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CANADIAN

ELECTRICAL NEWS

AND

STEAM ENGINEERING JOURNAL.

VOL. VII. OCTOBER, 1897 No. 10.

ELECTRICAL POWER TRANSMISSION PLANT AT THREE RIVERS, QUEBEC.

By H. R. Leyden.

The first long distance electrical power transmission plant to be installed in Canada has now been in operation for six months, with most satisfactory results both from engineering and financial standpoints. This plant has been installed by the North Shore Power Company, and transmits power from the water fall at Grande Chute, on the Batiscan river, over a distance of seventeen miles, to the city of Three Rivers. The present development is for 600 horse power delivered at the end of the transmission line, but the plant has been laid out with the view of increasing this largely for future demands. The most interesting feature in connection with this transmission plant is the novel method in which the new two-phase power is applied to an old electric lighting plant, which had previously been in operation, using single-phase alternating apparatus and a series arc system driven by steam power. The new power is applied to the old system with surprisingly few changes in the old method of distribution.

The old plant consisted of two single-phase alternators of 1,500 and 750 incandescent lamps capacity, and of two series arc dynamos, one of 35 and the other of 50 lamps capacity. All the dynamos were belted directly to high-speed steam engines. There was also a suitable boiler plant, using bituminous coal for fuel. In connection with the electric lighting plant, there was a pumping plant having capacity for delivering 1,000,000 gallons every twenty-four hours, which supplied the water service of the city. Both the lighting and the pumping plants were owned by the municipality of Three Rivers, and had been operated by them for over six years. A careful system of accounting has shown, however, that even with higher rates for service than are charged elsewhere by private companies, this municipal plant was running behind every year. The city authorities, therefore, decided to dispose of the plant and stop the continued outlay necessary to supply the yearly deficits in their lighting and pumping account. The plant was accordingly sold to the North Shore Power Company at

No. 1—The Water Fall.

a very large reduction from its original cost, and a contract made with that company for supplying the street lighting and pumping service required by the city at rates which are usual in cities of this size and character.

The company, in order to lessen the cost of such service, decided to employ water power, which is quite plentiful in this portion of the province of Quebec. The most available powers were at considerable distances from the city, and the cost of transmission was at first thought to be too great, but a careful investigation went to show that by utilizing the Grande Chute of the Batiscan river the cost of the transmission line would be comparatively small, and that the necessary investment for the hydraulic and electrical plant would pay a very good return.

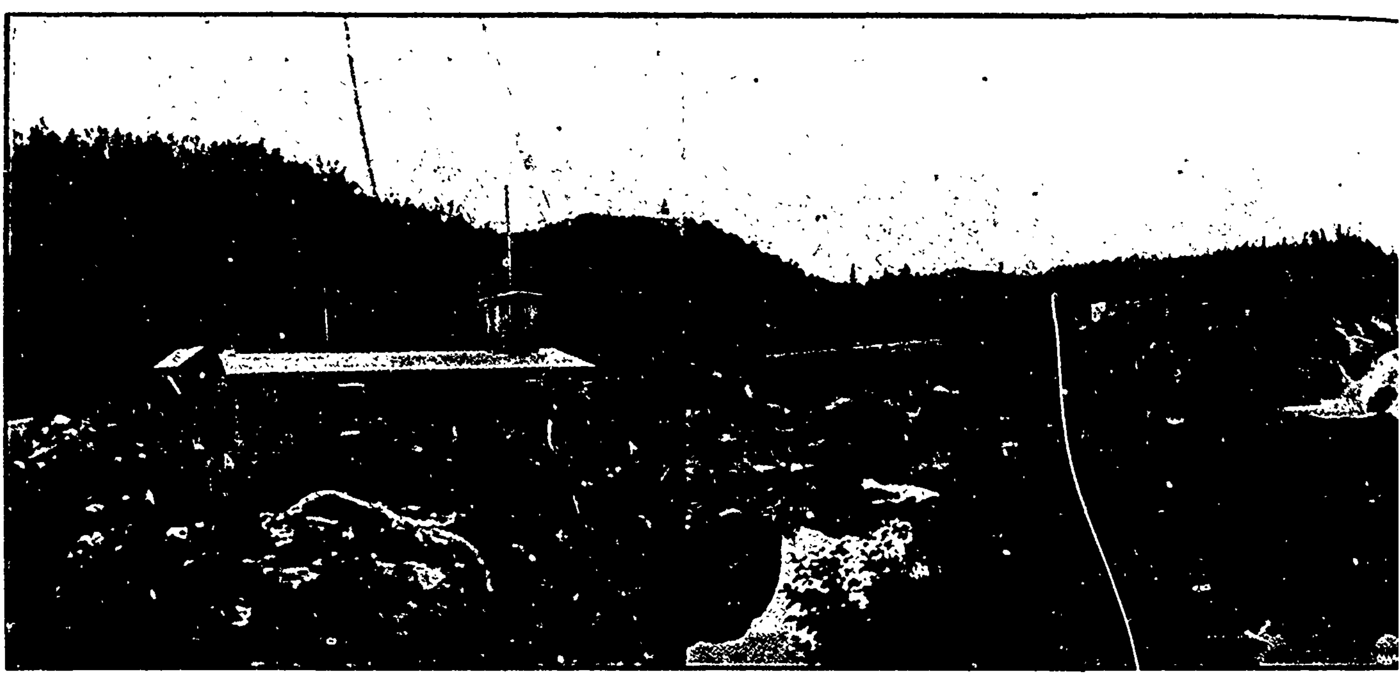
THE WATER POWER.

This beautiful water fall, a view of which is shown in cut No. 1, was almost ideal for a development of this character; the waters of the Batiscan at this point tumble over rocky ledges, giving a total fall of sixty feet within a distance of 100 yards. The Batiscan river always has a large and regular flow of water in all seasons of the year, being fed by large lakes a long distance back in the Laurentian Mountains. The power of the whole fall is estimated at over 3,000 horse power, but only a portion of this is utilized for the present requirements of the plant. In addition to this large and constant flow of water, this fall has the particular advantage of being free from a bug-bear of all water power plants in cold climates frazil. This is a peculiar ice formation differing both from anchor ice and slush ice, and which is much more dangerous to water wheels and racks than either, for it does not usually float on the surface of the water, especially if the current is swift. It forms only in open water, and in still water will rise to the top, so that the only reliable method of avoiding its dangers is to have a large still body of water above the dam. Immediately above the Grande Chute the water is dead and covered with ice in winter for a mile and a half up stream, so that there is no fear from this source.

This magnificent power seems to have been designed by nature for the purpose to which it is now being put, nearly all the dam work for its utilization had already been done by some volcanic upheaval, so that it only required the expenditure of a little over $1,000 on masonry work to render the large natural force of this power available in a very convenient form.

A general view of the premises is shown in illustration No. 2. It will be seen that only a short length of stone masonry work was necessary to form the dam and head gate construction. The stone for this work was procured on the spot by blasting away portions of the ledge, and the dam was built directly on the granite rock which formed the crest of the fall. The artificial dam only extends half way across the stream, the other part being a natural spillway over which the waters fall, as shown in view No. 1.

From the head gates the water is conducted in a steel flume down through a natural gulley directly underneath the power house, a distance of 400 feet. The flume is 6' 6" in diameter, and is built up in 6' lengths of one-quarter inch boiler plate, supporting foundations being built underneath it every 15 feet. It is the intention to cover the flume before cold weather sets in with spruce boughs, over which the snow covering will make a protective blanket against the intense cold of winter.



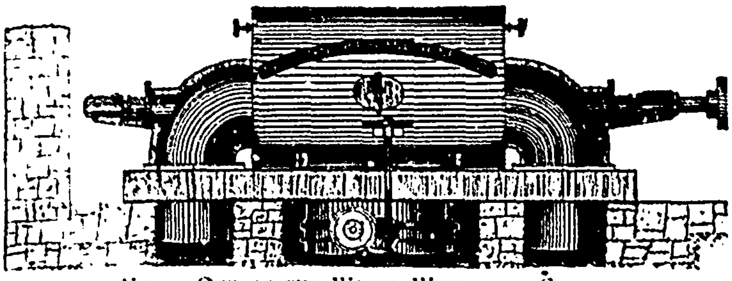
No. 2—General View of the Property and Power House.

THE POWER HOUSE.

The power house, shown in cut No. 2, is a substantial stone structure, and has for its foundation a flat ledge of granite. It is 62' in length by 36' in width, and is designed in such a way as to allow an increase of the present equipment as the demand for power grows beyond the present wheel installation of 800 horse power.

The lower end of the steel flume is terminated by a large head sheet, which is provided with a gate valve for draining when the water is shut out; a few feet from the lower end, and directly beneath the wheel cases, the water for supplying the turbine is taken from the feeder or flume by means of two branch pipes, these branch pipes leading vertically upward and connecting with the wheel cases, and being supplied with shut-off gates to clear the turbines of water when required.

The wheel cases stand directly on the floor of the power house on iron girders supported by heavy stone walls. They are built of 5/16" boiler plate 6' in diameter, with heavy cast iron heads, terminating in heavy quarter turn elbows 30 in diameter, each of the elbows forming the discharge of one of the turbines, and at the same time providing a bearing for the shaft which runs entirely through the case. The wheels are 20" in diameter, two being mounted on each shaft, and are arranged so that they discharge in opposite directions, equalizing the thrust and giving an even and uniform power on



No. 3. One of the Water Wheels, in Case.

the wheel shaft. Each unit of two 20" wheels gives over 400 horse power under a 50' head, running at 400 revolutions. The turbine shafts are connected directly to the generator shafts, thus doing away with the gearing and forming an ideal way of driving the generators.

Cut No. 3 gives an illustration of one of the cases, with its arrangement, taken from a drawing prepared for the plant, which will show more fully the compactness of this design. The wheels are of the Crocker type, and they, together with the flume and head gate work, were supplied and installed by the Jenckes Machine Company, of Sherbrooke, Quebec.

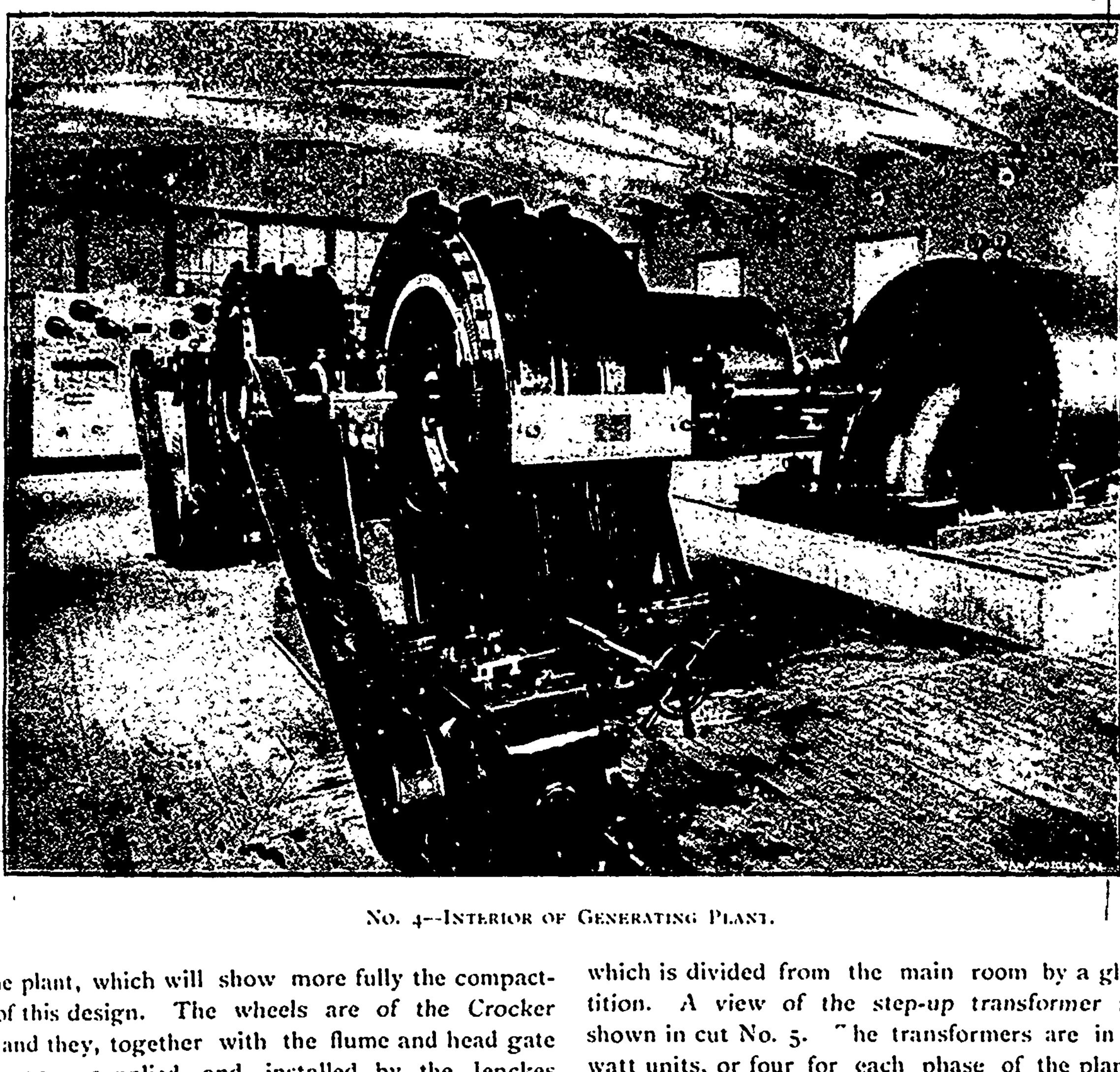
THE GENERATING PLANT.

The interior of the generator plant is shown in cut No. 4. The electric generators, of which there are two, are of the S. K. C. two-phase type, of 240 kilowatts capacity each, and were supplied, together with the rest of the electrical equipment, by the Royal Electric Company, of Montreal. The generators are connected directly to the turbine shaft by means of a flexible insulated coupling. These couplings are made of sole leather links, which connect projecting pins on the generator and turbine halves of the coupling. They have proved extremely satisfactory in service even when the shafts have not been in true alignment. The exciters, of which there is one for each machine, are belted to the other end of the generator shaft.

The current is generated at a pressure of 2,400 volts, and at a frequency of 16,000 alternations per minute. This periodicity was adopted because the electrical distributing apparatus at Three Rivers was designed for this number of alternations, and it was not considered advisable to change it. A neat switchboard of white marble has been installed to properly regulate the generators, which are designed to operate in parallel.

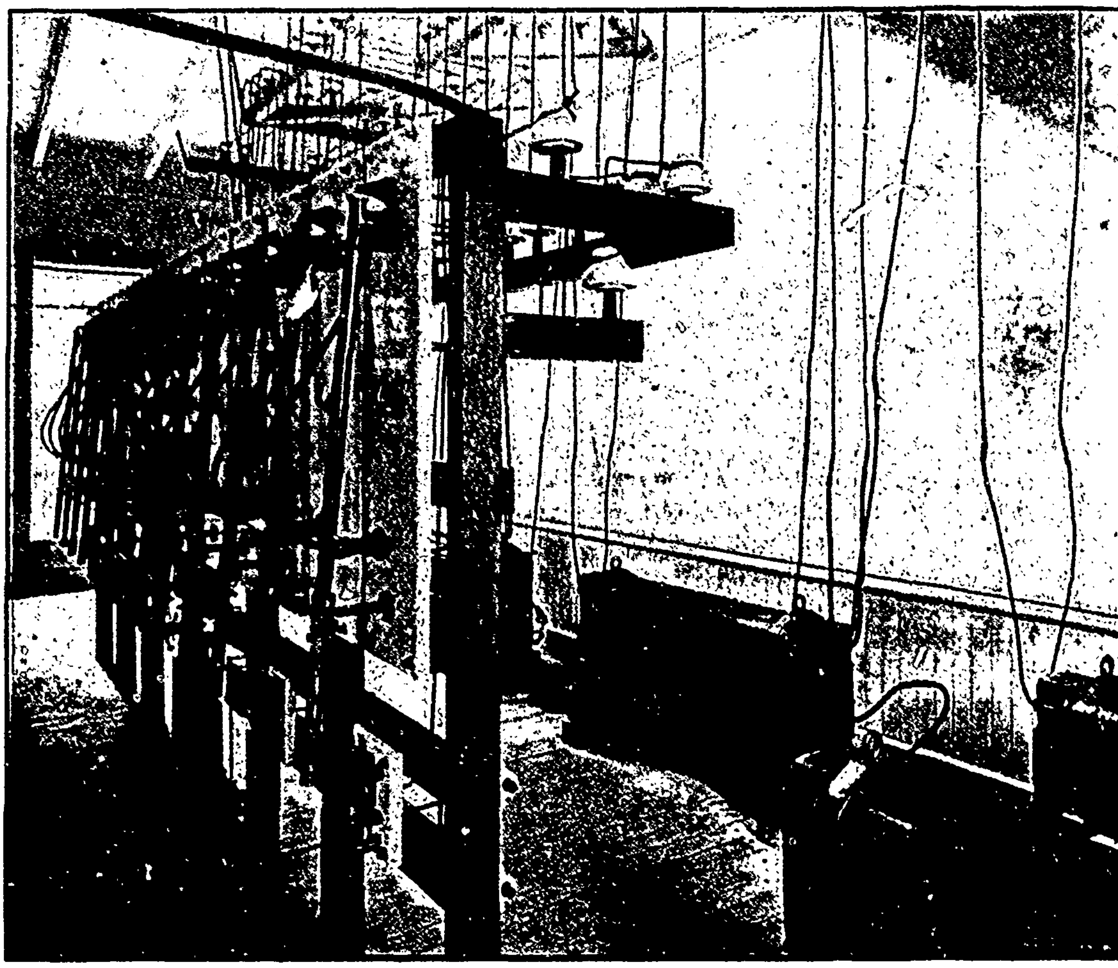
From the switchboard the current is carried to the step-up transformers, where the pressure is raised to 12,000 volts.

