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ELECTRICAL NEWS
AND
STEAM ENGINEERING JOURNAL

OLD SERIES, VOL. XV.—No. 6.
NEW SERIES, VOL. VII.—No. 11.

NOVEMBER, 1897

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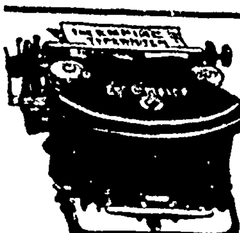

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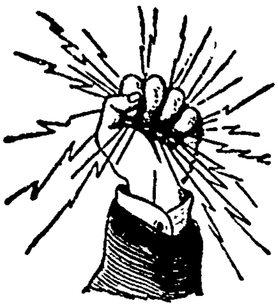

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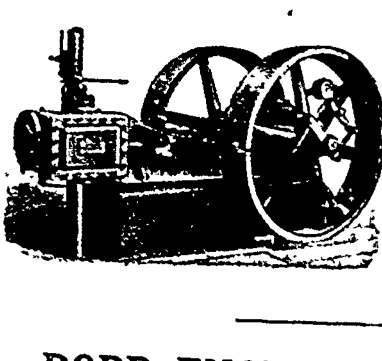

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VOL. VII. NOVEMBER, 1897 No. 11.

HYDRAULIC DREDGE FOR THE CITY OF TORONTO.

LAST year the city council of Toronto made an appropriation of $18,000 for the construction of an hydraulic dredge. The plans therefor were prepared by Mr. C. H. Rust, assistant city engineer, and the work of building awarded to Messrs. Medlar & Arnot. The dredge is capable of excavating to a depth of 16 feet, and is fitted complete with all necessary machinery for manipulating the material and feeding the cutter head continuously and uniformly over the bottom. The hull is 90 feet long, 28 feet wide and 6 feet deep, with two bulk heads the entire length. The cutter frame is of steel, and the dredge is also fitted with a rotary steel cutter head, 48 inches in diameter at the base, 30 inches at outer end and 36 inches long.

A pair of duplex hoisting engines, 8 x 12, with three drums and necessary attachments, are placed on the forward deck for the purpose of driving the cutter head, hoisting and lowering the cutter frame and operating the swinging lines. The dredging pump is of the 12 inch centrifugal type.

ENGINE ROOM OF HYDRAULIC DREDGE BUILT FOR THE CITY OF TORONTO.

In the engine room, a view of which is presented herewith, are to be found engines of the horizontal compound type, 10 x 17 x 15 inch stroke, of ample proportions for high speed and continuous running, and designed to operate at a speed of 170 to 200 revolutions, the indicated horse power being from 75 to 125. The boiler is of the locomotive type, 72 inches diameter, 22 feet long, having 130 tubes of 3 inches diameter and 15 feet long. There is also an air pump condenser, 6 x 10 x 12 in., and one duplex feeder pump with cylinders 5¼ x 3½ x 6 in. stroke.

Two spuds for holding the dredge in position and feeding it ahead are located at the stern of the dredge. These spuds are of oak 12 x 12 inches by 30 feet long. The contract provided that they should be operated by steam cylinders, but this was slightly altered, one horizontal cylinder for feeding the dredge ahead by means of the stepping spud being constr ted, and the hoisting being done by means of drums placed upon the lower deck immediately under the forward engine, and worked by a sprocket chain and two steel cables carri d over the deck house to the stern of the dredge. The machinery, with the exception of the boiler, was constructed by the Skinner Engine Company, of Erie, Pa. The dredge was christened the "Daniel Lamb," after the chairman of the Board of Works for 1895, through whose efforts the appropriation for the work was made.

LONG-DISTANCE TRANSMISSION OF ELECTRICITY IN CANADA.

But a brief space of time has elapsed since it was considered impracticable to transmit electric power beyond the immediate surroundings of the generating station. There were to be found, at that time, persons who predicted that the transmission of electricity to any considerable distance would never be successfully accomplished, owing to the many difficulties to be overcome, such as loss of current, dangers of transmitting current at high voltage, etc. The developments of the last few years, however, have served to show how erroneous were these conclusions. To-day we find electricity being successfully transmitted nearly half a hundred miles. This has been rendered possible by the present high standard of efficiency of electrical apparatus, making it perfectly safe to transmit current at 20,000 volts, and reducing the loss in the line to a very low point.

It would appear that the long-distance transmission of electric power is yet in its initial stages of development. On all sides we hear of projected schemes, the promoters of which evidently feel encouraged by the success of late undertakings in this direction. Many of the valuable water powers in Canada promise to be utilized at an early date to supply light and power to adjacent cities, towns and villages.

The longest electrical power transmission yet undertaken in America is that of the Southern California Power Company, which purposes to deliver current at Los Angeles and Pasadena, a distance of eighty miles from the water power and generating station. The electrical machinery for this scheme is now being installed by the General Electric Company. The second longest transmission line is at Salt Lake City, the distance being thirty-six miles.

