid longitudinally to take up the wear of the ice, etc.

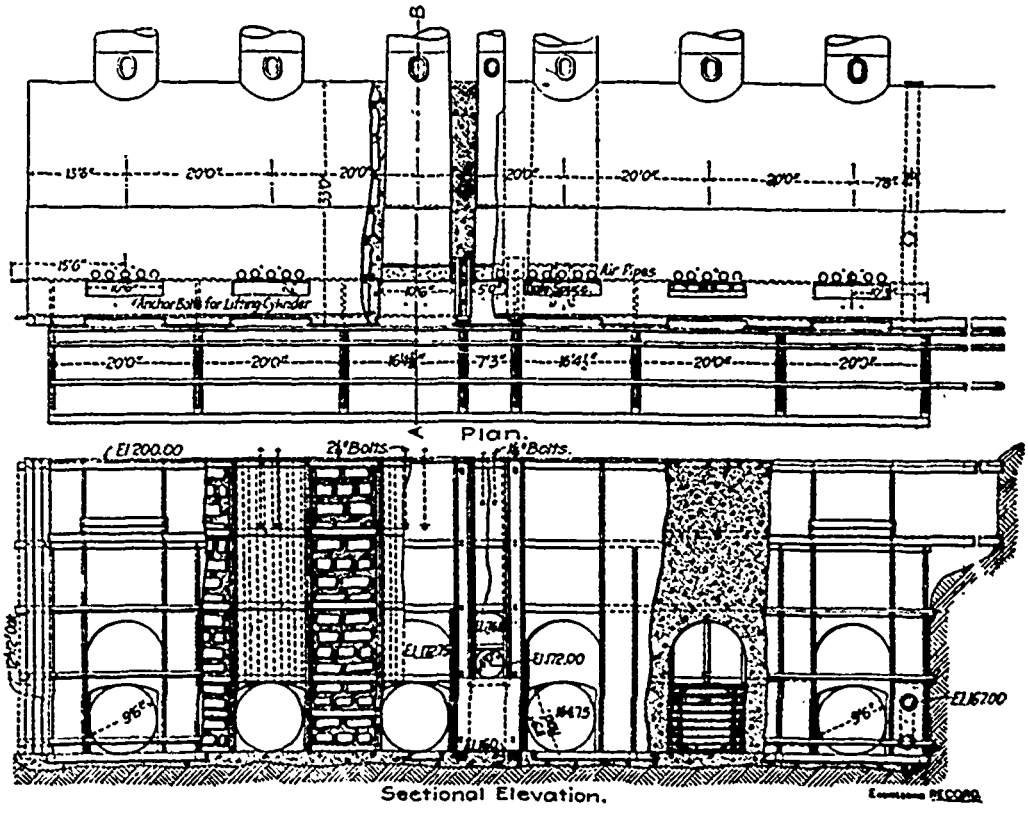
Heavy ring bolts are provided for securing the boom to the mooring posts. The main anchorage for the boom, however, will be 1½-inch steel chains secured to heavy ring bolts bedded in concrete in the river bottom. These are placed so that the boom will engage the boom piers at all heights of water and have a tendency to keep toward the piers. The chains secured from the ring bolts to the piers give double safety against the possibility of losing the boom.

The bulkhead is to be built of what may be called concrete rubble. The bottom under the bulkhead is solid rock, and on this will first be laid a footing of 1:2:5 concrete extending 25 feet in front of the bulkhead. On this the steel rack framing, gate slides, pipes, etc., will be set up, and the concrete bulkhead will then be placed. This is 32 feet wide on the bottom by 15 feet wide on the top, and the masonry is composed of heavy blocks of stone laid with at least 12 inches of concrete between, composed of 1 part cement, 2 parts of sand and 5 parts of fine broken stone. All stone must be kept back 12 inches from the face of the bulkhead, and any stone showing a face of over 4 square feet must be kept back 18 inches from the face.

A smooth face in concrete will be formed by laying 3 inches of 3 to 1 cement mortar against the forms, holding it in position by a light steel plate, then laying up concrete and drawing the plate, ramming the whole lightly together after the heavy ramming of concrete is completed.

The penstocks will be carried through the bulkhead in slightly conical shape, being 9 feet 6 inches in diameter at the mouth by 8 feet 6 inches where they project from concrete. There are six of these large penstocks, each of 5,000 horse-power capacity, and one of 3 feet 6 inches in diameter for the exciter wheels.

The danger of collapse from atmospheric pressure through sudden shutting of the gates and the withdrawal of water from the pipes, is provided against by having five vertical air pipes, 12 inches in diameter, extending up from the mouth of the pipes to the top of the bulkhead behind the gates. Two cut-off rings are placed on the outside of pipe to set in the concrete.



BULKHEAD AND PENSTOCKS.

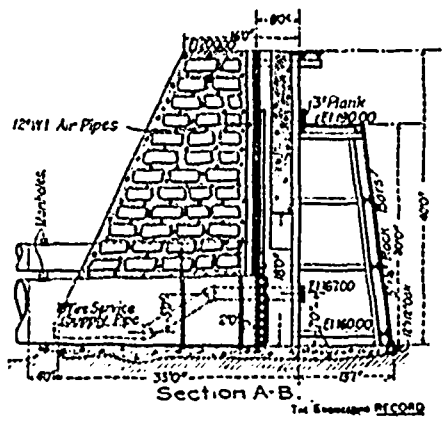
The gates are 10 feet high by 10½ feet wide, and are built of ⅜-inch plates on a framework of 10-inch I-beams, and slide on steel vertical strips bearing on T-bars riveted to channels bedded in the concrete. They are to be raised by pneumatic pressure from the power-house below, with properly regulated pistons to avoid any danger to the pipes through too sudden opening or closing of the gates. Each gate has a single shaft connected to two rods running through the whole height of the gate, and is so made that on commencing to raise the gate a section 12 inches high separates from the balance of the gate, and allows the penstock to fill with water, after which the whole gate is lifted together. The pneumatic pistons are designed, however, to open and close the gates under the total possible pressure due to a head of 40 feet.

The gate for the exciter pipe is of the same design but on a smaller scale.

In addition to the gates the penstock entrances are protected by stop logs formed by 12-inch channel slides

into which 12 x 12-inch timbers can be dropped in case of emergency.

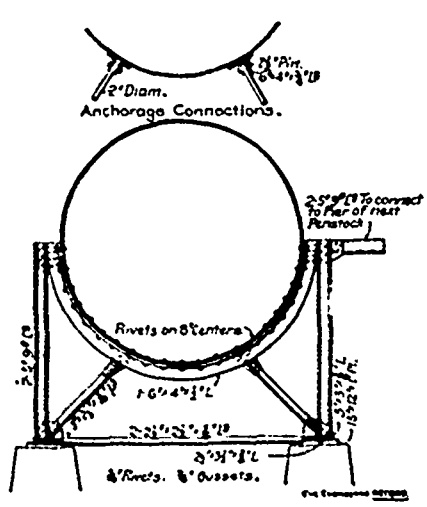
The rack framing is formed of trestles of I-beams set on oak stringers bedded in concrete in the bottom. Three lines of 15-inch I-beams, running horizontally, support the rack, which is laid on a batter of 3½ feet in the height of 28 feet and is formed by 3x¼ inch bars spaced at 2-inches centres, with thimbles between, in sections 3 feet long. These sections are separated, and are supported on cast-iron blocks, bolted to the oak



SECTION THROUGH PENSTOCK.

sill, of such a design that the section can be removed and replaced without the services of a diver. The sections are secured at the top against overturning by a hasp engaging in a staple spiked to the flooring of the rack platform. This platform is set 10 feet below the top of the bulkhead at a height where the rack can be raked conveniently for a greater part of the year.