These transformers are placed in a separate room, which is divided from the main room by a glass partition. A view of the step-up transformer room is shown in cut No. 5. The transformers are in 60 kilowatt units, or four for each phase of the plant; they are of the self-cooling type, using neither air-blast or water to keep the temperature down. The primary and secondary coils of each transformer are controlled by separate switches, so that they can be readily thrown in or out of service as required. The switches on the



No. 4—Interior of Generating Plant.

12,000 volt side are of the S.K.C. non-arcing plug type, as can be seen from the illustration. These switches will break a 12,000 volt arc effectually, with no danger to the operator or the switch, and form a valuable adjunct to the plant. The 2,400 volt switches are of the



No. 5 Step-up Transformer Room and High Potential Switchboard.

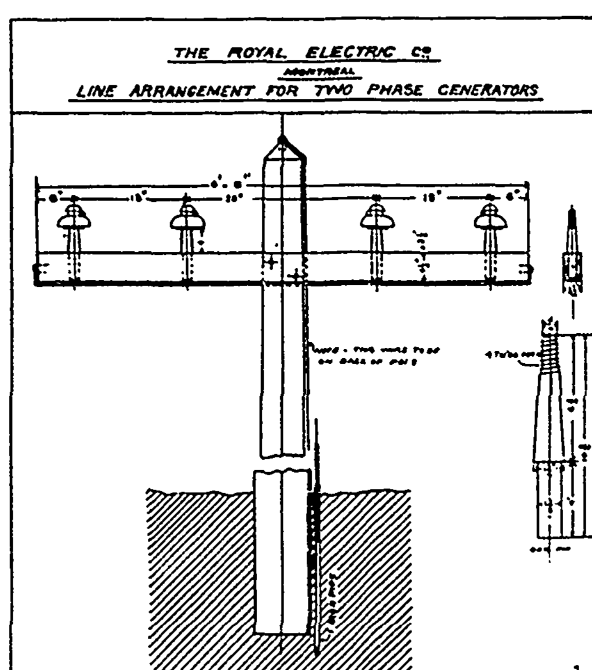
ordinary jack-knife type. On this step-up transformer board there are also placed two static ground detectors; they are for indicating any grounds on the transmission line, and are connected directly to the high pressure wires. From this board the wires are led to the cupola on the roof of the building by means of the porcelain line insulator construction shown in the illustration.

Taking it as a whole, this power house is a model of neatness and compactness for a plant of this kind. The interior is painted white throughout, and presents a clean and cheerful appearance.

From the power house the transmission line leads directly up the side of the mountain, and thence off on almost a straight line to Three Rivers. The country through which it passes is diversified between bush, public highway, farm division lines, and finally along the right of way of the Canadian Pacific Railway, which it follows for the last eight miles.

LINE CONSTRUCTION.

The line construction is shown in cut No. 6. The transmission circuit consists of four bare copper wires, No. 4 B. & S. gauge. This transmits the full power of the two generators over the 17 miles with a total loss of ten per cent., of which a little more than two per cent. is due to induction. The poles used are of white cedar 35' in length and 6" in diameter at the top, set 5 in the earth. The wires are placed 18" apart, and supported on special high voltage porcelain insulators. Considerable difficulty was experienced in procuring insulators suitable for this work. The requirement was that they should stand a high voltage stress of 40,000 volts for five minutes when placed in a salt water bath, and the hole for the pin also filled with salt water. Of the first lot supplied almost all failed in the test and were not accepted. Another manufacturer,



No. 6—Method of Line Construction.

however, supplied insulators of which less than 2[illegible] failed under this test.

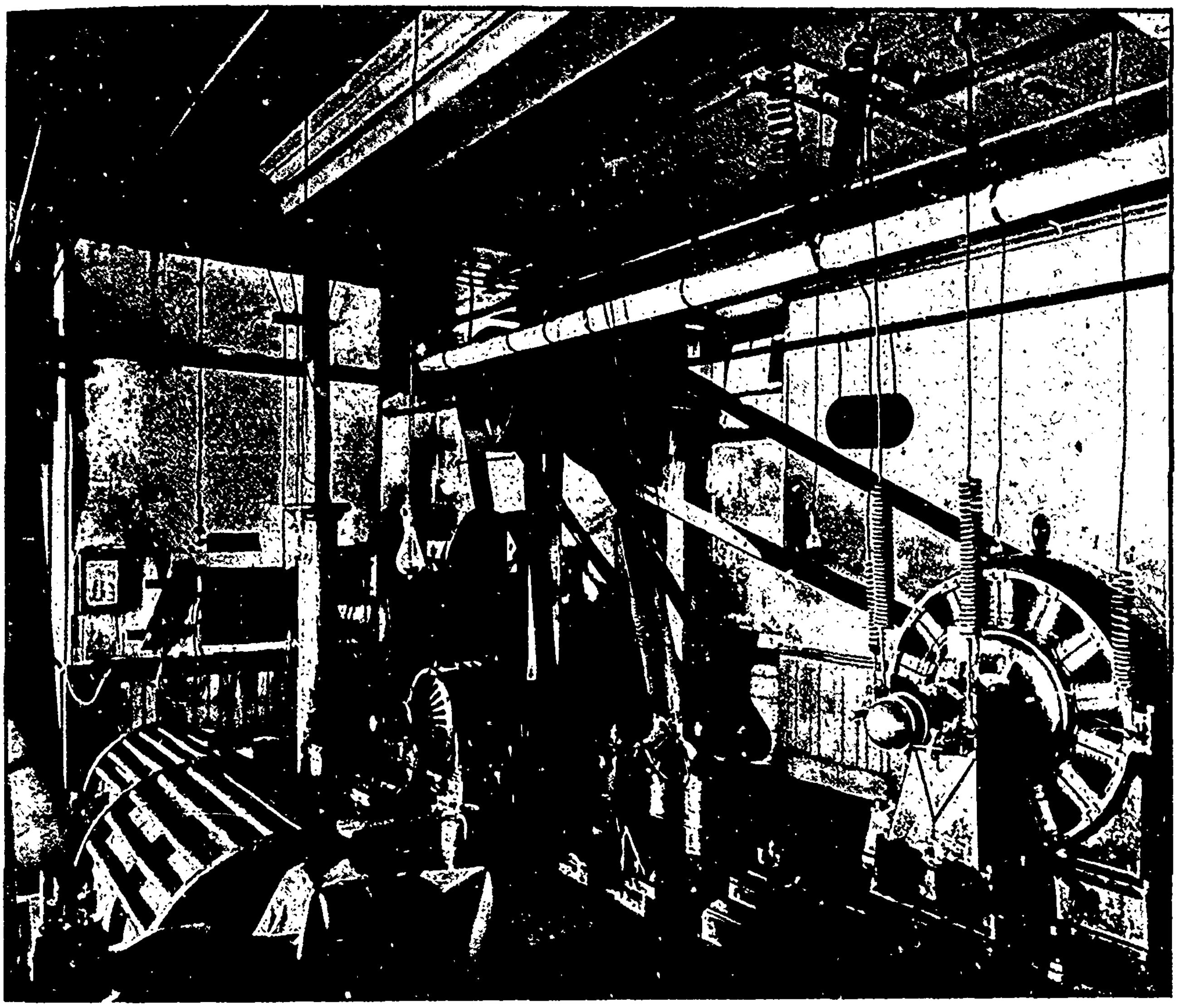
The pins supporting the insulators are made specially tall to keep the wires free from wet snow, which falls heavily in this region.

This line construction is giving very satisfactory results, the only accident being on the first night of the operation, when a limb of a tree got across the wires, the result being that the limb and the wire were both burned off at that point. Since then there has been no trouble whatever.

On the top of the poles and at each end of the cross arms are fastened lines of ordinary barbed fence wire as a lightning protector. These wires are attached with ordinary staples and grounded at every sixth pole, by means of extending a galvanized iron wire down through an iron pipe planted beside the pole. This lightning protection is supplemented by banks of lightning arresters at each end of the line. This method of lightning protection has proved itself thoroughly efficient during the past summer, in which time there occurred numerous electric storms without producing any trouble.

A telephone line, which is not shown in the cut, was afterwards strung by using ordinary galvanized iron wire attached to side brackets below the cross arms. Ericson's anti-induction instruments are used and no annoying hum is experienced. The ordinary solenoid instruments, which were first installed, did not operate well when the line was heavily loaded.

The line crosses the St. Maurice river on the highway bridge just outside of the city of Three Rivers; here the ordinary cross-arm construction built out from the side of the bridge is used. The wires run directly to the old power house at Three Rivers, which is used as a distributing station. Here step-down transformers are used to reduce the pressure to 1,100 volts, which is the voltage formerly employed in the old lighting service. A transformer board similar to the one in the power house at Grand Chute is used to cut in and out each individual transformer. The transformers used for incandescent lighting are made with regulating secondaries, so that the voltage on the lighting circuits can be controlled from here as well as at the generator. The old incandescent circuits were attached just as they were, no change of any character being necessary. The employment of 16,000 alterations in the new plant allows the use of the old transformers, while if a lower frequency had been employed, it would have been necessary to change them for new ones designed for the lower periodicity. The incandescent service is much improved since it has been operated in this manner instead of by means of the old steam plant.

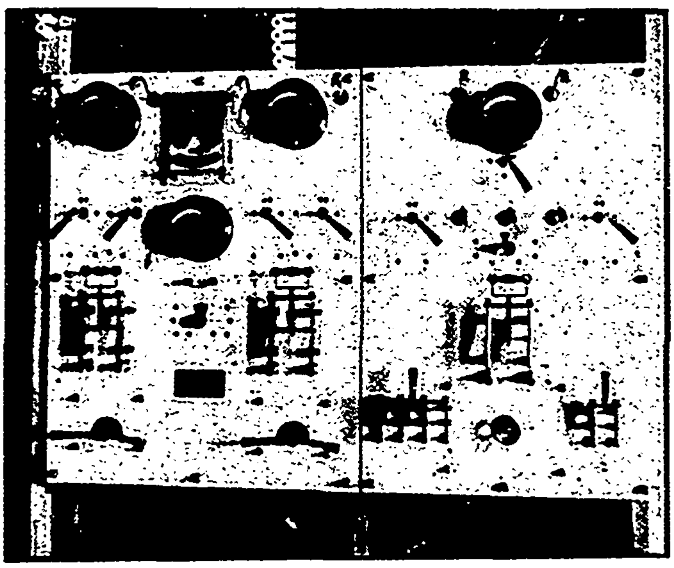


No. 7—Arrangement for Supplying the Arc Lighting Service.

THE ARC LIGHTING SYSTEM AND SYNCHRONOUS MOTOR.

Cut No. 7 shows the arrangement for supplying the arc lighting service. This was formerly supplied by two Royal arc dynamos, shown to the left of the illustration, belted direct to the engine pulleys. The new arrangement is to use the old 1,500 light single phase alternator as a synchronous motor operating from one phase of the two phase circuit to drive the arc machines instead of the engine, the other parts of the arc system, switchboard, connections, circuits and lamps remaining the same. The dynamos were not even moved from their former position, so that in case of accident to the water power the old belts can be put on and the plant operated by the steam engines as before. All that was required to accomplish this change was to place a shaft overhead to which all machines are belted, and to install a 10 horse power induction motor to bring the old alternater into synchronism with the generators at the power house. Clutch pulleys are used for driving the arc machines, so that the starting motor has only to start the synchronous motor and the shaft. When the synchronous motor is brought to speed, the current is thrown on and it immediately takes the load and the starting motor is shut down; the arc dynamos are then thrown into service with the clutch pulleys and the arc lamps operated in an entirely satisfactory manner. This is another reason for employing 16,000 alternations, for, if a lower periodicity had been employed, the old alternator being a 16,000 alternations machine, could not have been used for this purpose.

It is found that 60 kilowatts delivered from one phase



No. 8—Switchboard in Distributing Station.

of the generator will supply all the loss in transmission, the losses in the motor, shafting and arc machines, and operate 78 1,200 candle power lamps, with their circuits, which are about four miles in length. The simplicity and economy of this method of operating an old plant is strongly in favor of the flexibility of the two phase system for transmission work.

SWITCHBOARD AT DISTRIBUTING STATION.

Cut No. 8 shows the switchboard used at the distributing station. It is composed of two panels of white marble, having the instruments mounted directly on the slab; the right hand panel is for the synchronous motor. The ampere meter at the top is provided with a short-circuiting switch, so that it can be cut out when the plant is in operation; it is only used for the purpose of properly adjusting the field of the synchronous motor, so that it takes the least amount of current; that is, it is neither over nor under excited, so as to produce leading or lagging currents. Below the ampere meter is a synchronizer of the ordinary three lamp type, and on either side are seen the handles of duplex fuse blocks, which are on the back of the board; they are provided with two fuses each, so that if one should blow, by throwing this handle the other is immediately thrown into service. Below are shown the main switch, the field switch and exciter rheostat, and the four pole two phase starting motor switch. The left hand panel shows the incandescent distributing board; it is for two circuits, such being the old distribution. Each circuit is provided with an ampere meter, two fuse blocks, main switch and transformer regulator head. In addition, there is an "S.K.C." static ground detector and a voltmeter, each capable of being thrown on either circuit by means of a changing switch.

PUMPING PLANT.

The pumping, which is done in the same building, was formerly performed by a duplex steam pump. This plant is now being replaced by two triplex double acting power pumps, each driven by a two phase motor; one of these pumps will be sufficiently large for the ordinary service, but the second will be started in case of fire or extra calls upon the plant. The water will be pumped directly into the mains, no reservoir or gravity pressure being employed. In order to utilize the constant speed of the motors, the discharge pipes of the pumps will be provided with relief valves, so that whenever the pressure in the mains exceeds the prescribed limit, the extra water will run back to the suction pipes through the relief valve.

This simple arrangement will enable the company to perform all the lighting and pumping service of the city by means of the water power seventeen miles distant and to close down the steam plant entirely. The steam plant, however, will still be retained as an emergency plant in case any accident should interrupt the water power service.

The changes above described have been accomplished with no interruption of the old service, and have utilized all the electrical apparatus except the 750 light alternator, which is now not required. No money whatever has been required for changing the distributing system in order to accommodate it to the two phase current transmitted from the water power, and in accomplishing this the arc and incandescent services have both been very greatly improved.

ELECTRIC VS. STEAM RAILWAYS.

Steam railways have now to reckon with the competition offered by electric roads for local passenger traffic in the vicinity of cities. The only way in which the steam roads can hope to retain a fair share of this traffic is by meeting the low rates offered by the electric roads. We are told that the Grand Trunk Railway Company lost a valuable passenger business between Hamilton and Burlington, by refusing to meet the wishes of the people in the matter of a reduction of rates. In consequence of this refusal, the people who had been accustomed to travel on the steam road transferred themselves to the Burlington Electric Railway Company's cars. When the Grand Trunk people saw their traffic slipping away from them, they announced a reduction in rates to the figure which they had previously refused to grant. Their offer came too late, however. They had antagonized their customers, who, having found the electric road cheaper and more convenient, refused to come back. As a result the G.T.R. trains are running light and the electric road is doing a rattling trade.

