IN THIS NUMBER

Illustrated Description of the Chambly Water Power Electrical Transmission Plant.
Valuable Engineering Information—"Questions and Answers" Department.

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CANADIAN

ELECTRICAL NEWS

AND

STEAM ENGINEERING JOURNAL.

VOL. VII. DECEMBER, 1897 No. 12.

THE CHAMBLY ELECTRICAL POWER TRANSMISSION PLANT.

ALMOST phenomenal have been the strides made in Canada of late years in the development of water power for the generation of electricity. In several instances the power has been transmitted many miles, this being rendered feasible by the perfecting of means by which very high potentials can be controlled with absolute safety. Descriptions of the transmission plants of the Lachine Rapids Hydraulic and Land Company at Montreal, and the North Shore Power Company at Three Rivers, Que., have already appeared in the ELECTRICAL NEWS, and in the last number reference was made to the proposed works of the Cataract Power Company, of Hamilton, now in course of construction. In each of these plants engineering practice of high order and of special character has been called into requisition. Of equal importance, both from an electrical and hydraulic engineering standpoint, is the scheme of the Chambly Manufacturing Company, which is now being carried to completion, and which embraces many special features. The following description of this interesting installation, for which we are indebted to the Electrical World, will give a fair conception of the completed work:

At Richelieu village, about 25 miles distant from Montreal, the Richelieu River falls through a long series of rapids. From early days a wooden dam between Richelieu village on the one side of the river, and Chambly on the other, has been in existence, supplying power to a few small mills. The new structure which takes its place is one of the finest examples of hydraulic engineering on the continent, consisting of a massive

THE WASTE GATE FROM THE FORE BAY.

concrete dam, in which, as an integral part, is built the power house, with a capacity of 20,000 horse power. This dam is about 2,000 feet long, 6 feet wide at the crest, and constructed of a concrete composed of the broken rock of the river bed, mortared with sand from the vicinity and American cement. The back is vertical throughout, and the apron is curved so that the overflow water is discharged horizontally, obviating any destructive washing action at the base. A liberal use of one-half inch iron rods, incorporated with the mass of the concrete, gives great strength to the structure, and a surface dressing of neat cement insures the greatest impermeability. This is said to be not only the most carefully constructed, but also the largest concrete dam on the continent.

The dam consists of three portions, two of which run

TWO-STEP DAM FROM BELOW, SHOWING TAIL RACES AND FLUMES.

perpendicularly across the course of the river, while the third and middle part is parallel with it. In the lower third of the dam, and near the right bank of the river, is built the power house. Here the dam consists of two levels, or steps, over which is built a structure of steel beams and brick walls, 308 by 51 feet, for the protection of the machinery. The upper level, which is about two feet above the surface of the water in the lake formed by the dam, will contain the switchboards and controlling devices, and such offices as are necessary. In this part of the dam, eight rooms, or flumes, each about 20 feet square and 10 feet high, are constructed, their arched openings being under the water level, for the reception of the wheels. These, of the horizontal-shaft pattern, number four in each flume, each wheel being 46 inches in diameter. These wheels are mounted tandem on one shaft in two pairs, between the wheels of each pair being a large cast-iron box communicating with the draft tubes, which extend through the solid concrete of the lower step of the dam to a point below the level of the tail water. The draft tubes are built of sheet steel, and are 9½ feet in diameter where they leave the boxes, and 10 feet at their outlet. The upper extremities of these being one behind the other in the line of the shaft, necessitated their construction in a curious skew curve. This installation seems to run to superlatives since these draft tubes are the largest ever constructed. Their bedding in concrete excludes all possibility of leakage, and it is confidently expected that the full advantages of the head of 28 feet will be realized by their use, although the wheels are but a few feet below the level of the intake water. Under this head, and at the speed of 153 revolutions per minute, each wheel will develop 660 horse-power, or a total of 2,640 horse-power to each shaft and flume.

The governing of the wheels will be by means of Giessler electro mechanical governors, similar to those in use at the Lachine plant. These are relay governors, the revolving balls actuating a small lever which closes electrical contact at speeds higher or lower than that for which the instrument is set. These contacts control electro-magnets which operate clutches on the main shaft geared to the gate of each gang of wheels. It has proven an excellent and reliable governer in other large hydraulic installations, notably in that at Lachine Rapids.

At present only four of the eight sets of wheels are being installed, together with two 28-inch wheels, giving 750 horse power for driving the exciters of the large dynamos. The whole of the hydraulic machinery was

FLUME AND DRAFT TUBES BEFORE TURBINES WERE SET.

furnished by the Stillwell-Bierce and Smith-Vaile Company, of Dayton, Ohio, and reflects much credit upon that concern by the solidity of its construction and the great accuracy with which the parts of the heavy wheels and draft tubes were assembled at Chambly by its constructing engineer, Mr. H. A. Wright.

The shaft of each gang of turbines passes out horizontally through a circular steel bearing plate on the down-stream vertical face of the upper step of the dam, and is directly connected to a 2000 k. w. generator, giving two-phase current at 60 cycles per second and 12,000 volts.

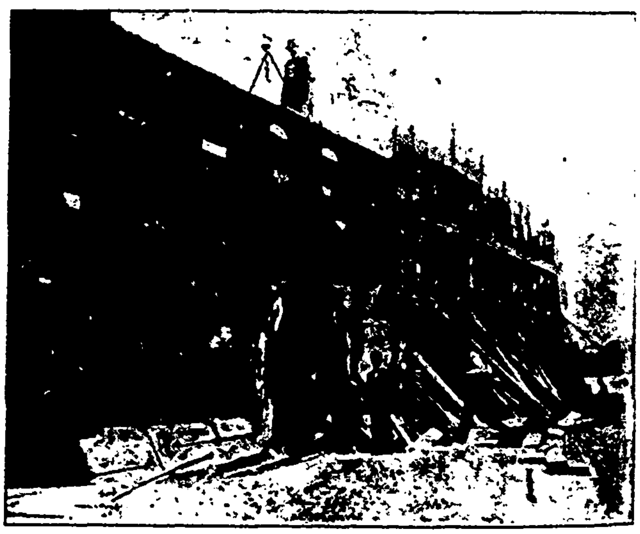
These machines are of the inductor type, having no moving wire. The inductor is about 10 feet in diameter, and of very massive construction. The single-circular field coil is wound on a brass spool of about 10 inches face by an equal depth, and completely surrounding the inductor. The armature is in two parts. The insulation of these armatures is necessarily most massive and substantial. All the dynamo machinery is now under construction by the Royal Electric Company, at Montreal, from designs by the Stanley Electric Manufacturing Company, of Pittsfield, Mass.

In the space above the flumes in the upper portion of the power house dam, a large conduit has been made for the reception of the leads from the dynamos to the switchboard. Lead-covered, rubber-insulated cable will be used for these. In the walls of the power house a number of large terra-cotta pipes, about 3 feet long,

CASINGS FOR FOUR TURBINES IN PLACE IN FLUME.

bent to a quarter circle, with the convexity upwards, have been built in, and through these the cables leading to the pole line will pass out without touching anything between the insulators inside and outside the building.

Two pole lines will be constructed to Montreal, either one being sufficient to carry the load. This construction was adopted to minimize the chances of accidental breakdown, and to make repairs easily possible without danger to workmen. The poles are of chestnut, none being less than 40 feet long. Each pole carries two cross arms, the usual "square" for two-phase transmission being observed. The insulators are of a deeply petticoated porcelain type, somewhat similar to the Niagara pattern, but lacking the grooves for conducting away rain water. They are mounted on oak pins, having a steel rod in the center of each. A line of



BUILDING THE UPPER STEP OF POWER-HOUSE DAM, SHOWING MANHOLE TO FLUME AND ENTRANCES TO CABLE WAY.

barbed wire is run along the tips of the poles, and four similar lines are attached at the ends of the cross arms, all five being connected together and grounded by means of 8 feet of iron gas pipe at each pole. The line wire is bare, of 00 gauge, and is tied to the insulators by two pieces of No. 12 gauge soft copper wire. A short distance below the main line a short cross-arm carries the two No. 12 copper wires of a telephone circuit.

The main power transmission line will end in the electric light station of the Royal Electric Company, at Montreal, where 6,000 horse power will be used for incandescent and arc lighting and direct-current motor

Looking Down Lower Step of Dam. Power-House Framing.

service. The large two-phase generators now employed in that plant for incandescent lighting and power will be re-wound as synchronous motors, and connected directly in the 12,000 volt circuit. These machines will then be belted by a system of countershafts to the arc-light generators and other continuous current machines of the station, to which they will furnish power. A group of static transformers of 150 kilowatts each will be arranged in the basement of the present station, reducing the line voltage of 12,000 for distribution over the present circuits at 1000 and 2,000 volts, two-phase.

The transformers are now under construction at the works of the Royal Electric Company, in Montreal. Their greatest feature of novelty is in the method of cooling employed. The transformer is set up in an iron case in the usual way, this being filled with oil for insulation, and the whole surrounded by a sheet iron water jacket. As the plant in Montreal is some feet below the

Looking Up the Tail Race Towards the Power House.

level of the Lachine canal, from which water is obtained under a small gravity head, the water going to the condensers will be allowed to circulate around these transformers in the jackets, and it is expected that this arrangement will result in very effectual cooling.

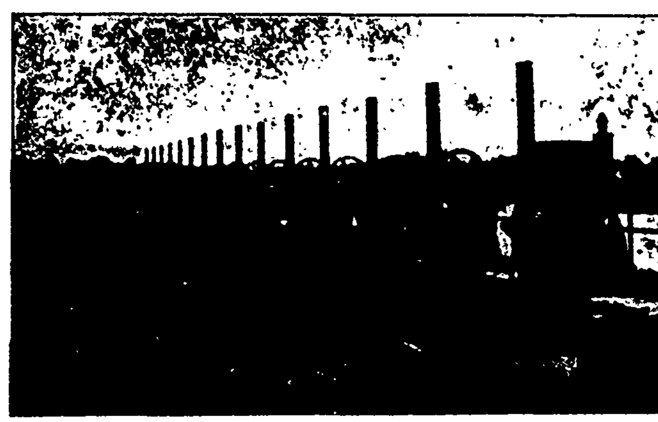
The troubles with ice, which have been so long a bugbear to many Canadian plants, are not expected to be at all serious at Chambly. The back water from the great dam will make a lake of still water at least 1½ miles long up the river, and, as this will freeze over the surface at the beginning of the season, no trouble whatever is expected from anchor ice. It is expected that floating ice in the spring thaws will clear the dam without trouble. It is a peculiarity of the Richelieu River, which is the outlet to Lake Champlain, that its current is comparatively steady throughout the year, and consequently no difficulties with freshets or low water are anticipated. The construction of the dam and other elements of the power development reflect great credit upon the engineer of the Chambly Manufacturing Company, Mr. J. G. Macklin. The work is progressing at an extremely rapid rate, and the contracts call for the installation of all the hydraulic machinery and the completion of the dam by January 1 next. One of the dynamos is finished and the others are well under way, so it is likely that current will be turned on from this installation in the early spring.

It is expected to deliver nearly 20,000 electrical horse power from this plant in Montreal when the total equipment is installed at Chambly. This will make a grand total of nearly 40,000 horse power sent to that city from two great water powers.

HOW TO MEASURE.*

By W. H. Ballard.

In measuring anything it must be compared with a standard, the measurement of which is known.



Waste Gates.

Examples of common standards are pounds, yards, etc. Although it is generally the case, it is not necessary that that which we measure is greater than the standard. In measuring a surface or area, we take a small portion of the surface (it may be anything, a square foot, yard, etc.) and compare the extent of the whole surface which we do not know with that which we do know. For instance, take a surface 12 ft. square and mark off one square yard in the corner; four of these squares would reach from one side to the other and form a strip one yard wide, and if this strip is repeated until the whole surface is covered, the measurement of the area will be found by multiplying the number of strips by the number of square yards contained in each. No matter how far extended the surface may be, it is measured by this process. Whatever you start multiplying by the result must be; if by feet the result will be in feet, and if by yards the result will be in yards. The same principle is used in measuring any figure, large or small. To take a proportion we have to start with something which we definitely understand. In measuring solids we start with the cubic inch, foot or yard.

This brings us to the second point. In the first place

* Paper read before Hamilton Association No. 2, C. A. S. E., by Mr. W. H. Ballard, Inspector of Schools.

it was shown that measurement consists in comparison. Secondly, it consists in comparing with something else of the same kind. If weight is to be measured it must be compared with a certain definite understood weight, such as pounds, etc. Value is measured by the dollar; area by the square foot or square yard; volume by cubic inches, feet or yards; length by something which contains a certain known length; if any moving object passes through a certain space in a certain time it is a measure of velocity. The surface of a cone is measured by multiplying the slant line by half the surface of the base. To find the cubic contents of a cone, first find the area of the base and go through the process of finding the volume of a cylinder, then divide by three as a cone equals exactly one-third of a cylinder.

A simple way to find the height of a smokestack is by measuring the length of its shadow and comparing it with the shadow of some object of which we know the length.

The imperial standard of measurement is a bar about 40 or 42 inches long at two points, on which there are two gold plugs, and the difference between these plugs is the imperial yard. In all measurement of length the yard is the standard. Measurements were originally made by comparing objects with parts of the human body, such as the length of the hand, etc., and land was measured by the length of the footstep. The standard of weight is made to depend on the standard of time. All measurements have reference to the three fundamental units—time, weight and length.

MR. HARRIS P. ELLIOTT.

It is with pleasure that we present in this number a portrait of Mr. Harris P. Elliott, who has recently been appointed to the position of Lecturer in "Electricity" and "The Steam Engine" at the Toronto Technical School, in succession to Mr. James Milne. These two courses of the School are very largely attended, and good work is being accomplished.

MR. HARRIS P. ELLIOTT,
Lecturer in "Electricity" and "The Steam Engine," Toronto Technical School

Mr. Elliott, the new appointee, was born at London, Ont., in October, 1875, his father being of English descent. He entered the School of Practical Science, Toronto, in 1891, and during the following summer was engaged by Messrs. Mallock & Fairbairn, manufacturers of elevators, London, Ont. In the fall he again entered the School of Science for a second year, but on account of illness was compelled to give up his studies. He was then employed for a year by the Canadian General Electric Company in London. He finished the second year at the School of Science in 1894, and during the summer was engaged upon the engineering staff of the London street railway, in the construction of their Springbank line, under Mr. Kenneth Mackay.