Coming nearer home, we find the water power of the Niagara Falls being utilized to supply power to the city of Buffalo, a distance of twenty-two miles. Then in Canada we have the transmission plant at Three Rivers, Que., a description of which appeared in the ELECTRICAL NEWS for October, and a less pretentious scheme at Trenton, Ont., both in successful operation. In British Columbia the West Kootenay Power and Light Company are developing the water power of the falls of the Kootenay river, the Canadian General Electric Company now being engaged in installing the electrical machinery. It is intended to develop 2,000 horse power immediately, the ultimate ope of the undertaking being to utilize the full power of the river, estimated at 10,000 h. p. The current will be carried, at 20,000 volts, to a substation at Rossland, where it will be reduced to 2,000 volts and delivered to motors for use in mining operations.

The latest scheme to take definite form is that of the Cataract Power Company, of Hamilton, Ont. This company, of which Hon. J. M. Gibson is president, was incorporated in the summer of 1896, having for its object the transmission of electric power from DeCew Falls to Hamilton, a distance of thirty-two miles. The matured plans of the company, however, show that the original intention of utilizing these falls has been abandoned. The power will be transmitted from a point near St. Catharines. The water power to be used is the overflow from the Welland Canal, which is led to the Niagara escarpment, where it will have a fall of about 260 feet. The length of the transmission line will be a little more than thirty miles.

The contract for the electrical machinery and line construction for this extensive undertaking was awarded a fornight ago to the Royal Electric Company, of Montreal. This is among the largest contracts of the kind ever given in Canada, the price of dynamos alone being in the vicinity of $200,000. The turbines will be supplied by the Stillwell, Bierce & Smith Vale Company, of Dayton, Ohio.

The scheme includes the construction of a canal from Allanburg to to the cliffs at DeCew Falls, at the foot of which the power house will be built. This canal will be four and one-half miles in length, and from 40 to 45 feet wide, and will tap the Welland canal at Allanburg. The contract for the canal has been given to Angus McDonald & Company, who have already commenced work.

The initial installation will be for 3,000 horse power, but the plant will be designed for an ultimate capacity largely in excess of this amount. The current will be transmitted at 20,000 volts, the danger to operators in transmitting under this pressure being removed by a specially constructed switchboard.

The company have appointed Mr. H. R. Leyden, late of the Royal Electric Company, as manager. Mr. Leyden's experience in work of this character gives special fitness to his appointment to this position. It is expected that the enterprise will be completed early next spring, when the company will be in a position to supply light and power to the city of Hamilton. The entire work, including machinery, canal and distribution line, will, it is estimated, cost in the vicinity of half a million dollars, and must be regarded as a gratifying evidence of Canadian enterprise.

A full description of the engineering features of this important plant will be furnished in a future number of this journal.

The Perth Waterworks Company, Limited, which is installing the waterworks system for Perth, will use electric power for pumping. Their pump-house is located within the limits of the town of Perth, but the power which they intend using is about four miles away, on the Tay river. Here they are installing a water wheel and a 200 h.p. generator, which will, in addition to supplying the power for pumping purposes, furnish light and power for the town of Perth. The Waterworks Company has bought out the old Tay Electric Company, and will distribute light and power on their old circuits. The electrical machinery is being installed by the Royal Electric Company, who will use their S.K.C. two-phase system for this work. The pumping is to be done by means of a 75 h.p. motor belted directly to a triplex double-acting power pump, which pumps directly into the mains, no gravity system or stand-pipe being employed. The mains are equipped with a relief valve, so that the pressure can be maintained constant without varying the speed of the pump. The pump is arranged so as to be operated at two different speeds, in order to raise the supply of water and the pressure for fire purposes.

MR. D. H. KEELEY.

The late F. N. Gisborne, who died in August, 1892, was succeeded as general superintendent of the Dominion Government Telegraph Service by Mr. D. H. Keeley, a portrait of whom appears on this page. Mr. Keeley was ably qualified for the position by his past experience in telegraph work, and since assuming his duties has given the utmost satisfaction to the department.

The subject of our sketch has been prominently connected with the Canadian Electrical Association, having contributed valuable papers thereto. He is a member of the Council and of the Medal Award Committee of the Canadian Society of Civil Engineers, in which office he may be said to stand as the representative of the electrical engineers' branch of the Society. He is also a member of the British Institute of Electrical Engineers.

The ELECTRICAL NEWS of March, 1895, contained an interesting article entitled "Our Government Telegraphs Their Scope and Special Functions," which showed the extent of the government telegraph system and the territory served. At that time there were 2,451 miles of land lines and 206 miles of submarine cable,

MR. D. H. KEELEY.

with a total of 148 offices. These were distributed from British Columbia to Newfoundland. It will thus be seen how arduous and important are Mr. Keeley's duties, which continue to increase each year. In 1893 there were transmitted over government telegraph lines 41,550 messages. The expenditure upon the service was $49,000, and the revenue collected amounted to a little over $9,000.

The steamship "Newfield" is provided with the necessary appliances for picking up and relaying cables, and is made available for the work in the gulf when needed. The electrical work has been for years superintended by Mr. Keeley. When a break-down occurs in a cable electrical tests have usually to be made to determine the location of the trouble.

CANADIAN AGENT WANTED.

The management of the Montreal Cotton Mills Company at Valleyfield, Que., contemplates substituting electricity for coal to dry the cotton.

NEW PLANT FOR THE METHODIST BOOK-ROOM.