The Jenckes Machine Co., of Sherbrooke, shipped last week a complete tramway plant to the Lucky Jim Mines, at Sandon, B.C.

THE STEAM ENGINE INDICATOR.*

By G. B. Risler.

The indicator is an indispensable assistant to the engineer, and of late years it has become evident that intelligent and wide-awake steam plant owners recognize the necessity for such a valuable instrument, and they are also appreciating the services of the engineer who is competent to use it properly.

The indicator diagram is actually the only means of showing on paper what really takes place in a cylinder. To read an indicator card correctly is not an easy matter, and in order to be able to do so, considerable study and practice are necessary. The handling of such a delicate instrument requires a great deal of care, and sometimes considerable skill and ingenuity must be employed in making the needed attachments. By its use many stumbling-blocks will be removed, while the calculations and geometrical work which the engineer will be impelled to make in connection with it will lead to the acquisition of a good, general knowledge of the whole subject. Careful consideration of the diagrams from different engines, under varied conditions, cannot fail to lead to thought and investigation. A general knowledge of the law of gases (especially Mariotte's law) is needed, and a study of physics, mensuration and mechanics is most beneficial.

In order to determine the most economical plan of operating a steam plant, many tests are made. Such tests if properly conducted are valuable, and are much to be appreciated by steam plant owners, who will find it to their interest to give every encouragement and assistance to the engineer along this line. The diagrams traced by the indicator pencil will vary widely, and depend on the condition of the different engines from which they are taken, and it therefore becomes necessary to know how to interpret these variations correctly. This information the engineer can only acquire through the processes of reasoning and hard study. In attaching the indicator considerable skill is sometimes needed, and circumstances must determine what plan can best be employed. The reducing motion must be such that it will give to the paper barrel in its reduced scale an exact reproduction of the movement of the piston.

Examine your indicator and see that every part of it is moving freely, has no lost motion, and is well oiled. A cord that will stretch is to be avoided. Good judgment is required in putting the proper tension on the paper barrel spring for differently speeded engines. The indicator springs should be tested occasionally to see if they agree with a standard steam gauge of known accuracy. Do not use too light a spring for the pressure. If the instrument is a reliable one, and the necessary precautions have been taken in every particular, the diagram will then show you the pressure acting on the piston on both sides, and at any part of the stroke during one revolution of the engine, and that is all it will do. Knowing the scale of the spring, it is an easy matter to determine the pressure at any point of the stroke. This little tell-tale instrument will leave on a piece of paper a good deal of information, providing the atmospheric pressure line is properly established on the diagram. It is of the greatest importance that this line be drawn correctly, as it is the neutral line of the diagram, and from it all pressures above and below must be determined. After removing the card from the paper barrel it is advisable that all data be made on it as complete as possible, and then will its study be pleasant and profitable.

The following terms are used in speaking of the different lines and curves: The atmospheric line, vacuum line, admission line, steam line, exhaust line, counter pressure line, compression and expansion curve. The beginning and termination of some of these lines are called points, and their continuation indicates periods in the stroke of the piston. Technical terms for pressure are as follows: Boiler pressure, absolute pressure, initial pressure, cut-off pressure, terminal pressure, back pressure, and mean effective pressure. The mean effective pressure is what we must find in order to calculate the indicated horse power of the engine, and the indicator card is the only means of getting it correctly.

Having once established the mean effective pressure from the diagram, the work done in one stroke, in foot pounds, can be calculated as follows: Multiply 144 by the mean effective pressure, and by the cylinder volume in cubic feet, displaced by the piston. Two simple and easily remembered rules for finding the indicated horse power when the mean effective pressure is known, are as follows: 1. Multiply the mean effective pressure by the cylinder area in square inches and by the piston speed in feet per minute, and divide by 33,000. 2. Multiply the mean effective pressure by the length of the stroke in feet, by the area of the cylinder in square inches, and the number of strokes per minute, and this, divided by 33,000, will equal the indicated horse power. From the foregoing it can easily be seen that the indicator is invaluable in determining the work done by an engine.

But this is not all, by any means. An analysis of the expansion curve, which requires considerable knowledge and accurate working from a geometrical and arithmetical standpoint, is of great value, and the nearer the actual expansion curve of the diagram approaches the theoretical (often called the equilateral hyperbola) the greater will be the economy. A considerable deviation from the actual and the hyperbolic curve impels the engineer to think and to reason out the cause. A leaky piston, a leaky steam valve, re-evaporation in a cylinder, or a leaky exhaust valve—all these tend to bring about an expansion curve, which is not in accordance with the law of gases laid down by Mariotte, viz., that the volume should vary inversely as the pressure. This, of course, is to some extent an impossibility in an engine cylinder, owing to loss of heat and leakage. Nevertheless, diagrams have been taken from steam engines which are a credit to the engineer, as well as to the engine builder, and are almost identical in the expansion curve to the hyperbola. It is not advisable to come to hasty conclusions in regard to the expansion and compression curve, as well as other lines, because the laws of nature can have quite an influence in this respect, owing to the surroundings and conditions under which a steam engine may be working. The engineer well knows that dry steam should be furnished to an engine; therefore, it is reasonable to state that the steam boiler at times can be held responsible for a diagram which does not approach the ideal. If the steam pipe leading to the boiler is too small in diameter, the indicator diagram will give an indication of it, but this should be verified with the diagrams taken direct from the steam chest or the steam pipe. The indicator card will furnish the means of knowing how the steam is distributed in the cylinder. If the valve gear is not properly working the card will show it. With calculations from the diagram we can find with what sort of economy, mechanically and thermodynamically, the engine is working, and if underloaded or overloaded the engineer will be in a position to advise his employer exactly what changes should be made in order to insure greater economy in fuel. The steam line may show considerable initial expansion or loss of boiler pressure, and the back pressure line can point out excessive resistance to the piston. Both cases are evidence of wasteful expenditure of steam.

Economy, to the engineer, means keeping down the fuel account, having small bills for repairs, little or no loss from shut-downs, regular speed, and the least possible loss from deterioration. The engineer must be guided by circumstances, and if he finds himself confronted with conditions that render the attaining of strict economy impossible, he then can only make the best of bad surroundings. Steam engine economy is made up of many factors, and it is to be hoped that the endless study and exertion on the part of the intelligent and ambitious engineer will be appreciated by the employer.

It is my belief that many steam plant owners or managers are willing to assist the engineer financially in obtaining such an instrument as the indicator, as well as other most valuable appliances, which would serve as aids in many instances to the greatest economy.

My employers, The Advertiser Printing and Publishing Company, of London, have recognized the wisdom of this, and assisted me to the extent of $50 in purchasing an indicator in 1893, and also obtaining for me in 1896 a free engineer's scholarship with the International Correspondence Schools, in Scranton, Pa.

*Paper read before the Canadian Association of Stationary Engineers at their annual convention at Brockville, Ont., August 19th, 1897.

RECENT CANADIAN PATENTS.

Patents have recently been granted in Canada for the following electrical and steam engineering devices: No. 56,453, electric railway, Harry C. Reagen, jr., Philadelphia, Pa.; No. 56,457, steam boiler, Edward J. Cusack, Havelock, N. B.; No. 56,464, steam engine, Johan Burchardt Opsahl, Toronto; No. 56,501, electric furnace, John Joyce, Andover, and James A. Denther, Boston, Mass.; No. 56,504, ore reducing electrical machine, Charles P. Tatro, Seattle, Wash.; No. 56,578, application of telephone to electric bell systems, Frederick Hodgson, Hampstead, and George A. Edwards, Peckham, Surrey, England; No. 56,580, governor for waterwheels, Marcus P. Schenck, Springfield, Mass.; No. 56,632, governor for steam engines, E. B. Thornburn, Highlstown, New Jersey; No. 56,649, rotary engine, David Morgan, Launceton, Tasmania; No. 56,653, feed-water heater and condenser, James M. Keller, Denver, Col.; No. 56,660, electrode for storage or secondary batteries, Paul Ferdinand Ribbe, Lessingstrasse, Prussia, Germany; No. 56,662, storage battery, Albrecht Heil, Frankisch, Crumbach, Germany; No. 56,683, steam boiler, Edward Makin, Manchester, Eng.; No. 56,684, steam generator, Edward Makin, Manchester, Eng.; No. 56,759, dynamo electric machine, Wm. M. Morday, Loughborough, Eng.; No. 56,760, safety device for electric circuits, Lewis G. Rowland, Camden, N.J.; No. 56,761, telegraph or telephone cable and their connections, James M. Barr and C. E. S. Phillips, Castle House, Kent, Eng.; No. 56,782, switchboard annunciator, Bell Telephone Company, Montreal; No. 56,794, steam generator, David M. Thompson, Providence, R.I.; No. 56,798, steam indicator, Karl Maslard and Wilhelm Heerensson, Berlin, Prussia, Germany; No. 56,806, rotary engine, Eber B. Tree, Woodstock, and Robert H. Eldon, Toronto; No. 56,808, telephone toll apparatus, Siegfried Silberberg, New York, N.Y.; No. 56,809, toll apparatus for meters, Seigfried Silberberg, New York, N.Y.

CANADIAN
ELECTRICAL NEWS
AND
STEAM ENGINEERING JOURNAL

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

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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Use of the Incandescent Lamp. WE have been watching with interest the growing use of incandescent lamps for decorative and advertising purposes. During the recent jubilee celebration in Toronto some of the principal business and public buildings were handsomely decorated with incandescent lamps arranged in a variety of forms and in rich and harmonious colors. During the evenings when these illuminations were on view the streets were thronged with people till midnight. By the use of the incandescent electric lamp the windows of many large stores have been rendered even more attractive at night than in the day time. Electrically illuminated street signs are a conspicuous feature of the streets of New York at night, while an immense globe of blazing incandescent lamps surmounts the dome of one of the largest buildings on Broadway, and is a conspicuous object for miles around. There is large room for development in Canada in the use of electricity for such purposes as those mentioned, and wide-awake electric light managers and business men will find it to their profit to cultivate this field.

Municipalities and Street Railways. WHEN public franchises are to be disposed of it is reasonable to expect that municipal authorities will endeavor to make the best bargain possible, and to receive the greatest remuneration for the privilege granted. It is just possible, however, that the conditions exacted in some cases may be of such a nature as to operate against the interests both of the municipality and the company securing the franchise. As an instance of this we may point to the street railway in the city of Hamilton. There, according to agreement, the street railway company has been compelled to pay to the city six per cent. of the gross earnings, besides a certain mileage charge. The company found themselves unable to do this, and a few months ago the city council passed an amended relief by-law, but it is said to have been so loaded down with conditions that the company refused to accept it. The possession of a street railway franchise in the city of Hamilton is not likely to prove very remunerative to any company, and more especially under unfavorable conditions. It would seem to have been in the interest of the city to have given such concessions as would permit the company to pay a reasonable dividend to its shareholders, and improve the efficiency of its system. Being crowded financially, this became an impossibility. There is said to be a movement in favor of the city taking over the railway. Should this be decided upon the operation of the road will be watched with much interest.

Electric or Hydraulic Elevators.

THE new municipal buildings at Toronto are about to be equipped with elevators, for which tenders have been invited, and the question has arisen as to the comparative cost of operating and maintaining hydraulic and electric power machines. The first cost is greatly in favor of the electric elevator, while the architect has also recommended its adoption. The chief argument in favor of the hydraulic system is that when the heating plant in the building is in operation, the extra cost of fuel consumed to generate high pressure steam to supply power to operate the pumping plant is very small. It is further claimed that the exhaust steam from the pumping plant can be used to heat the building, thus lessening the cost of heating. Notwithstanding this, figures obtained by the architect of the comparative cost of operating the two classes of elevators in the principal buildings in Toronto show the average cost per day of electric elevators to be 58 cents, against 96¼ cents for hydraulic elevators. From this it would appear that under ordinary conditions electric power for elevator purposes is the more economical, but in many cases the choice of elevator will no doubt be determined by special conditions and surroundings.

Prospects For Foreign Business.

IT is most gratifying to observe that Canadian machinery manufacturers are securing a foot-hold in foreign countries, and that our goods are regarded as equal to those of any other manufacture. In electrical and steam engineering apparatus the outlook is fully as favorable as in other lines. On another page reference is made to a franchise secured by Mr. Chapman, of Montreal, for an electric railway in Jamaica, much of the machinery for which will, it is said, be supplied by Canadian manufacturers. It will be remembered that Mr. William Rutherford, formerly chief engineer of the Canadian General Electric Company, left last spring to accept the management of the electric traction department of the English engineering firm of Dick, Kerr & Company. Mr. Rutherford has recently been on a visit to America, and while here placed a contract with the Robb Engineering Company, of Amherst, Nova Scotia, for several high speed engines for electric tramway service at Barcelona and Madrid, Spain. He also placed contracts with the General Electric Company, of New York, and the Allis Company, of Milwaukee, for electrical machinery and engines to the value of one hundred and sixty thousand pounds. It is said that the prospects for European trade in electrical machinery are favorable, and the above facts would seem to verify the statement. Canadian manufacturers are certain to receive their share of the trade.

Electrical Cooking and Heating.

A COMPARATIVELY new field for the employment of electricity is its application for heating and cooking purposes. For the former purpose it has already been used in Canada to some extent, but electrical cooking is of more recent origin. Two Canadian manufacturing companies have lately placed on the market lines of apparatus for cooking and heating by means of the electric current, an exhibit of which was made last month at the inauguration of the Lachine Rapids Hydraulic and Land Company's plant at Montreal. In a paper read by Mr. J. P. Jackson before the American Institute of Electrical Engineers, some figures are given of the relative cost of cooking by means of electricity and coal as the source of energy, the results being determined by actual experiments. The cost of cooking three meals by the electric current was found to be 13.1 cents per meal, and the cost by coal 3.15 cents per meal. The energy required for four hours' ironing was produced by electricity at a cost of 22.7 cents, and by coal at 12.25 cents. The results of these tests would seem to indicate that for the ordinary cooking of a family electricity is yet too expensive to become very generally adopted, but there are many advantages in its use, such as cleanliness, decreased fire risk, convenience, etc., which will undoubtedly cause it to be employed by those who value these considerations above the single item of cost. It is also possible that with the more general adoption of electricity it may be in the interest of central stations to reduce the price charged, especially for day load service. There appears to be a growing recognition by central station managers that every possible means should be employed of increasing the day load, and electrical heating and cooking will provide a means of doing this.

CANADIAN ELECTRICAL ASSOCIATION.

THE Executive of the above Association, encouraged by the success of the convention at Niagara Falls in June last, are taking time by the forelock as regards the preparations for the convention to be held in Montreal next year.

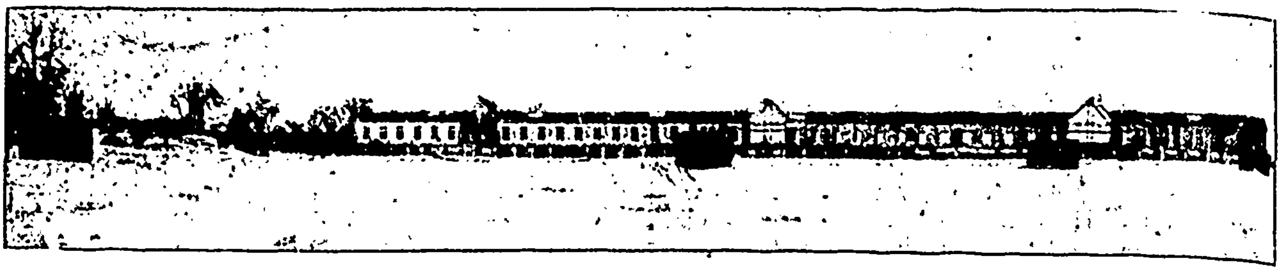
At a meeting of the Executive Committee held recently, Messrs. C. B. Hunt, A. M. Bowman, A. A. Dion, J. J. Wright, A. M. Wickens, W. H. Browne and the Secretary were appointed a committee to procure suitable papers.