Another narrow platform is set level with the top of the bulkhead. The ice chute previously mentioned forms a convenient means of disposing of all trash raked from racks, which can be worked along the racks and into the chute. A light glance boom will be placed



SADDLE CARRYING PENSTOCK.

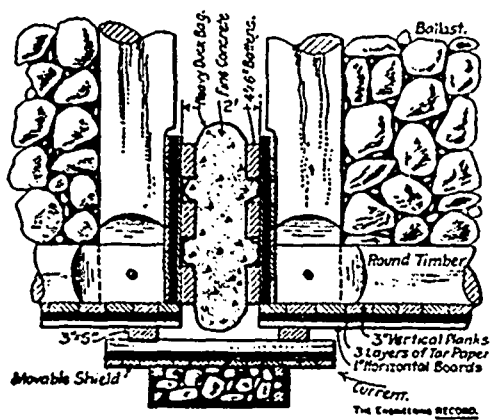
in the head-race leading to the ice chute, so that no floating debris will come against the racks. The height of water floating through the ice chute will be regulated by stop logs at the entrance.

Three of the large penstocks, two of them 500 feet long and one 650 feet long, will be laid at once. They will be lap-jointed on both longitudinal and girth seams at upper end, lap-jointed on the girth seams and but-strap jointed on the longitudinal seams at the lower end. The plates are 5 16 inch in thickness at the upper end and 7-16 inch at the lower end. The pipes will be supported on steel saddles 15 feet apart, riveted to the pipe and resting on concrete base piers. These saddles are built of channels and angles, with gusset plate connections. The angles on which the pipe rests being curved to fit the pipe. The bases of the saddles will be held down with 1-inch fox-bolts running through the piers into the solid rock. The saddles are designed to receive bolting and framing of wooden housing for the pipe. This housing is necessitated by the extreme cold and will also obviate trouble through expansion and contraction due to the changes of temperature. Anchor rods secured to angle connections on the pipe and to fox-bolts in the rock will counteract the tendency to slide down hill.

Two of these pipes will run to the main power-house of the company where they will each operate horizontal double turbine units of 5,000 horse-power with single generator units of the same capacity. The electrical apparatus will be supplied by the Westinghouse Electric & Manufacturing Company and the turbines by the I.P. Morris Company, Phiadelphia.

The power-house foundations will be of massive rubble masonry in cement mortar and concrete. The walls will be built of stone, supporting steel roof trusses and track beams to carry an electric travelling crane of of 50 tons capacity.

The third pipe will be used by the Pittsburg Reduct-



JOINT BETWEEN COFFER-DAM CRIBS.

ion Company in a separate power-house, discharging into the main tail-race. Two double turbine units of 2,500 horse-power with direct-current generator on each end, of 1,250 horse-power, will be installed in its power-house, which will have masonry foundations with brick walls, and steel framing for roof and travelling crane.

The Shawinigan Carbide Company, a company formed to manufacture calcium carbide for the production of acetylene gas, has leased 10,000 horse-power with an option on 20,000 horse-power additional. It will erect works one mile from the power-house along the main line of the railway, its first building being a 150 x 900-foot structure, on a masonry foundations.

General surveys for the present development were conducted under circumstances of great hardship during the winters of 1897 and 1898, and during the summer of 1899 other extensive surveys were carried out, including those for an electric railway to Three Rivers and the location for the branch to the Great Northern Railway. The contract for the railway branch and work on the first development, including excavation, cribwork and masonry was awarded on May 15, 1899, to the Warren-Scharf Asphalt Paving Company of New York.

On May 23, 1899, work was commenced by opening up a wagon road 2½ miles long into the Falls. Work

on the excavation in the head-race and the tail-race was commenced about August 1, 1899, and has been continued ever since, with the exception of about two weeks lost through an abnormal flood in October.

The head-race excavation was taken out by 12 guyed derricks, 55-foot booms, six on each side of the cut, set about 120 feet apart. These derricks, together with spoil tracks, were set on top of the bank about 40 feet above the finished bottom of the cut.

At the intake a temporary coffer-dam had to be constructed. This was commenced about September 15, after the logs had passed down the river, and was placed in six weeks' working time, being delayed about one month by the flood before mentioned.

This coffer-dam is 640 feet on the water line by an extreme height of 30 feet, and was placed, without accident of any kind, in a current running at from 3 to 5 miles per hour. It was placed 15 feet away from the limit of excavation, and extends right over to the top of the Falls. The sand and gravel, 5 or 6 feet in depth in deep water, was first removed by means of a 6-inch centrifugal pump, set on a scow with separate boiler and engine, and discharging into midstream. This sand and gravel was thoroughly cleaned off, so as to allow the cribs to set on solid rock.

To cut off the current through the opening, due to the water being lower on the inside than on the outside of the cribs, stop-gates were run down on the outside of the openings between the cribs. These gates were about 4 feet wide and 30 feet long. They were made of two layers of 2-inch plank with tarred felt between, and laid against vertical bearing strips on each crib, A ballast box on the outside of the gate was filled with stone and the gate sunk into position when the pressure of water made it bear tightly. The bolting of this coffer-dam was done with ⅞-inch round spikes driven into ¾-inch round holes.

The coffer-dam has proved so tight that the head-race behind it has been easily kept dry by one 8-inch centrifugal pump working at about half speed.

After the work of excavation is completed, the rock filling will be removed from the cribs with an orange-peel dredge bucket, and the timber taken off or allowed to go over the falls so as to leave no obstruction whatever at the entrance to the head-race.

It was originally expected that the bulkhead at the lower end of the head-race would be built simultaneously with the excavation in the head-race, but for various reasons was delayed until the frost made the laying of concrete inadvisable, and provision had to be made for its construction this spring.

The coffer-dam at the intake is exposed to the full force of the open river, and is not calculated to stand against floods, nor is it high enough to exclude high water. Further, it reduces the flood overflow area of of the river by one-half, and any attempt to raise it would increase the flood level of the river to a dangerous height. Therefore, a second cribwork dam has been constructed across the head-race, and it will protect the bulk-head site after the outside coffer-dam has been removed.

The coffer-dam is a single continuous crib built across on the level bottom of the head-race, and extended on the top of the bank on both sides to the high ground on the one side, and the cribwork permanent wing dam on the other side. This dam is 27 feet wide for a height of 23 feet, and 16 feet wide for its remaining height of 17 feet. It is of the same description of cribwork as the coffer dam at the intake, and is sheathed in the same manner.