THE largest printing establishment probably in Canada is that owned by the Methodist church, and known as the Methodist Book & Publishing House, situated on Richmond street west, Toronto, and having a frontage also on Temperance street. The Richmond street building has 100 feet frontage and is four storeys high, exclusive of basement. Here is situated the retail department, editors' and others offices, board room, etc. The Temperance street front extends over 118 feet, on which is a six storey building, with basement, containing engine and boiler rooms, shipping offices, wholesale book departments, binding, folding and stereotyping rooms. Connected with these front buildings is another, consisting of four storeys, in which is contained the press room, composing room, book stock room, general office and store room.

The buildings are heated entirely by steam, the mechanical department by exhaust from the engines, and the front buildings, offices, etc., by the low pressure gravity system. The boiler and engine rooms of an establishment of this extent are necessarily large and attractive. In the boiler room are two 60 horse power boilers made interchangeable for high and low pressure. These are fed by a Northey steam pump. In the engine room are the engines, two Wheelocks, 60 and 90 h. p., connected to an underground shaft by large belts and arranged with friction clutch pulleys so that either engines or both may be used at any one time.

A new electric light plant has recently been installed for lighting the building, the electricity being generated by a 10½ x 10 Ideal engine, direct connected to a 50 k. w. dynamo, manufactured by the Toronto Electric Motor Company, the engine and dynamo only occupying a space 6 by 8 feet. Current is generated for 650 incandescent lamps of 16 c. p. each, and from the machine there can be run as well, through motors, arc or incandescent lights. The armature of the generator is of the wave-wound type, with ventilated core, and so constructed that no wire passes over the ends. Consequently no dust or dirt is allowed to accumulate. The crown is of heavy iron, with the laminated poles cast in so that the magnetic current is perfect. Beside the generator stands a marble switchboard, with instruments complete, the whole making an up-to-date and efficient plant. The establishment is protected against fire by two large stand-pipes running from cellar to roof, with hose on each flat attached and ready for use.

Mr. G. C. Mooring has entire charge of the steam plant and machinery, having been employed by the firm for over eight years. He is popular with his brother engineers, and was a charter member of Toronto No. 1, C. A. S. E., of which association he is now president.

Mr. Wm. T. Bonner, formerly general agent for Canada for the Babcox & Wilcox Company, has recently returned from a trip abroad, and will take up his residence in Montreal again, as manager for Canada for Babcock & Wilcox, Limited, of London and Glasgow. Temporary quarters have been taken in the Board of Trade Building, but as soon as the decorators and furnishers can complete their work, the Babcock & Wilcox offices will be located in the Mechanics' Institute building, at the corner of St. James and St. Peter streets. A full line of samples and models of the Babcock & Wilcox water tube boilers and accessories will be exhibited, and every facility and convenience placed at the disposition of the engineers and steam-users, to give them a thorough understanding of the merits of the Babcock & Wilcox Company's goods.

DISCOVERIES OF MICHAEL FARADAY.

Some interesting particulars of the life of Michael Faraday, the great electrical discoverer, are furnished by the American Electrician, to whom we are also indebted for the accompanying portrait.

Michael Faraday, born 1791, died 1867, the son of a poor mechanic, was, at the age of thirteen years, apprenticed to a bookseller. He worked for some years as a bookbinder, afterwards securing a position with Sir Humphrey Davy in the Royal Institution, where his great career was commenced. A diligent student, and always seeking information, he attended lectures on natural philosophy and other subjects, which created a strong desire in him to engage in scientific work. He was first appointed laboratory assistant in 1813, and his first discoveries were made seven years later.

In 1821, Woolaston conducted some experiments in the laboratory of the Royal Institute to realize an idea he had formed from Ampere's discoveries, that a conductor carrying a current could be made to rotate about the pole of a magnet and vice versa. In this he was unsuccessful, but Faraday, taking up the subject, finally succeeded in obtaining such rotation. The apparatus thus constructed by Faraday was the first electric motor; ten years later he constructed the first transformer and also the first dynamo the Faraday disk.

MICHAEL FARADAY.

In the period between 1821 and 1831, among other discoveries made in chemistry by Faraday was that of the element chlorine. He became director of the Royal Institution laboratory, and in 1831 made his great discovery of electro-magnetic induction, which turned his mind definitely toward pure science as the sole object of his life, and thenceforth he permitted nothing to distract his attention from it. On August 29 of the same year he succeeded in making the greatest discovery of all time and laying the foundation upon which rests the great electrical development of the past 25 years. It was that electricity was capable of being produced by magnetism. The apparatus used consisted of an iron ring wound with two coils of bare wire, one about 72 feet and the other 60 feet long, the turns being separated by twine and the layers by calico. The longer coil was connected to a primary battery, and a loop of the other passed over a magnetic needle. When the battery circuit was made or broken, the needle was deflected one way or the other, by the induced current set up. This apparatus was the first transformer, combining every principle of the modern apparatus known by that name.

These discoveries followed: September 24, that a current was induced in wire coiled on an iron cylinder when a magnet was approached to the latter; Oct. 1, that if a current passed through one of two adjacent coils on a block of wood was made or broken, a momentary current flowed in the closed circuit of the other coil; Oct. 17, that current could be generated in a coil by merely inserting and removing a magnet.

On October 28th Faraday made the first dynamo by revolving a disk between the poles of a magnet; when one end of the wire of a closed circuit was pressed against the circumference of the disk and the other against its axis, a continuous current was produced.