The following persons were appointed a committee to endeavor to extend the membership of the Association: Messrs. F. C. Armstrong, J. A. Kammerer, K. J. Dunston, A. A. Dion, O. Higman, F. H. Badger, E. E. Carey, and the Secretary.

A committee on arrangements was appointed as follows: Messrs. Wm. Thompson, W. H. Browne, John Carroll, L. B. McFarlane, J. A. Baylis, F. H. Badger and O. Higman.

It is gratifying to see this evidence of the determination of the Executive to complete as early as possible arrangements which will tend to ensure the success of the Montreal meeting.

The Association is actively engaged in other directions also in behalf of the electrical interests, and is receiving the hearty co-operation of many of the electrical companies. Those companies which have as yet failed to reply to the circular recently issued by the Association, should do so without further delay, and fall into line with those who have already promised co-operation with the work which the Association has in hand.



Lachine Rapids Hydraulic & Land Company—A Winter View of the Uncompleted Power House.

INAUGURATION OF THE LACHINE RAPIDS HYDRAULIC AND LAND COMPANY'S POWER PLANT.

The inauguration of this company's new hydraulic and electric plant at Montreal took place on Saturday, September 25th, under favorable weather conditions. The directors issued nearly three thousand invitations to prominent persons in Montreal and elsewhere, and the company's magnificent power house, nearly one thousand feet long, was crowded with visitors. Letters of regret were read from Sir Wilfred Laurier, Hon. Messrs. Marchand and Robidoux, Sir Adolphe Chapleau, Hon. W. S. Fielding, Hon. A. G. Blair and others.

Those who, previous to the construction of these works, had been acquainted with the general appearance of the Lachine rapids at point of utilization, were pleased to observe that the carrying out of such an immense industrial enterprise had not in any way marred the beauty of the rapids. The neat appearance of the power house, both externally and internally, was freely commented upon.

Promptly at 2 p. m. the president of the company, Mr. G. B. Burland, received the guests in No. 1 power house, and read an interesting address, which in part will be found below.

PRESIDENT'S ADDRESS.

A little over twelve months ago, said Mr. Burland, I stood almost upon this same spot, and made certain statements and promises to those present; to-day, in the name of the directors of the Lachine Rapids Hydraulic and Land Company, I invite you to witness how these statements have been fulfilled and the promises carried out. I told you that we would divert the river from its course, and excavate its bed, that we would build a wing dam a mile long and a cross dam 1000 feet long; that we would then restore the river to its place; that instead of a roaring torrent we would show you a still basin in which would be locked up a force equal to 8,000 horse power. I ask you now to look around and see whether we have accomplished all this. We have accomplished more; we have here a power which registers not only 8,000, but 21,000 horse power.

I will not detain you with any details of construction. You see results, which speak more strongly to you than any mere statement of mine: The 300,000 yards of rock removed, the millions of feet of lumber in our dam, the thousands of yards of cut stone and concrete, the tons of steel, and the thousands of men employed, and all this has been accomplished without a single loss of life or serious accident of any kind; without any outside financial assistance; without any excess of expenditure over estimates, without any payments for extras, and without any mistakes either in calculations or construction.

I will not detain you longer to discuss such myths as back water, frazil and ice pressure. The best proof that we believe they are myths is that fourteen (14) of our subscribers were found willing to invest $1,400,000 of their own hard-earned cash in the enterprise. Our temporary works have been here over a year, and we experienced no trouble from ice pressure, we saw nothing of back water, and we did not find enough frazil to stop up the leaks in our temporary dams.

Our capital in the first instance was $1,000,000. That amount our engineers deemed sufficient to acquire rights, to construct head and tail races, power house, and install 66 water wheels, with the necessary gearing and jack shaft. How far they have succeeded in their estimate you may gather from the fact that since the commencement we have increased the number of wheels from 66 to 72. We have deepened 1,200 feet of the river bed below the main dam, removing an immense reef of rock, which was the great stumbling block to all who went before us. We have constructed a system of booms and guard piers in our head race. We have extended the length of our power house over 120 feet, and notwithstanding this, when all our work is completed as you see it to-day, we are still $25,000 under our original estimates, a fact in itself which crowns the ability of our engineers.

The engineers' estimate of the power produced under the first contract was about 8,000 horse power. To-day they have provided for installing 72 wheels, each of which is capable of giving, under a thirteen foot head, 300 horse power, or a total of twenty-one thousand six hundred (21,600) horse power, and the head on our wheels is to-day (if any one of you here present have a doubting spirit and a tape measure or rule, you may satisfy your own curiosity) between fifteen and sixteen feet, which will yield much more power than that already given.

Now, it stands to reason that if it was estimated to cost $1,000,000 to complete the hydraulic installation and to supply power on the jack shaft, the same power could not be converted into electricity without an increase of capital. It was for this purpose that the capital of the company was increased from $1,000,000 to $2,000,000. We have in reserve, therefore, for our electrical transmission and distribution over $900,000, which, in our opinion, will be ample to provide a transmission and distribution system to market the whole of our power. Already we have constructed an underground system in Montreal, which, in itself, we look upon as a step in advance and in the right direction, that will, we hope, rid our streets of the unsightly poles, and rid our firemen of the difficulty of fighting fires through a network of wires. Eighty miles of underground conduit have already been laid, including cables crossing the canal, and a sub-station has been erected, situated on the corner of McCord and Seminary streets, in the city of Montreal.

Our transmission line, starting from this power house to the Curran bridge on Wellington street, has been constructed in the most permanent manner, of latticed iron poles embedded in concrete, sufficient to stand any strain on the wires during the heavy winds and sleet storms of winter.

Cooking by electricity is also making progress. The ladies will be interested in seeing the tea and coffee made by the current from the rapids to-day. Already broilers, chafing dishes, coffee pots, five o'clock tea kettles, hot water urns, smoothing irons and curling tongs can be obtained from any electrical supply dealer, and it will be the aim and object of this company to supply current at a rate which will allow of their more extended use. We will very soon be prepared to install a separate meter to measure the current used in cooking, and furnish the same at a still greater reduction.

The accomplishment of this great project and the economy of its construction is ample evidence of the skill and ingenuity of our engineers, and the capability of our contractors, Messrs. Davis & Sons, with others engaged in the work, who have in no small degree assisted in the satisfactory and wonderful result you now see before you.

At the invitation of President Burland, R. Wilson Smith, Esq., mayor of Montreal, turned the water on six of the wheels and started the machinery in motion. Mrs. Burland closed the switch, completing the circuit between the Lachine Rapids and the City of Montreal.

The building is an immense structure, nearly 1,000 feet long by 50 feet wide, running directly across the river. The superstructure rests upon huge cut stone piers, resting upon the bed rock of the St. Lawrence, and laid in Portland cement. At the shore end of the superstructure is a square brick tower, used as offices for the staff, and equally distant are three square brick buildings with slate floors, which will contain the generators and switch-boards. The wheels are so arranged that they are in parallel rows the entire length of the building.

The head race or dam is 4,000 feet long by 1,000 feet wide, with an average depth of 13 feet, making a beautiful stretch of perfectly smooth water running parallel with the shore.

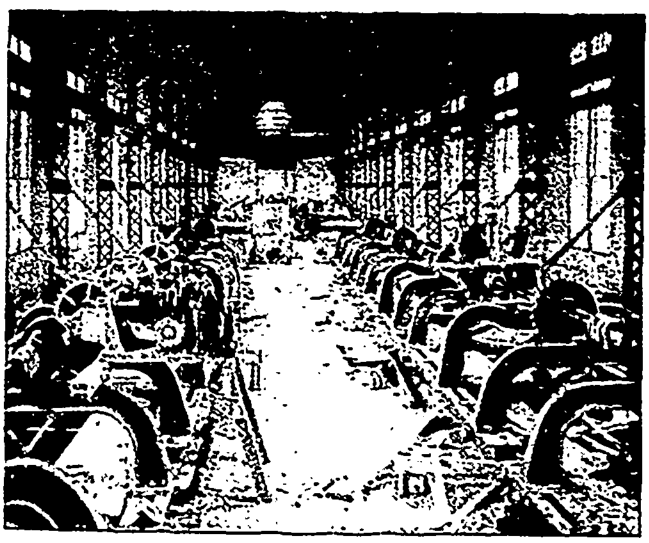
THE HYDRAULIC MACHINERY.

The hydraulic installation, when complete, will consist of seventy-two 57 inch Victor wheels with cylindrical gates, connected up in twelve series of six each by means of mortise bevelled gearing and horizontal shafting directly connected to the generators.

The wheels are governed by an improved governor, known as the Gesler, which is supposed to operate instantaneously the gates of the wheels. The flumes, 36 in number, in which the wheels are placed, are 20 feet wide by 40 feet long, and contain two wheels in each. Forty-eight of the wheels are already installed and twenty-four of them connected to generators. Each wheel is capable of giving 300 horse power under a 13 foot head, so that when installation is complete the hydraulic machinery will be capable of generating 21,000 horse power.

THE ELECTRICAL MACHINERY.

The electrical installation, when complete, will consist of twelve 750 k. w., three phase generators, made by the Canadian General Electric Company, each direct connected to six water wheels and operating at 4,400 volts at 175 revolutions. The generators are of the revolving field type, and each have separate belt driven exciters. Four of these generators are already installed



Looking Down the Power House from the Centre.

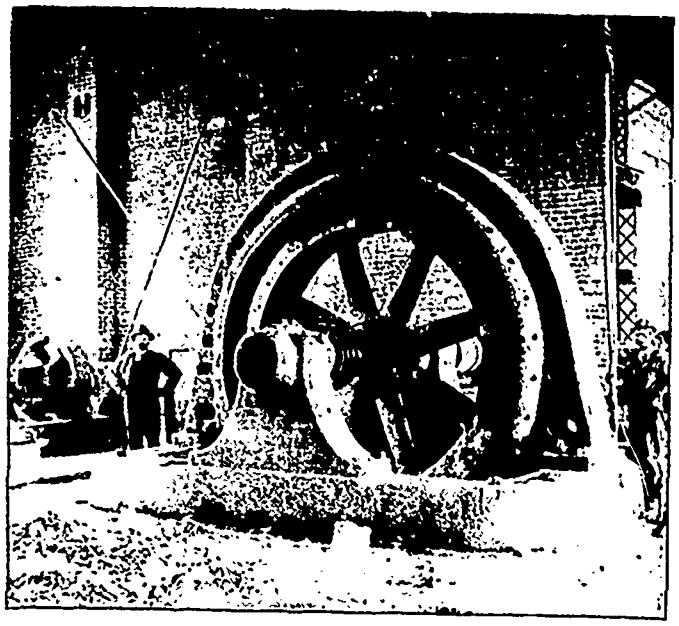
and in operation, and four more are in course of erection.

Both the hydraulic and electrical machinery are evidently substantial and constructed with the greatest care, and so arranged that cost of attendance during operation will be reduced to a minimum.

THE SWITCHBOARD.

The switchboard is situated in the down stream end of the dynamo house, and at present has four panels, with common buss bars, the centre panel being devoted to the exciters and containing ammeter, volt meter, switches, rheostats and pilot lamps, while on the other side are the panels of the main generators or alternators, which contain high tension, quick breaking switchers, high pressure volt meters, ammeters and synchronizing lamps.

A magnificent repast was provided by the directors. At 5 o'clock the guests again assembled in power house No 1 to listen to congratulatory addresses by



One of the 750 k. w. C. G. E. 4,400 Volt Dynamos.

His Worship, Mayor Wilson Smith, Hon. Thomas Duffy, Hon. J. I. Tarte, Ald. Prefontaine, M.P., Sir Jas. Grant, Hon. L. Beaubien, Hon. J. D. Rolland, John Crawford, Esq., and John Morrison, Esq., all of whom spoke in terms of highest praise, congratulating the engineers, Messrs. Walbank and Pringle, upon the successful achievement of their plans.

ELECTRICAL COOKING AND HEATING APPARATUS.

One of the most interesting features of the proceedings was the display of electrical cooking and heating apparatus. The Canadian General Electric Company's exhibit included three-phase induction motors, varying from thirty horse power to five, and a complete electrical kitchen, with range, pots, hot water urns, radiators, ventilators, chafing dishes, etc.; in fact, it fairly represented the utility of the electric current in the factory, the parlor, the kitchen, the dressing room, and even the invalid's boudoir.

The Dominion Electric Heating and Supply Company, of Ottawa, exhibited an excellent selection of heating and cooking apparatus, all made under Canadian patents and constructed in Ottawa.

The W. A. Johnston Company, of Toronto, showed Wagner transformers, long burning arc lamps, a single phase self-starting motor, and induction ceiling fan.

Mr. Kingsbury, an electrical engineer of Sydney, Australia, was a visitor to Canada during the past month, studying the developments in electrical science. Mr. Kingsbury was delighted with the evidences of Canada's progress in electrical engineering, a matter in which Australia is as yet comparatively young. He was impressed with the utility and general character of the Canadian street railway systems, and considers that a large business might be secured in Australia by Canadian manufacturers of electrical apparatus.

THE LATE MR. F. B. ROBB.

The particulars of the sad death of Mr. F. B. Robb, of Amherst, N. S., are already known to readers of this journal. Deceased was secretary-treasurer and manager of the Robb Engineering Co., Limited, and was drowned while bathing at Fox Harbor, N. S., on July 20th. He was born at Amherst, Nova Scotia, on the 8th of November, 1857. His father, the late Alexander Robb, was one of the pioneer manufacturers of Nova Scotia, having established in 1848 the business which has since developed into the Robb Engineering Company.

The subject of our sketch received his education at Cumberland County Academy and Dalhousie College, Halifax, afterwards being especially fitted for his work by a short experience in banking and commercial college course at St. John. In 1876, when only 19 years of age, he, with his brother, D. W. Robb, now president and engineer of the company, took the full management of the extensive business in which he labored up to the time of his death.

Mr. Robb's strongest characteristic was unceasing industry both of body and mind. Having a love of work, and being gifted with quick perception and methodical habits, he was able rapidly to master every detail of his work, and has been largely instrumental in building up the Robb Engineering Company's business, which has during the past few years extended to all parts of Canada.

THE LATE MR. F. B. ROBB.

The late Mr. Robb had a very sympathetic nature, and early in life was impressed by deep religious feeling, which prompted him to take a prominent part in the work of every religious and charitable organization that came in his way. There are probably few men who have done more personal work in the way of assisting others, especially boys and young men, and by acts of kindness and good council leading them to a higher plane of living both morally and physically. Mr. Robb was an elder and active member of the Presbyterian church of his native town. He was especially interested in the Y.M.C.A. work among boys and railway men, being chairman of the Y.M.C.A. Railway Branch. At the time of his death he was assisting in the management of the Y. M. C. A. Boy's Camp, which every year gathers the boys for an outing at some one of the lovely spots on the sea coast of Nova Scotia or New Brunswick. Through his intense desire to do good he was able to wield a large influence, not only in his own town, but in many districts all over the maritime provinces.

In 1883 Mr. Robb married Miss Jessie MacFarlane, neice of Senator MacFarlane, of Wallace, who, being also devoted to the work of religious organization, has been a congenial companion and helper in this department of his labor. She with her three children have the sympathy of many who mourn the loss of one who was ever a true friend.

CANADIAN ASSOCIATION OF STATIONARY ENGINEERS.

NOTE.—Secretaries of Associations are requested to forward matter for publication in this Department not later than the 25th of each month.

KINGSTON NO. 10.

Kingston association is apparently progressive. At a meeting on September 16th, a large number were present. In the absence of President Simmons, the chair was occupied by Vice-President Asselstine. The regular business being concluded, an interesting discussion took place on the merits of Taylor's hydraulic air compressor. The question-box contained a number of difficult problems, which were worked out on the blackboard. It was reported that a change had been made by the Executive in the members of the Legislative Committee, which is now composed of one member from each association at Toronto, Montreal, Ottawa and Kingston.

LONDON NO. 5.

An open meeting of the above association was held early in September, the chair being occupied by Mr. J. D. Campbell. Mr. G. B. Risler, past-president of the association, made a few remarks, stating that the object of their meetings was to mutually assist and instruct each other in the acquirement of greater knowledge by the interchange of members' ideas in engineering matters. The engineer could well be proud of his calling, and his true aims should be safety, reliability, intelligence and economy. It was the engineer who could, by skilfully managing his steam plant, bring about a good dividend for his employer. Addresses were delivered by Mr. Robert Angus, superintendent of E. Leonard & Sons, and Mr. Thos. McHattie, locomotive foreman of the G. T. R.