Cross ties are framed 10 feet apart in each course, and staggered in alternate courses, forming 5 x 11-foot ballast pockets. These are filled with loose stone closely packed, and loose stone has also been piled on top of the offset between the widths of 27 feet and 16 feet, making the dam practically 27 feet wide from top to bottom. The joint between the crib and the rock sides and bottom is made with concrete and puddled clay, the clay in vertical corners being held in place by corner boards. Two flumes about 2 feet square are carried through the crib to admit water when required.

Another coffer-dam has been built in the tail-race to hold back high water while the power-house foundations are being built. This dam is 26 feet high, with cut-offs through the gravel to rock at each side, and is 200 feet long; 160 feet of its length, where it rests on a clay bottom, is built with an inclined top in bents of heavy rough timber on 4-foot centres. This dam is 80 feet wide on the bottom. The covering is 2-inch and 3-inch dressed plank covered with two layers of tarred felt protected by 1-inch boards, the felt and the joints in the boards being swabbed with hot pitch. The toe of this dam is made tight with double sheet piling well puddled. The remaining 40 feet of the dam is formed of square cribwork, as previously described, 20 feet wide.

Water from the river is pumped by a Northey pump with 3-inch suction, and delivered to two storage tanks, one of which has a capacity of 2,000 gallons, and is elevated 75 feet. Service pipes from it supply boilers on both sides of the head-race.

There is a 15-arc light dynamo from the Royal Electric Company, Montreal, driven by a 35 horse-power Laurie automatic engine, and lamps are placed on each side of the cut for night work.

There is a camp for boarding 300 men. The maximum number of men employed has been about 1,200. In the summer it was difficult to keep the men on the work, but they were anxious to work through the severe winter weather, and the rock excavation and crib building was carried on almost uninterruptedly with a force of over 1,000 men.

Messrs. T. Pringle & Son, Montreal, are the engineers of construction: Mr. Wallace C. Johnson, Niagara Falls, is the consulting hydraulic engineer, and Mr. Wm. I. Bishop, Montreal, is the engineer in charge. Mr. D. A. Rexford is the contractor's superintendent.

At the annual meeting of shareholders of the Ottawa Electric Company a very satisfactory statement was presented. The company has now installed 87,114 incandescent lights, 644 arc lights, 163 motors, and 23 heaters, all distributed among 4,357 customers. This is a substantial increase over last year. During the year there was installed an electric storage battery of 250 cells which is employed as an auxiliary to the motor service. The board of directors were relected.

Mr. James Kent, general manager, and Mr. B. S. Jenkins, general superintendent, of the C. P. R. Telegraph Co., have recently returned from a tour of inspection of the company's lines in the Northwest and British Columbia. Mr. Kent states that additional wire facilities of 1,000 miles will be provided this year to meet the increasing demands of the trade. A new wire has been put up between New Denver and Nelson, in the Kootenay, which will allow the duplicate system to be worked from Vancouver to Nelson and Rossland, and so double present facilities. The wires of the Manitoba and Northwestern system have been extended into Winnipeg, thus giving direct wire service between Winnipeg and all points on the Northwestern branch system.

MR. ALBERT MITCHELL.

As one of the many Canadians who have secured responsible positions in far-off lands, we present a portrait of Mr. Albert Mitchell. A few months ago Mr. Mitchell succeeded Mr. H. J. Somerset, as superintendent of the Winnipeg Street Railway, Mr. Somerset having been appointed manager of the street railway system at Perth, Australia Mr Mitchell subsequently resigned his position in Winnipeg to become superintendent of the street railway at Perth, a position carrying with it greater responsibilities and increased salary.

Mr. Mitchell spent his early years in Ontario, but left his home to learn the mechanical trade with the Vulcan Iron Company, of Winnipeg. He had only a common school education, but while learning his trade he took every opportunity to add to his store of knowledge and afterwards took a course in engineering and electricity in a technical school. He worked at his trade for twelve years and spent one year in building electric motors. In 1896 he accepted the position of chief engineer of the Winnipeg street railway, holding same until his appointment as superintendent. We bespeak for him success in his new field of labor.

MR. ALBERT MITCHELL.

BY THE WAY.

THE following story is told by W. S. Churchill in his "The River War", of the manner in which General Kitchener improvised a reel for field telegraph work in the Soudan. "He walked to the largest coil of wire picked it up and approached the smallest donkey. He took the little animal's two hind legs in his left hand, and put them into the coil. He lifted the wire up until it passed around the donkey's back, like a horse collar, only that it hung between the fore and hind legs. He caught hold of the loose end of the wire and smacked the donkey with the other hand. The beast moved forward, tripping and stumbling over the wire, which began, albeit jerkily, to unwind. Then he walked abruptly back to his horse. By this method the Field Telegraph accompanied the Flying Column."

Mr. V. L. Emerson, of Ottawa, is reported to have invented a powerful automobile, which is designed to be operated by a hydro-carbon motor, at a speed of 30 miles an hour.

Under the direction of Mr. L. M. Lash and Mr. P. F. Sise, of the Bell Telephone Company, Montreal, a large new switchboard is being installed in the head office of the New Westminister and Burrard Inlet Telephone Company, of which Mr. H. W. Kent is the general superintendent. The cost of this new switchboard will be about $30,000.

PERSONAL.

Mr. Wilfrid Phillips has resigned the position of manager of the Niagara Falls Park & River Railway.

The authorities of Columbia University have granted for the third time the Tindall Scholarship to Prof. R. B. Owens, of McGill University.

Mr. Wm. Marconi spent the greater part of last month in Ottawa. He has returned to Europe but is expected back again a few months hence.

Mr. Thos. Ahearn, of Ottawa, accompanied by his family, is on his way to Europe. He will visit the Paris Exposition and spend some time in England and Scotland.

Mr. R. W. Angus, B.A., son of Mr. R. Angus, superintendent of E. Leonard & Sons, London, has been appointed lecturer in mechanical engineering in the School of Practical Science Toronto.

The death is announced at Brantford, Ont., of Mr. W. Barron, who was for many years manager of the Brantford street railway. The deceased had been some time previous to his death in poor health.

Mr. John G. Ridout, of the firm of Ridout & Maybee, patent solicitors, Toronto, has been awarded a premium by the Chartered Institute of Patent Agents, London, Eng., for one of the five best original papers read before the Institute this year.

Mr. P. McCullough, electrician at the power house of Toronto Railway Company, has resigned his position, and left on June 24th to take charge of the electrical department of the corporation tramways at Liverpool, England. Prior to his departure Mr. McCullough was presented with an illuminated address and a gold chronometer by the electrical and mechanical staff of the railway.

SPARKS.

A fire which occurred a few days ago in the sub-station of the Lachine Rapids Hydraulic and Land Company, Montreal, caused considerable damage to the machinery, and resulted in the death of the watchman.

The Dominion government have awarded the contract for a cable to connect Belle Isle with the Canadian telegraph system. The cable will be delivered in Canada within six weeks and within a month thereafter will be laid.

The gas and light committee of the Brockville city council have offered the sum of $85,000 to the Brockville Light and Power Company for its plant. The company have accepted the offer on condition that the council will pay for recent extensions, tools, and stocks at the cost price.