On the final day of his great experiments, he found that by merely passing one side of a closed circuit between the poles of a magnet, a momentary current was induced in it. To explain all of the various phenomena observed, he conceived the idea of lines of magnetic force proceeding from a magnet, or surrounding a conductor carrying current; that when a conductor cuts such lines an E. M. F. is generated in it; and that the amount of this E. M. F. is proportional to the number of lines cut in a given time.

It should here be remarked that Henry in August of 1831, independently discovered electromagnetic induction, his experiment being very similar to the first successful experiment of Faraday. He did not, however, follow it up.

Two other epoch-making discoveries are associated with Faraday's name the laws of chemical decomposition and the magnetic rotation of the plane of polarization of light.

After a magnificent series of experiments he laid down the law known as Faraday's law, which formulates the relation between the strength of current and amount of any substance deposited by it. He also found that if a ray of light was passed through certain media, and if these media were placed in a field of force, the plane of polarization was changed, being rotated through a definite angle for each substance and each strength of field. This principle has recently been used by Crehore and Squier in the construction of a chronoscope and in a system of rapid telegraphy. This is only some of the discoveries made by Faraday.

It is expected that there will be keen competition between Canadian and United States firms for supplying the equipment of the proposed electric railway at Kingston, Jamaica. Messrs. Wm. McKenzie and James Ross are the chief promoters of this scheme.

A contract was concluded a couple of months ago between the Southern California Power Company and the General Electric Company for the transmission of the power of the river running through the Santa Ana Canyon to Los Angeles and Pasadena, Cal., a distance of 80 miles. The amount of power to be transmitted at first is 4,000 horse power. The station will be located in the Santa Ana Canyon, 12 miles from Redlands and about 80 miles from the towns in which the electric power will be utilized. The water will be taken from the river to canal, flume and tunnel along the side of the canyon. Here it will be led into a pipe line 2,200 feet long, giving what will be equivalent to a vertical fall of 750 feet. This transmission will be the longest electrical power transmission yet undertaken. At present the longest is at Salt Lake City, where power is transmitted a distance of 36 miles.

MUNICIPAL LIGHTING PLANT.

The town of Orillia, Ont., operates its electric system in connection with the waterworks plant. The management of the plant is vested in a board selected from the town council, Mr. J. S. Millan being chairman. Mr. P. Ritchie is engineer-in-charge, and under him are three assistants.

The plant is situated near the lake, where condensing water is easily obtainable. The G. T. R. tracks pass alongside the power house, by which means the fuel supply is easily obtained. Nature supplies an abundance of pure spring water into a partly submerged tank, with a capacity of 33,000 gallons. These springs are situated on Muskoka Hill, an elevation in the northern part of the town, and the water gravitates to the tank.

Besides this tank there is a stand-pipe three-quarters of a mile away, with from 100 to 120 pounds pressure. There is also a reservoir on Peter street with a capacity of 250,000 gallons.

Forty-five arc lamps light the streets, and 2,300 incandescent lamps are installed for public and private lighting.

The power house is a substantial brick structure, divided into two compartments – one for engines, dynamos, etc., the other for the boilers and pumps. The dynamo room is 35 x 40 ft., and presents a neat appearance. Two Goldie & McCulloch 100 h.p. cut-off condensing engines, harnessed to a line of shafting which extends across one end of the room, operate the machines. Four clutches by the same makers are on the shafting, so that one or all the machines may be worked together, or separately. These machines are two 1,000 k.w. Thomson-Houston alternators, and three Ball arc machines of 25 lamps each, each lamp being of 2,000 c.p.

In the centre is the large steam pump built by McQuillan & Co., of Toronto, capable of pumping 900 gallons of water per hour and throwing 19 gallons per stroke, with 50 strokes to the minute. A spare pump, of Northey make, with a capacity of 200 gallons per minute, is kept in case of emergency. A Goldie & McCulloch condenser in the basement, fed by a Northey pump, condenses for the engines.

The steam main from the boilers is six inches in diameter, with five-inch feeds to the engines and four-inch to the pumps.

At the end opposite the shafting is a large C. G. E. skeleton switchboard, fully equipped, placed half-way up the wall, and reached by iron stairs leading to an iron platform surrounded by brass railings. This is claimed to be a great improvement over the usual manner of arranging switchboards, as the operator is right over his work and has view of all the machines, engines and pumps.

The ceiling of the building is of matched lumber and nicely painted, setting off the bright dynamo room. The boiler room is smaller than the dynamo room, but there is space left for an increase of plant. Two boilers fed by a double-plunger pump and a steam pump generate steam for the two engines. The plunger pump is operated by a belt from one of the engines on the dynamo.

One boiler of 100 h.p. is made by Goldie & McCulloch Co., the other by Perkins & Co., of Toronto.

The plant, as a whole, is very creditable, and few better are found in Ontario.

CORRESPONDENCE

THE PROPOSED STEAM BOILERS ACT.

DARTMOUTH, NOVA SCOTIA, Oct. 11th, 1897.

To the Editor of the CANADIAN ELECTRICAL NEWS.

SIR, In reading the bill called "The Steam Boilers Act," as it appeared in your issue of June, that was put before the Dominion parliament last session, by the Canadian and Ontario Associations of Stationary Engineers, it appeared to me that the fifth clause or section as it reads, seriously impairs the usefulness of the whole Bill from an engineer's standpoint.