The following year Mr. Elliott took his third term at the school, graduating with honors in 1895. An engagement was then obtained with Dr. Samuel T. Tracey, of New York, handling X rays apparatus. In the college season of 1896-97 he took a post-graduate course, obtaining the degree of B.A.Sc. from Toronto University, with honors. During the past summer he obtained a position on the engineering staff of the Fort Pitt Bridge Company, of Pittsburg, Pa., tendering his resignation to assume his duties at the Technical School.

Mr. Elliott is a nephew of the Hon. Mr. Justice Proudfoot, of Toronto. By his ability and energy the efficiency of the departments under his supervision will no doubt be maintained.

THE PROPOSED STEAM BOILERS ACT.

TORONTO, Dec. 3rd., 1897.

To the Editor of the CANADIAN ELECTRICAL NEWS.

SIR,—In your November number I see a letter signed "Acadian Engineer," concerning a bill entered at the last session of the Dominion Parliament, in which he takes exception to one of the clauses. The engineers in the west have for several years done considerable work along this line, and we are pleased to hear from our eastern members of the profession, even if it is only to give us his opinion of where we were wrong. There is no doubt but a bill drawn upon the lines he speaks of would be an excellent arrangement for those who have had some technical education as well as some experience, but it would be very hard upon men who had safely operated steam plants for years without knowing exactly what the safe pressure or the tensile strength of the material was. If such a clause was passed what would thousands of our factories do for an engineer? Simply shut down until such a man could be found. I am afraid that if such a law was asked for it would not receive many votes in the House of Commons. A law to be useful must be framed in such a way as not to greatly interfere with present commercial practice, and necessary changes be brought on gradually. Here in the west it has been our experience that it is very much easier to amend a law than it is to get it on the statute books.

What we require is that the government should see and understand the necessity of having steam boilers under the care of accredited men. Once we get this thoroughly established, a law should be enacted that will bring the desired end without hardship to the owners of steam plants. I think if the matter is put into the same position as the steamboat men were at the passing of the Steamboat Act in 1868, we would then have every man now operating a plant secure a certificate to run the plant at which he is employed, and if he should want to operate a larger plant he would have to pass an examination before he could do so. This would have the effect in a few years of raising the standard of knowledge required to operate our steam plants. The western engineers are alive to this, and will be very much pleased to have the fullest assistance possible to get a law passed, and we will never complain if it is as stringent as "Acadian Engineer" says it ought to be.

Yours respectfully,
TORONTO ENGINEER.

The corporation of the city of Lachine are installing in their power house one of the Royal Electric Co.'s 2,000 light alternators.

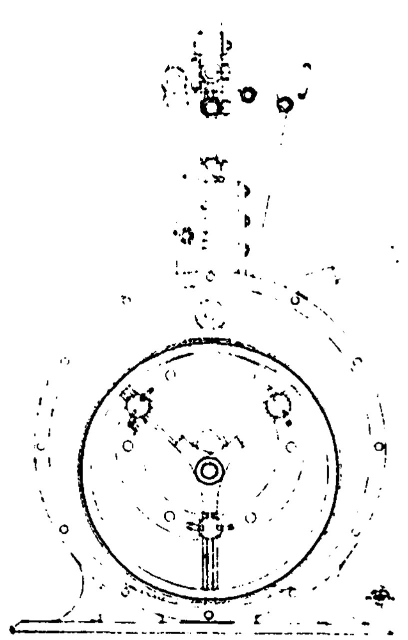
Mr. Geo. Hartman, of Peterborough, in renewing his subscription to the ELECTRICAL NEWS, writes: "I find it very useful and should not care to be without it."

Mr. J. W. Cochrane, of the Glenboro Roller Mills, Glenboro, Man., under date of Nov. 2nd, wrote the Dodge Pulley Co., of Toronto, as follows: "You should see our rope drive; it is just the slickest thing I ever saw in the way of a drive. If you have any prospective customers for a drive, just refer them to me, will you?

THE TREE ROTARY ENGINE.

MESSRS. Baird & Tree, of Woodstock, Ont., have recently been granted a patent for, and are now manufacturing, a new and improved rotary engine embodying many points of merit. The manufacturers claim that it is especially adapted for service in connection with electric lighting plants, and where economy of space is a consideration, as it only occupies from one-tenth to one-quarter that of the ordinary engine. It is also much cheaper to build. In the accompanying cuts the two elevations of the engine are shown.

Some of the most important features of the Tree rotary engine are: The double casings (the inner ones revolving with the wings inside and being fastened to and a part of the ring piston), which casings almost entirely do away with the friction that has been one great cause of failure in many rotary engines heretofore; a bearing on both ends of the ring piston, one fastened to the main shaft, the other revolving on a stationary shaft, with an offset inside the ring piston casing, making the ring piston shaft; the automatic adjustable metal packing around the wings and wing swivels, the double ring packing between casings and main chamber coming right to the corner of the cylinder, and the automatic adjustable packing between the ring piston proper and the top part of the steam chamber, making the whole engine absolutely steam tight, and thus overcoming another of the difficulties in former rotary engines, viz., steam tightness. The exhaust at the large part of the cylinder gives a forward pressure and a supplemental exhaust at the top, both of which are new. The three intakes of steam for the wings, made

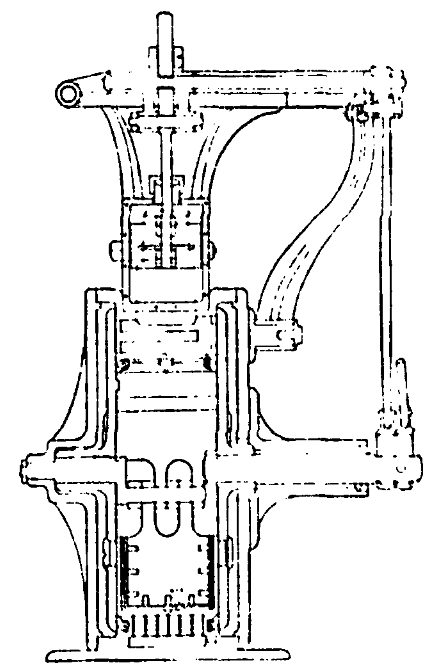


THE TREE ROTARY ENGINE.

with one up and down motion of the valve, utilizes expansion to a much greater degree than the ordinary engine could possibly do, on account of the first part of the cylinder being small. This utilization of expansion is claimed to be the first attempt ever made on a rotary engine that has been successful. Another important feature is the reversing device in connection with the ordinary link motion, making a perfect reverse, and controlled with one lever. All of the above points are believed to be strictly new.

On account of the high speed that is enabled to be attained, it can be connected directly to the shaft of any dynamo, thereby saving friction of pulleys and belting, which means economy of steam. The friction is so light that the durability of the engine is certain to be great.

The first part of the cylinder being small where high pressure live steam is used, and the balance of the cylinder increasing in size as the steam expands and gets weaker, and the leverage increasing at the same time, the average pressure on the ring piston is always the same; and the second wing taking the live steam again before the preceeding one exhausts, makes the pressure continuous, and, of course, the absence of all



THE TREE ROTARY ENGINE.

reciprocal motion gives the engine a perfectly steady speed.

The manufacturers have already lifted 18 h. p. with an ordinary 12 h. p. boiler running only 600 revolutions per minute. The engine complete, pulley, balance wheel, and bed plate, only occupies two feet square and 8¼ inches in diameter inside, 4 inches wide, and only using 1½ inches on the average of the outside of the 8¼ inch cylinder. They have used an engine of this size from the 1st of May to the present time, and are now running one ten ton lathe, two smaller lathes, one shaper, two large press drills, emery wheel, etc., in their work shop by this engine. They are building a 75 h. p. engine, which they expect to complete in a few weeks. A test of this engine will be made at the School of Practical Science, Toronto, or at McGill University, Montreal, and the results published.

Persons desiring further particulars of this engine should communicate with the manufacturers, Messrs. Baird & Tree, 39 Finkle street, Woodstock, Ont. Their factory is always open to inspection, and visitors are assured of a cordial reception.

Application will be made for the incorporation of the St. Lawrence Foundry Company, to develop water powers and furnish electric light and power in the province of Quebec.

A trial trip of Heilmann's electric locomotive was made on November 13th, the route being from Paris to Nantes. The train hauled by the locomotive weighed about 200 tons. The speed did not exceed sixteen miles an hour. The principle of the locomotive is simple, an ordinary steam engine working a dynamo, the electricity being conducted to motors upon the axles of eight pairs of wheels. The locomotive resembles the hull of a torpedo boat. It is 18 metres long and weighs 125 tons. It is regarded as a great improvement on Heilmann's first engine, and the directors of the railway are said to have decided to adopt it.

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

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Information regarding examinations will be furnished on application to any member of the Board.

Fuel Economy With Locomotives. THE work of compounding the locomotives in use on the Canadian Pacific Railway lines was begun a few months ago at the company's workshops in Montreal, and is being proceeded with as rapidly as possible. The compounding of these locomotives is said to have reduced the expense per running mile from six to three cents.

Wattage of Lamps. THE wattage of lamps is a matter in which a saving might be effected by central stations. Lamps can be obtained of 60, 54 or 50 watts each. In an average 1,000 light plant probably an average of 6,000 lamp hours per night are supplied. The difference between using 50 watt lamps and 54 watt lamps is 24,000 watt hours nightly, which is almost 50 horse power hours. Putting this at its coal equivalent shows that 50 watt lamps will save about 23 tons yearly over 54 watt lamps, and at $3 this means $69 yearly. In order to use 50 watt lamps it is absolutely necessary to have a very close voltage regulation, and this can be effected by a liberal use of copper and careful attention. Five per cent. interest on $1,400 is $70, and this liberal use of copper will not cost $1,400, so that a net saving will result, not to speak of the increased lamp capacity of the machine.

The Power Question in Toronto. SOME peculiarly interesting questions, having a bearing on electrical matters, have recently come before the City Council of Toronto for consideration, and it seems rather a cause for regret that they have not received a more careful and thorough discussion. The most advantageous, that of lighting and furnishing elevator power for the new city and county buildings, has for long been a cause for not only discussion, but even dissension, among the many advocates of different methods. As to whether the power shall be purchased from the Toronto Electric Light Co., or generated by a plant placed in the buildings themselves, or by a plant placed in the waterworks pumping house, is a question which cannot be solved by the application of purely general principles without regard to the particular conditions. The Toronto Electric Light Company is, of course, desirous of obtaining the contract, and offered the very reasonable price of 3 cents per k. w. h. It seems doubtful whether the current can be generated in the buildings themselves for such a figure.

Electrical Development.

WITH this number of the ELECTRICAL NEWS the seventh volume of the new series is completed. Taking a retrospective glance over the past twelve months, we must conclude that in some respects the year has been one of phenomenal advancement. Perhaps the greatest work has been accomplished in the utilization of water powers for the generation of electricity, in which direction Canada is rapidly coming to the front. The Chambly transmission plant, a description of which appears in this number, possesses engineering features quite on a par with those of the Lachine Rapids installation, while it is not lacking in unique features also. The magnitude and necessary efficiency of these undertakings have naturally called into requisition the employment of the very best machinery, and our Canadian manufacturers of electrical apparatus have demonstrated beyond a doubt their ability to meet the requirements in this respect. Of the prospect for the electrical business we are most sanguine. It would appear that we are on the eve of an electrical era, when electricity will be employed for purposes for which it was never thought of a few years ago. It promises to be utilized for the supply of power, in mining operations, for cooking and heating purposes, and in many fields that will increase its usefulness. With improved commercial conditions such as are likely to be experienced in the near future, the outlook for the electrical industry is quite hopeful.

Advantages of Radial Railways.

IN discussing the question of the enlargement of St. Lawrence market in Toronto, Ald. Lamb referred to the benefits to be derived by the city and vicinity from the construction of radial railways, and pointed out that steps should be taken to induce the building of such roads. We presume that Ald. Lamb had in mind railways operated by electricity, which has proven to be the most economical and satisfactory system for short distance lines. In this respect, considering her commercial importance, Toronto does not compare favorably with other cities in the province. Hamilton is surrounded by suburban roads, each of which is believed to be a paying investment and to have assisted in building up the city. A system of radial railways would undoubtedly prove of equal, if not greater, benefit to Toronto, and every encouragement should be given to legitimate enterprises of this character. The failure of the Grand Trunk Railway Company to successfully operate the belt line road constructed around Toronto a few years ago has probably tended to discourage investment in radial railways. This, however, should not be the case, as the failure of this road, which was operated by steam, was attributable to causes which do not apply to electric railways. We are pleased to learn that a company is now seeking authority to purchase existing roads, and to build new ones in the County of York, and that the charter includes the taking over of the G. T. R. belt line above referred to.

Candle Power of Arc Lamps.

WE have already had occasion to refer to the candle power of arc lamps, and the very indefinite way of specifying it. It seems to have become fixed in the minds of a large number of persons that a 9.6 ampere arc lamp will give 2000 candle power, and that a 6.8 ampere will give 1200 c. p. When, therefore, such lamps are put in a circuit, and seem to give a light deemed not up to their standards, disappointment and dissatisfaction result. The manufacturing companies are blamed for trying to sell under worthless guarantees, and the customer considers himself badly treated. Now, it is not the business of this journal to take the part of manufacturers against the public, but we deem it in the true interests of the electrical industry to point out to our operating readers that the above dissatisfaction is most emphatically largely their own fault. A man who does not take the trouble to study the details of a business out of which he makes his living almost deserves to be deceived, more especially when the whole literature of the subject is at his disposal, is extremely interesting, and written in a state to suit not only the technical, but also the popular reader. When purchasing an arc dynamo the purchaser usually asks for a 2000 or a 1200 c. p. outfit, and without giving the matter a moment's thought, concludes that a "nominal" 2000 c. p. lamp will give actually 2000 c. p. If he were to devote to the subject as much thought as he gives to the purchase of a hand lamp for his kitchen—to use oil—it would probably occur to him that just as the amount of light given to his coal oil lamp depends on the quality of the oil, the size of the wick, and whether the wick is turned up or down, so the light given by an arc lamp depends not merely on the current, but also on the quality of carbons, their size, and the distance between their points. As a matter of fact, any one can prove for himself that one can get more light from a 5 ampere lamp than from a 10 ampere one, by simply varying the size, quality and distance of the carbons. An arc lamp is nothing more or less than a mechanism for keeping two carbon rods always a little distance apart, and the lamp itself has no more to do with the light than has the bulb of the hand lamp that holds the oil, or the screw that raises the wick. So that if a purchaser desires to buy arc lamps properly, he should not ask for one of a particular candle power, but for one adapted for the use of a certain current to maintain the carbon rods a certain distance apart, and with a certain drop of potential across its terminals. The candle power is then entirely his own affair, and if he wishes to be very severe in his requirements he will then need to specify that with such a lamp as above, and using carbons of such and such a particular make, the candle power observed at such and such a distance from the crater, and at a specified angle from the horizontal plane passing through the crater, must be what he considers he wants. With a specification such as this he is equipped and is in a position to talk to manufacturers, but to consider himself badly treated and deceived because a lamp bought as a supposed 2000 c. p. does not give it with any kind and size of carbon, and at any distance from the ground, is just about as business-like as to buy a heating stove without saying whether it is to burn wood or coal. As a matter of fact it has been over and over again proved that a nominal 2000 candle power lamp does not give more than 800 c. p. in the most intense direction with ordinary carbons, etc. If the electrical operating industry would take a hold of its interests a little better and would dictate its requirements it would be better for both operators and manufacturers.