The Board of Control, of the Toronto city council, have passed a resolution recommending the city engineer to prepare an estimate of the cost of installing and operating a municipal telephone system for 6,000 and 10,000 subscribers. A committee of the council has also been appointed to consider the question.

Mr. Wm. Mouall, of Montreal, who is a member of the syndicate controlling the street railway franchise in Havana, has recently returned from Cuba. He states that the Cuban electric railway enterprise, in which Halifax and Montreal capitalists are interested, is showing satisfactory results. The net receipts for the first month's operation amounted to $6,000. The company are constructing a new line three miles long to the city of Gaunadacoa, where it is proposed to establish a pleasure park.

The Toronto Electric Light Company are having a tunnel constructed beneath the railway tracks on the Esplanade immediately opposite their works, in which to place the cables connecting with their underground system. The company, during the present year, have laid vitrified clay conduits enclosing cables on a number of the principal thoroughfares, including Front street, King and Queen streets as far west as Spadina avenue, Yonge and Queen street and up Terauley street to their station on that street.

The Bell Telephone Company have notified the fire department of Toronto to remove all fire alarm wires from the company's poles, otherwise they will hold the city responsible for any resulting damage. There are in use in the fire alarm system 879 poles belonging to the Bell Telephone Company, 479 poles of the G. N. W. Telegraph Company and 869 of the Electric Light Company. The G. N. W. Company has rendered an account for $200 for the use of its poles. The Electric Light Company says the city is welcome to use the wires free.

The project for the construction of an electric railway from Port Dover to Preston, via Simcoe, Waterford, Boston, Mount Pleasant, Brantford, Paris, Ayr, Blair, Doon, Berlin and Preston, is being brought prominently before public notice. It is proposed to acquire the Brantford Street Railway covering the City of Brantford, the Galt, Preston and Hespeler Electric Railway, with which connection will be made at Preston for Galt and Hespeler, and the Berlin and Waterloo Electric Railway with which connection will be made at Berlin. Connections will be made at Port Dover with the Shenanago Car Ferry running to Conneaut, or Erie, on the American side of Lake Erie; at Simcoe with the Wabash Railroad; at Waterford with the Michigan Central Railway and Toronto, Hamilton and Buffalo Railway; at Brantford with the Toronto, Hamilton and Buffalo Railways; at Ayr and Galt with the Canadian Pacific Railway. The total cost of the road is placed at $1,500,000. It is stated that the greater part of the capital required has already been arranged for, and application is now being made for bonuses from the municipalities along the route.

ENGINEERING and MECHANICS

UTILIZATION OF EXHAUST STEAM.*

By E. P. Roberts.

Among the uses to which exhaust steam may profitably be put is heating the feed water. The heating of the feed water is the most common use, but it is not always understood how small a portion can possibly be utilized in this manner. If we have 3,000 pounds of water and the initial temperature of the feed-water be 60 degrees f. and the exhaust steam pass through the heater at atmospheric pressure it will heat the water to about 200 degrees f. For each pound of feed-water we merely require 140 heat units or a total of 420,000, or approximately one seventh. Evidently there will still be a large surplus. Often feed-water is not heated as hot as it might be without cost, and in such cases the saving to be made by the addition of suitable apparatus for raising the temperature of the feed-water will pay large returns on the investment. Having used all the exhaust steam needed for heating the feed-water there will still be a balance which may be disposed of in any of the following ways:

First, exhaust it into the atmosphere. Second, condense it and obtain the greater economy on the engine. Third, use it for heating buildings, etc., which to do in any instance will depend entirely upon the local conditions.

Upon the supposition that sufficient money is available for such improvements and extensions as will bring the largest percentage returns on the total expenditure, a general statement can be made. Determine the first cost and additional cost of the operation, including in operating expenses an allowance for depreciation and repairs and determine the gross income; the difference between the above will be the net profit. This is a simple proposition, but an accurate de rmination of the result requires a most careful examination of all the details of the proposition, and is far from being a simple matter. The second possibility is usually the easiest of determination. It is the advisability of condensing. The first step is to ascertain the existing conditions: First, how much steam is being used? Second, the range of load—the nearer the average load is to the rated, the greater the economy from condensing; on a very light load, condensing may cause a loss. Third, what pressure is carried, and what can be carried, and how long are the boilers good for such pressure? Fourth, are the engines overloaded at times, so that more power is needed? Fifth, are the boilers overloaded? Sixth, is it possible to install new boilers or engines? What will it cost? Will the results cost more and be better or worse than if made condensing? Seventh, what will it cost to put in a condensing system? Is water available without cost except pumping? If not what will a cooling tower cost? Eighth, what is the character of the water? If bad, will not surface condensers save a considerable amount by lessening scale in the boilers?

These are the more important points to be considered and the value of each determined accurately, when the profitable utilization of the exhaust steam other than heating the feed-water is to be decided upon.

To find the largest expenditure for the condensing system that can be made to obtain a saving of one per cent., first find the total cost of fuel for the year. One per cent. of this amount will represent the interest on the maximum amount that may be expended in obtaining a net saving of one per cent.

The next consideration is the use of exhaust steam for heating buildings, etc. The subject of charges for heating is one deserving of considerable attention. Mr. Roberts in speaking of this matter said: "The correct basis of charge is evidently the amount of steam furnished. This evidently requires meters. Steam meters until recently, have been of the velocity type, and have given a greater or less degree of satisfaction, that is for meters. Meters are now made which record the water of condensation, and this is a correct measure. But exclusive of meter measurements, flat rates can be made in the heating business on a far more satisfactory basis than in lighting. Such basis is the the square feet of heating surface, and is fairly satisfactory, because a square foot will condense a certain amount of steam, and although such amount depends upon the initial temperature of the air to be heated, nevertheless the average for the year can be quite closely approximated. The principal objection to this basis is that customers are liable to regulate the temperature, not by closing off the steam but by opening windows. But even such objection is not a very important one when there is sufficient exhaust steam for use in the coldest weather, because it is the coldest weather which determines the maximum and at such time windows are not opened.

Sometimes the charge is based on the cubic feet of space to be heated. This is a very crude basis as in one case one square foot of radiating surface may be needed for 60 cubic feet of space and in another case we may heat to the same temperature 120 cubic feet or more. These figures refer to direct radiation. For indirect radiation, fan system, etc., the amount will be changed. By far the majority of steam heating is by direct radiation, although in any installation of considerable magnitude consideration should be given to each of the above methods."

The rules for heating of buildings are many and various but the following are given as having been found reliable in practice. Allow one-fourth square foot of radiating surface for each $\frac{3}{3}$ of the cubic contents for first floor rooms and halls; the same amount of radiating surface for each $\frac{3}{3}$ of cubic contents of room for second and upper floor rooms, and one-fourth square foot of radiating surface for each square foot of glass surface plus that of exposed wall. Wolff gives the following allowance for special conditions: Increase ten per cent. for northerly exposures subject to wind, and ten per cent. when the building is heated during the day time only and when the building is not exposed. Increase 30 per cent. when the heating is done in the day time only and when the building is much exposed. Increase 50 per cent. when the building is heated during winter months intermittently at long intervals. The above factors make a considerable modification and what factor to use in any given case is a matter of judgment based on experience.