For the benefit of those who may not have read the Bill I will, with your permission, quote the abovementioned clause :

"Every person who, at date of the the passing of this act, has been for two years engaged in the operation of steam boilers, upon producing a certificate of his uniform good conduct and sobriety from the owners by whom he has been employed during the said period, and also from some responsible person not connected with the business of such owners and a resident in the municipality or in each of the municipalities in which such boilers have been so operated, or a holder of a certificate from any incorporated body or from any province, *shall be entitled*, upon making an application to the chairman of the board on or before the first day of January, 189 , and upon payment of dollars *to the chairman, to receive a certificate of qualification and to be* registered under the provisions of this act."

Now the fact that a man has had two years experience in charge of a steam plant is certainly no guarantee that he is qualified to operate steam boilers and engines safely and with intelligence, even though his character may be the best, and the fact of his obtaining a certificate without an examination won't make him so. I can call to mind men who have been feeding fuel to the furnace and twisting the throttle valve and squirting oil for years, but if you were to ask them what is the safe working pressures of their boilers, or the tensile strength of the plate therein, they would look at you in astonishment – they never heard of such a thing. Will it be fair to honest and studious engineers to grant such men certificates? Will it be fair to the public? If I understand the said clause correctly it will not.

Brother engineers, let us have an act that will be a credit as well as a benefit to ourselves – an act that will be a guarantee to the public that the men who are in charge of such terrible agents of destruction (when carelessly and ignorantly handled) are men who have been duly examined and have been found well fit to fill the positions they hold.

Under a proper license law, every man, no matter how many years of experience he has had, should undergo an examination and receive a certificate according to his fitness, if he be entitled to one. Also, what size plant a man holding a certain class certificate will be allowed to operate, should be clearly stated.

We all know, once an act becomes law, what a job it is to have it amended. I hope we will hear from other engineers on the subject. Thanking you for space, I remain

Yours truly,

ACADIAN ENGINEER.

The Strathroy Electric Light Company, Limited, are adding an incandescent lighting equipment to their new arc lighting plant and have placed their order with the Canadian General Electric Company for a 30 kilowatt standard single phase alternator of the company's latest type.

CANADIAN ELECTRICAL NEWS AND STEAM ENGINEERING JOURNAL

PUBLISHED ON THE TENTH OF EVERY MONTH BY

CHAS. H. MORTIMER,

OFFICE: CONFEDERATION LIFE BUILDING,

Corner Yonge and Richmond Streets,

TORONTO, - - CANADA.

Telephone 2362.

NEW YORK LIFE INSURANCE BUILDING, MONTREAL.

Bell Telephone 2299.

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Apparatus for Improving Electrical Supply.

IN the continent of Europe and in the United States engineers are devoting their energies towards the improving of electrical supply, not only for lighting, but also for power, heating, electrolytic and railway services, and the last two years have seen great changes, and great progress in the methods of central station operation and in the general economies of electric lighting and power. In Germany, where some of the best and most prosperous electrical central stations are to be found, they use storage batteries in connection with nearly every generating plant, and in Great Britain they have evolved and taken rapid hold of two very important improvements, viz., the 220 volt lamp and the alternating current rectifier for arc circuits. Is there a rectifier in the whole of Canada? Is there one individual central station in the Dominion that has manifested sufficient regard for its own interests as to investigate the merits of a storage battery auxiliary? Has anyone ever asked for a 220 volt lamp? The matter rests with the public. Let them insist on improved, up-to-date apparatus, and be willing to pay reasonable prices for it, and the manufacturing companies will meet the demand.

Method of Charging For Current.

A MATTER that is receiving the attention of wide awake managers in Great Britain, and is even spreading to America, is the method of charging for current. It seems open to question whether a meter rate is always the best way. There seems to be a limit of population below which a "flat rate," while theoretically imperfect, is commercially the better way, and above this limit the flat rate can be applied in certain cases where the rate of current consumption is regular and the hours certain, while meter rate is applied to the customers. But even then it can be reasonably argued that there should be graduations in the meter charges, corresponding to the duration of the time during which current is supplied. Assume for purposes of illustration a 1000 light plant, with current supplied by meter, and take two consumers; the first burns thirty 60 watt lamps for 10 hours, consuming 18,000 watt hours, the second burns one hundred 60 watt lamps for three hours, also consuming 18,000 watt hours. While their consumption has been the same and they pay the same, still it is evident that the central station has to keep one-tenth of the capacity of the machine for the second consumer, but only one-thirtieth for the other. It is plain, therefore, that the first consumer is the more profitable, and others like him should be encouraged. In the smaller plants, however, it is at least open to question whether the expense of purchase and up-keep of meters would repay their use. No doubt the business done could thereby be extended somewhat, but the continual testing of meters and questioning of their accuracy would impose a burden hard to be borne.

The Paris Exposition.

THE great exposition that is to take place in Paris, France, in 1900, should not be lost sight of by Canadians, and by Canadian manufacturers in particular. The time is distant a little less than three years, and it is now none too early to begin preparations for making a creditable display of Canadian products and manufactures. We are pleased to observe that a deputation from Montreal has drawn the attention of the Dominion government to the matter, and that there is a strong probability of assistance being received from this source. But in addition to a Dominion grant, it would seem fitting that each provincial government should assist to secure the advantages which are certain to accrue to us from a commercial standpoint by having Canada properly represented at this exposition. This year the Dominion of Canada has been advertised abroad as never before, and the benefits therefrom have already commenced to be realized,' as shown by enquiries received by manufacturers. Having thus made a start we should sieze every opportunity to further extend our trade relations, and where a foothold is once secured the quality of our manufactures may be relied on to keep the market.