SAMPLES OF SCALE AND FEED WATER WANTED.

Mr. Wm. Thompson has in course of preparation for this journal a series of articles on "Corrosive and Scale Foming Agents in Boiler Feed Waters." To make these articles of special value to our readers, Mr. Thompson wishes to receive from responsible steam users in all parts of the Dominion samples of scale and feed water. It is Mr. Thompson's intention to make complete analysis of the various samples, using them as practical illustrations of the formation of scale through various sources. These samples should be addressed to Mr. Thompson at Montreal West, Que.

ELECTRICAL TRANSMISSION OF POWER THE SUBJECT OF ARBITRATION.

PORT Arthur has been the scene of a most interesting arbitration case, which terminated on the 24th of November, after lasting two weeks. The case in dispute was as to whether one of the contestants should be permitted to divert the waters of the Kaministiquia river, at the head of a rapid on land owned by him, and carry it by means of a canal across not only his own land, but also across that owned by the other party, discharging the water at the foot of a fall 120 feet high which is situate on the land owned by the second party. The question left for the arbitration to decide was as to whether there was, at all seasons of the year, a sufficient quantity of water in the river to allow of the proper supplying of all the power that could at present, and in the near future, be consumed in Port Arthur and Fort William, using the 30 foot "head" that existed on the first contestant's property, or whether the natural flow of the river was liable to go so low that the above amount of power could not be generated except by utilizing the whole head between the top of the rapids and the foot of the fall--amounting to about 180 feet.

In order to properly appreciate the bearing of the mass of technical evidence given on both sides, and which will be of both interest and value to our readers as throwing light on the subject of the electrical transmission of water power, it will be necessary to explain that at a point distant some twenty miles from the towns of Fort William and Port Arthur, situate at the head of Lake Superior, the Kaministiquia river forms the Ecarte rapids, falling about 60 feet in one mile, and then precipitates itself over the Kakabeka Falls into a gorge 120 feet below their crest. In Fort William are four huge C. P. R. elevators, besides repair shops and other power consuming industries, and Port Arthur has one large cleaning elevator. In order to use the power of the Kakabeka Falls it will have to be electrically transmitted over the intervening 20 miles, and it will thus be evident that hydraulic and electrical engineering of a very high class will have to be employed.

The matters to be decided by either observation or argument were: The actual quantity of water in the river at the time of the arbitration, and whether that quantity was likely to be the minimum or not; the amount of power that that quantity of water would enable to be actually laid down in consumers' premises in the towns 20 miles away; and the actual and prospective market for power in the towns and elsewhere. The engineers engaged in preparation of reports and in giving expert testimony were: For Mr. Jenison, who was endeavoring to get the right to use the whole head of 180 feet, Mr. White-Fraser, of Toronto; and for the Kakabeka Land and Power Co., who were striving to restrain Mr. Jenison from so using the whole head, Mr. H. Wilde, chief engineer of the Sault Ste. Marie Pulp Co., who had charge of a portion of the Canadian locks at the Soo; Mr H. Von Schon, a distinguished United States hydraulic engineer; Mr. H. Rickey, Mr. R. Hesketh and Mr. J. Armstrong, the last two of Toronto.

A most accurate guaging was made of the river, using current meters, and the probable low water was calculated on the basis of the whole drainage area of the river, taken in connection with the raintall, precipitation, etc., and temperature reports of the government. Some deductions were made of great interest and value. It appeared that the Kaministiquia river has varied between low and high water from a flow of not more than 5,000 cubic feet per minute in about February, to about 56,000 cubic feet in October, and a vast and totally unmeasurable quantity in floods. But what will probably be of most interest to our electrical readers is the calculations on transmission losses, which showed how much water would be required at 30 and at 180 feet head in order to render available 1,000 horse power at a consumer's shafting 20 miles away. It first came out that the following efficiencies could be depended on for the apparatus mentioned below, in very large units and of first-class construction and design:

Wheels	80 per cent.	
Generators	97 " "	
Step-up and down transformers	99 " "	each.
Large motors	97 " "	

Giving a total efficiency (leaving lines out of consideration) of nearly 74 per cent., that is, that of each theoretical 100 h. p. in the water, 74 h. p. could be used. The transmission line calculations were even more interesting, involving, as they did, the calculation of the losses of power due to the reactance of the circuit. On the basis of 1000 h. p. laid down in Fort William, 20 miles away, with various voltages and percentages of resistance drop, it was shown that with 15,000 volts--10% resistance drop--it required a loss of 126 h. p. in lines alone to transmit 1000 h. p., not considering the losses in the wheels, etc.

With the above given efficiencies, and using 10%, 15% and 20% line losses for resistance, and calculating therefrom the resultant reactance losses, it was shown that to lay down 1000 h. p. 20 miles away required the following actual expenditure of power which had to be furnished by the water:

To lay down 1,000 h.p. with 10% loss required 1,550 h.p. in water.
" " " " 15% " " 1,694 " "
" " " " 20% " " 1,882 " "

The value of using a high voltage is shown by comparing the result of using 10,000 volts instead of 15,000, as below:

Using 10,000 volts--
To lay down 1,000 h.p. with 10% loss required 1,694 h.p.
" " " " 15% " " 1,806 "
" " " " 20% " " 1,908 "

Comparing the 15,000 volt table with the one given under for 20,000 volts, shows that in all transmissions there is an economical voltage.

Using 20,000 volts--
To lay down 1,000 h.p. with 10% loss required 1,560 h.p.
" " " " 15% " " 1,617 "

Calculations as to the cost of the circuits showed that to lay down 1000 h. p. the cost would be as follows:

Using 10,000 volts, with 10%, would cost $23,760.
" " " " 15% " " 15,850.
" " " " 20% " " 11,880.
Using 15,000 volts, with 10%, would cost 11,880.
" " " " 15% " " 7,920.
" " " " 20% " " 4,977.
Using 20,000 volts, with 10%, would cost 5,940.
" " " " 15% " " 4,977.

If power were very valuable, that is, if the stream were not very powerful, or if power could be sold at a very high figure, then it would be best to save as much as possible by using 10,000 volts and 10% drop, or 20,000 volts at 10%. But on the other hand, if power were plentiful and could not be sold at a very high price, then it would probably be best to save the cost of transmission by using the highest voltage possible. It is needless to suggest that every case should be weighed on its own merits. In this arbitration it is understood that the result is that Mr. Jenison has proved his point, and as he proposes to undertake the work very soon, a most interesting construction may be expected, involving the transmission of nearly 5,000 h. p. over the long distance of 20 miles.

CANADIAN ASSOCIATION OF STATIONARY ENGINEERS.

NOTE. Secretaries of Associations are requested to forward matter for publication in this Department not later than the 28th of each month.

ELEVENTH ANNUAL BANQUET OF TORONTO NO. 1.

OVER one hundred persons assembled at the Richardson House, Toronto, on Thanksgiving eve, Nov. 24th, in response to the invitation of Toronto No. 1 to participate in the eleventh annual dinner of the association. The proceedings of the evening were presided over in an able and discreet manner by Mr. G. C. Mooring, president of the association, and near him sat Messrs. A. M. Wickens, the founder of the society; E. J. Phillip, executive president; A. E. Edkins, Registrar Ontario Association; John Fox, past president; T. Eversfield, vice-president; R. C. Pettigrew, Robert Mackie, George Mackie, and J. Hunter, of Hamilton association. Besides a large number of other engineers, there were present the following persons: Mayor Shaw; Prof. Galbraith, principal School of Practical Science; George Anderson, manager Royal Oil Company; John C. McLachlan and F. H. Leonard, of the Toronto Motor Company; James McLaughlin, traveller Samuel Rogers & Co.; John J. Main, Polson Iron Works Co.; John Bayne, city traveller Royal Oil Co.; Joseph Wright, Bennett & Wright Co.; James Milne, Weeks-Eldred Co.; James Sinclair, Eureka Mineral Wool Co.; W. P. Sutton, manufacturer Sutton's compound; Geo. W. Grant, of Geo. W. Grant & Co., oil merchants; Mr. Powers, Vacuum Oil Co.; Alex. Horwood, secretary Toronto Technical School; W. G. Blackgrove, traveller Wilson & Co., oil merchants; O. B. St. John, representing Marine Engineers' Association; C. B. Edler, Montreal; J. Litster, manager Pure Gold Mfg. Co. Shortly after nine o'clock the guests gathered around the tables, and for an hour the menu engaged the attention of all, and no evidence was lacking that it was fully appreciated. During this hour Mr. A. E. Harding furnished choice selections on the piano.

The president welcomed the guests to the eleventh annual dinner. He referred to the formation of the association some twelve years ago, when eleven engineers met in in Mr. Wicken's house and took the first active steps. Since that time great progress had been made, and the association now extended from Montreal to Winnipeg. He hoped that before long it would be spread over the whole of Canada. He asked all to join in singing "God Save the Queen." Then followed the toast of "Canada, our Home," coupled with the name of Mr. Anderson, who had recently returned from Japan. Mr. Grant sang "The Maple Leaf." Mr. Anderson said he was sorry they had mentioned that he was an oil man, as they had the reputation of being a pretty slippery and greasy lot. Referring to his visit to Japan, he said he was received like a king, being tendered banquets and otherwise entertained. At Japanese banquets the bill of fare included chestnuts, bamboo, raw fish and molasses. He thought our prospects for trade in the east were very encouraging. We had a country to be proud of, with boundless resources. He was told that there was two hundred and fifty million pounds sterling in England ready to come to Canada for investment. Our trade in the east, he believed, would astonish the world within the next ten years. Our manufacturing industries compared favorably with those of other countries, and the government was doing its duty to assist manufacturers; but business men, if they wished to succeed, should take off their coats and work. That was the only way to get trade. By request Mr. Geo. W. Grant sang "The Land of the Maple," and was followed by a comic song by Mr. Harry Brown. Mayor Shaw arrived just in time to respond to the toast of "Toronto, our Home." He was proud of the progress Toronto had made, and hoped to have the honor of opening the new city buildings next year. Referring to the city's future, he said that while Toronto wanted factories, he believed a greater necessity was to make Toronto an attractive city, a statement to which exception was taken by several of the speakers following. Mr. James Fax here made the usual hit by a comic song, followed by a witty story as an encore.

Coupled with the toast of "The Manufactures" were the names of Messrs. J. Main, of the Polson Co., F. H. Leonard, of the Toronto Motor Co., and James McLaughlin, of Samuel Rogers & Co. After a song by Mr. Litster, Mr. Main was called upon. Speaking of the engine and boiler trade, he stated that his firm were experiencing a greater demand every day. That trade was improving was shown by the increased enquiries from all parts of the country for boilers and steam power. As to Mr. Anderson's remarks that we could capture eastern trade, he did not think we could compete with the Chinese and Germans, who were paid low wages, unless by employing cheaper labor, of which he was not in favor. We could not manufacture boilers and compete with these countries. What was wanted was the development of our own resources—we wanted smelting furnaces and rolling mills to work up our own ore and nickle. He did not agree with the Mayor's remarks as to the necessity of of beautifying the city. In his opinion it was manufactories that were wanted, and something should be done to bring them here. Mr. Main closed his remarks with one of his humorous stories, and was heartily applauded. Mr. Leonard followed. He agreed with Mr. Main that prospects were never better for manufacturers than at present. Referring to the electrical business, with which he was most familiar, he said the development within the last five years had been wonderful. A few years ago it was almost impossible to find a future for the business, but it had gradually grown, until it was now an important factor in the industrial field. When in Montreal recently he learned that the Dominion Cotton Mills Company had made a contract for 1,500 horse power in a single piece, taking the place of three large engines. This amount of power was delivered at their switchboard, and distributed from there as required. By this means manufacturers were enabled to save power by dispensing with shafting. Toronto was not blessed with great water powers such as were to be found in the vicinity of Montreal, yet it was a good manufacturing point owing to its central location. Even if we had to rely on steam power, he thought there was a great future for the city. He knew of instances where steam power was being supplied at seventeen, eighteen and twenty dollars per horse power per year, with coal at a higher price than in Toronto. There was one point in favor of the steam engine—it was a reliable prime mover and could be depended upon, while you could not always depend on water power. Mr. McLaughlin said that since 1887, with one exception, he had been present at every banquet of the Toronto Association. He compared the working men of to-day with those of the early days, when they could barely eke out an existence. Now, thanks to the inventor and the workshop, they were no longer subject to the tyrannical beck and call of their master. Their position was now almost equal to those who were their employers. He gave some figures of imports and exports, which showed that only during the last two years had our exports exceeded our imports. The tide had recently turned, and we were now on the eve of increasing prosperity.

Songs by Mr. Thomas Eversfield and Mr. W. G. Blackgrove followed. The latter sang "Out on the Deep," and for an encore "Rocked in the Cradle of the Deep." "Educational Interests" was placed in the hands of Prof. Galbraith and Mr. A. G. Horwood. The former said that technical education had grown and developed wonderfully within the last fifty years, and the great gulf between educated and uneducated men had to a large extent passed away. Such education was drawing men closer together and unifying them, and would also have an effect in solving political problems. Messrs. Grant and Fax here sang a duet which created much laughter, some of the verses of which were as follows:

> I've just heard some news that will cause you to say
> Oh, goodness gracious!
> The engineers flourish and prosper to-day,
> Goodness gracious.
> Just ten years ago they were hoble-de-hoys,
> And as a society just a few boys,
> Now nothing on earth can shake their equipoise,
> Goodness gracious!
>
> Since then they've increased both in numbers and strength,
> And spread over the land its entire width and length.
> To judge from this gathering as it now appears,
> We'll be overrun in the next dozen years,
> For if they keep on, we'll be all engineers.
>
> To be at their gatherings is always a treat,
> A jollier set very seldom you'll meet,
> From president Wickens to Mooring to-day,
> And men of their stamp there is none will gainsay,
> They meet to do good, and have come to stay.