BERLIN NO. 9.

DEAR SIR,—The following is a correct list of the officers of the C. A. S. E., No. 9, Berlin: Past-president, W. Oelschlager; president, Geo. Steinmetz; vice-president, J. Heyd; secretary, W. J. Rhodes; treasurer, Wm. Tiedt; conductor, J. L. Bowman; door-keeper, Augt. Prizgodda; trustees, Oelschlager, Amdt, Sararas; auditors, Steinmetz and Oelschlager. The association meets every Friday evening.

Yours fraternally,

W. J. RHODES, Secretary.

MOONLIGHT SCHEDULE FOR NOVEMBER.

Day of Month.	Light.	Extinguish.	No. of Hours.
	H.M.	H.M.	H.M.
1	P.M. 10.30	A.M. 5.30	7.00
2	" 11.30	" 5.30	6.00
3	....	" 5.30	4.40
4	A.M. 12.50	....	
5	" 1.50	" 5.30	3.40
6	" 2.50	" 5.30	2.40
7	No Light.	No Light.	.....
8	No Light.	No Light.	.....
9	No Light.	No Light.	.....
10	No Light.	No Light.	.....
11	P.M. 5.20	P.M. 7.40	2.20
12	" 5.20	" 7.40	2.20
13	" 5.20	" 8.40	3.20
14	" 5.20	" 9.50	4.30
15	" 5.20	" 10.50	5.30
16	" 5.10	" 11.50	6.40
17	" 5.10	A.M. 12.50	7.40
18	" 5.10	" 2.00	8.50
19	" 5.10	" 3.20	10.10
20	" 5.10	" 4.30	11.20
21	" 5.10	" 5.40	12.30
22	" 5.10	" 6.00	12.50
23	" 5.10	" 6.00	12.50
24	" 5.10	" 6.00	12.50
25	" 5.00	" 6.00	13.00
26	" 5.00	" 6.00	13.00
27	" 5.30	" 6.10	12.40
28	" 5.30	" 6.10	12.40
29	" 5.30	" 6.10	12.40
30	" 5.30	" 6.10	12.40
.....	....	....	....
		Total,	214.20

QUESTIONS AND ANSWERS.

WE have received the following answers to the engineering questions asked in our September issue :

ANSWERS BY MR. A. M. WICKENS.

"ONTARIO" : (1.) Should use oil carefully. Put up a tin or metal splasher to keep oil off the belt. (2.) In raising the speed you increase the horse power; and in lowering the speed the horse power is decreased—the boiler pressure remaing the same. (3.) It is most economical to carry the pressure of such a height that the point of cut-off is between ¼ and ⅜ of the stroke; the release should be very near the atmospheric pressure. There is not sufficient data for the latter part of the question to be answered intelligently. What kind of pumps? What is the system of the drying room, live steam or exhaust? If exhaust, what is the back pressure?

"SUBSCRIBER": If subscriber's engine is 9½" diameter × 12" stroke, the piston speed at 280 revolutions per minute is 560 feet per minute. 80 pounds of steam cut off at ¼ stroke is equal to a ratio of 4. This would give an M. E. P. of 41.68 lbs. per square inch. The piston, being 9½" in diameter, has an area of $9\frac{1}{2} \times 9\frac{1}{2} \times .7854 = 70.88''$.

$$\frac{70.88 \times 560 \times 41.68}{33,000} = 50 \text{ h. p.}$$

250 amperes at 115 volts = 28,750 watts.

$$\frac{28,750}{746} = 40 \text{ h. p.}$$

"J. G." can use an exhaust steam for heating his building by piping it correctly and having sufficient radiating surface. If his coils or radiators have surface enough to heat the building at, say, 2 lbs. pressure, he can get a perfect circulation by adopting the principle of giving the steam ample room to travel, and giving plenty of fall in the direction of travel; first, run a main riser of ample size near the centre of the building, and up to the coils of the top flat. This main should have no outlet except those going to coils or rods. Tap the riser for the coils each way several feet above the coil, and set coil with good fall. At each end of building put up relief pipe riser, with safety valve on top; set to blow off at 2 lbs. Discharge all coils into these. At the bottom of each riser a relief or drain pipe should be put in and be piped to tank or hot well or drain.

"JAS. JOHNSTON" : You should put in good bridge walls back of gates, a damper at the stack mouth, and fire carefully—regulating by stack damper.

"JAS. MCPHERSON" : One of the boys thinks that if you have run that elevator without oil for four years, it would be a waste of money to use any now.

ANSWERS BY MR. WM. THOMPSON.

"J. G.": You can hardly expect to heat your building by exhaust steam without some back pressure, no matter how slight. You must also bear in mind that use of exhaust steam at very low pressure will make a serious difference in the heating capacity of your radiating coils. Suppose, for instance, you have a back pressure of only ½ pound per square inch; then the sensible heat of your steam will be 213° Fahr., while the temperature of your present system with a pressure of 15 pounds is 250° Fahr. Consequently you would require to add 15% more radiating surface to secure present radiating efficiency with exhaust steam under conditions named. You could by use of an automatic back pressure valve, set in exhaust main, maintain a continuous pressure on heating mains, with steam from exhaust from engine, and return all drips to boiler, all surplus steam exhausting into atmosphere. Of course, back pressure on exhaust main would act against engine, but with ample radiating surface this could be reduced to a minimum.

"JAS. JOHNSTON" : Your question covers a very wide field; everything depends upon construction of your furnaces, how the hot gases are utilized after leaving combustion chamber, etc. A knowledge of exact conditions, with diagram of boiler and setting, would help us to aid you in solving the problem.

"ONTARIO" : (1) Prevention is better than cure; examine your engine thoroughly and find out where oil comes from, then take steps, by use of shields, good oil cups, etc., to have oil placed where intended, and not on the belt. Addition of whiting, etc., finally only aggravates trouble, and if any of it gets into a bearing look out for a hot journal. Get your belt cleaned by a reliable belt manufacturer, and careful attention will prevent further trouble unless your engine is habitually "dirty." In that case cure is almost hopeless. (2) Increasing the speed of an engine gives more power; decreasing speed, less. Usually engine builders design to get best results both for economy and safety at given speeds, and it is not wise to deviate far from this. (3) An automatic cut-off engine is supposed to adopt its steam admission to its load; consequently a high pressure and light load mean an early cut-off, and in the case of many high speed engines, heavy compression, a too early cut-off, and consequent long expansion is conducive to loss by cylinder condensation caused by the two extremes of temperature. On the other hand, low steam pressure and heavy load means that cut-off will not take place until late in the stroke, and all advantages arising from the use of steam expansively are lost. A steam pressure adapted to the load is the most acceptable, say to cut off at ¼, ⅓ or ½ stroke, according to the economy of your engine. The best pressure is that which gives the most economical point of cut-off. An indicator would be very useful to you, enabling you to determine cut-off with different loads and different pressures, and thus enabling you to decide what pressure is likely to give best results in your particular case.

"SUBSCRIBER" : I do not see how you can hope to gain any decided advantage by placing pipes as suggested, unless they are in direct contact with the flue gases. The quantity of heat that would radiate from breeching to water would be very small. Every unit of heat extracted from flue gases reduces the intensity of your chimney draft a corresponding degree. The greater the difference between the temperatures of the external air and internal gases, the greater the intensity of the draft. Any cool substance, whether water or air, in contact with the stack, will act as a condensor and extract heat from internal gases. Suggested pipes placed inside of breeching in direct contact with flue gases is practically the principle of "Green's Economiser," and would briefly have a double effect : 1st, the raising of the temperature of the feed water; 2nd, the lowering of the draft gauge. 1st, by restriction of breeching area for passage of flue gases; 2nd, by reducing the temperature of flue gases. Reduce product of dynamo to electrical energy or horse power expressed in watts:

Ohm's law is $E \times C = W$

Then 115 volts × 250 amperes. = 28750 watts,

and 28750 ÷ 746 watts in one h.p. = 38.5 electrical h.p.

Next find power engine is capable of developing, cutting off at ½ stroke, with, say, a mean effective pressure of 35 pounds to the square inch. This is done by simple formula :

$$\frac{A\ N\ P\ S^1}{33000} = \text{h. p.}$$

When A = area of piston in square inches.
N = number of strokes per minute.
P = mean effective pressure.
S^1 = length of stroke in feet.

Then $9.5^2 \times .7854 = 70.88$ sq. in. area of piston; and
280 revolutions per minute × 2 = 560 strokes per minute.

$$\frac{70.88 \times 560 \times 35 \times 1}{33000} = 42 \text{ h. p.}$$

There is, however, a loss of power between the engine cylinder and the terminals of the dynamo, varying in accordance with the conditions under which the dynamo is operated, but which in modern plants should not exceed 10 per cent., which is about, in your case, the difference existing between generator and engine with a boiler pressure of 80 pounds and an M. E. P. of 35 pounds to the square inch. The method of calculating M.E.P. and H.P. will be fully detailed in educational department in due course.

ANSWERS BY MR. JAMES MILNE.

"ONTARIO": The exhaust steam can be readily used for heating purposes without making any great difference on the back pressure, by having the combined area of the pipes leading to the various departments equal to, if not greater than, the exhaust pipe.

"JAMES JOHNSTON" : Don't know what could be done to reduce the temperature of gases. The trouble lies in the design of the boiler.

"ONTARIO" : (1) With Armington & Sims engines, together with the majority of these high-speed engines, this trouble is very common and hard to get rid of. One remedy, or rather partial remedy, is to use grease, and as little oil as possible. Unless your belt is completely saturated with oil, whitening or chalk should prevent slipping for considerable time. You should not scrape it while running. (2) By increasing speed the power of an engine is also increased. (3) The most economical pressure is from 80 to 100 lbs. for simple high speed engines. The higher the pressure is the less steam is used.

"SUBSCRIBER" : A very long length of piping would be required to increase the temperature of your water to any considerable degree. It would reduce your draft a little. If your gases are only 450, we don't think it would pay you to do it. The horse-power of an engine can be calculated by the following formula:

$$\frac{P.L.A.N}{33,000}$$

Where P = Mean effective pressure.
L = Length of stroke in feet.
A = Area of piston in square inches.
N = No. of strokes per minute.

In your case the unknown quantity is P, which can be arrived at near enough for your purpose, in this manner:

Suppose the engine cuts off at $\frac{1}{3}$ stroke, which is equal to a ratio of expansion of three.

The mean pressure is = Initial absolute press. $\left(\frac{1 + \text{hyp. log of } 3}{3}\right)$

∴ Mean effective press. =

Initial abs. pressure $\left(\frac{1 + \text{hyp. log of } 3}{3}\right)$ back pressure.

The initial pressure = 80 + 15 = 95, and the back pressure of the engine is non-condensing, say

5 lbs. above atmosphere = 20 lbs. absolute.

Then M.E.P. = 95 $\left(\frac{1 + 1.098}{3}\right)$ − 20 = 46.5 lbs. 46.5 lbs.

From this the h. p. of the engine can be calculated.

$$\text{h. p.} = \frac{46.5 \times 1 \times 70 \times 560}{33,000} = 55 \text{ h. p.}$$

To run your dynamo to the load, viz., 250 amperes, at 115 volts, would take, including friction, etc., nearly 50 h. p. Therefore your engine is large enough.

"JAMES MCPHERSON": Oil is not necessary.

ANSWERS BY THE ROBB ENGINEERING COMPANY.

"J. G.". The Barnard system is a very effective and simple system of exhaust heating. Write for particulars to Geo. A. Barnard, 39 41 Cortlandt street, New York City.

"JAS. JOHNSON". You can reduce the temperature of flue gases by *reducing the grate surface or increasing the heating surface* of your boiler. The heating surface may be increased by placing in smoke flue a small economizer of the Green type, consisting of vertical pipes between which the gases pass on their way to the chimney, and the feed water by being passed through the tubes is heated to 250 to 300 degrees.

"ONTARIO". (2) Most high speed engines are designed for about a certain speed, at which they will run smoothly and regulate best, but a variation of 25 revolutions above or below the rated speed may be made without any serious disadvantage, provided the governor is properly adjusted. (3) 80 lbs. pressure would be more economical than 50 lbs., provided the work being done is sufficient to require the cut-off to be as late as ¼ stroke or later. If the engine is underloaded a less pressure might be more economical in order to prevent too early cut-off and too great expansion. It is not economical to expand more than three or four times in a single cylinder.

"SUBSCRIBER": It would not pay to put water pipes on the outside of your flues. You could use Green's economizer to advantage if you have sufficient draft, but not without. A 9½ × 12" A. & S. engine running at 250 revolutions should develop about 40 horse power at ¼ cut off, and would work up to about 56 horse power at latest point of cut-off. 250 amperes at 115 volts = $\frac{250 \times 115}{746}$ = 38.5 electrical horse power; add 25 per cent. for friction and loss in engine, and dynamo would equal about 48 horse power. The engine should do this without being too greatly overloaded.

ANSWER BY "JEAMES."

In answer to "James McPherson, I have been using cylinder oil and some times common machine oil. I don't really know if it is necessary to give it much oil. How about the piston packing being chewed up by it and the valves in your pump, if you have one? There is one thing I would like to know, and that is how to stop that everlasting grunting and groaning in the steam end of elevator pumps. They are nearly all the same when put on elevator work. I know of three different makes, so it is not the makers fault. I notice that when the pump is going at her speed she is all right, but the minute she slows down that minute she begins to groan and scrape. Would it be any use feeding graphite? But, then, a sight feed would not take it. Pointers will oblige.

SIR, As I have been thinking of altering my boiler setting, I would like, before doing so, to know what is the generally accepted plan. There are many others like me who do not really know whether their conditions are right or not, and who would be glad of enlightment on the subject; so to try to benefit others as well as myself, I have thought of asking the following questions, with the hope that superintendents or engineers will give us the sizes as in their plants. Each man looking for the information would *therefore be able to pick out his own size boiler, etc., and* compare conditions and results. If some of our large engine builders and engineering expert friends could be got to give us their opinions, the time it would take them to do so would not be lost.

What size are your boilers, length, diameter, size of tubes and number of same; how much heating surface and what is h. p. of boiler?

Size of furnace, length, breadth and height from boiler?

Kind of grate bars, shaking or stationary, what air space, and how are bars placed?

Height of bridge wall from boiler, and how built?

Depth of combustion chamber and how it is shaped back of bridge wall?

What should be the ratio between grate surface and heating surface and between tube area and grate (for different fuels)?

What air openings, if any, and where situated, bridge wall or sides of furnace?

What mode of firing and thickness of fire, and what is found to be the most economical rate of consumption per square foot of grate per hour?

How do you bank your fires?

When unable to weigh coals, but passing water through a meter, how much water should a boiler of a given size be able to use and be up to its economical limit? Under that amount we would understand that it was too large for the work required, and over that we would say it was being forced?

What should draft be at chimney and at furnace?

Have you ever used forced draft and with what result?

What should temperature of flue gases be?

What is the efficiency of your boiler?

When wishing to check draft whether would you close damper in flue or close ashpit doors, taking into consideration that when closing damper in flue you choke tubes with soot?

How are your boilers covered in? Does the flue return on top again or do you use top of boiler as a dead flue, i.e., gases get on top but no circulation, or when boiler is bricked in at sides in usual way do you have bricks or other covering lying directly on top, or do you have an air space between boiler and covering?

Have you any arrangement for heating feed water apart from exhaust steam water? If so, explain it.

Do you think it is better to force a boiler for a few hours or cut in another one?

What does a pyrometer cost and would it be of any value to have it?

Besides giving sizes, etc., a few remarks as to the advantages or disadvantages of any of the points would be advisable.

ALFRED O. PEACH.

"INDICATOR" writes: I was thinking of putting on an indicator on my engine, an A. & S. Would some one give me all the sizes *for the correct rigging and how to set it up? Please indulge* in no generalities, as I have had no experience in this matter. My engine has 12 inch stroke.

SIR, Would you please ask in your first issue. (1) Whether it is best to run with dirty flues or to run with clean flues and damper, say, half shut. Closing the damper makes sooty tubes. My boiler fully half the time is too large and I cannot brick up grates. (2) Is a return steam trap or an injector the most economical in steam consumption for boiler feeding? (3) I have a steam drum used for drying purposes through which the steam at 50 pounds blows, slightly throttled on discharge side, and I should like to connect it on to a nasor trap, if it would work through the following piping: Drum stands 3 feet from floor; discharge pipe would have to dip 30 inches below floor, then rise 3 feet in a length of, say, 10 feet and connect on to another pipe going to the trap. I would put on a check valve just before it connected on to the other pipe.