Municipal Control of Electric Lighting.

THE ratepayers of the city of Toronto will shortly be called upon to decide one of the most important questions ever submitted to a popular vote. They will be asked to declare themselves for or against the municipal control of electric lighting. The subject is receiving much attention from the public press, and, as is usual with questions of this character, widely varying opinions are expressed. The Globe, in a leader in its issue of November 5th, states that according to statistics over two hundred American cities have experimented with public electric lighting plants, and follows this with some figures showing the cost per lamp per annum in several of the cities where municipal control obtains. The figures as given, unaccompanied by any particulars of the conditions surrounding the operation of the plants, are evidently intended as an argument in favor of municipal control. But only one side of the case is presented. Of the two hundred cities that have thus experimented, no information is given regarding the plants that have proven an entire failure under municipal management, but half a dozen or more plants are selected which evidently suited the requirements of the article. The city of Detroit is pointed to as having greatly reduced the cost of its lighting by installing a public plant. A fair comparison may be made between the cities of Detroit and Toronto, the population being about equal. We have in our possession the annual report of the Detroit municipal lighting plant for the year ending June 30th, 1897. This statement shows that the city operates 1,600 arc lamps of 2,000 c. p. each, and that the actual cash outlay last year was $64.19 per lamp, exclusive of depreciation of plant, interest on outlay, or taxes which would otherwise be paid to the city. Allowing for these, the report gives the total cost per lamp as $89.42, as compared with $87.40 the previous year. But in the item of depreciation only the boilers are taken into consideration, on the ground that as the balance of the plant was kept in the best possible condition of repair, the cost of depreciation would be too small to be worthy of consideration. That this is an unfair comparison every reasonable person will admit. Careful attention may prolong the life of the machinery, but it cannot prevent it from ultimately wearing out. Furthermore, no allowance is made in the report for insurance. Placing the depreciation and insurance at the very low estimate of 3 per cent., the cost per lamp per annum would be $97.26. Let us see how these conditions compare with those in Toronto. We are supplied with about 1,200 arc lamps of same capacity as those in Detroit at $74 per lamp per year, a difference of $15 as compared with the cost of lighting in Detroit as given in the report, and of $23 if depreciation and insurance are taken into account. Then there is the fact that the cost of fuel and supplies is less in Detroit than in Toronto, a very important consideration. It has been pointed out that Detroit is now producing its light at a lower cost than that paid by private contract previous to the installation of the plant. This is not due to the economy of a civic plant, but rather to improved machinery, cheaper supplies and other considerations. As proof of this stands the fact that the cost of electric light to the city of Toronto by contract has also been greatly reduced within the last few years. Now, as to the first cost of an electric plant of sufficient capacity for the present requirements of Toronto, the figures given in the Detroit report show an investment of nearly three-quarters of a million dollars, and that each arc lamp cost $337.88. These are considerations which should be carefully weighed by the ratepayers. They will do well to be guided by the results of experience rather than by theory.

Extraction of Ore By Electricity.

THE mining world has been watching with much interest the success of the experiments by Mr. Edison to recover by an electrical process the iron contained in low grade ores. It has long been known that by means of magnetism the extraction of iron ore could be accomplished, but the problem to be solved was the perfecting of a process which would render the treatment of even the leanest deposits commercially feasible. To this end Mr. Edison has in a measure concentrated his efforts, and it would now seem that after a large expenditure of money he is to be rewarded by success. His experiments have been carried on in New Jersey, where about $3,000,000 has been expended in plant. The process by which iron mining promises to be revolutionized consists in applying the principle of the magnet, by which the little black particles of ore are drawn from the pulverized rock. The powder is allowed to fall in close proximity to electric magnets, which deflect the iron to one side and the non-metallic matter falls to the other side by gravity, the entire process being automatic. This is one of the greatest of Mr. Edison's many achievements, and one which will undoubtedly have a far reaching effect upon the iron industry throughout the world. To Canada it is likely to prove of great benefit. We have abundance of iron ore deposits, but the difficulty in the past has resulted from the absence of cheap coal in close proximity to the mines. Thus the advantages of the application of electricity for ore extraction are at once apparent. That he has finally reached the goal of success must be a source of gratification to all persons as well as to Mr. Edison.

LIGHT, A BRANCH OF ELECTRICITY.

BY C. A. CHANT, B.A.

THE most distinguishing feature of the science of our age has been the establishing of comprehensive general principles as results from closely-reasoned processes of induction. Any branch of science is chosen, and after analyzing its almost countless phenomena in order to discover as well as possible their true nature, the reverse process is taken, objects with analagous properties are classed together, these classes are again co-ordinated, until at last we reach a grand unity, held together by a single broad principle.