Mr. Horwood, in responding, referred to the good work of the Technical School. It was attended by a large number of engineers. At the last session of the Ontario House a bill was passed permitting towns to establish technical schools, and there was some doubt as to what effect this would have upon our high schools. Farmers would probably give their sons a scientific education. He was strongly in favor of shorter hours for workmen, and especially engineers.

Mr. E. J. Phillip responded to "The Executive. He said the association was growing gradually, and he hoped they would soon secure a compulsory license law, for which they were now working. In educational matters he believed the Hamilton association was doing the best work of any branch. Mr. Brown sang

"A Hot Time in the Old Town To-night," after which Mr. Wickens, the fathe of the order, was asked to respond to the toast of the "C.A.S.E." The association, Mr. Wickens said, was founded on principles different from any other society—it was founded on principles of self education, and was essentially and theoretically an educational institution. They could educate the employer as well as the engineer or fireman. The engineers felt they should have a license law. Marine engineers were compelled to pass an examination, and it was more important that stationary engineers, having charge in some cases of plants in factories where several hundred people were employed, should give proof of their competency. They got a permissive law for Ontario four years ago, and in that time 750 certificates had been granted to engineers. After getting this permissive law, the Toronto association commenced to agitate for a Technical School, and succeeded in securing a grant of $2,000 from the government. That it was a success was shown by the attendance and the fact that the cost per pupil in the public schools was $36.50 per year, while in the Technical School it was only $6.60. The Toronto association had collected $4,500; of this amount between $70 and $80 had been spent for assistance to members; $440 for educational work; $158 for legislative purposes; $600 for property and library, and $400 to the executive. They had assisted 200 members to secure situations, and employers were willing to pay higher wages for the services of members of the association.

The toast of "Sister Societies" followed a song by Mr. Grant. Messrs. Mackie and Pettigrew responded. They spoke of the relationship that existed between the Hamilton and Toronto associations, and of the good educational work that Hamilton No. 2 was doing. They had had some valuable papers, and others were arranged for. Mr. Mackie then proposed the toast of "Toronto No. 1," to which president Mooring replied briefly. The next toast was that of "The Press," which was acknowledged by Mr. Biggar, of the Canadian Engineer, and Mr. Young, of the ELECTRICAL NEWS AND STEAM ENGINEERING JOURNAL. After the health of the host had been drunk, the eleventh annual dinner became a thing of the past, amidst cheers for Toronto No. 1.

The banquet committee was composed of Messrs. Thomas Eversfield, chairman, Geo. Thompson, secretary, James Huggett, Samuel Thompson and C. Moseley.

MR. G. C. MOORING.

AT Northamptonshire, England, in the year 1857, Mr. G. C. Mooring, president of Toronto No. 1, first saw the light of day. When a robust boy, 17 years afterwards, he removed with his parents to Canada, and found his first employment with Messrs. Thompson & Williams, engine builders, of Mitchell and Stratford, remaining with them for three years, during which time he obtained valuable experience in engine building and general machine work. Upon removing to Toronto he was employed by the Toronto Reaper and Mower Works for three years as machinist, and subsequently by the Massey Manufacturing Company. Then he accepted a position with the Toronto Bridge Company, now the Dominion Bridge Company, but after four years' service the works were removed to Lachine, and Mr. Mooring, choosing to remain in Toronto, assumed charge of the steam plant of the Standard Woolen Mills, remaining there four years. He then went to Brandon, Man., and put in a steam plant in Christie's saw mill, and while there assisted in forming the Brandon branch of the C. A.S.E. Mr. Mooring returned to Toronto in 1889 to accept his present position with the Methodist Book and Publishing Company, where, besides having charge of the steam and electric plant, he has the entire mechanical superintendence of the establishment. He may be said to be an engineer by inheritance, his father, Mr. James Mooring, being a stationary engineer, and for twelve years has had charge of a steam plant in Toronto for Messrs. Langley & Burke.

Mr. Mooring has always taken an active interest in association work, and claims to have been greatly benefitted thereby. He was a charter member of the order, and the first secretary of the executive, and holds a first-class certificate from the Ontario association. In Toronto No. 1 he has passed through all subordinate offices to his present position.

MEETINGS OF TORONTO NO. 1.

At the regular meeting of Toronto No. 1, held on Wednesday, November 23rd, one new member was initiated. The receipts of the evening were $110. Bro. Wickens read a paper on the "Indicator," which will be found in another column, and which resulted in an interesting discussion. At the meeting on the 1st inst., the Hall Board was granted permission to purchase a piano for the use of the association and tenants. The Banquet Committee reported, and it was stated that the Engineers Hand-Book was ready to be turned over to the association. Commencing in January next, the second Tuesday in each month will be set apart for open meetings, to which steam users and engineers are invited. At 2 a.m. on the morning following the last meeting fire was discovered in the Engineers' Hall, 61 Victoria street, which destroyed their furniture, carpets, charter, etc., the damage being estimated at $200. We are glad to learn that the library was only slightly damaged. It is thought the insurance will cover the loss.

HAMILTON NO. 2.

The Hamilton branch of the Stationary Engineers held an open meeting in their hall on Tuesday, Nov. 8th., president Wm. Norris in the chair. The meeting was well attended and very interesting. Instead of having a regular paper read, a number of questions taken from the question box were answered by some of the members. Pres. Norris explained the difference between an alternating dynamo and a constant current dynamo. He expected a paper going more thoroughly into the subject would be read later on in the season. He also made a few interesting and useful remarks on the construction and use of magnets. Mr. Geo. Mackie gave the formula, and explained the method of ascertaining the amount of horse power to be used by an engine in increasing or decreasing the number of revolutions per minute. He also satisfactorily answered a question on the supporting power of stays. At a later meeting a paper on "Measurement" was read by Mr. Ballard, which will be found elsewhere. The open meetings in connection with this association are very interesting and instructive, and are well attended.

KINGSTON NO. 10.

At the last meeting of the Kingston association an interesting paper was read, which provoked considerable discussion. A number of questions were found in the question box, and these were answered to the satisfaction of all.

DOMINION LICENSE LAW WANTED.

AT a meeting held in Engineers' Hall, Toronto, on Nov. 23rd., to consider the question of securing legislation for engineers at the coming session of the Dominion Parliament, it was unanimously resolved that such a measure be introduced, and that all engineers and steam users possible for the committee to reach be communicated with, and their co-operation solicited. President F. G. Mitchell, 276 Talbot st., London, and Registrar A. M. Wickens, 280 Berkeley st., Toronto, will be pleased to furnish all enquirers with data and matter to work upon. A committee was appointed to draft a circular setting out the facts and necessities of the case, which the Registrar will have for distribution in a few days. The committee have had enquiries from Nova Scotia in the east, and British Columbia in the west, regarding such a law, and feel that the movement will be in keeping with the rapid advancement of the affairs of the Dominion at large.

The Ottawa Car Company are building a number of open cars for the new electric railway at Sherbrooke, Que. The company have about completed an extra long double truck vestibule car for the electric line running between Grimsby and Hamilton.

THE INDICATOR.*

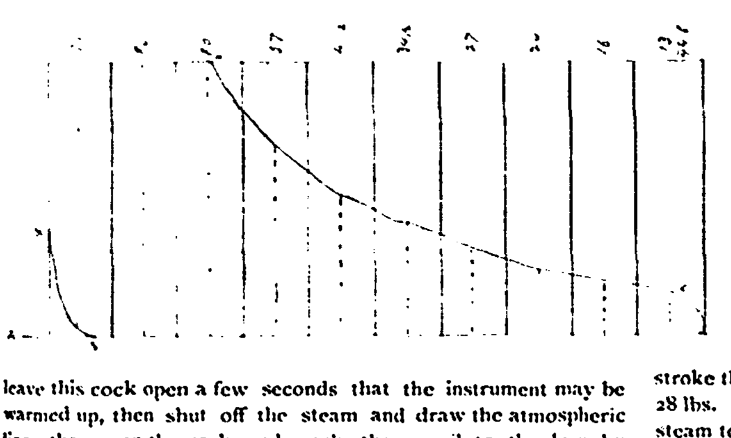
By A. M. Wickens.

At our last talk about the indicator we went into the matter of explaining the different motions to show the necessity of having the instrument carefully handled and connected with the cylinder for the pressure, and with some of the reciprocating parts of the engine to represent exactly the motion of the piston upon the revolving drum. It is imperative that the instrument shall be in perfect order, to insure accuracy. One means of testing this is to remove the spring and see that the piston will drop freely to the bottom of the cylinder when released from any point of its travel. You can make a further test by putting the spring in place and the indicator upon the connecting pipes, with a paper on the drum. Now push the piston down to the bottom of the cylinder, and release the pressure slowly, and when the pressure is all removed, draw the atmospheric line. Again pull the piston as far up as you can and again let it return to its normal position slowly, and draw the atmospheric line. If it is exactly upon the first line you may be sure it is correct at that point, and you may take it for granted that it will be correct at all other points of its travel.

The marking or pencil point should be fine and smooth, and if a metallic point is used, it should not be too sharp, thus avoiding cutting the paper. Do not allow the paper drum to run all the time, but stop it as soon as the diagram is taken. This can be done either by unhooking the driving cord, or by the stop motion with which many of the indicators are supplied.

You must be careful in the selection of the spring used; usually each indicator has instructions with it as to the different spring to use for different pressures. It may be taken as a general rule that the spring should be marked at one-half the initial pressure. It is best to use as light a spring as the pressure will allow, thus making the card as large as possible, for the larger the card the greater the defects will be shown. You must also exercise great care to get the drum motion to exactly represent the piston movement. This is difficult to do in high-speed engines. The best test is the length of the card; if it is longer when taken at full speed than when taken at the slowest speed the engine can be run at, then there is something wrong, and you will not get a correct card.

After having blown out the pipes with steam, put on the indicator and attach your cord, adjusting its length so that your card is exactly in the centre of your paper. Now unhook your cord and put on your paper, being sure that it is even at the corners and tight around the drum. You are now ready to take your card. Start up your drum by hooking on your card. Now turn on the steam by opening the cock at the bottom of the indicator; leave this cock open a few seconds that the instrument may be warmed up, then shut off the steam and draw the atmospheric line, then open the cock and apply the pencil to the drum by pushing it towards the paper and holding it firmly against the stop on the instrument just sufficient time for the engine to make one revolution. You will then have a clean, fine-lined card—the only correct card to measure up the power of the engine from.



Having taken the diagram with our indicator correctly adjusted, and the connection properly made, we now want to know what is the h.p. as shown by the diagram. To find this it is merely necessary to measure the space enclosed by the diagram, and by this means get the mean effective pressure exerted upon the piston throughout its stroke, which this area really represents. This pressure being multiplied by the number of square inches of the piston area gives us the total pounds of force exerted, and as this force is acting through the distance travelled by the piston, we multiply it by the number of feet travelled per minute, and the product is the number of foot pounds exerted in one minute. This divided by 33,000 is the h.p. of the card.

Having our indicator in perfect order and applying it, as described, to an automatic cut-off engine with the piston tight, and valves well set and tight, we should get such a card as shown, provided the load was such as to give us a cut-off about ¼ stroke. You now want to get the h.p. of this card, and to do this you only need to get the area of the space enclosed by the diagram, and as it is of rather a peculiar shape, we go about it in this manner: We erect a set of ordinates, or lines, at right angles, or perpendicular to the base line or the atmospheric line upon the card. Any number of these ordinates will do, and for convenience we usually put up 11 lines, making 10 equal spaces; the smaller the divisions the greater the accuracy. We now take a scale suitable to the spring used in the indicator, that is, a scale with each inch upon it divided into as many equal parts as the spring is intended for; this you will know by a mark upon the base of the spring, such as 16, meaning 16 pounds to the inch, or 40, meaning 40 lbs. to the inch. In this case we used a 40 spring, and consequently we take the 40 scale and proceed to measure the height of the diagram one-half way between each ordinate, or upon the dotted lines of the diagram. The height of the diagram at the first point of measurement is 3/8 less than 2 inches, and represents 77 lbs.; the next is exactly 2 inches, representing 80 lbs.; 3 inches, 80 lbs.; 4 inches, 57 lbs.; 5 inches, 41½ lbs.; 6 inches, 34½ lbs.; 7 inches, 27 lbs.; 8 inches, 20 lbs.; 9 inches, 16 lbs.; 10 inches, 13 lbs., making a total of 446.

Now, as we have measured 10 spaces, we add them up and divide by 10; this gives us 44.6 lbs., and is the mean effective pressure (M.E.P.) throughout the stroke. This measurement has simply reduced our peculiar-shaped area enclosed by the diagram to a parallelogram the length of the card and of a height equal to 44.6, or 1 4/5 inches high. We know that the work done by the steam is the same as though the pressure was 44 3/5 lbs. from start to finish of the stroke. Assuming that our piston has an area of 100 square inches, and that it travels at the rate of 500 feet per minute, we can very readily arrive at the horse power represented by the card. 100 square inches x by 44.6 lbs. = 4460 lbs.; this, you may say, is 4460 lbs. moments of work. Now, as our piston is travelling 500 feet per minute, we multiply the moments of work by the feet travelled per minute, 4460 x 500 = 2,230,000; these are the foot pounds of work, and the foot pounds divided by 33,000 is the horse power of the card, $\frac{2,230,000}{33,000} = 67.57$ h.p. This is the total power exerted by the engine, including its own friction. Should you want to figure the water consumption from the diagram, it would be necessary to know the clearance of the engine—that is, the space between the piston and the valves—when the engine is on dead centre, and erect an ordinate at each end of the card, far enough away to represent the percentage of the clearance to the total piston displacement; but for simply measuring the h.p., or finding the M.E.P., this knowledge is not necessary. You will see at the lower left hand corner a curve marked G. & K.; this is the compression curve and represents that the exhaust valve closed at the point G., or about 3 inches before the stroke was completed. Our engine during this travel was compressing any small amount of air still remaining in the cylinder, and by the time the piston reached the end of the stroke the pressure reached the point K, or a pressure of about 28 lbs. This occurred before the steam valve opened to admit steam to move the piston in the opposite direction. Compression is useful for several reasons—one is that it decreases the knock when the motion of piston across head is reversed by gradually taking up any slack there may be, and another is that it fills the clearance spaces with steam compressed up to nearer the boiler pressure, and starts to re-heat the surface of piston and cylinder walls. If you should have a back pressure your diagram would show the atmospheric line, marked A, to be lower than the diagram, and it can be measured by the scale the same as the pressure, and should be deducted from the h.p. of the card.