*Abstract of paper read before the Ohio Electric Light Association.

CANADIAN ASSOCIATION OF STATIONARY ENGINEERS.

Toronto No. 1.

At the last regular meeting of Toronto No. 1 Canadian Association of Stationary Engineers, held on June 20th, 1900, the following officers were elected for the ensuing year,—President, J. Huggett; vice-president, W. J. Webb; recording secretary, J. Marr; financial secretary, N. Kuhlman; treasurer, S. Thompson; conductor, W. Butler; doorkeeper, G. D. Bly; trustees, G. Mooring, C. Moseley, Jas. Bannon; delegates to convention, J. Huggett, W. J. Webb, H. Terry, A. Storer, N. Kuhlman.

Hamilton, No. 2.

At the last regular meeting, June 19th, 1900, the following officers were elected:—President, Thos. Chubb; vice-president, F. J. Scutthorp; recording secretary, Jos. Ironside; financial secretary, Jas. Carrol; treasurer, W. R. Cornish; conductor, Jas. Wadge; door-keeper, Jas. Cook; delegate to convention, Bro. Geo. Mackie; alternate, Geo. Dawson.

Annual Convention.

The eleventh annual Convention of the Canadian Association of Stationary Engineers will be held in Toronto, commencing August 21st next. The meeting place will likely be the Engineers' Hall, 61 Victoria street. The local Association have already made preliminary arrangements for the entertainment of the delegates, and one of the most successful conventions yet held is predicted. In next issue further particulars will be given.

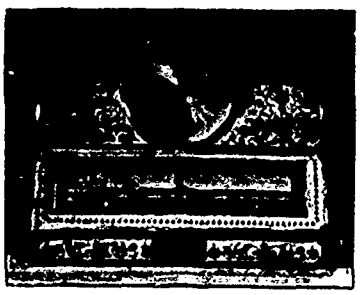
The Canadian Association of Stationary Engineers, of Montreal, have elected the following officers for the ensuing year:—President, H. F. Thompson; first vice-president, F. D. Jones; second vice-president, H. Wady; secretary, past president W. Smythe; treasurer, past president T Ryan; financial secretary, H. Nuttal; conductor, J. Carr; doorkeeper, H. Knight; trustees, past president J. J. York, past president G. Hunt, past president W. Weir.

The Electric Reduction Co., Buckingham, Ont., is installing two 25 k. w. direct current generators supplied by the Royal Electric Co.

THE MARTIN AUTOMATIC RECORDER AND REGISTER.

This device, as shown in the cut, is for drawing load curves, such as the total output of one or more switchboards, also to check the time when the readings are taken. The recorder carries a two months supply of cross section paper, made up in the shape of daily charts (Fig. 2). These charts pass out at the back of the recorder, once every twenty-four hours. They are kept moving at the same rate as time by the clock, which is geared to the roller which carries them forward.

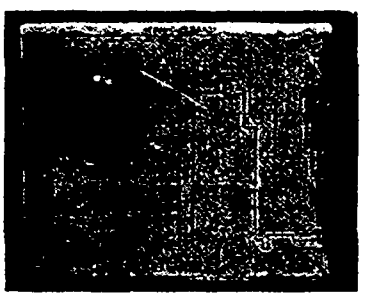
The attendant when taking the reading, every fifteen or thirty minutes as the case may be, records the reading by turning a milled headed nut on the right hand side of the recorder, which moves the pens along a scale to correspond to the amperes. He



must record at the proper time and cannot neglect several or any readings, and then jot them down by guess work and fil in his report.

Referring to Fig. 2, the column of figures on the left are for a D. C. switchboard; they are printed in red ink and the curve is also drawn in red ink. The column on the right is for an A. C. switchboard; these are printed in blue ink and the curve is also in blue ink. The idea is to be able to distinguish the two curves as they may cross or recross each other during the twenty-four hours.

The charts can be printed for other purposes such as to show a voltage curve and an ampere curve, or both for amperes, etc. The figures at the top and bottom of the chart show the time starting at 12 o'clock midnight, until the following 12 o'clock midnight (24 hours). By referring to the chart it is readily seen at any time what the load was on each switchboard. The charts



can be filed and kept for future reference to compare the output of the station for the different days, months or years, etc.

The recorder is provided with a stamp on the left hand side which the attendant operates by pressing a button at any time when the loads have not changed since the last reading, thus showing that he was at his post. The recorder being locked up by the manager or superintendent, the pens carrying at least enough ink to last a week, it will be seen that it is not necessary for the attendant to have access to the recorder only from the outside. It is neatly finished in white nickel, and looks very attractive, mounted with a Seth Thomas eight day clock, and constructed so as not to get out of order. Made by the Martin Automatic Recorder and Register Co., Hamilton, Ont.

At the request of the city council the city engineer has prepared an estimate of the cost of installing and operating a municipal lighting plant. The figures which he has submitted are as follows: The buildings and plant would cost $950,000, and the cost of installing an arc lighting plant, with a capacity of 1,350 lamps, would be $300,000. If the electric wires were placed underground in the central portion of the city, the cost would be about $510,000. The annual cost of operating the plant with overhead wires would come to about $63 per lamp per annum, or about 17.2 cents per night. Using underground wires, the cost would reach $70 or 19.16 cents per lamp per night.

ARMOURED CABLE.

MESSRS. Jack and Robertson, of Montreal agents for the Sprague Electric Company, New York, have sent us the following in reference to armoured cables:

Our principals in New York, have now turned out a new and modern article, namely Armoured Flexible Cable for Conduit work. The Sprague Electric Company, owning all the patents and equipments of The Interior Conduit & Insulation Company, has, like its predecessor, led the progressive march of improvement in the manufacture of conduit and kindred appliances, and in answer to a persistent demand from some of the leading engineers in this country for further development in the art of electric wiring, is now ready to announce another period in the art-one more mile-stone in the path of progress and a near approach to the highest ideals of those who are mindful only of the interests of electrical developments.

For many years certain engineers have questioned the advantages of a "drawing in" system of interior wiring, involving as it does, two distinct and expensive operations, one being necessary for the installation of the conduit, another for that of the conductors, and base their argument on the fact that considerably less than one tenth of one per cent. of the electric conductors in buildings are subject to disturbance or removal.

With this condition recognized we then have the question—Why must the burden of two installations be imposed on the user of electric current, when only one should be necessary?

Two replies have invariably been ready for this question—First, the absence of definite knowledge regarding the life of insulation. Second, the entire absence of any suitable flexible armour or covering that would protect insulation from mechanical injury. The doubt expressed in the first argument has been removed by time, there being innumerable installations made from ten to fifteen years ago, and in which the wires show a higher insulation resistance to-day, than was obtainable immediately after they were placed in position.

The Sprague Electric Company now replies to the second argument by placing upon the market the Greenfield Flexible Steel Armoured Cable, comprising electric conductors so insulated and braided as to be thoroughly protected from atmospheric influences and armoured so as to defy any mechanical injury incidental to installations in the fire-proof or other buildings of the present day.