Illustrations will at once suggest themselves. In biology we have the great principle of evolution. Many gaps, no doubt still exist in a complete statement of it, but the general theory itself is so based on hard experimental fact, that it must be true in its general outline at least. In chemistry, although the non-predictable nature of many of its combinations gives to it a certain arbitrary or empirical aspect, has as its fundamental ground-work the principle of the conservation of matter, that is, matter cannot be created or destroyed, but only transformed from one shape to another. From the time that this was first solidly established a little over a hundred years ago, the science has continued to grow in a healthy way. Of late it has become somewhat more physical in nature, due to its employment of physical methods and working on the border line between physics and chemistry. In physics we have the grand principle of the conservation of energy, a fitting complement to the base-principle of chemistry.

These are probably the greatest illustrations of the statement I have made, but there is another, not quite so wide in its nature, of which I wish to speak, namely, of the intimate relation between radiant heat, light and electricity which has been triumphantly demonstrated in very recent years, and which is usually known as the electro-magnetic theory of light.

Since this theory has come into prominence so lately, many are inclined, on learning of it, to think of it as a purely recent production. But such is not the case. No great scientific principle ever sprang from the mind of man full-grown. As a matter of fact, the seeds of the theory were sown more than half a century ago by that prince of experimental philosophers, Michael Faraday; the plant was cultivated and brought into bloom by Clerk Maxwell as much as thirty years ago; while, led by Hertz, the world has plucked the ready fruit during the last decade. A discovery may be flashed over the world in a day, for instance, the Roentgen X rays; but almost two years have passed and we have scarcely begun to learn their inner nature by which alone we can rationally classify them.

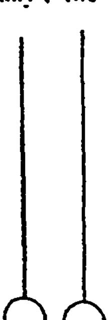


FIG. 1

I shall attempt to explain in a few words how light has come to be regarded as included in electricity.

We are all familiar with the old experiment of rubbing sealing wax on a woollen coat-sleeve and then picking up bits of paper. By rubbing we are said to charge the wax with electricity. Electrical machines, with glass plates, are more efficient in producing a similar effect. Suppose we suspend two metal balls by means of silk thread (Fig 1), and then charge each of these by means of an electrical machine. It has been found that there is then a force exerted between A and B, variable with the distance between them. In this case they mutually repel each other. This fact was an old, old one; but Faraday conceived that the action of A on B must have something to do with the space between them.

To test this, he filled the space between the two attracting or repelling bodies with various substances, such as paraffine, petroleum, etc.; and, just as he suspected, the mutual action was thereby much altered. He therefore concluded that this "electric force" was handed on from one body to the other by means of something between them. But this force is exerted even in a vacuum, and so the handing-on medium must be quite distinct from ordinary matter.

In a similar way let us consider two magnets (Fig. 2)

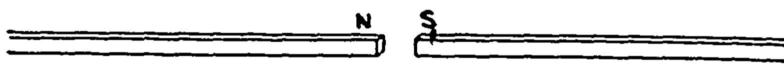


FIG. 2.

with two poles N and S, near together, but so long that the other poles may be neglected in our reasoning. There is an attraction between N and S. If we immerse them in water, or oil, the change in this attraction is so slight that we cannot detect it. But if we could surround the magnets in an atmosphere of iron, this force would be very greatly diminished. As before, the action depends on what is between the two poles, and so magnetic force is also to be considered as being handed on from one body to the other by means of something in the space between.

But if a body transmits through its mass a motion given at one point, time is required to do it. For instance, sound takes time to pass through the air, water, iron, or any other substance. The question is naturally suggested, With what speed are the electric and magnetic forces transmitted from one body to another? Faraday tried to measure this for magnetic force. Indeed, Lord Kelvin tells us that the very last time he saw him at work in the Royal Institution he was down in the basement, far from disturbance, endeavoring to determine the time required for the magnetic action to travel from an electro-magnet to a magnetized needle many yards away; but the attempt failed, no time was observed.

Maxwell followed, and on applying his great mathematical ability, he succeeded in deducing a theoretical value for this speed, and this value when calculated turned out to be extraordinarily near the velocity of light so near, indeed, that he was led to believe they were really identical.

Now, for many years the wave theory of light has been accepted as true, and this theory requires us to believe that light action is handed on from one point to another by a medium pervading all space, known as the ether. At once we grasp at the suggestion that this ether is the very medium required for the transmission of electrical and magnetic effects, and when Maxwell found that the speed of transmission in each case is the same that of the velocity of light, 186,000 miles per second he considered this suggestion practically demonstrated to be true. He then propounded the theory that the disturbance known to us as light is really electro-magnetic in its nature. Very recently the actual velocity of the transmission of electric and magnetic actions has been measured, the same as the velocity of light. If, then, light is an electro-magnetic phenomenon, optics must be but a branch of the imperial science of electricity.

Again, energy, in the form of light, is transmitted in the ether by means of undulations or waves; electrical energy should likewise be transmitted through the same ether in waves. We are well acquainted with methods of generating and of detecting light waves; how can we generate and then detect electric waves? Hertz answered this question. One of his radiators, or generators of electrical waves, is illustrated in Fig. 3.

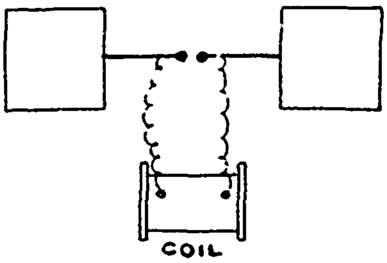


FIG. 3.