*Paper read before Toronto Association C.A.S.E., Nov. 17th, 1897.

A new 75 horse power boiler has been placed in the electric light station at Digby, N.S.

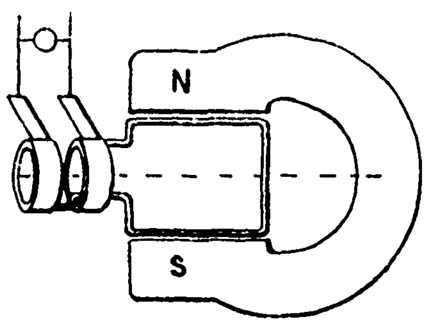
The Fern Mine, Hall Siding, in the Rossland district, B.C., are lighting up the mill and yards, as well as the tunnel of the mine, by electricity, and have placed the order for machinery and apparatus with the Royal Electric Co.

DIRECT AND ALTERNATING CURRENTS.*

By F. H. Leonard.

You are all aware that direct or continuous currents are so called from the quality which they possess of maintaining a uniformity of direction of flow with regard to the conductor through which they are passing. Direct currents, however, are not always of constant pressure; but are often intermittent or pulsatory in their character, and under such conditions exhibit many of the characteristics of alternating currents, which are constantly fluctuating with more or less rapidity from a positive value to the opposite or negative value many times in a second, the frequency of commercial alternators varying from 25 to 140 complete periods or cycles per second.

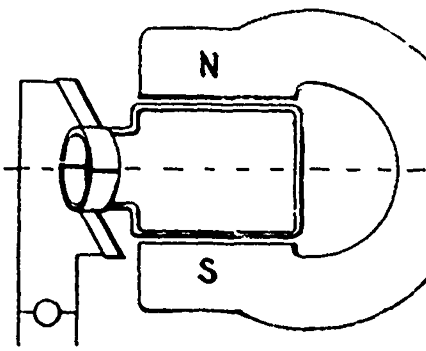
I shall not attempt in the short space of time you have to listen to me to-night to skim over the whole field, but will confine my remarks more particularly to the kind of electric currents the steam engineer is more apt to come in contact with. The rapid strides that electricity is taking makes it important that all should familiarize themselves with the laws governing this subtle force. Most any of you are liable to be placed in a position where you will have charge of one or more dynamos for generating electric



Alternating Current Dynamo.

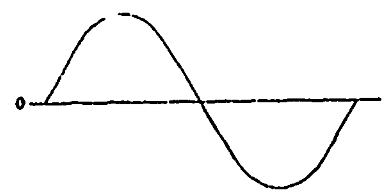
current for lighting or power purposes, and it is to dynamo electric current that I shall more particularly refer to-night. I assume that you are aware that metallic substances are good conductors, copper being the best commercially, also that most other substances are poor conductors, some being such poor conductors as to be termed insulators, such as glass, porcelain, dry wood, paper and cloth. The great Faraday, who may well be called the father of the electric dynamo, discovered in 1831 that when a coil of wire was made to approach a magnet, an electric current was momentarily established in the coil, as indicated by the deflection of a galvanometer connected in circuit with the coil. This discovery was followed by a series of experiments probably unequalled in any branch of scientific research for brilliancy of perception and clearness of reasoning power. This philosopher, before his death, gave to the world the fundamental principles upon which the dynamos of to-day are constructed.

Starting with Faraday's principle of induction, let us construct a very simple form of dynamo. Take an ordinary horse-shoe magnet, and for simplicity I will show a single turn of wire arranged to revolve in the magnetic field; if to the two ends of this coil of wire we attach a pair of rings, and on them place two

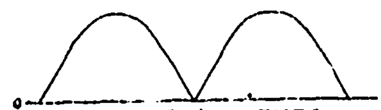


Single Coil Direct Dynamo.

strips of thin sheet copper for brushes to conduct the current to the outside circuit, we have all that is essential for our dynamo. If in the circuit of this elementary dynamo we place a galvanometer which is an instrument for indicating the flow of electric currents—we shall find that as we turn the coil about there will be a deflection of the pointer of our instrument, first in one direction, then in the opposite, as the coil in our dynamo assumes first one, then the other position with regard to the magnet. We have produced then an alternating current. If we wish to obtain direct currents, we must change our construction, and substitute in place of our two rings a commutator, which in its simplest form consists of two sections. We will split a piece of tube in two, and mount it on the spindle in place of the rings, connecting one end of our wire to one part, the other end to the other part, insulating the two parts from each other, so there will be no electrical connection between them. Again we rotate the coil, and we shall find the galvanometer deflection takes place always in the same



Alternating EMF Sine Curve.



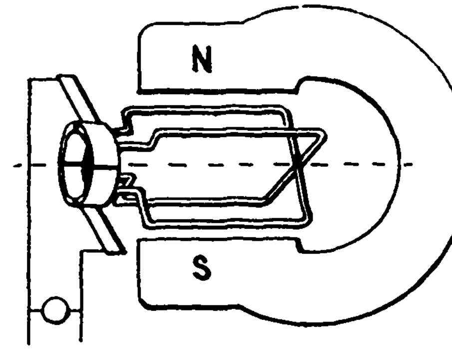
Direct Current Single Coil E.M.F Curve.

Direct Current 2 Coils (Dotted Crests 4 Coils)

direction, but comes to zero at each half revolution of the coil. We can represent by a curve just what takes place in the coils or armatures of these two forms of dynamos during the period of one complete revolution. Just as the steam engine indicator represents the pressure at every part of the stroke, so our curve will show the electro-motive force at every point of the revolution.

The E.M.F. (electro-motive force) curve of our alternating dynamo, starting from a line of zero potential, will rise more or less abruptly, depending upon the design of the dynamo to a point of maximum positive potential, then droop, and passing the neutral or zero potential line, descends to the point of maximum negative potential.

The most desirable form of all-round work, and the one which most modern, well-designed alternators follow, is the sign curve, though many single phase alternators, which are perfectly satis-



Two Coil Direct Current Dynamo.

factory for lighting purposes, depart considerably from this form and show a peak-topped, and some a flat-topped curve. The E.M.F. curve of our direct current dynamo differs from the alternator for the reason that the commutator replacing the collector rings slips from under one brush to a position under the opposite brush, just at the moment the current in the coil is about to reverse, and instead of descending below the zero line, it again ascends, making in a complete revolution two curves, similar to the first half of our alternating current curve, both of which are above the zero line. Such a curve represents a series of impulses following each other with every half revolution, and would not make a satisfactory current for practical working. Other evils would also creep in, as we multiplied the number of turns to obtain the commercial voltages, which would produce vicious and destructive sparking at the commutator.

To obtain a commercial dynamo for direct currents we must then alter our design, and instead of using a large number of turns of wire in a single coil, we must divide these turns into a number of smaller coils, and furnish segments in our commutator to correspond with the increase in number of coils. We will first

* Paper read before Toronto No. 1, Canadian Association of Stationary Engineers.

see the effect of two coils spaced equally around the periphery of our armature with a segment attached to each end of the coils.

Now, if we trace an electro-motive force curve from this armature, we shall find that the pressure does not fluctuate so much as with the former arrangement, and instead of dropping to zero at each half revolution, the pressure is always maintained at a point of considerable pressure, for the reason that soon after a coil has passed into a position in the field where the rate of cutting lines of force is less, the commutator sections corresponding to this coil have slipped from under the brushes, and the sections connected to the other coil have passed under and into contact with the brushes, and supplies the circuit with a fresh E.M.F. rising in potential; the other coil in the meantime is out of circuit or idle. If, instead of two coils we employ a still larger number, we continue the process of smoothing out till we finally get a practically constant pressure throughout the revolution. Also, as we multiply the coils we shall find it desirable to avail ourselves of the E.M.F. generated in the coils, which are not in a position of maximum potential, and utilize the potential of coils rising to maximum and descending to zero; this will also materially reduce the sparking at the commutator. Thus, all the coils in a commercial dynamo are connected together and loops taken to the segments of the commutator, except in a few cases, notably the Brush arc dynamo.

So far the dynamos we have been considering have been constructed without iron in the armatures, but as iron is a much better conductor of the magnetic lines of force, which are depended upon to induce the E.M.F. in our coils, it would evidently be better to introduce an iron core into the structure, thus reducing the reluctance of the magnetic circuit. Also, we have used a permanent horse-shoe magnet, whereas we can obtain a much more dense and powerful magnetic field by using an electro magnet, which may be obtained by passing the electric current through a coil of wire surrounding an iron core. The shorter and thicker we can make the magnetic circuit, the less energy there will be required to produce the magnetic field, and wide air spaces are to be avoided, as they offer serious resistance to the flow of lines of force through the magnetic circuit. Part of the electric current generated by the dynamo itself is generally utilized to excite the field of direct current dynamos, though alternators are usually separately excited by a smaller direct current dynamo. What applies to the magnetic circuit in a direct current dynamo is equally true in regard to an alternating current dynamo. Care must, of course, be taken to insulate the copper of the electric circuit from the metal which is used for the magnetic circuit, as well as to insulate the various turns or convolution of the electric circuit from each other, so as to avoid short circuits.

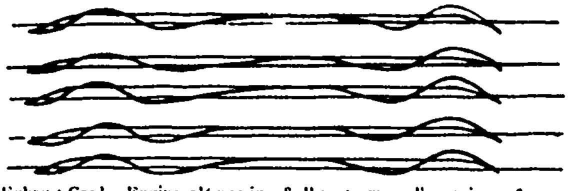
From what has been said, I trust you have been able to form a fair idea of the manner of obtaining both alternating and direct currents by means of the dynamo electric machine, which is only a piece of apparatus for transforming the mechanical energy of the water-wheel or steam engine into electrical energy. There are several types of direct current machines, but they can be divided into two principal classes—constant current dynamos and constant potential dynamos. The constant current dynamo is used principally for arc lighting, the flow of the current remaining fixed while the E.M.F. increases as the arc lamps or other devices are added in series. The constant potential dynamo is the type generally used for incandescent lighting and power purposes. This type of dynamo is designed to maintain a constant E.M.F. or pressure, and the current is increased as lamps or motors are added to the circuit in multiple. Alternators are also built for constant current and constant potential, though the former are not much used at present.

Direct currents are generally used at low E.M.F., 110 to 125 volts being common for lighting plants, though in arc dynamos the pressure in the larger sizes reaches as high as 8,000 volts. At 110 to 125 volts, of course, large conductors would be necessary to supply any considerable amount of energy, which necessarily confines this type of dynamo to limited areas, so the work can be reached without too large an expenditure for copper conductors. The alternating currents, however, on account of the facility with which they can be transformed from a high to a low voltage, or vice versa, without the necessity of any moving parts in the transformers or convertors, as such devices are called, are generally used for transmitting energy to greater distances, and for distribution covering areas of many miles. The Niagara power is transmitted 26 miles to Buffalo by alternating currents generated by 5,000 h. p. two phase alternators at 2,000 volts, transformed to three phase alternating currents at 10,000 volts for the transmission, and at Buffalo transformed from 10,000 to about 340 volts alternating, which is then transformed by rotary transformers into direct current at about 550 volts for supplying the street railway motors. As can be seen from this instance, the flexibility of the alternating current system is wonderful, particularly when it is understood that these transformations take place in the static transformers with a loss of less than 2 per cent. for each change, the greatest loss for any change being in the rotary transformer, and even this is obtained at an expense of about 5 per cent. Under the high pressure alternating currents are transmitted with allowable loss and transformed to the lower and safer pressures on the spot where the current is to be utilized. It is difficult in so short a space to give much of an idea of either direct or alternating currents, not to mention their differences, but I have tried to touch on a few points, which I hope will awaken sufficient interest to bring about a deeper study of the subject.

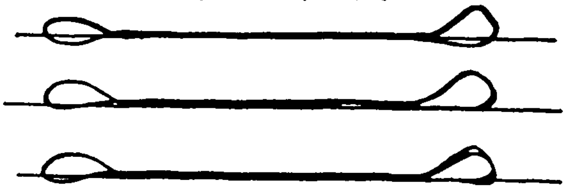
QUESTIONS AND ANSWERS.

In the October issue of the News, "Indicator" stated that he was thinking of putting an indicator on his engine, an Armington & Sims, with 12 inch stroke, and asked to be given the sizes for the correct rigging, and instructions as to how to set it up. In reply thereto, a correspondent sends the following, accompanied by a number of cards, some of which we reproduce:

Sir,—In answer to "Indicator," although only an amateur at this work, yet I think my rigging correct. It is as follows: First, a plate 2½" x 2½" x ½", with a slot in centre 2" deep x ½, is screwed on to crosshead, then a standard screwed on to crosshead guide

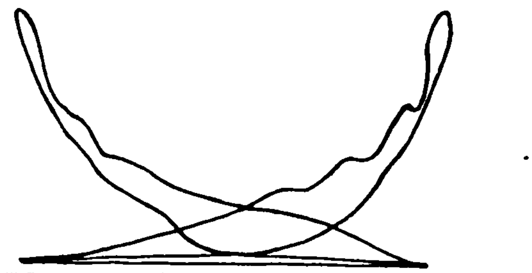


Exhaust Card. Engine 9½ x 12 in., 80 lbs. steam, 10 lbs. spring, 289 rev.; No. 10 dynamo, 60 amp. load, 113 volts.