Engineers will recognize the advantages of flexible conductors so thoroughly insulated and armoured for use in marine or ship wiring where a rigid conduit system can only be installed at great cost in order to overcome the many obstacles presented by reason of the form of a vessel's structure, the small space available for equipment and fittings, excessively high temperatures, and incessant vibration of the ship.

Factory and mill wiring has hitherto been accomplished chiefly by the use of insulating knobs and cleats, moulding being used in some cases for the larger conductors. Where insulators and cleats are used, as in the majority of such work, the wires, being run from beam to beam, become dust collectors of the best kind, and especially is this the case in cotton and flour mills where the conductors will support an accumulation of lint and fine dust many times exceeding their own size. Perhaps the most costly feature of "open wiring" in such places is the general destruction caused by the breaking or slipping of a belt, which, when once fast caught in the wiring usually brings down several sections, sometimes wrecking or disabling valuable machinery by the operation. These objectionable possibilities are entirely eliminated by the use of "Greenfield Flexible Steel Armoured Cables" and "Cords" which can be firmly secured on the surfaces of the structure wired.

Finished buildings frequently present to the engineer and contractor wiring problems he would prefer to avoid, the alternative being in many cases the practical ruination of handsome, trim and costly decorations or the fishing of conductors without conduit from outlet to outlet, leaving their insulation as legitimate prey for the tools of the mechanic or the teeth of the ever-cheerful and busy rodent, in direct violation of the rules of safe construction. In such buildings "Greenfield Flexible Steel Armoured Cables" can be "fished" from pockets cut at convenient points and may be left with the full knowledge that they are absolutely secure from mechanical or other injury.

New buildings equipped with electrical conductors in accordance with the practice of the present day, require, as before stated, not less than two distinct installations—one of conduits, another of conductors.

The electrical contractor is compelled to make the progress of his work conform to that of other workmen, and is often subjected to costly delays. Alterations from original plans, however necessary or desirable, are in most cases costly in the extreme and sometimes impossible. Under the most favorable conditions, the electric wiring equipment is suggestive of a certain feeling of doubt amounting almost to distrust, and lacks that element of permanence and stability with which it should be associated and to which it is justly entitled.

This Company as the leading conduit manufacturers in the world, might well foster these ideas and practice and cater to them, but in the interests of the public and of the advancement of the art, it seems fitting that we should at this time introduce a new feature in electric wiring, one which at once reduces its cost and places in the front rank of permanent equipments with which the modern building is provided. We feel that this has been accomplished by the development of the "Greenfield Flexible Steel Armoured Cables" for which we ask from architects, electrical engineers and constructors their most favorable consideration.

These flexible products have been fully approved by the Underwriters' National Electric Association.

SPARKS.

Mr. Laliberte, chairman of the harbor committee of Quebec, has submitted to that body a project for utilizing the power of the tides of the harbor, for the operation of grain elevators and industrial concerns.

The Citizens Electric Company, Limited, of Smiths Falls, Ont., has been incorporated, capital $35,000; president Mr. J. H. Gould, secretary Mr. J. S. Gould. The company are enlarging their works and further developing their power.

The promoters of a number of new pulp mills, for the manufacture of pulp and wood products, to be erected twelve miles above the falls of the St. John river, propose to utilize the power of these falls to generate and transmit electricity to the works.

The annual financial statement of the St. John, N.B., Street Railway Company shows a net profit for the year of $37,792.53, out of which two 3 per cent. dividends were paid amounting to $30,000. The old Board of Directors was re-elected.

A contract has been given by the provincial government, to the Cataract Power Company for the supply of current necessary to light the building and grounds of the asylum for the insane. Provision is made for 1,100 incandescent lights for the building, and 10 arc lights for the grounds, with wiring capacity for 1,500 lights.

The Dominion Government have received an application from Hon. Fred. Peter, formerly Premier of Prince Edward Island, and E. O. Fador, for certain shore rights in the harbor of Vancouver, B. C. They propose to utilize the tides to generate electric power, which will serve Vancouver, New Westminster, etc., and at the same time provide cheaper power.

It is reported that a large number of men are at work on the power development scheme of the Metropolitan company at Brittania. It is stated that the construction of the power station will be commenced during the present month. The cofferdam built last year, is being demolished, it having been found to be defective. Another one will be built at the other end of the channel.

Mr. J. P. Graves has made an offer to purchase from the city of Grand Forks, B. C., the water works and electric light plants at the sum of $70,000 and to expend $30,000 additional in improving the system. He also seeks to acquire an exclusive street railway franchise. The ratepayers will be asked to vote on the question. In return for a bonus of $30,000 Mr. Graves offers to provide water works, electric light, and trolley systems for the city of Columbia.

MOONLIGHT SCHEDULE FOR JULY.

Day of Month.	Light.	Extinguish.	No. of Hours.
	H.M.	H.M.	H.M.
1....	P.M. 9.00	A.M. 3.30	6.30
2....	" 9.30	" 3.30	6.00
3....	" 9.50	" 3.30	5.40
4....	" 10.20	" 3.30	5.10
5....	" 10.50	" 3.30	4.40
6....	" 11.20	" 3.30	4.10
7....	A.M. 0.00	" 3.40	3.40
9....	" 0.40	" 3.40	3.00
10....	" 1.30	" 3.40	2.10
11....	No Light.	No Light.	....
12....	No Light.	No Light.	.....
13....	No Light.	No Light.	.....
14....	No Light.	No Light.	.....
15....	P.M. 8.00	P.M. 10.30	2.30
16....	" 8.00	" 11.00	3.00
17....	" 8.00	" 11.30	3.30
18....	" 8.00	" 11.45	3.45
19....	" 8.00	A.M. 1.00	5.00
20....	" 8.00	" 1.30	5.30
21....	" 8.00	" 2.10	6.10
22....	" 8.00	" 3.00	7.00
23....	" 8.00	" 3.50	7.50
24....	" 8.00	" 3.50	7.50
25....	" 8.00	" 3.50	7.50
26....	" 7.50	" 3.50	8.00
27....	" 7.50	" 3.50	8.00
28....	" 7.50	" 3.50	8.00
29....	" 7.50	" 3.50	8.00
30....	" 7.50	" 3.50	8.00
31....	" 8.20	" 3.50	7.30
		Total.....	148.25

TRADE NOTES.

The Anchor Knitting Co., Almonte, Ont., are installing a 10 k. w. multi-polar direct current generator, supplied by the Royal Electric Co., to light their factory.

The Granby Consolidated Mining & Smelting Co., Grand Forks, B. C., is installing a 10 k. w. multi-polar direct current generator purchased from the Royal Electric Co.

The Shawinigan Water & Power Co., Shawinigan, Que., is installing a 150 k. w. "S. K. C." two-phase inductor generator purchased from the Royal Electric Company.

Mr. Clayton, manager of the Central Electric Co., of Portage La Prairie, while on a trip through the East a few days ago placed an order with the Royal Electric Co. of Montreal for one of their 150 k. w. "S. K. C." two-phase generators.