ONTARIO NO. 2.

"WILLIAM HIGGINSON" writes: "We have a steam plant here driving the electric lights, which is going to be too little for the work we can get for it to do, and we are thinking of putting in storage batteries to carry the peak of the load for about four hours. Can you inform me where any batteries are now in use to *carry the peak of the load as above mentioned?"*

ANSWER.—We do not know of any plant in Canada using a storage battery to carry the peak of the load. There are several battery plants in use, but none of them are used for that purpose. Henry Morgan, Montreal, and the Toronto University Chemical Laboratory have them, but use them only when the generator plant is shut down.

"T. C. D., Guelph, Ont., asks: "What are the names of the principal slow and medium speed steam engines, slide valves, fitted with fly ball governors, used in England, and what is the most popular governor regulator used in England?

ANSWER.—There are so many engine builders in England that it is pretty hard to give "the principal ones. Messrs. John Fowler & Co., engineers, Leeds; Roby & Co., Globe Works, Lincoln; Ransomes, Sims & Jefferies, Limited, engineers, Ipswich and London, and Tangyes, Limited, Birmingham, are among the most prominent. We cannot advise you at present as to the most popular governor.

The Gutta Percha & Rubber Company, West Lodge avenue, Toronto, have lately installed a 60 k.w. generator, and are wiring their factory for 450 incandescent lamps and 15 arc lamps. All wiring is being done with rubber wire in cleat work. The plant is to be divided into six sections with separate feeders for each section, and having an elaborate switchboard containing switches for each feeder and station instruments. The whole of the work is being installed by Mr. H. F. Strickland, electrical contractor, 35 Adelaide Street East.

SPARKS.

Incorporation has been granted to the Strathroy Electric Co., with a capital of $20,000.

The Electric Light Company, of Revelstoke, B. C., have their power house in course of erection.

The London Street Railway Company have completed the extension of their road to Pottersburg.

The town council of Almonte, Ont., is being urged by ratepayers to purchase an electric light plant.

The Exeter Electric Light & Power Co., of Exeter, Ont., has been incorporated, with a capital stock of $15,000.

Messrs. O'Reilly & Murphy, of Ottawa, recently installed an electric light plant, consisting of 130 lights, in the Archbishop's palace in that city.

An explosion occurred recently at the Chambers Electric Light Works, Truro, N.S., by which the new engine was almost completely ruined. None of the employees were injured.

For the preservation of wooden telegraph poles the Boucherie process of injecting a solution of sulphate of copper into the pores of the wood is said to prolong their lives to about fifteen years.

The Jenckes Machine Co., of Sherbrooke, Que., shipped last week one of their heavy 50 horse power slide engines, with standard steel tubular boiler, to Desire Thibault, Esq., of East Hereford, Que.

The dam at Magog for the civic electric light plant is completed, and the 50" Crocker water wheel, which is being furnished by the Jenckes Machine Co., of Sherbrooke, is expected to be installed now within a short time.

The Monte Cristo Mining Co., of Rossland, have made a fresh strike, and have ordered a complete new hoisting and pumping plant from the Jenckes Machine Co., of Sherbrooke, which has been supplied from their Rossland stock.

The Great North-Western Telegraph Company, in conjunction with the Spokane & Fort Steele Telegraph Company, have completed the erection of a new telegraph line from Kalispell, Mont., to Warder and Fort Steele, B.C. Other extensions are contemplated in the near future.

Messrs. Ahearn & Soper, of Ottawa, have secured the contract for the telegraph wiring of the Ottawa & New York Railway. The line will extend from Ottawa to Moira, N.Y., and along the cable under the St. Lawrence. The amount of the contract is said to be large.

Water was turned into the flume at the factory of the Boston Rubber Co., at St. Jerome, Que., on the 25th ult. The steel flume, which is 350 ft. long and 6 ft. in diameter, was furnished complete, including a 55" Crocker wheel, by the Jenckes Machine Co., of Sherbrooke, Que.

The power station of the Sherbrooke Street Railway, of Sherbrooke, Que., is rapidly nearing completion, and the turbine plant being installed by the Jenckes Machine Co. is also about completed. Mr. Burke, the president, states that they expect to be in operation by the 15th of October.

Hunter & Oliver, solicitors, of Victoria, B.C., give notice of application to parliament for the incorporation of a company to construct a narrow gauge railway from Portland Inlet to Teslin Lake, with power to build bridges, telegraph and telephone lines, etc., and to supply light, heat and power.

The Consumers' Cordage Co., Limited, of Halifax, N. S., have for some time been considering the adoption of electricity as a motive power for operating their machinery. The manager of the company states that owing to the cost of the machines, they have concluded that it is not economical at present.

The Kootenay Electric Co., of Kaslo, B.C., are utilizing the new water power to generate electricity, and have placed an order with George C. Hinton & Co. for a 150 k.w. "S. K. C." generator complete, with transformers and motors. The latter firm are agents in British Columbia for the Royal Electric Co.

The Parry Sound Electric Light Company held their annual meeting on September 7th. Directors were elected as follows: Messrs. S. Armstrong, William Beatty, Dr. Walton, W. H. Pratt, J. J. Jolliffe, J. F. Mossley and Dr. J. R. Stone. The company have now over 900 private lights and 40 street lights under contract.

The Bridgewater Power Co., of Bridgewater, N. S., have lately been reconstructing and enlarging their electric light plant, and have replaced their three wire system by an alternating current system, for which purpose they have purchased a 40 k.w. "S.K.C." two-phase generator from the Royal Electric Co., and 600 light capacity in transformers.

The total length of the world's telegraph system is given as 4,908,921 miles, exclusive of 180,440 miles of submarine cables. Of this, Europe has 1,764,790 miles; Asia, 310,085 miles; Africa, 99,419 miles; Australia, 217,479 miles, and America, 2,515,548 miles. These figures are given by United States Consul Germain, of Zurich, to the State Department.

The Electric Light Company at Dartmouth, N. S., are introducing the meter system. The rates for lights so supplied will be 12½ cents per one thousand watt hours, or ½ cent less if meter is owned by consumer. Where bills are less than $2.50 a month a rental of 25 cents a month will be charged for the meter when it is supplied by the electric light company.

At a recent trial on the Ottawa river a new invention, called the submarine searchlight, proved a decided success. The searchlight showed the bed of the river plainly for a circumference of 50 feet; and at a depth of 35 feet objects could be distinguished without any difficulty. The object of the inventor is to enable divers to perform their work with accuracy and to trace lost treasure. It is especially adapted to assist the workers on wrecked vessels lying underneath the water at a great depth. The inventor is Mr. Joseph de l'Etoile.

Mr. Geo. Eastbrook, who is about taking his departure for Delagoa Bay, South Africa, where he is erecting flouring mills and other industries for a wealthy syndicate of Canadians, is taking with him a complete electric lighting plant. The apparatus and material complete are being purchased from the Royal Electric Co. This we believe is the first instance where a Canadian electric lighting plant has been sold for service in the antipodes.

From a carefully prepared table of statistics published in a German contemporary it appears that 80 per cent. of the continuous current stations in that country are provided with accumulators, the total output of which is 31 per cent. of the whole power of these stations. Notwithstanding such figures as these, there are many American electrical engineers who still doubt the advisability of installing accumulators in connection with central stations.

The water power of the Shawenegan Falls, on the St. Maurice river, in Quebec, was recently sold by the Crown Lands Department to Mr. David Russell, of Montreal, who is said to represent a strong syndicate intending to manufacture calcium carbide for acetylene gas. One of the conditions of the sale was that the purchasers should expend $2,000,000 within eighteen months on the erection of buildings and plant and in developing the water power, and a further $2,000,000 within the next two years.

Wireless telegraphy is occupying a good deal of attention just now, and to accompany the encouraging reports from Mr. Tesla of his advances and success with new apparatus for such work, we note the statement from Marconi that he is about to signal electrically without wires from St. Paul's Cathedral, London, to the Eiffel Tower, in Paris, a distance as the crow flies of perhaps 150 to 200 miles. It will be interesting to see what comes of all this movement, which may well betoken a new advance in electrical discovery and invention.

According to a London exchange, a report on the electrical and allied trades in Cape Colony is being prepared by Mr. A. P. Trotter, honorary correspondent for that district of the London Chamber of Commerce. In his report, Mr. Trotter will allude to the prospects of employment for electrical engineers in South Africa. He desires it to be made known that no electrical engineers should go to South Africa at present unless they have secured definite appointments before sailing. Many competent electrical engineers in that country are now unable to find employment.

The Nelson Electric Light Company, of Nelson, B.C., have declared a dividend of 12 per cent. for the financial year just closed. This company have elected directors as follows: John Houston, president and manager; John J. Malone, vice-president; J. H. Matheson, secretary; John Johnson, treasurer; J. Fred Hume, J. A. Mara and John Hamilton, directors. The city council has recommended that the offer of the company to light the streets for a period of five years be accepted, provided they agree to dispose of the plant, franchise, etc., to the city within one year at a price not to exceed $40,000.

The interest in the electric railway question in England has extended as far as the question of trolley car etiquette, as will be seen from this quotation from a London contemporary: "We are told that another peculiarity of the American street cars is that ladies are not allowed to stand in them. When a lady enters a crowded car a seat is promptly vacated for her convenience. No doubt this is sometimes done even in England, but rarely in the same way, with the result that while here it is recognized as courtesy and thankfully acknowledged, there it is taken as a right, for which no thanks are necessary."

The Willow Creek Gold Mining Company, of which Mr. E. Todd, of Brantford, is president, are about to undertake the construction of an electric railway from Bell City to Island Bay, on Bad Vermillion lake. The railway will be four miles in length, and will be extended as occasion demands. It is proposed to utilize the water of the falls on the Vermillion river and Grassy lake for power purposes, and to put in sufficient electrical machinery to operate a custom stamp mill, as well as the railway. Mr. M. W. Hopkins, electrical engineer for the company, will shortly make a report on the water power.

Among the visitors to British Columbia recently were Messrs. George G. Ward and S. S. Dickenson, general manager and superintendent respectively of the Commercial Cable Co., of Canso, N. S., where the cable connects with the land line. Regarding the Australian cable question, Mr. Ward stated that it would undoubtedly be built at an early date, and in his opinion its construction was warranted. If Vancouver was the terminus, as undoubtedly it would be, he stated that his company would probably work in connection with the Australian cable, and for that purpose he had examined the proposed landing place and secured all the information possible on the subject.

The Hull Electric Company and the Ottawa Electric Company are engaged in a legal combat over the privileges of electric lighting for the city of Hull. The former company claims to have an absolute and exclusive privilege for lighting the city for 35 years, and asks the Ottawa company to remove their poles and electric apparatus and to pay them $20,000 damages. On the other hand, the Ottawa Electric Company states that the corporation of Hull, as far back as 1887, granted the company permission to erect poles and furnish electric lighting, and that the by-law passed by the corporation in 1894 granting the privilege to the Hull Electric Company does not affect their rights.

EDUCATIONAL DEPARTMENT

INTRODUCTORY

After mature deliberation the publisher of this journal has decided to devote a certain amount of space each month to what may be termed an Educational Department, wherein both mechanical and electrical formula and mathematical problems will be discussed, illustrated, and as far as possible rule and example given. At the request of the editor, I have with pleasure undertaken to contribute to this department regularly each month, and before discussing actual mathematical problems, wish to briefly introduce the subject at issue.

The primary object of this department is chiefly to increase the value of an already valuable paper, by placing in the hands of every engineer who has any knowledge of the rudimentary principles of mathematics, such matter as will enable him by a little study to master the most intricate mechanical and electrical formula. Many of our most valuable engineering works and publications from time to time contain formula that is in many cases but vaguely understood, and very often entirely misunderstood, thus rendering an otherwise valuable work practically valueless to the reader.

Just at what particular point our calculations should commence became a matter of serious thought, and past experience had to be carefully considered, bearing in mind the fact that there are many really good engineers whose early education has, through force of circumstances, been deficient, and many others who, through lack of opportunity, have not been able to review their early education for years. Knowing by observation and experience the great necessity of having a thorough elementary education before attempting to digest and calculate problems, and the almost utter impossibility of the student arriving at a satisfactory conclusion of his studies without a thorough knowledge of the principle of mathematics involved, I have decided to commence at a point and carry out the programme outlined in this journal, commencing at the foundation and advancing by easy stages until the principles underlying the most obtuse and difficult formula can be readily explained and easily understood. The advantages to be derived from an education of this kind, coupled with practical mechanical ability, is too well understood to require comment.

The programme which has been outlined for the succeeding nine months will embrace:

DECIMAL FRACTIONS—Definitions and explanation of principles of, and method of reduction to common fractions, and vice versa.
SQUARE AND CIRCULAR MEASURE—Definition and explanation and practical demonstrations of.
CUBICAL AND CYLINDRICAL MEASUREMENTS—Definitions and explanations of, with practical hints.
SQUARE AND CUBE ROOT—Definitions and explanations of.
SAFETY VALVE CALCULATIONS—(Spring and Lever Types)—Principles of, with practical demonstrations.
BOILER CONSTRUCTION—Stays, rivets, joints and seams, iron and steel plate, strength of, with formula and practical demonstrations.

It is not the intention to fill these columns with a mass of figures hastily compiled without reference to any particular object; on the contrary, every problem will be carefully thought out, and only such information given as will be of use to you, and an effort will be made, based on experience and a knowledge of the requirements, to make his series of tests complete in every particular.

WM. THOMSON.

[ARTICLE VI.]

SAFETY VALVE CALCULATIONS.

(Continued.)

SPRING-LOADED SAFETY VALVES.

THE questions of most importance to the practical working engineer regarding spring-loaded valves are: Size of steel from which the spring shall be made; required inside and outside diameter; compression required to have given effect.

A standard spring, if made of the best square steel, contains an area of .25 of a square inch, the inside diameter is exactly two inches and outside diameter three inches; it contains thirteen complete coils, and measures exactly eleven and one-half inches in length. The working load is assumed at 600 pounds, one-sixth of its breaking load when hardened to a temper just sufficient to break it; at this load it should deflect exactly one inch.

Example (1): A safety valve 4 inches in diameter has a spiral spring made of square steel 3" diameter outside and .25" thickness of steel; what will be the pressure per square inch?

Formula:

$$\frac{12{,}000\ S^3}{d} = \text{whole pressure on valve.}$$

Where S = thickness of steel in inches,
d = diameter of spring from centre to centre of steel,
12,000 = constant used for square steel,
8,000 = constant used for round steel.

$$\text{Then, total weight} = \frac{12{,}000 \times .5^3}{2.5} = 600 \text{ pounds.}$$

Diameter of valve is given as 4 inches. Area of valve then $= 4^2 \times .7854 = 12.5664$ square inches. ∴ pressure per square inch $= 600 \div 12.5664 = 47.7$.

The foregoing is the fundamental principle to connect the loading of the spring valve with that of a direct weighted valve, and from it may be obtained both the proper thickness of steel to be used and the proper inside and outside diameters of the spring.

Example (2). What must be the outside diameter of a spiral spring for a safety valve 5 in diameter? The pressure to be carried is 50 pounds, and the diameter of the steel is ¾ inch.

Formula:

$$d = \frac{8000 S^3}{W}$$

Where d equals as before the mean diameter of the spring, S thickness of steel, W the whole weight on the valve, then

$$d = \frac{8000 \times .75^3}{5^2 \times .7854 \times 50} = \frac{3360}{981.75} = 3.42 \text{ inches.}$$

This, however, is only the mean diameter, or the diameter from centre to centre of steel. Therefore, the diameter of the steel must be added to this to get the outer diameter.

∴ outer diameter $= 3.42 + .75 = 4.17$ inches.

Example (3): The diameter of a spring loaded safety valve is 5 inches, gauge pressure 60 pounds, and mean diameter of a spiral spring 5 inches, what must the area be for square steel, also the length of each side, the area and diameter for round steel, and the inside and outside diameter of each spring.

The Steamboat Inspection Act adopts the Board of Trade rule for the determination of the required size of steel under the following formula:

$$\sqrt{\frac{w \times d}{c}} = s$$

s = Side or diameter of steel in inches.
w = Load on spring in pounds.
d = Diameter of spring from centre to centre of steel.
c = 12,000 for square steel.
c = 8,000 for round steel.