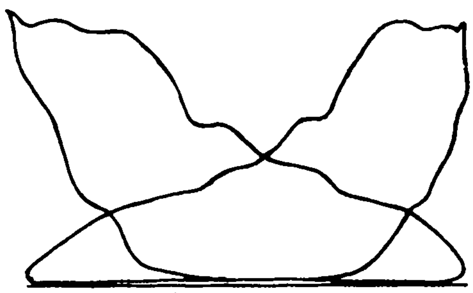


Exhaust Card. Engine, 9½ x 12 in., 80 lbs. steam, 10 lbs. spring, 285 rev.; 185 amp. load, 113 volts.

either by a hollow bolt or the oil cup itself. The lever is supported from this standard by a pin and held in place by a nut. At the bottom end of the lever there is a ½" pin to work in the slot in crosshead plate, with the pin a little long so that it will have no tendency to come out of slot. My lever is 20" x ¾" x ⅜", and from centre to centre of pins is 18" long, equals 12 times the length of stroke. My cord is attached to a pin 4½" from top pin; instead of a cord, which I found stretched, I use a fine wire. At the end of crosshead guide I have a standard, with leading pulley attached, so as to take off my cord equal on both ends of stroke. If I am wrong at any point, I will be glad if those who know better will show the fault. The accompanying cards were taken by this rigging, and I would like to have a discussion on them. I make no remarks on them myself, as I cannot fully read them all, but perhaps some of your readers will be willing to take the trouble to do so. The exhaust cards were taken off the 9½" x 12" engine by a connection at the drain pipes through to the exhaust about 12" below cylinder. I inserted into the exhaust a piece of ½" pipe 3" long, the top half of pipe cut off so that it formed a channel



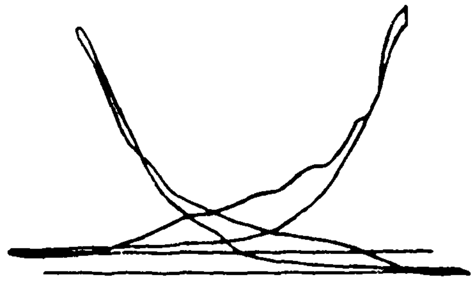
Centre T Connection.—Engine, 9½ x 12 in., 80 lbs. steam, 40 lbs. spring, 291 rev.; No. 10 dynamo, no load.



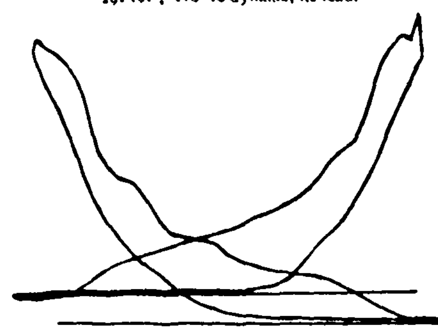
Centre T Connection. Engine 9½ x 12 in., 80 lbs. steam, 40 lbs. spring, 285 rev.; 185 amps. load, 113 volts.

for the steam to flow to the indicator. That it formed no back pressure can be seen by the cards off the cylinder, which were taken after I inserted this exhaust pipe. From the exhaust to indicator, pipe was 18" long. My cord from reducing lever was led over the leading pulley as for other cards. To let out any water, I put a cock on right at indicator, so that nothing lay there to distort card. The cord I used then stretched a little, so they are about ⅛" too long. The direct connection cards were taken when there was only indicator cock and couple and nipple between cylinder and indicator. I had, of course, to change indicator to each end each time, but as I had a steady load it did not matter. I moved the paper purposely on the barrel each time. In each case the head end is at the left hand side and the crank end at right. The centre T connection was arranged with a globe valve at each end and indicator in centre. I could have sent more cards of this, but those sent will show how much out this arrangement was. The 12" x 12" engine is also an Armington & Sims, but had had considerable tinkering at it before we got it. The crank-pin runs almost hot nearly all the time, and we dare not key it up as it ought to be, and as a consequence she pounds the whole time. We have had the expert man of our village at it, and men from three different shops of our neighboring town, but nothing could be done, and thus it has been for two years. These cards I have taken just for my own enlightenment, and I trust they show up the trouble. Do they? The cards I would like most to be figured out are the exhaust, straight connection and direct connection. Of course, if any one would go into more of them, I think it would be generally appreciated. Would there be any advantage in carrying a higher or lower pressure for the different loads?

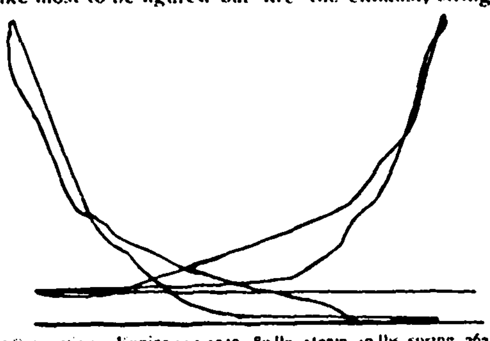
"AMATEUR."



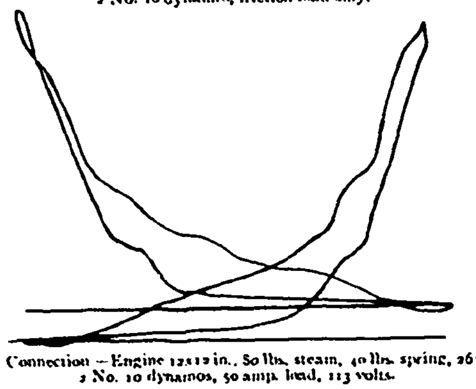
Straight Connection.—Engine. 9½ x 12 in. 80 lbs steam, 40 lbs. spring, 292 rev; No 10 dynamo, no load.



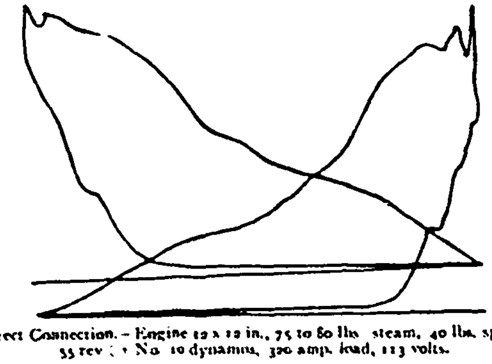
Straight Connection—Engine 9½ x 12 in., 80 lbs steam, 40 lbs. spring, 289 rev.; No 10 dynamo, 85 amp load, 110 volts.



Direct Connection—Engine 12 x 12 in., 80 lbs. steam, 40 lbs. spring, 262 rev.; 2 No. 10 dynamos, friction load only.



Direct Connection—Engine 12x12 in., 80 lbs. steam, 40 lbs. spring, 263 rev., 2 No. 10 dynamos, 50 amp. load, 113 volts.



Direct Connection.—Engine 12 x 12 in., 75 to 80 lbs steam, 40 lbs. spring, 55 rev; 2 No. 10 dynamos, 320 amp. load, 113 volts.

MR. WM. THOMPSON sends the following answers in reply to questions asked in our November number:

"Ontario": Point of cut-off will vary in direct proportion to the load within reasonable limits. Under ordinary conditions, your engine at 80 lbs. gauge pressure, with a load of 25,000 watts, will have a ratio of expansion of about 4. It is not economy, in a single cylinder of this type, to expand more than 4 times. When load is reduced down to 6,250 watts, cut-off must take place considerably earlier in the stroke, with a corresponding increase in number of expansions. While engine is running underloaded, it would be economy to reduce steam pressure as suggested, so that point of cut-off will be about ¼-stroke. This, however, can only be carried out within reasonable limits, and much depends on style and condition of engine. "Ontario" must bear in mind that the same degree of efficiency cennot be obtained while running "underloaded" in comparison with "normal" load.

"Subscriber": Chimneys are required for a two-fold purpose, 1st, to carry off obnoxious gases; 2nd, to create draft. The first requires area, the second height. The intensity of the draft varies in direct proportion with the difference between external and internal temperatures, and any reduction in the temperature of the internal gases, with the temperature of external air remaining constant, directly affects the intensity of the draft. I would refer "Subscriber" to the report of a test made on the boilers of the Armour Packing Company at Kansas, to determine the saving effected by the use of "Green's Economizers," and published in Power for July or August last. In this report "Subscriber" will observe very clearly that as temperature of flue gases decreased readings of draft gauge also decreased, as well as combustion of fuel per square foot of grate surface per hour. The fact that "Green's Economizers" can be used with natural draft is due to many causes, chiefly to two: 1st, draft previous to installation of economizer was sufficiently good; 2nd, use of economizer may effect a saving in fuel ranging from 1 to 50 per cent., and required combustion of fuel per square foot of grate surface per hour is correspondingly less. The life of pipes would depend upon four things: 1st, quality of material and workmanship; 2nd, circulation and corrosive action of water on inner face of pipes; 3rd, depositing of scale forming materials from the water; 4th, action of corrosive acids generated from the fuel (such as sulphurous, sulphuric and nitric acids). A given quantity of heat is required to heat a given quantity of water to a given temperature. This is the same whether heat is applied by fuel or steam. I consider heating feed water with live steam a loss, and should only be used where no better method can be had, and then only because it prevents undue expansion and contraction of boiler plates and fittings due to cold water being pumped into the boiler.

"Subscriber" writes: I had been using two boilers, but the manager decided to operate one only, on the ground of economy. The small boiler is 5 x 13, and the large boiler now used 6 x 16, rated at 120 h.p. It is being forced to do the work of the two. The engine is 150 h.p., and there is a 1½-inch pipe running from boiler through the shop to dry lumber. Shavings are used for fuel. Do you think we are effecting a saving by using only one boiler?

ANSWER.—"Subscriber" does not say what power the 150 h.p. engine actually develops. If steam required for engine and drying purposes requires single boiler to be forced, there is certainly no economy in using only one boiler. Forcing a boiler past its capacity is extremely hazardous, and liable to lead to serious results. It is also a wasteful practice, as process of combustion cannot be carried out properly when fires have to be forced. If consumer could give quantity of water required to be evaporated hourly a very much clearer opinion could be offered.

"N.S." writes: Will you kindly let me know how storage batteries are charged. Can they be charged from an alternating current?

ANSWER.—Storage batteries cannot be charged by an alternating current; if, however, the current supplied by an alternating generator be rectified in any way, then it can be used to charge them. Storage batteries are charged by being connected across the mains of an ordinary direct current source of supply, like a lamp or other load, and left in circuit until the instruments used with them indicate that they are charged. Batteries are not apparatus that an inexperienced man should play with; they are rather expensive, delicate, and apt to get out of order if not very carefully charged and discharged. If properly cared for, they can, in certain conditions, be a valuable auxiliary to a plant.

Proposals for the construction of electric railways in the city of St. Petersburg are being considered. There will be eight miles of these tramways, with four central stations and a number of side stations. Fares will be about two cents first class and about one cent second class. The promoters of the railroads have asked for a concession for forty years, giving the city the option to purchase after twenty years.

At the present session of the Ontario Legislature the following companies will seek incorporation to build electric railways: Bothwell & Florence Electric Railway Company; Chatham City & Suburban Railway Company; Toronto and York Railway Company; Smith's Falls, Rideau & Southern Electric Railway Company; Seine River, Foby and Fort Frances Railway Company; and Sandwich, Windsor and Amherstburg Railway Company. The Hamilton and Dundas Street Railway Company, the Kingston, Portsmouth and Cataraqui Electric Railway Company, and the Toronto and Scarboro' Electric Railway, Light & Power Company will seek amendments to their charters.

WEBSTER SYSTEM OF STEAM HEATING.

Referring to the discussion on exhaust steam heating which has recently appeared in our "Questions and Answers" department, Messrs. Darling Brothers, Montreal, Canadian representatives of the Webster patent system of exhaust steam heating, write as follows:

"When the Webster system was first introduced in Canada and the United States, steamfitters would bid upon a gravity system and then add cost of the Webster system, resulting in a prohibitive figure for the work in most cases. After some experience they now estimate the cost of a gravity system and offer to install the Webster system at the same figure, and in some instances for less money. We offer the Webster system entirely on its merits and economics, claiming it well worth the price, when compared with systems offering no similar advantages. In fuel economies alone we have the most accurate data, taken from indicator cards, where the engineer was entirely impartial, showing that a back pressure of ten pounds on the engines caused a loss of fuel equal to 29%, and an efficiency equal to that percentage resulted from the application of the Webster system. The extent to which we can reduce pipe and valve sizes, the discarding of all forms of air valves, the less labor required, are incidental only, and permit the installation of the Webster system at a cost not exceeding a first-class gravity system."

PRESENTATION TO MR. JAMES MILNE.

For several years Mr. James Milne has been connected with the Terauley street electric light station in Toronto, formerly as superintendent for the Incandescent Light Company, and since its amalgamation with the Toronto Electric Light Company, as superintendent for the latter company. A few weeks ago it was announced that he had resolved to sever his connection with the company to assume the management of the Weeks-Eldred Company, general contractors and manufacturers of the Jones underfeed mechanical stoker. General regret was expressed among the employees, and as a token of their appreciation Mr. Milne was presented with an illuminated address, accompanied by a marble clock. Mr. Henry Amos, foreman of the meter department, made the presentation. The address, which was signed by over thirty employees, was as follows:

To James Milne, Esq.

Dear Sir,—We, the employees of the Incandescent Electric Light Co., have learned with regret that you are about to leave us and sever your connection with the company. We take this opportunity to place on record our appreciation of your straightforward and manly treatment of us, and of your distinguished abilities displayed in the discharge of the duties of the office of superintendent of the company for the past five years. As a small mark of the esteem in which you are held by us, we beg to present you with this marble clock, and although its intrinsic value is not much, it will serve to keep us in remembrance.

We wish you complete success in your new position, and for Mrs. Milne, yourself and family, LONG LIFE AND PROSPERITY.

[Signed]	Henry Amos	J. G. Groucher
	Chas. Moseley	William Goddard
	Alex. Rutherford	Wm. Pike, &c.

Mr. Milne replied in a happy speech, referring to the harmony that had always existed between the employees and himself. Mr. J. G. Croucher and others followed, emphasizing the kindly sentiments expressed concerning Mr. Milne in the formal address.

Mr. Milne takes to his new position ability of high order, coupled with a full stock of energy. When to these is added the advantage of a valuable training and experience in engineering, it will be apparent that in his present position he is likely to prove himself to be the right man in the right place.

INEFFICIENCY OF STEAM PUMPS.

Toronto, Nov. 23, 1897.

To the Editor of the Canadian Electrical News

Dear Sir, No economy should be too small to receive the attention of a careful manager. I recently heard of one which I commend to all. Steam pumps for boiler feeding, I claim, are a very inefficient apparatus, and could be replaced by either power pumps operated off the shafting, or by others actuated by an electric motor. In either case the power consumed in the mere forcing of water against the boiler pressure would be a very inappreciable item, whereas if the quantity of steam consumed by a steam pump could be measured, it would be found quite considerable. It is seldom, if ever, required to pump while getting up steam, and indeed it might always be arranged to pump the boiler full after shutting down; the actual annual saving in coal consumed would be found to considerably more than pay interest on the cost of the apparatus, whether a power or steam pump were used.