The Penetang & Midland Street Railway Light and Power Company, Penetang, Ont., has greatly increased its incandescent lighting business and has purchased a 150 k. w. "S. K. C." two-phase generator, complete with exciter and switchboard from the Royal Electric Company.

The Brantford Electric & Operating Co., Brantford, Ont., who have been furnishing arc and incandescent lights and operating motors from a 180 k. w. "S. K. C." successfully for the past four years are largely increasing their power and lighting business and have ordered from the Royal Electric Co., a 360 k. w. "S. K. C." two-phase machine.

SPARKS.

It is reported that an American firm of manufacturers of electrical machinery and supplies are considering the advisability of establishing a branch factory in Ottawa.

Representatives of a number of Street Railway Companies in Ontario met in Toronto recently and arranged for circuit entertainments to be given in the parks owned by the companies.

The employees of the British Columbia Electric Railway Company held their annual picnic on June 13th, in Queens Park, New Westminster. A good programme of athletic sports was provided.

Robt. C. Trouax, electrician for the Thousand Island Park Association, was killed by an electric shock on June 23rd. It is thought that while closing the circuit his hand touched the contact bar.

Extensive improvements are being made to the Bell Telephone Company's system at Winnipeg, and communication is being established with Portage La Prairie and a number of other outside towns.

It is said to be the intention of the Ontario Power Company to begin the construction of development works this summer. The company claim to have received applications for 30,000 horse power.

Work was recently commenced on the long distance telephone line, between Winnipeg and Brandon, via Portage La Prarie. The line is already completed to a point sixteen miles west of Winnipeg.

Niagara Falls are to be illuminated by electricity during the coming Buffalo Exposition. By means of searchlights placed on both sides of the river, the colours of the lights which are thrown on the Falls will be constantly changed. Arc lights will also be placed in the Cave of the Winds, which will give to the water which falls in front of it a phosphorescent effect.

Work will shortly be commenced on the construction of a new power house for the Ottawa Street Railway Company. It will be a duplicate of the present power house, will be entirely fireproof, and will cost, including water wheels and plant, about $150,000. The plant will include a 2,000 horse power generator, now being manufactured by the Westinghouse Co., at Pittsburg, and four large water wheels.

Mr. J. G. Macklin, of the Royal Electric Co., Montreal, has prepared plans and data at the request of the Renfrew Power Company, for the utilization of the power of the Bonnechere river. Mr. Macklin estimates that when the water is lowest, 725 horse power can be obtained, and at high water 1,500 horse power. The estimated cost of the development of this power is $40,000. The company is now applying for a charter and has elected the following provisional directors:—Messrs. A. Barnet, P. S. Stewart, John Ferguson, M. P., W. A. Mackay, Dr. Murphy and Thos. A. Low.

Some time ago the council of Winnipeg gave notice of its intention to discontinue its arrangement with the Bell Telephone Company, under which the company operated the city fire alarm system. Quite recently the mayor requested the company to continue the operation of the system for a few months longer until the city could complete arrangements for taking it over. In reply the company stated that having made arrangements to occupy the space used by the fire alarm instruments, they were not in a position to accede to this request, but would be willing to renew the contract for a further period of three years. To this proposal the city would not consent, and thus the matter stands.

The annual meeting of shareholders of the Canadian Electric Light Company was held at Quebec on June 26th. The annual report of the directors, submitted at this meeting, showed that the development works are well advanced and will probably be completed by the end of September. Contracts have already been made for 3,000 lights, and it is expected that operations will be commenced with a lighting load of 5,000 to 6,000 lights. Negotiations are in progress and are proceeding satisfactorily, for lighting the streets of the town of Levis. Applications have also been received for power from several manufacturing concerns. Tenders have been received for the laying of a sub-marine cable to carry current from Levis to Quebec, and the right has also been secured from the Quebec Bridge Company to use their bridge for the like purpose. The shareholders will be asked to authorize the issue of additional stock or debentures to complete the works. The probable revenue for the first year is estimated at $25,000, and the operating expenses at $1,000 per month.

SPARKS.

While repairing the fire alarm system Edward J. Tremblay, a lineman in the employ of the city of Hull, came in contact with the Ottawa Electric Company's wires charged with 2,000 volts, and was instantly killed.

A company is being organized at Ottawa to manufacture a new form of gas, which is said to be composed of 93 per cent. of air and 7 per cent. of illuminating mixture. The process of manufacture is thus described: An electric motor worked automatically at intervals during an hour, collects a certain amount of air into a blower. The air then goes into a chamber containing acid, and passes from there into a place containing carbonators. The acid chamber robs the air of carbon, and when the air goes into the carbonators it is practically pure oxygen and non-poisonous. In the chamber containing the carbonators there are wicks saturated with the illuminating mixture which is supplied from a receptable attached to the apparatus. The atmosphere in passing into the carbonators is combined with 7 per cent. of the illuminating mixture. The gas finally goes into the chamber from which it may be used. As the gas becomes exhausted in the tank out of which it is drawn for light, an automotic arrangement causes the electric motor to work and send in more air. The electric motor, beyond sending in the air, has no connection with the gas making machine. In fact, a system of weights could be used instead of a motor. The light produced is said to be pure white and 7 times stronger in illuminating power than a 16-candle electric light. The cost of production is said to be only $100 for 250 lights. The gas is employed for heating as well as for lighting. Messrs. J. R. Booth, J. A. Sayboll, and Capt. C. Foxwell are said to have secured control of the process of manufacture for Canada

SPARKS.

Messrs. Wm. Moore & Sons, Meaford, Ont., have purchased a 1000 light alternator from the Royal Electric Co.

The Penetanguishene Electric Light Company have contracted with the Royal Electric Company, of Montreal, for a new 3,000 light dynamo.

Mr. Thos. Low, of Renfrew, Ont., is forming a company to develop the water power of the Bonnechere river. It is intended to spend about $40,000.

By the explosion of a boiler in the Dominion Iron & Steel Company's quarries at Sydney, C.B., the engineer, Mr. Perry, of Londonderry, was killed.

The town of Hespeler, Ont., will submit a by-law to the ratepayers to provide $10,000 for the purpose of taking over the electric light plant of Mr. Shantz.

By coming in contact with a live wire in the power house of the Lindsay Light, Heat & Power Company, at Fenelon Falls, Ont., engineer Poole was instantly killed.

The ratepayers of Bracebridge, Ont., will vote on a by-law on July 16th to raise $6000 by the issue of debentures for the purpose of developing power for the generation of electricity.

The Ottawa Electric Company has just awarded a contract to the Stillwell-Bierce and Smith-Vaile Company of Dayton, Ohio, for water-wheels for their new electric light station.

The Brantford Electric & Operating Company have just decided to build a new power house. All the machinery will be raised 10 feet above the highest flood level known. The estimated cost of the proposed improvements is $30,000.

A piece of steel was successfully removed from the eye of one of the employees of the Canada Atlantic Railway, by means of a magnet in the office of the Ottawa Electric Company.

Col. Tracey, City Engineer of Vancouver, B.C., has reported for the corporation of Revelstoke, B. C., as to the value of the Revelstoke Company's plant, which will probably be taken over by the town.