Then we require to multiply total load in pounds by mean diameter in inches, and divide by either constant 12,000 or 8,000, as the case may be, and cube root of quotient equals diameter of steel.

First find what w of formula represents, by multiplying area of valve by pressure per square inch.

$$\therefore w = 5^2 \times .7854 = 19.635 \text{ sq. in. area.}$$
$$19.635 \times 60 = 1178.1, \text{ total weight.}$$
$$1178.1 \times 5 = 5890.5.$$

$$\text{Then } \sqrt[3]{\frac{5890.5}{12000}} = \text{diameter for square steel.}$$

$$\text{and } \sqrt[3]{\frac{5890.5}{8000}} = \text{diameter for round steel.}$$

$5890.5 \div 12{,}000 = .49$, and $\sqrt[3]{.49} = .788$ inches length of each side for square steel.

$.788 \times .788 = .62$ square inches area of square steel.

$5890.5 \div 8000 = .736$, and $\sqrt[3]{.736} = .9$ inches diameter of round steel.

$.9^2 \times .7854 = .63$ square inches area of round steel.

For a spring constructed of square steel our dimensions then become:

Mean diameter of spring (i.,e., from centre to centre of steel) . . . . . . = 5 inches
Outside diameter of spring equals 5 inches plus size of steel . . . . . . = 5.788 inches
Inside diameter of spring equals 5 inches minus size of steel . . . . . . = 4.212 inches
Size of steel . . . . . . = .788 inches
Area of steel must contain . . . . . . .62 sq. in.

And for a spring constructed of round steel, dimensions are as follows, viz.:

Mean diameter of spring . . . . . . 5 inches
Outside diameter of spring is 5 in. + .9 . . . 5.9 inches
Inside diameter of spring is 5 in. − .9 . . . = 4.1 inches
Diameter of steel wire . . . . . . = .9 inches
Area of steel must contain . . . . . . .63 sq. in.

With a standard spring before us it is easy to determine the required sectional area of any steel spring when fundamental principles of this formula are understood.

As we are given the whole of the dimensions of a standard spring made of spring steel, we can determine the sectional area of a square spring by the following process:

As given weight is to required weight so is given sectional area to required sectional area.

For example, let us compare our determination of sizes for a square spring with a standard spring; our question then becomes.

As 600 : 1178.1 :: .25 : required area.

Then $1178.1 \times .25 = 294.5$.

$294.5 \div 600 = .49$, sectional area of spring at a load of 1178.1 pounds.

$\sqrt{.49 \div .7854} = .788$ required size of steel to comply with standard spring. All other dimensions of the spring will change in same proportion.

With spiral springs then there is to the practical operating engineer the important question of determining the increase in pressure by compression or the decrease in pressure by reducing the compression, or the change similar and corresponding to the graduation of a lever safety valve.

The formula for this is $\frac{W \times d^3}{S^4 \times G} \times n$ = total compression.

Where W is the total weight pressing upwards against the valve in pounds
d = mean diameter of spring
S is thickness of steel in sixteenths of an inch
G is constant 30 for square steel
G is constant 22.8 for round steel
n is number of coils in spring.

Example (3): A spring loaded safety valve 5 inches in diameter is set for a gauge pressure of 90 pounds, but owing to weakness of boiler, pressure must be reduced to 60 pounds; the outer diameter of spring is five inches and spring is made of ⅝ inch steel with 15 coils; what compression must be given to produce required pressure starting with spring slack?

$\frac{W \times d^3}{S^4 \times G} \times n = \frac{5^2 \times .7854 \times 60 \times 4\frac{3}{8}^3 \times 15}{10^4 \times 30} = 4.932$ inches, total compression required.

From this formula may be deduced the number of coils required, so that a given pressure shall require a given compression, or the load on the valve with a given compression, the diameter of coil or thickness of steel, if the other quantities are given.

The most important of these to the engineer is the determination of the number of coils required; the change in pressure by a given change in compression, and also the determination of the total weight bearing down against the valve or the weight required to lift it off its seat when dimensions of spring and compression are known.

To determine the number of coils required to balance a given pressure with a given compression, we construct from above formula the following:

$$C \div \frac{W \times d^3}{s^4 \times G} = N.$$

Where W, d^3, s^4, G and N have same values as in last formula, and C equals compression in inches, result will be required number of coils.

To determine pressure at which valve will blow off, with a spring of given dimensions and given compression.

Formula:

$\frac{s^4 \times G}{a \times d^3 \times N} \times c = P$, pressure at which safety valve will blow off.

a equals area of valve in inches.

To determine total weight holding the valve in place, with a valve of given dimensions and given compression.

Formula:

$\frac{s^4 \times G}{d^3 \times N} \times c = W$, total weight holding valve down.

Reference has been made to every safety valve requiring a given orifice or opening to allow of free passage of steam, so that increase in boiler pressure shall not take place. It is at the same time just as important that area of valve should not be too great to allow the free discharge of steam.

For steam above 10 pounds pressure above the atmosphere, the weight of steam that will escape into the atmosphere through an opening one square inch in area is, in 70 seconds, just equal to the pounds in the absolute pressure of the steam per sq. inch.

Example: To what height must a 5 inch safety valve rise from its seat to allow steam to escape at the rate of 9,200 pounds per hour, if the pressure on the boiler is 75 pounds per sq. inch above the atmosphere.

Since the weight of steam that will escape per square inch in 70 seconds is equal to gauge pressure plus atmospherical pressure, we proceed to find the weight of steam escaping from one sq. in. per hour.

Gauge pressure, 75
Atmosphere, 15
90, absolute pressure.

Then as 70 : 60 :: 90 : to the weight of steam escaping per minute.

Then, $\frac{60 \times 90 \times 60}{70} = 4628.5$, pounds of steam per hour per sq. in.

Then as 4628.5 : 9,200 :: 1 sq. inch to required area,

$\frac{9200}{4628.5} = 1.98$ square inches of escape required.

Then if required area is divided by circumference of valve in inches, result will be distance valve will be required to raise from its seat to allow the escape of 9,200 pounds of steam into the atmosphere.

3.1416
5
15.7080 = circumference.

15.708)1.98000(.126 of an inch lift.
15708
41920
31416
105040
94248
10792

.126
8
1.008 = Lift must be ⅛ of an inch.

From this, weight of steam escaping into the atmosphere from any orifice may be determined.

OHM'S LAW.

As stated in our last, and following out the principles therein set forth, the current in a conductor varies directly as the pressure or potential at the terminals, and inversely as the resistance of the conductor. From this then we get the following formula:

(1) $C = \frac{E}{R}$

This is known as Ohm's law, and is in continual use in the study of formula underlying the principles of electrical engineering.

In equation 1 we have formula for C, when both E and R are known. It consequently follows that we require but a simple transposition in the terms of our algebraic equation to find any of the quantities E, R or C when any two of them are known.

(2) Thus $R = \frac{E}{C}$

which simply means that the resistance is equal to the electromotive force (E M F) divided by the current, and

(3) $E = R\ C$

meaning that the E M F is equal to the resistance multiplied by the current.

From these equations it will be readily seen that if any two of the quantities E, R or C are given, the third may be found from one of the three equations, and that they are all based on the same law.

The energy in an electric circuit is equal to the pressure or potential at the terminals of the conductor multiplied by the current flowing through the conductor or circuit, and can be expressed in formula as follows:

(4) W or watts = E + C

Here we have a simple formula for the purpose of finding the electrical energy of a circuit or generator when E and C are known.

But it frequently occurs that we must find W when any two of the units E, R or C are known. In equation (3) we have E = R C. With this information before us let us substitute this value of E in (4); we then get

$$W = (R\ C) \times C \text{ or}$$
$$C^2 \times R = \text{watts}$$

Again in equation (1) we have

$$C = \frac{E}{R}$$

Substitute this value of C in equation (4), and we get

$$W = \left(\frac{E}{R}\right) \times E \text{ or}$$
$$\frac{E^2}{R} = \text{watts}$$

Following out then the general principles laid down, we get these formula for the determination of the electrical energy in any circuit when any two of the units E, R or C are known, or in other words the capacity of any circuit or dynamo to do work.

In our mechanical studies we establish the important fact that the energy cannot be destroyed, and that it will occur either as mechanical force or heat, or both.

And when an electrical current is passed through a wire or conductor a certain amount of electrical energy is lost as such, but makes its appearance as heat. Consequently the amount of heat generated must be equal to the electrical energy lost, and must therefore be measured in watts.

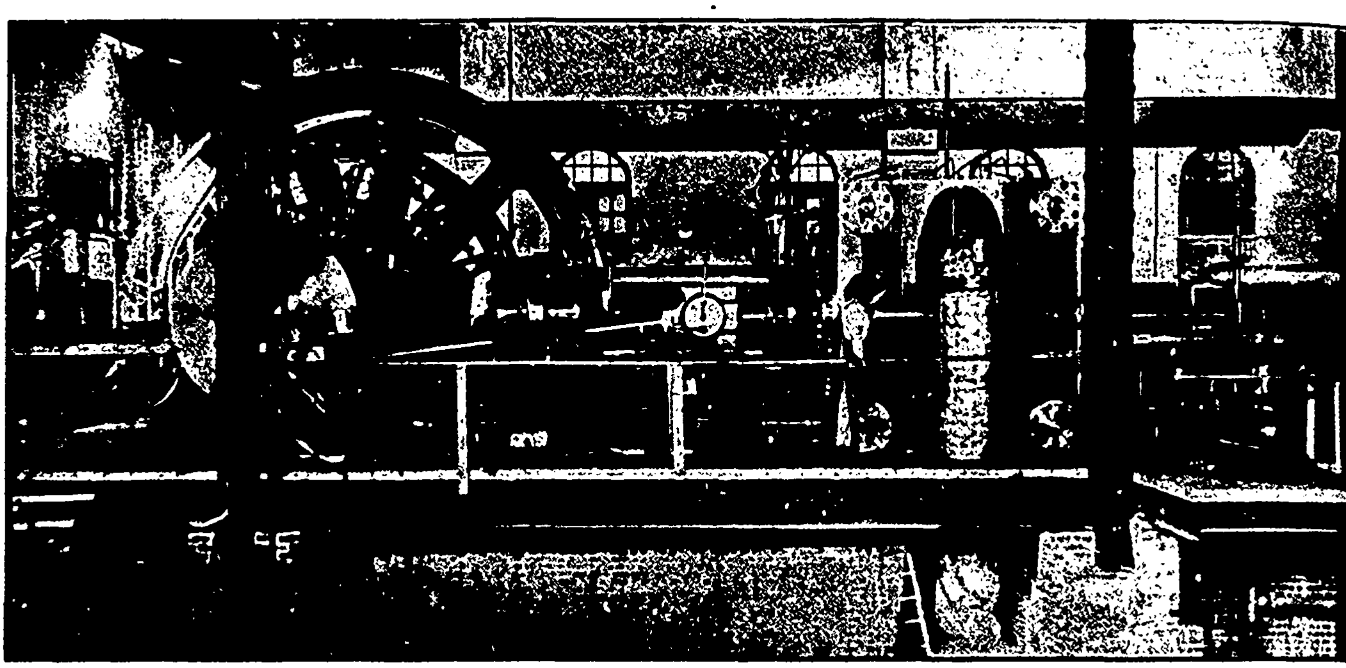
Formula: $W = C^2\ R$ is the formula generally used for the computation of heat generated in a circuit. If the resistance of a circuit and current flowing is known it is only necessary to multiply the resistance of the circuit by the square of the current to find electrical energy lost in transmission and appearing as heat.

Mr. C. H. Rust, assistant city engineer of Toronto, attended the recent convention of Telephone Superintendents at Detroit. Mr. Rust gives it as his opinion that it would be impossible for any company to compete with the Bell Telephone Co. in Toronto so long as they maintain their present rates.

ELECTRIC RAILWAY DEPARTMENT.

LARGE ENGINE FOR STREET RAILWAY SERVICE.

At the William street power house of the Montreal Street Railway Company there is now running in regular service the large engine recently built for the company by the Laurie Engine Company, of Montreal. Owing to the dark location of the engine, the photograph from which the accompanying illustration was made was not as good as was desired. This engine is said to be the largest and most powerful electric generating engine that has ever been built on this continent. It is of the horizontal cross compound Corliss condensing type, provided with tail rods and back end cross-heads and guides, for the purpose of supporting the weight of pistons, thus relieving the cylinders entirely of this weight and consequent wear (which is the only objection to the horizontal engine as compared with the vertical). This is obtained as follows, viz.: After the pistons are fitted, the rods are supported on points representing the position of the cross-head at either end, the deflection of rod due to weight of piston accurately measured; thus the piston rods are given a permanent deflection equal to that due to weight of pistons. In this way the piston rods are practically straight when supporting full weight of piston.



4,500 H.P. LARGE ENGINE IN POWER HOUSE OF MONTREAL STREET RAILWAY COMPANY.

The dimensions of the cylinders are as follows, viz.: High pressure, 36 inches diameter; low pressure, 64 inches diameter and 60-inch stroke. Both cylinders are steam jacketed throughout.

The valve motion on each cylinder is so arranged and operated that steam may be cut off at any point up to seven-eighths of the stroke. The governor controls the valve motion on both cylinders. An auxiliary governor is provided of same design as the regulator, which is attached to a stop valve in such a manner that should an accident occur to the regulator which would allow the speed of engine to be increased 10 per cent., the auxiliary governor would close the stop valve and thereby stop the engine.

The fly-wheel is 24 feet in diameter, built in ten sections, and weighs about 100 tons. It is secured to a shaft 26 inches in diameter in centre; 24-inch bearings, weighing 21 tons. The wheel was turned on its own shaft, running in its own bearings on the lathe, and therefore runs perfectly true.

The main bearings or frames are enormous castings weighing over 27 tons each, and so designed that the weight of metal is directly in the line of strain, and at the same time presenting a large bearing surface on the foundation. The main bearings supported by these frames are two feet in diameter and four feet long, the bottom sections (which take the weight of wheel, shaft and generator) of which are water-jacketed.

The air pump is of the single acting, vertical type, and is driven direct from the steam piston rod. The circulating pump is driven from one end of the air pump shaft. The surface condenser is of the Wheeler type.

The engine is designed to work with a pressure of 160 lbs. of steam, at which pressure 4,500 h.p. can be developed. The whole engine weighs 400 tons, and makes a smooth, silent-working machine.

ELECTRIC RAILWAY FRANCHISE IN JAMAICA.

ONE of the largest foreign enterprises that Canadians have yet undertaken is shortly to be carried out in Jamaica, through the efforts of Mr. W. B. Chapman, of Montreal. This gentleman has for some time been negotiating for an electric tramway franchise, and has at last secured a charter from the government to build twenty-five miles on the island, in the vicinity of Kingston, which, it is estimated, will cost half a million dollars. Associated with him are Messrs. F. S. Pearson, of the Metropolitan Street Railway, New York, and Mr. B. F. Pearson, of the Halifax, N. S., Tramway Company, and the enterprise will be known as the West India Electric Company. A large power house will be built on the foreshore, and electric lighting will also be taken up. The contract has already been given to a Canadian firm, and everything entering into the construction and equipment of the road will be Canadian except the rails. Concerning the venture, Mr. Chapman says: For some years this has been a hobby of mine, my attention being first drawn to the matter in 1890. Since then I have been several times to the island, but the old street car company, which has earned large dividends for 20 years, was too influential and barred me out. This year I went down in January, and arranged to buy the old road's rights and assets at a fair price, so gaining a decided advantage in tendering. Then I had to get their general "Tramway Law" amended in many respects to insure our charter being satisfactory when obtained. The next step was to get an act of incorporation passed allowing us to build and operate tramways or generate electricity and distribute it "for any useful purpose." This you see allows us to take up electric lighting and telephone as well, and eventually will give us the entire electrical business on the island, which has 700,000 inhabitants in a very small area. Our troubles were not over then, because a Boston company was competing with us for the "license" from the Governor, which was still necessary to enable us to use our charter. Both parties appeared daily for a week before the Privy Council, and argued their respective cases. The Boston people offered 'penny fares,' but we objected to consider this, and gained our point on general superiority. We have two districts (in city and suburbs) 4 cents each, that is, a maximum of three miles for 4 cents or six miles for 8 cents. Everyone will ride at these rates. We serve immediately about 80,000 people, and will have twenty miles of road in operation within a year, meantime working the horse cars. Only open cars will be required, as the climate is like our July all the year round, excepting May and November, when it rains. We can lay coal down under $4 per ton, and wages and working expenses are very low."