I would be pleased to learn the views of others interested in the subject.

Yours truly,
"Engineer."

TRADE NOTES.

The Royal Electric Co. is shipping the Hamilton Electric Light & Power Co. one of their single phase 2000 light alternators, with station apparatus, etc.

The W. A. Johnson Electric Company, Toronto, have removed from York street to 134 King street west, where they have more commodious and convenient offices and warerooms. This company are representatives of the celebrated Wagner transformers.

Roberval, Que., is to have an electric light plant. Mr. B. A. Scott, who has the matter in charge, has placed an order for the Crocker special turbines with the Jenckes Machine Co., of Sherbrooke, Que., to be delivered in ten days.

The Canadian Cotton Mills, of Milltown, N.B., have closed a contract with the Royal Electric Co. for one of their 30 k.w. "S.K.C." two phase dynamos, wound to deliver 110 volts to the service mains. Within the last eight weeks this is the third large manufacturing establishment to install one of these machines of the Royal Electric Co.'s make, the Penman Mfg. Co., of Paris, and the Cockshutt Plow Co., of Brantford, being the other two.

Mr. J. H. Walker, who for many years was manager of the Canadian Rubber Company's Toronto branch, has recently severed his connection with the company and established a wholesale agency for rubber goods at No. 88 Bay street, Toronto. Mr. Walker's long and valuable experience in handling this line of goods, coupled with his personal qualifications, will doubtless enable him to make satisfactory business connections and win success in his new venture.

We are advised by the Packard Electric Co., of St. Catharines, Ont., that they have recently imported from England a sand blast frosting machine, which will enable them to produce frosted lamps superior to those which have been previously placed upon the market. The fine frosting produced by this machine absorbs much less of the light than an ordinary frosted lamp. This company are also in a position to do any style of fancy frosting, bringing out letters, monograms and any desired design upon lamps to be used for decorative purposes.

PUBLICATIONS.

"The Elementary Principles of Machine Design" is a valuable little book by J. G. A. Meyer, and published by the Industrial Publishing Company, New York. It treats of the subject in a clear and concise manner, and is well illustrated.

The Power Publishing Company, New York, have favored us with a copy of a very useful and comprehensive book, entitled "Power Catechism." It contains what are claimed to be correct answers to numerous questions covering the main principles of steam engineering and the transmission of power, and should be of special assistance in preparing students for examinations. Profusely illustrated, carefully prepared and neatly printed, a volume of considerable merit is presented.

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. THOMPSON.

[ARTICLE VIII.]

APPLICATION OF OHM'S LAW.

(Continued.)

IN our last article we dealt with the application of Ohm's law to what may be termed single conductor circuits, where the source of electrical energy may be either a battery or a dynamo, as the case may require. In this article we will briefly illustrate by example the application of Ohm's law to portions of circuits, and also to divided or shunt circuits.

PORTIONS OF CIRCUITS.

All portions of a single circuit must of necessity receive the same current, but the electromotive force, or what is usually styled difference of potential, or drop in potential, and resistance, may vary to any extent in different sections of the circuit.

Example (4): A generator maintains a constant E M F of 110 volts between its terminals. The terminals are connected to and current is passed through a series of four coils, one having a resistance of 50 ohms, one 25 ohms, one 12.5 ohms, and one 6.25. Paying no attention to the resistance of the conductors between these coils, what is the E M F between the terminals of each coil?

A solution of this problem can best be reached by application of principle laid down in rule 3, viz.: That the electromotive force varies directly with the resistance and with the current.

In this case we wish to find E M F at given points on the line, when R alone of coil is known. The total R of the four coils is 93.75 ohms; calling the coils 1, 2, 3, and 4, and the difference of potential at their terminals E^1, E^2, E^3, E^4, we get the proportion.

$$\text{As } 93.75 : \begin{matrix} 50 \\ 25 \\ 12.5 \\ 6.25 \end{matrix} :: 110 \text{ volts} : \begin{matrix} E^1 \\ E^2 \\ E^3 \\ E^4 \end{matrix}$$

Then working out the problem by regular rules of proportion, we get

$$\begin{aligned} &\text{E M F of } E^1 = 58.7 \text{ volts.} \\ &\text{E M F of } E^2 = 29.3 \quad " \\ &\text{E M F of } E^3 = 14.7 \quad " \\ &\text{E M F of } E^4 = 7.3 \quad " \end{aligned}$$

An examination of the problem will also prove to the student the theory of the statement that all portions of a single circuit must receive the same current. Taking, for example, total resistance of line at 93.75 ohms, and E M F at terminals of generator at 110 volts, and applying rule No. 1, we get

$$C = \frac{E}{R} \text{ or } \frac{110}{93.75} = 1.17 \text{ amperes.}$$

Applying the same principles to the coils, E^1, E^2, E^3 and E^4, we find that current at terminals of each is the same.

Example (5): Suppose the same external circuit was connected to a generator having a resistance of 10 ohms. The E M F of the 50 ohm coil has been found to be 60 volts, what is the E M F at the terminals of the generator, and what would be the E M F of the generator on open circuit.

The total R of our coils has been found to be 93.75 ohms, and by rule 3 we demonstrate that, as the resistance of the coil is to the total R of the circuit, so is the E M F at the terminals of the coil to the E M F at the terminals of the generator,

Or, as 50 : 93.75 :: 60 : x,

and ∴ x = 112.5 E M F at terminals of generator.

By following rule 1, we find the current at the terminals of coil No. 1 to be

$$\frac{60}{50} = 1.2 \text{ amperes.}$$

The total resistance of the circuit is the internal resistance of the generator = 10 ohms; the resistance of the conductors, of which no account has been taken, and the resistance of the four coils = 93.75 ohms.

$$10 + 93.75 = 103.75 \text{ ohms, total R of line.}$$

Then to find required E M F of generator to maintain a current of 1.2 amperes through a resistance of 103.75 ohms, we must apply rule 2.

$$E = R\,C,$$

$$\text{or } 1.2 \times 103.75 = 124.5 \text{ volts, required E M F of generator.}$$

STRENGTH OF BOILERS.

Having determined the strength of the boiler at the joints, we next require to determine safe working pressure, thickness of plate, tensile strength per sectional inch, etc.

A standard boiler is said to be 42 inches in diameter and have a safe working pressure of 100 pounds per square inch, if constructed in best manner of iron plate one-quarter inch thich, having a tensile strength of 48,000 pounds per sq. inch of section.

From this, then, we can construct the following formula to determine the safe working pressure of any boiler:

$$\frac{TS \times 2T \times \%\text{ strength of joint}}{D \times FS} = P,$$

and from this we require but a slight transposition to construct a formula to determine either the diameter or thickness of plate required to conform to this standard, and

$$\frac{D \times P \times FS}{TS \times \%} = 2T \div 2 = T, \text{ and}$$

$$\frac{TS \times 2T'' \times \%}{P \times FS} = D.$$

This formula refers to any boiler, no matter whether constructed of iron or steel, 48,000 pounds being taken as the tensile strength for iron, and 60,000 pounds being taken as the tensile strength for steel, and four being taken as a factor of safety in each case when boiler is constructed in best manner.

Example (1): Find the safe working pressure of an iron boiler, made in best manner, joints having a sectional strength equivalent to 70% of solid plate; boiler being 42 inches in diameter and having plate ⅜ of an inch thick.

$$\frac{TS \times 2T \times \%}{D \times FS} = P = \frac{48{,}000 \times .75 \times .70}{42 \times 4} = 150 \text{ pounds, safe working pressure.}$$

Same boiler in steel would become:

$$\frac{60{,}000 \times .75 \times .70}{42 \times 4} = 187.5 \text{ pounds per square inch safe working pressure for steel.}$$

Example (2): Find the required thickness of plate (steel) required in a boiler five feet in diameter, to carry a safe working pressure of 100 pounds to the square inch, sectional strength of a triple rivetted joint being 70% of strength of solid plate.

$$\frac{D \times P \times FS}{TS \times \%} = 2T,$$

$$\frac{60'' \times 100 \times 4}{60{,}000 \times .70} = 2T =$$

$$\frac{24{,}000}{42{,}000} = .571 \div 2 = .285 \text{ inches, or nearly } \tfrac{9}{32} \text{ inch, required thickness of plate.}$$

Example: What diameter should a boiler be when constructed of iron made in best manner and with ½ inch plates, working pressure to be 200 pounds per square inch, joints and rivet sections having a tensile strength equal to .70% of strength of solid plate.

$$\frac{TS \times 2T \times \%}{P \times FS} = D = \frac{48,000 \times 1. \times .70}{200 \times 4} = \frac{33,600}{800} = 42 \text{ inches.}$$

Same boiler constructed in steel:

$$\frac{60,000 \times 1. \times .70}{200 \times 4} = \frac{42,000}{800} = 52.5 \text{ inches.}$$

Example: Find the strain per sectional inch on a boiler 42 inches in diameter, having ¼ inch plate and having a working pressure of 100 pounds per square inch.

Formula:

$$TS = \frac{P \times D}{2T} = \frac{100 \times 42}{.5} = 8400 \text{ pounds strain per sectional inch of plate.}$$

STEEL FURNACES AND FLUES.

The Canada Steamboat Act provides that the external working pressure to be allowed on plane circular steel furnaces and flues when subjected to such pressure, when the longitudinal joints are welded or made with a butt strap, shall be determined by the following formula: 90,000 × the square of thickness of plate in inches ÷ (length in feet + 1) × diameter in inches equals the working pressure per square inch, provided it does not exceed that found by the following formula:

$$\frac{8,000 \times T''}{D''}$$

T" thickness in inches.
D" diameter in inches.

The length to be measured between the rings, if the fuanace is made with rings.

Example: Find the working pressure of a circular flue 36 inches in diameter, 6 feet long and made of ⅜ inch steel plate.

$$\frac{90,000 \times \frac{3}{8}^2}{(6+1) \times 36} = \frac{90,000 \times .1406}{7 \times 36} = \frac{12654}{252} = 50 \text{ pounds working pressure.}$$

$$\text{Check: } \frac{8,000 \times T''}{D''} = \frac{8,000 \times .375}{36} = 83.3 \text{ lbs.}$$

The collapsing pressure of a plane circular furnace tube is found by the following formula:

$$\frac{806,300 \times T^2}{D.\ L} =$$

When T equals thickness of plate in inches.
D equals diameter of flue in inches.
L equals length of flue in feet.

Example: What is the collapsing pressure of a furnace tube whose diameter is 36 inches, length 6 feet and thickness of plate ⅜ inch?

$$\frac{806,300 \times .1406}{36 \times 6} = \frac{113,365.78}{216} = 524.84.$$

CORRUGATED STEEL FURNACES AND FLUES.

Steel flue furnaces, when new, corrugated and machine made, and practically true circles, the working pressure is found by the following formula, provided that the plane parts at the ends do not exceed six inches in length, and the plates are not less than 5/16 of an inch thick and furnace made in one length.

$$\frac{12,500 \times T''}{D''} = \text{working pressure.}$$

And for corrugated iron furnaces made similarly the following formula can be used:

$$\frac{10,000 \times T''}{D''} = \text{working pressure.}$$

Example: Find the working pressure allowable on a corrugated steel furnace flue 42 inches wide, 7 feet long and ⅜ thickness of plate,

$$\frac{12,500 \times .375}{42} = 111.6 \text{ pounds.}$$

Find the working pressure allowable on same furnace constructed in iron.

$$\frac{10,000 \times .375}{42} = 89.3 \text{ pounds.}$$

The electric light company at Dartmouth, N. S., have offered to dispose of their plant to the town for $30,000. By agreement they are bound to give the corporation the first right of purchase. The citizens' committee has reported that the plant is not suited to the requirements of the town, and it is probable that arrangements will be completed with a New York company, represented by C. K. Corsaut, to purchase the plant. This company have in view the development of the water power at Fall River, at an expenditure of $100,000.

PERSONAL.

Mr. J. B. Kelly, of Blyth, Ont., has accepted the position of manager of the Goderich electric light plant.

Mr. Chas. W. Hagar, formerly manager of the Royal Electric Company, Montreal, has been appointed manager of the Dominion Burglary & Guarantee Company.

Mr. J. F. Richardson, chief electrician of the Canadian Pacific Railway, has just returned from the Yukon, where he surveyed the route for a telegraph line over Chilcoot Pass.

Mr. Shirley Davidson, of Montreal, has accepted a position as electrical engineer in Jamaica. Mr. Davidson was captain of McGill University football team, and is an all-round athlete.

We regret to learn that Mr. F. S. Barnard, manager of the British Columbia Electric Railway Company, is suffering from a broken leg, the result of being thrown from his buggy.

Mr. Peter Patterson, superintendent of the National Tube Works Co., McKeesport, Pa., was recently promoted to the position of consulting engineer. Mr. A. M. Saunders has been appointed superintendent.

Mr. W. L. Bird, of Bracebridge, Ont., at present taking the course in electrical engineering at the Canadian General Electric Company's works in Peterboro', has accepted a position with the Lachine Rapids Hydraulic & Land Co.

Mr. F. B. Brothers, superintendent of construction on the Montreal Street Railway, left a fortnight ago for Jamaica, in connection with the proposed electric railway at Kingston. Mr. Brothers expects to return to Montreal in a short time.

LEGAL DECISIONS.

A CASE of considerable interest was heard at Stratford, Ont., last month, being an action for damages brought by Cyrus Hacking against H. P. Dwight, president of the G.N.W. Telegraph Company. Hacking, who was an operator employed by Messrs. Gladwin & Donaldson, brokers, of Buffalo, wrote the latter firm, who had leased a wire in Western Ontario from the Great Northwestern Telegraph Company, intimating that they were being overcharged by the G.N.W. Telegraph Company. The letter was shown to President Dwight, who wrote Gladwin & Donaldson to the effect that Hacking's epistle was "a piece of gratuitous impertinence," and that Hacking "was on the black list for some time and was likely to remain there." Hacking complained that Dwight's letter was libellous and claimed damages. The jury returned a verdict for Mr. Dwight, asserting that there was no libel.