The Bowmanville Electric Light Co., Bowmanville, Ont., has been compelled, by a large increase in its business, to purchase new machinery, and has ordered from the Royal Electric Co. a 90 k. w. two-phase "S. K. C." inductor alternator.

Mr. Matthew Neilson, C. E., of Almonte, manager of the St. John, N. B., electric railway, has recently returned from Jamaica, where he was engaged for several months in [illegible] intending the construction of an electric railway for his company.

No further action has been taken by the Ottawa City council towards granting a renewal contract to the Ottawa Electric Company, and on the other hand no steps have been taken by the company in the direction of negotiating with the city for the sale of its plant.

Joseph Geddes, an electrician in the employ of the Chambers Electric Light & Power Company at Truro, N. S., recently came in contact with a live wire while working with an arc light. He was severely burned on the head and hands, but recovered from the shock.

A scheme is said to have been decided upon by the interested concerns for improving the Chaudiere water power at Ottawa. It is understood that all obstructions will be removed and the intakes enlarged, and that the work will cost about $50,000. The The Ottawa Electric Company, McKay Milling Company, J. R. Booth, and others are interested.

Contracts have been awarded for the erection of a handsome new building in Montreal to serve as the headquarters of the Canadian Pacific Telegraph Company. The new building will be erected on the site of the old one which is now being torn down. It will have a frontage of 100 feet on Hospital street, 45 feet on St. Francois-Xavier street, and 51 feet on Exchange Court. It will consist of eight stories, the lower stories to be constructed of New Brunswick sandstone, and the upper stories of mottled pressed brick. Modern skeleton steel construction will be employed, and the structure will be made fire-proof throughout. The operating room will be located on the eighth storey with an entrance on the corner of Hospital and St. Francois-Xavier street, and a second entrance on the last named street for employees and messengers. The ground floor will be occupied by the Company's offices. The main entrance will be on Hospital street.

SPARKS.

The ratepayers of Paris, Ont., will offer Mr. Melbrum $8,000 for his electric light plant.

Mr. John Sutherland, of Ottawa, is endeavoring to form a company to establish an automobile factory in that city.

Work has been commenced at Cascade, B.C., on the power house development scheme of the Cascade Power & Light Company.

The town council of Cannington, Ont., will submit a by-law to the ratepayers to raise $7,000 for the purchase of a municipal lighting plant.

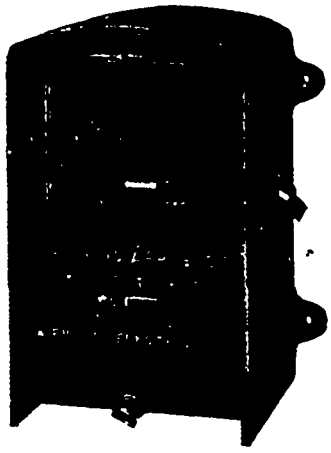
The best way of testing the balancing of armatures says a contemporary, is to mount them in bearings which are free to move; then while the armature is running, the heavy side can be found with a piece of chalk, and counterweights adjusted on the opposite side until the cessation of movement of the bearings shows that the centre of gravity coincides with the axis of the shaft.

A company composed of Winnipeg capitalists and business men, has been organized under the name of the Lac du Bonnet Company to transmit electricity for power and light, from a water power at Lac du Bonnet to the city of Winnipeg, a distance of 62 miles, using a voltage of 40,000 volts. Plans have been prepared for the power house and plant. The building is to be 317 feet long, by 56 feet wide, and will be thoroughly fire proof. A gallery which runs the whole of one side of the building is designed to receive the switchboards, leaving the main floor to be used for the generators and transformers. On the main floor will be placed 20 direct connected generators, each of 1000 kilowatts capacity. Step-up transformers will be employed to raise the voltage to 40,000 volts. The water wheels, dynamos and transformers will rest on stone arches. The flume will be 72 feet long, 16 feet wide and 10 feet deep.

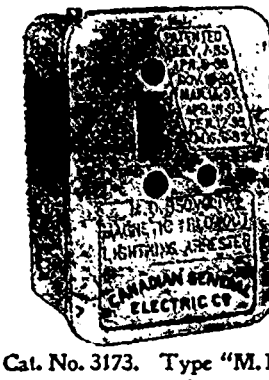
CANADIAN GENERAL ELECTRIC COMPANY'S

LIGHTNING ARRESTERS

For Direct and Alternating Current Circuits

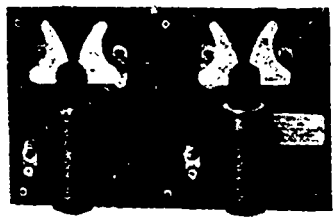


Cat. No. 3168. For Arc Circuits.
(For Line Service.)
75 Lights or less.



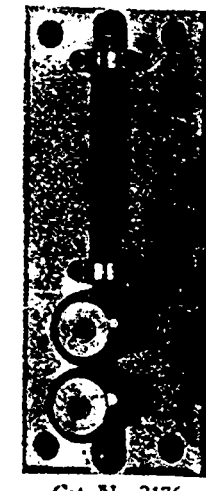
Cat. No. 3173. Type "M. D."
Specially adapted for Railway Work for circuits up to 850 volts.

Cat. No. 3171. For D. C. Incandescent Circuit.
For Station Service on circuits up to 300 volts.

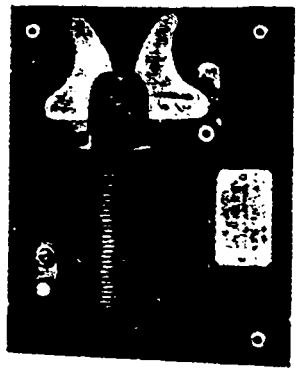


Cat. No. 3169. For Arc Circuits.
(For Station Service.)
75 Lights or more.

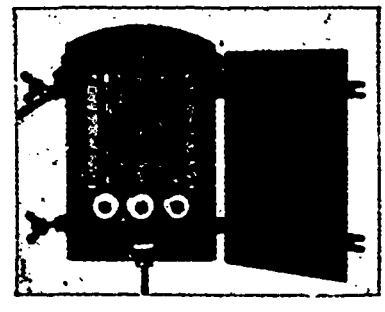
Cat. No. 3173.
With cover removed.



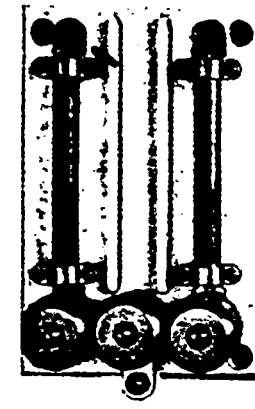
Cat. No. 3176.
For Alternating Circuits.
1000 volts S. P. for Station Service.



Cat. No. 3170. For Arc Circuits.
(For Station Service.)
75 Lights or less.



Cat. No. 3182. For Alternating Circuits.
2000 volts D.P. (in iron box.)
For line service.



Cat. No. 3181.
For Alternating Circuits.
2000 volts D.P. For Station Service.

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