SPARKS.

The Electric Light Company at Rat Portage, Ont., are erecting a new office building.

The town of Dartmouth, N. S., is at present considering the renewal of its electric lighting contract.

The capital stock of the Halifax Street Railway Company has been increased from $600,000 to $800,000.

A gentleman named Baumgarten is said to be negotiating for the construction of an electric railway at Brockville.

The announcement comes from Paris that the Auto Mobile Club is organizing a monster race of motor cars from Paris to St Petersburg.

Mr. Fowler, on behalf of a syndicate, is still endeavoring to secure the construction of an electric railway from Lanark to Carleton Place.

The Montreal Park & Island Railway Company held their annual meeting last month, at which the old board of directors was re-elected.

Messrs. A. Bouin, Louis Bartin and F. X. Drolet, of Quebec, have been appointed provincial examiners of boiler inspectors for the province of Quebec.

The Montreal Street Railway Company closed its business year a fortnight ago, and the total receipts are shown to be $1,333,632.84, an increase of $80,226.07 over last year.

The capital of the Quebec Street Railway Co. is to be increased from $320,000 to $400,000, thus enabling the company to complete without delay the whole line intended to be built.

Mr. D. Lamont, manager of the Palmerston electric light plant, states that he finds the ELECTRICAL NEWS very interesting, and considers it as a necessary part of every well equipped plant.

At the annual meeting of the Ottawa Car Co., held last month, directors were elected as follows: T. Ahearn, president; P. Whelan, W. W. Wylie, J. W. McRae, and William Scott.

The Vernon & Nelson Telephone Co., of which Mr. H. W. Kent is superintendent, have commenced the construction of a metallic circuit long-distance telephone line between Nelson and Trail, B C

On the 9th ultimo a by-law was carried by the township of King granting a bonus of $12,000 to the Aurora & Schomberg Railway Co. It is proposed to commence the work of construction in the spring of 1898.

The St. John Street Railway Co. have lately received two new vestibule cars from the Ottawa Car Co. They are said to contain several improvements, including electric buttons on either side of each window, electric heaters, etc.

The Sherbrooke Electric Railway Co. have completed their line from the city limits to the end of Lennoxville. Mr. Mylon, of the Canadian General Electric Co., is looking after the company's interests in connection with the construction of the road.

The city of Montreal has entered an action for $21,000 against the Montreal Street Railway Co. The city claims that it is entitled to receive a percentage of the receipts taken by the company in the suburban municipalities, while the company contends that it is bound to account only for the receipts within the city limits.

Mr. A. J. Corriveau, of Montreal, has lately returned from a trip over the proposed route of the Montreal Southern Counties Railway. It is Mr. Corriveau's intention to construct the line through Chambly, where the motive power will be obtained. The route embraces St. Johns, St. Alexandria, Bedford, Cowansville, Knowlton, Sherbrooke, Lennoxville and other towns.

John Inglis & Son, of Toronto, have obtained a verdict of $700 against the Hamilton, Grimsby & Beamsville Railway Co The company purchased a flywheel for an engine from Messrs. Inglis & Sons, but claimed it was defective and refused payment. The plaintiffs claimed that it was made according to contract and passed by the company, and were awarded judgment as above.

Mr. J. B. Griffith, manager of the Hamilton Street Railway Co., has become financially embarassed. At a meeting of creditors a statement was presented showing assets of $48,500, consisting of shares in the Hamilton Street Railway Co. The liabilities amount to $47,127, of which $45,227 is secured by the hypothecation of the shares. It is probable the estate will be wound up.

There appears to be friction between the Hull Electric Railway Co. and the management thereof. A short time ago Mr. G. W. Seguin, who was acting as secretary-treasurer, retired from the company, and now it is announced that Mr. H. B. Spencer, superintendent of the road, will probably resign, owing to a desire on the part of the company to reduce expenses. Mr. Spencer was engaged about one year ago as superintendent for five years, at a salary of $3,000 per year.

The Engineering News states that a contract has been signed by the Southern California Power Company for an 80-mile transmission, which is the longest distance on record, the next one to it being 36 miles for the Salt Lake City plant, in which only one-fourth the power is transmitted at one-third the line pressure used on the Niagara Falls-Buffalo transmission. The power station is 12 miles from Redlands; there will be four three-phase generators of 750 k.w. each, directly connected with impact turbines; 250-k.w. transformers will raise the pressure to 33,000 volts.

It is reported that the Belgian government have decided upon trying electric locomotives on the ordinary state railways. The first experiment is to be made between Brussels and Tervueran, a distance of nine miles. The accumulator system is to be adopted. The accumulators for this service will weigh 12 tons, the electric motors and appliances 10 tons, and the cars, which will carry 80 passengers, 20 tons. The charging of the accumulators occupies one hour for every eighteen miles of running power, but are capable of being charged for seventy-two miles of operation The motors are to be compound wound and the pressure of current about 500 volts. The success of the trial will be watched with much interest.

TRADE NOTES.

The Foley Mines, Seine River, Ont., are now installing two 100 horse power steel boilers, built by the Jenckes Machine Co., of Sherbrooke.

Mr. C. B. McAllister, of Peterboro', is lighting his new mill by electricity, and has placed an order for the dynamo and fixtures with the Royal Electric Company.

Mr. H. Corby, of Belleville, is lighting his distillery and warehouses with electricity, and has placed his order for the dynamos, etc., with the Royal Electric Company.

D. Champoux & Bro., Disraeli, are installing an electric lighting plant, and have purchased for this purpose a 30" Crocker turbine from the Jenckes Machine Co., of Sherbrooke, Que.

The Galvanic Battery Works Company, of Toronto, in their new catalogue, devotes considerable space to a description of electro neurotyne apparatus for use in the treatment of spinal and other diseases.

The Hawthorne Woolen Co., of Carleton Place, have recently enlarged their premises, and are lighting them throughout with electricity. The contract for electrical apparatus has been awarded to the Royal Electric Co.

The Owen Sound Portland Cement Co., of Shallow Lake, have purchased an electric plant from the Royal Electric Co., and will have the same operating in a very short time. It is their intention to work twenty-four hours per day during the season.

The 30-stamp mill at the Sultana Mines is almost ready to commence operations. This mill is probably the most modern one in the district, and the complete plant with which Mr. Caldwell is equipping the property was furnished by the Jenckes Machine Co., of Sherbrooke, Que.

The Old Ironsides Mine at Greenwood, B. C., have got their new plant, which was furnished by the Jenckes Machine Co., of Sherbrooke, Que., into position, and are now about ready to ship ore. This property is expected to enter the list of dividend payers within the next few months.

In the Machinery Hall at the St. John Exhibition the Robb Engineering Company, of Amherst, N.S., exhibited one of their well-known 40 horse power side crank engines. A railing surrounded a stage, upon which the engine was set, thus forming an ideal engine room. The exhibit was in charge of Mr. J. J. Porter.

The Goldie & McCulloch Company, of Galt, Ont., exhibited at the St. John Exhibition one of their Ideal engines, for which engine is said to make a great saving in oil, using as it does one they have the exclusive right of manufacture for Canada. This oil cup, and is the only self-oiling engine built in the Dominion.

The Robb Engineering Company, Limited, have received an order for three tandem compound engines, side crank type, for export to Spain. These engines are to be direct connected to electric generators, and were ordered by an English engineering firm who are building electric tramways at Barcelona and Madrid.

The Dominion Paper Company, extending and enlarging their mills at Kingsey Falls, Que., have placed an order with the Jenckes Machine Co., of Sherbrooke, for two of their 30" Crocker special turbine wheels. These wheels are mounted on one shaft, set horizontally in a steel case, thus doing away with the gearing and attendant evils.

The Cockshutt Plow Co., of Brantford, have bought additional premises, and are doubling the capacity of their works. Among the important changes is the substitution of electricity for gas. They have placed their order for a 30 k. w. generator and 250 light installation with the Royal Electric Company. The generator is to be of the "S. K. C." two-phase type, wound to deliver 110 volts direct to mains. This system for isolated lighting is a radical departure from the old lines, and is the second instance in Canada where it has been placed in use for factory lighting.

The Thompson Electrical Company, of Hamilton, Ont., report sales of their "T. & T." arc lamps to the following: The Sarnia Gas & Electric Co., Stratford Gas & Electric Co., Guelph Gas & Electric Co., St. Thomas Gas & Electric Co., Preston Electric Light Co., Gananoque Electric & Gas Light Co., Manitoba Electric & Gas Light Co., Wallaceburg Electric Light Co., Hamilton Electric Light & Power Co., Niagara Falls Electric Light & Power Co., Welland Electric Co., Woodstock Electric Light & Power Co., City of Windsor, Ont., Montreal Rolling Mills Co., Ontario Rolling Mills Co., John Bertram & Sons, Garrioch, Godard & Co. A complete 100 arc light plant, including dynamos, lamps and circuits, has been sold to the city of Chatham, Ont., for lighting its streets.

PERSONAL.

Mr. Karl Wildern, inspector for the Bell Telephone Company, was recently married at London, Ont., to Miss Wilkins.

At Victoria, B. C., recently, Mr. Robert W. Harrup, of the British Columbia Electric Railways, was married to Miss Williams.

The resignation is announced of Mr. William Bathgate, who for the past twelve years has been manager of the Winnipeg Gas and Electric Company.

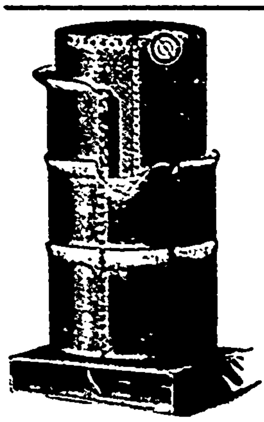
Mr. J. A. Culverwell, formerly with the General Electric Co. at London, Ont., has received the appointment of local manager for Toronto and Central Ontario for the London & Lancashire Life Insurance Company.

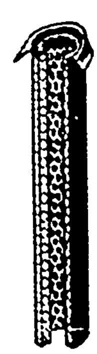
RAPID TELEGRAPHY.

Prof. A. C. Crehore and Lieut. G. O. Squier, U. S. A., in a paper read before the April meeting of the American Institute of Electrical Engineers, entitled "The Synchronograph: A New Method of Rapidly Transmitting Intelligence by the Alternating Current," describes a new method of rapid telegraphy. The transmitter consists of a mechanism for opening an alternating circuit at the exact instant when zero value is reached, and keeping it opened during one or more alternation; one or more half waves may thus be omitted according to the requirements of the telegraphic alphabet. By means of a perforated paper band corresponding to the message to be sent, the half waves are omitted in the proper order. The receiver rests on the principle that if a ray of polarized light is passed through liquid carbon bisulphide or one of a number of other substances, the plane of polarization is rotated by any change in value of a magnetic field set up by a coil surrounding the liquid—that is, by any change of current in the coil. This principle is utilized to register the current from the transmitter, by photographic means, the suppression of the half waves above referred to being thus registered at the receiving end of the line in the form of a record comparable to that printed on a tape by a Morse receiver. The transmitter may also be used in connection with a chemical receiver, such as the Delany. In experiments no difficulty was experienced in obtaining records with the use of a frequency of 545 periods per second, which corresponds to a transmission of between three and four thousand words per minute.

Messrs. A. P. McLaurin & Co., of Lachine, Que., are about to light their factory by electricity. The order for the dynamos and material has been given to the Royal Electric Co.

The Perth Waterworks Co., of Perth, Ont., have decided to do their pumping by electricity and also to light the town of Perth. For this purpose they have placed their order with the Royal Electric Co. for a 150 k.w. "S.K.C." two-phase generator, from which will be driven the pumps by two-phase motors, the balance of the capacity of the machine being used for lighting and power to be furnished in Perth. A more extended description of this plant, which is rather unique, will appear in the next issue of this paper.





SPARKS.

Mr. N. Duval, of 85 St. James street, Montreal, has invented a new water wheel which is laid flat in the water.

Rogers, Robertson & Co., oil merchants, Montreal, have amalgamated with the Bushnell Oil Co., Limited, of that city.

The village of Glencoe, Ont., has invited tenders for electric street lighting for a term of five years. Tenders closed on the 2nd inst.

A reduction in fares will, it is said, be made by the Metropolitan Railway Company between the C. P. R. crossing and the cemeteries.

Incorporation will be asked for the "La Compagnie de Telephone de Beauce," for the purpose of establishing telephone lines in the province of Quebec.

An assignment has been made by C. W. Henderson, dealer in electrical supplies, Montreal. The direct liabilities are given as $8,327, and the indirect liabilities as $2,186.

The New England Telephone Company have established a long distance service between Boston and points in Canada, connecting with the wires of the Canadian Bell Telephone Company.

The Sarnia Gas & Electric Light Company recently purchased a new boiler from the Goldie & McCulloch Co., of Galt, and an incandescent machine from the Canadian General Electric Co.

The receipts of the Toronto Street Railway Company for the year ending August, 1897, were $1,020,215.40. The largest receipts for any one month was during July, when they reached $106,750.

Messrs. S. J. Lightbound, Louis Hall, John Smith and James O'Brien, of Huntsville, Ont., have passed the examination of the Ontario Association of Stationary Engineers and received their certificates.

It is stated that the capital stock of the Toronto Electric Light Company will be increased from $1,400,000 to $2,000,000. This increase is said to be necessary for the extension of plant and new buildings.

In Montreal recently Mr. Frederic Nicholls, of the Canadian General Electric Company, had a conference with Sir Charles Ross in reference to the water power scheme at Kootenay, B. C., for which his company is furnishing the electrical machinery. It is expected that early in November power from this source will be supplied to Rossland.

The annual meeting of the shareholders of the Great North-Western Telegraph Company of Canada, was held in Toronto on the 29th ultimo. The directors chosen were: H. P. Dwight, president; Adam Brown, vice-president; A. S. Irving, Richard Fuller, H. N. Baird, Hon. Wm. Macdougall, Charles A. Tinker, James Hedley and W. C. Matthews.

The name of the Electrical Supply Company, of Hamilton, Limited, has been changed to the Electrical Power & Manufacturing Company, of Hamilton, Limited.

The effort to bring about an agreement between the Hamilton and Dundas Railway Company, and the Hamilton Street Railway Company, in relation to the former's running rights over the street railway in Hamilton and the supply of electric power, has been unsuccessful. The Hamilton and Dundas company is continuing its arrangements to change the present system to that of electricity, and to continue on its old tracks throughout the city.

According to professor Ebert, a German physicist, a single horse power would be sufficient to run 46,000,000 Puluj lamps of 16 candle power. This is a phosphorescent lamp constructed 15 years ago, and consists merely of a piece of mica painted with sulphide of calcium and subjected to the action of Cathode rays in a vacuum. Should it become possible to convert mechanical energy into light alone, a single man turning a crank could develop sufficient energy to light a whole city.

The announcement is made that D. MacLauchlin Therrell, the Southern electrician of the Postal Telegraph Company, whose headquarters are at Atlanta, Ga., has conceived a device by which he hopes to revolutionize long-distance telephoning. The invention, which combines the principles of the telephone and phonograph, has been publicly tested in a room at Atlanta, where renditions of vocal and instrumental music were transmitted through a resistance equal to that of 12,000 miles of wire, and were perfectly audible to all who had assembled to witness the experiment. Mr. Therrell's pet scheme is to have a telephone line across the Atlantic. This, he thinks, could be accomplished by having his repeaters located in bells at a distance of a thousand miles apart.

Mr. John McGill, of Kingston, son of the clerk of the county court, has invented a motor which he claims can be used in connection with steam, water power or compressed air, and that he can multiply the power of the usual steam engine ten times. "Take an engine," he says, "with a six inch cylinder. That is equal to about 28½ inches of steam space. To drive the piston one revolution at 90 pounds pressure will use 51,300 inches of steam. In my system it will take only 5,180 inches of steam to produce the same result, or take an engine with a five inch bore cylinder that is equal to 20 inches steam space. To run it at five pounds pressure, one revolution will require 2,000 inches of steam, and the power would be scarcely sufficient to overcome friction and set the engine in motion. In my system 910 inches of steam at five pounds pressure will yield a power of 24,000 pounds, equal to 7½ horse power." An ordinary turbine will scarcely move at 5 *pounds per square inch, while with the new motor almost any* amount of power can be obtained at that pressure, varying according to the size of the motor from, say, 25 to 100 horse power.