The American Society of Mechanical Engineers met in New York this month, and from the number and value of the papers presented the proceedings must have been of more than usual interest. Mr. F. R. Hutton, 12 West Thirty-first street, New York, is secretary of the society.

The annual statement of the Cornwall Street Railway Company, recently issued, showed a total year's business of $25,282.68, made up as follows: Passenger receipts, $16,557.35; freight, $1,661.47; other sources, $7,063.80. The operating expenses were $20,172.81, the items being salaries, repairs, fuel, snow sweeping, insurance and sundries. The bond interest was $2,500, and the account interests $1,250, leaving a net profit of $1,359.87. The capital stock of the company is $150,000, and it has in the treasury $33,800.

ELECTRIC RAILWAY DEPARTMENT.

ELECTRIC RAILWAY DEVELOPMENT.

An exchange gives some interesting firgures relative to the development of electric railways in the United States :

Ten years ago there were only 86 miles of electric railway track in the United States. Now there are over 14,000 miles. In these ten years street railway propulsion has been revolutionized. Horse cars have disappeared entirely from most of the lines and will soon be curiosities, cable lines have probably reached their maximum mileage, while the number of electrically operated cars has grown from 172 to 37,000. These are some of the impressive facts shown by the following table, taken from an article in the Western Electrician, entitled "A Decade of Electric Railway Development:"

	January 1 1888	1897
Total number of operating street railway companies in the United States	615	806
Number of street railway systems operated by horses	566	167
Number of street railway systems operated by cable	18	38
Number of street railway systems operated by steam dummies (not including elevated)	35	33
Number of street railway systems operated by electricity	21	698
Mileage of horse car track	5,474	1,010
Mileage of cable track	217	515
Mileage of steam dummy track, (not including elevated)	216	145
Mileage of electric track	87	13,580
Total mileage of street car tracks	5,993	15,250
Number of horse cars	21,736	3,664
Number of cable cars	2,777	5,957
Number of steam dummies and cars	423	318
Number of electric cars	172	37,097
Total number of street cars, all descriptions	25,108	47,036

In 1888 the horse car tracks represented over 91 per cent. of the total, and the electric railway tracks a little over 1 per cent. At the commencement of this year the horse car tracks were a little more than 6½ per cent. of the total, while electric railway tracks represented more than 89 per cent. and were still growing. It is important to note, however, that in these ten years of electrical development very little progress has been made in the direction of substituting electric motors for steam locomotives, excepting upon elevated roads.

C. J. Myles, A. J. Nelles, and Mr. Jennings, C.E., recently made a trip over the proposed extension of the Hamilton, Grimsby and Beamsville railway from Beamsville to St. Catharines.

The by-law to guarantee the sum of $50,000 for the building of an electric railway in St. Thomas, Ont., was carried by the ratepayers on the 30th ultimo by a large majority. Under the agreement the company must build six and one-half miles of track. Mr. J. H. Still is the promoter of the scheme.

Messrs. B. F. Pearson, of Halifax, and Wm. Mackenzie, of Toronto, were in Montreal recently completing arrangements for the construction of the electric railway at Kingston, Jamaica, reference to which was made in the November number of the NEWS. The work of construction is to be pushed on rapidly during the winter months, so that by the next hot spell the inhabitants of the island may enjoy all the delights of rapid locomotion in hot weather, without the discomfort of personal exertion. Among those interested in the Jamaica syndicate are: H. M. Whitney, Boston, Mass.; F. S. Pearson, New York; Jas. Ross, Montreal; William McKenzie, Toronto; W. B. Ross, Q.C., Halifax; R. C. Brown, Halifax; B. F. Pearson, Halifax; R. D. McGibbon, Q.C., Montreal; Granville C. Cunningham and W. B. Chapman, Montreal.

THE LATE MR. ROSS MACKENZIE.

A TELEGRAM from Nelson, B. C., a few days ago, announced the death of Mr. Ross Mackenzie, a gentleman well-known to many readers of this journal. At the time of his death, which is supposed to have resulted from an injury received at Niagara Falls, and for which an operation was performed, he was employed officially by the C. P. R. in connection with the construction of the Crow's Nest Pass railway.

The late Mr. Mackenzie had for years been engaged in railway work. He was a son of Mr. Campbell Mackenzie, of Toronto, and was born in 1857 in the city of New York, but removed to Canada when quite young. In 1873 he entered the service of the Shedden Company in Toronto, and two years later was removed by the company to Hamilton. In 1878 he accepted the

THE LATE MR. ROSS MACKENZIE.

position of book-keeper for the Credit Valley railway, and in 1884, when this railway was merged in the Canadian Pacific railway, he became general superintendent's accountant of the Ontario division. Afterwards he was removed to Montreal, where he remained for several years. Shortly after the completion of the Niagara Falls Park and River Railway, the management thereof was offered to and accepted by Mr. Mackenzie. About one year ago he tendered his reignation, and quite recently accepted a position on the Crows' Nest Pass Railway. Mr. Mackenzie was a member of the Canadian Electrical Association, and served on the executive committee for one year while manager of the Niagara Falls road.

A few years ago Mr. Mackenzie stood in the front rank as an athlete. He was best known as a lacrosse player, being captain of the Toronto lacrosse club early in the eighties, and the holder of the world's record for throwing the ball.

The American Rattan Co. have just completed their new factory and are removing to the town of Walkerton. They have purchased from the Royal Electric Co., for lighting their factory, a complete electric lighting equipment.

SPARKS.

Brockville, Ont., is agitating for a municipal lighting plant.

An electric light plant is being installed at McAdam Junction, N.B.

Noble & Barber, electrical contractors, have started business in Montreal.

The town of Cobourg, Ont., are asking for permission to install an electric light plant.

The city council of Stratford, Ont., will advertise for tenders for the right to build a street railway.

Messrs. Smith & Co. have a contract for lighting the village of Gatineau Point, Ont., by electricity.

Late exports from New York City to Hamburg, in Germany, included large quantities of electrical supplies.

Elias Rogers has put in a dynamo for electric lighting and to operate the crane used in unloading coal vessels.

The Dodge Wood Split Pulley Company, of Toronto, recently received an order from an English firm for 3,900 pulleys.

The Knowlton Electric Light Company, Knowlton, Que., has been dissolved. Austin W. Peters is now sole proprietor.

The Montreal Street Railway Company have re-elected Mr. L. J. Forget president, and Mr. James Ross vice-president.

Two hundred and twenty installations of electric light are said to have been made in Buenos Ayres, Argentine, this year.

The Mayor of Hamilton has been interviewed by a gentleman who submitted a scheme for an electric railway from Hamilton to Caledonia.

Mr. H. J. Beemer is credited with a scheme to purchase the North Shore line of the C.P.R., and have the whole Quebec system electrified.

Mr. Morley Jarvis, of Guelph, and Mr. Page, of St. Marys, have invented an apparatus whereby exhaust steam can be used for different purposes.

The Deschenes Lighting Company have been asked to stretch wires across the river and supply electric light to the villages of Britannia and Birchton, Que.

Mr. St. Germain, of North Toronto, is said to be negotiating for the construction of horseless carriages, to run between York Mills and the C.P.R. crossing.

The Hull Electric Company has purchased the Aylmer branch of the C.P.R., which is at present under lease, the price being in the neighborhood of $100,000.

The town council of Annapolis, N. S., have voted in favor of purchasing an electric light plant. The question will be submitted to a vote of the ratepayers.

The appeal of the London Street Railway Company against an assessment of $80,000 on rails, poles and wires was argued a fortnight ago, and judgment reserved.

Swainson & Pierce have commenced business at Wallaceburg, Ont. They will handle electrical goods, such as medical batteries, door bells and burglar alarms.

The Ottawa Street Railway Company have experienced considerable trouble on account of motors being either absolutely destroyed or seriously damaged by water.

A scheme has been mooted to build an electric railway from Bobcaygeon to Peterboro, the cost being estimated at $200,000. Provincial and Dominion aid will be asked for.

The Kingsville Electric Light & Power Co. have placed an order with the Royal Electric Co. for a 50 light 6½ amp. arc machine, with lamps, for lighting the streets of Kingsville.

Abraham Goodwin and John Kerr, Brantford, have bought out the repair department of the A. R. Williams Co.'s machinery agency there, and will operate it on their own account.

The Dominion Cotton Mills Company have given a contract to the Lachine Rapids Hydraulic & Land Company for the supply of electricity for power purposes for a period of twenty years.

Messrs. Moodie & Son, of Terrebone, Que., have completed their new factory and are lighting the same throughout with electricity. The order for the electrical apparatus has been placed with the Royal Electric Co., Montreal.

Mr. Treffle Lavigne, foreman in the street railway power house at Ottawa, and who recently ran for alderman in Victoria Ward, is suffering from an electric shock. He was working on one of the machines when he made a short circuit. Immediately the wires which he was holding became a mass of flame, and his hands got a severe scorching.

The Lachine Rapids Hydraulic & Land Company have made a proposition to the Harbor Commissioners to supply shipping interests with electric power for loading and unloading vessels. The chief engineer has been requested to report on the proposition.

The St. Jerome Electric Light Co., of St. Jerome, Que., have purchased from the Royal Electric Co., and are installing in that town, a 50 k.w. S.K.C. two-phase alternating current dynamo, with Stanley transformers, etc. They expect to start up with 750 lights installed.

An important innovation is being made on the Canadian portion of the Grand Trunk Railway system, in substituting compressed air for steam as a motive power in their shops. It is said to be cheaper than steam, and has been applied successfully in the shops at Toronto, Belleville and other places.

It is rumored that the Sherbrooke Street Railway Company will extend the line to Little Magog Lake next summer. It is also rumored that Messrs. R. N. Arkley & Son will construct a dam on the Magog, below the Little Lake, at a point on Mr. Henneker's estate, to develop supplementary power for the company.

The Folger-Hammond Mines Company has been organized in Toronto, Sir Richard Cartwright being president and Mr. W. H. Carvey secretary. They propose operating near the Saw Bell mine, in north-western Ontario. Tenders will be invited for the supply of electric power from Clearwater Falls, one mile distant.

The Department of Public Works at Ottawa has been advised of the completion of the extension of the government telegraph line along the north shore of the St. Lawrence, from Esquimault Point to Agwanus, a distance of 80 miles. Offices have been opened for business at Agwanus, Piastro Bay and Sheldrake. The line is now 350 miles from Belle Isle.

The Windsor Electric Light & Power Co., of Windsor, N. S., whose plant was destroyed by the late fire, immediately started to rebuild the same, and have given an order to the Royal Electric Co. for apparatus and transformers, etc., consisting of S. K.C. alternators and Stanley transformers. The ashes of the old station had hardly grown cold before the order for the new apparatus was placed.

Referring to the proposed transmission plant at Goldstream, B.C., Mr. F. S. Barnard, manager of the British Columbia Electric Railway Company, writes as follows: "We have not yet definitely decided upon plans for a transmission plant. I may say, however, that our generating station will have a capacity of about 1,000 h.p., developed by water delivered under a 570 ft. effective head. This power will be transmitted by a voltage of about 10,000 to the sub-station at the city of Victoria, a distance of about twelve miles, and there distributed for the purpose of running our street cars, arc and incandescent light and power circuits.

The corporation of Fort William is about to erect as complete an electric lighting plant as, perhaps, is in use in any town in Canada. They are installing one 50-light 2,000 c.p. arc dynamo, with 35 double or all-night lamps for lighting the streets of the town and the C. P. R. yards, and for the incandescent service are installing an S.K.C. alternating current dynamo with a capacity of 1,000 lights, with Stanley transformers throughout. The corporation expects to be in a position to furnish light by the 1st of January next. The entire electrical equipment has been bought from the Royal Electric Co., and the engines and boilers from the Robb Engineering Co., of Amherst, N.S. The station which is now being erected is only temporary, and will likely be changed in the spring when the new waterworks system is installed.

SPARKS.

The electric light plant at Drayton, Ont., owned by J. L. Pollock, was recently damaged by fire.

The motormen and conductors of the Ottawa Electric Railway have formed a fraternal organization.

The Rosamond Woolen Co. have ordered an $8,000 boiler and engine from Goldie & McCulloch, of Galt.

Mr. J. E. Jones, of Kingston, Ont., has invented a street car fender, which is said to work very satisfactorily.

The Canadian General Electric Company have in course of construction at Peterboro', Ont., a new power and pump house.

The London Street Railway Company will probably return to the use of coal stoves. It is said that heating by electricity exhausts too much power.

At the Digby, N. S., electric light station recently, the attachment to the governor gave way and a smash-up followed. Engineers Daley and Armstrong received a slight ·ck.

The St. Jerome Power & Electric Light Con, any have had such success in canvassing for lights that they have changed their order from a 1,000-light S.K.C. machine to one of 1,500 lights capacity.

The Gravenhurst Electric Light & Power Company have purchased new arc lamps.

The Cascade Water Power and Light Company, composed of Rossland and Spokane capitalists, will build an electric railway in the vicinity of Grand Forks. It will also furnish electric light.

Mr. A. A. Dion, of the Ottawa Electric Company, is delivering a series of lectures on "Electricity" at the Canadian Institute. A large number of students are taking this course at the institute.

Charles R. Hosmer, of Montreal, general manager of the Canadian Pacific Telegraph service, the Postal-Pacific Telegraph Company, and the Commercial Cable Company, has lately returned from the west. He says that within the next year the Canadian government will construct and complete a telegraph line to Dawson City, and by the identical route originally surveyed 30 years ago by George Kennan, the Siberian traveller.

The United States consul at Crefield reports the discovery of what he terms incandescent gas. A single jet of ordinary size can emit light of much more than 1,000 candle power, and fine print can be read at a distance of 100 feet. The inventor says that the cost of a light of 1,500 candle power is only 4½ cents per hour, while that of an ordinary electric light of 400 candle power is 14 cents per hour.

The Governor General has approved of the rules for the inspection of steamboats and for the examination of marine engineers.

It is rumored that the Atlantic and Lake Superior Railway Company, who own the Lachute and St. Andrew's railway in the province of Quebec, intend converting the road into an electric system and extending it to Carillon. The question of motive power has not yet been definitely decided upon.

Some years ago a company was formed in Bridgetown, N. S., to light the town by electricity, but nothing was done. Now we are informed that the company have completed arrangements with the owners whereby they will acquire the right to lay pipes, construct dams and sluices, and build a complete waterway from Curell's Brook. In addition to lighting the town by electricity, they also propose to furnish power for commercial purposes.

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