It consists of two sheets of metal from which run out rods ending in knobs near together. If, now, this be joined to an induction coil, and the coil be put in action, sparks will pass between the knobs, and every time a spark passes, the ether about the metal will be agitated, and the disturbance thus caused will spread in every direction, just as light radiates from a candle.

But how shall we detect these waves? The eye, which is so marvellously sensitive to light waves, is entirely unaffected by these longer ones. But Hertz discovered that by taking a wire with a knob on each end and bending it round as in Fig. 4, he could use this for his purpose. Holding it almost anywhere near the radiator, small sparks would pass between the knobs, caused by the electric energy transmitted to it. By suitable arrangements sparks could be seen more than twelve yards away. By means of such radiators and receivers (or detectors), Hertz investigated the nature of the electric radiation, and found that it was in waves which, he showed, possess all the ordinary properties of light, i. e., they both follow the same physical laws.

Since these researches (1887-1890) radiators and re-

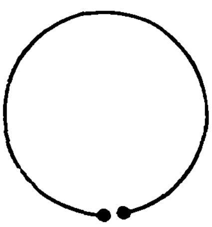


FIG. 4.

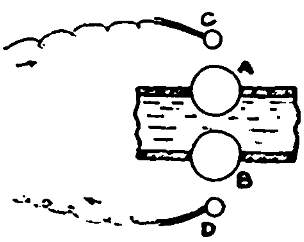


FIG. 5.

ceivers of many different forms have been devised to more easily illustrate the discovery of Hertz. A very convenient form of radiator, due to Righi, Professor of Physics in the University of Bologna, is illustrated in Fig. 5. A and B are two metal spheres fitting tightly in the centres of two ebonite discs which form the top and bottom of a cylinder with flexible walls. This cylinder is filled with vaseline oil, so that half of each ball is in the oil. The knobs C and D are connected to the coil, which, when excited, causes sparks to pass from C to A and D to B, and then from A to B through the oil. By this means electric waves are sent out in every direction. If the cylinder be placed in a parabolic reflector (of sheet metal) the radiation may be projected forward in a single direction, like that from a locomotive headlight.

One of the most convenient receivers is what Lodge has termed a "coherer." It consists simply of a glass tube nearly filled with metallic turnings or filings (Fig. 6.) When this is placed in the path of electric waves,

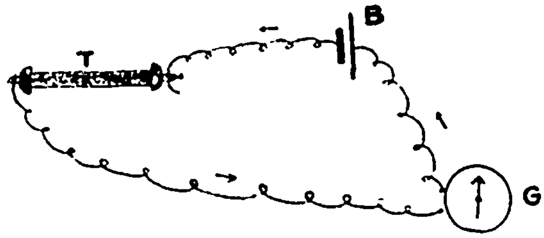


FIG. 6.

the bits of metal seem to cohere, so that an electric current can pass through them more freely. The arrangement to show this is given in Fig 6. T is the tube, and pieces of wire run into each end and terminate amongst the turnings. B is a voltaic battery, and G is a galvanometer for measuring the electric current. These are joined as in the figure. Usually the resistance of T is so great that no appreciable current flows and the galvanometer is undeflected, but as soon as the electric waves get amongst these turnings they "cohere," the resistance falls, a current passes, and round goes the needle! By simply tapping the tube the coherence disappears and all is ready for another trial. This tube may also be enclosed in a parabolic reflector, and thus made more sensitive in certain directions. Using these instruments the various laws of optics can be verified for electric waves.

To show reflexion, let us arrange the radiation and receiver as A, B in Fig. 7. The radiation goes out

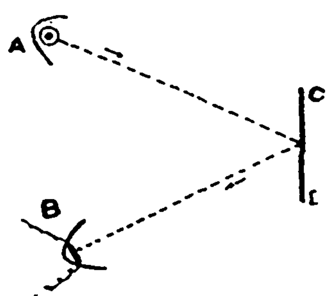


FIG. 7.

from A in the direction indicated by the arrow, and if a metal sheet (tin foil on a board will do) be held at C D the beam is reflected toward B and will be indicated on the galvanometer.

Refraction is very interesting. To show this we place the radiator and receiver as shown in Fig. 8. The receiver is little affected on working the radiator; but on putting a prism of some good non-conductor, such as paraffine or pitch, at C D E, the galvanometer at

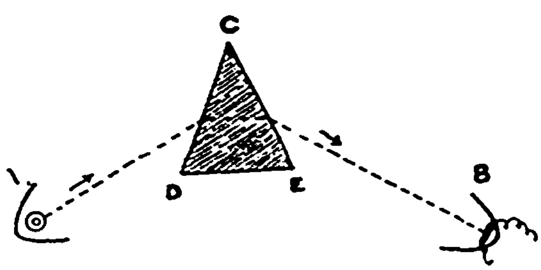


FIG. 8.

once registers a strong action. The radiation is bent from its original direction by the prism C D E. Hertz's original experiment is a famous one. His radiator and receiver were of great size, and the section of the prism made of hard pitch was an isosoceles triangle, having a side of nearly four feet and refracting angle, C, of 30 degrees. The height of the prism was nearly five feet, and it weighed over 1,300 pounds.

Experiments on total reflexion, double refraction, polarization, and other well-known optical effects have been successfully made, thus completely identifying electric and light waves.

Great interest has been shown during the last year or two in the experiments made by Preece and Marconi on signalling without wires. The former is chief of the British Postal Telegraph, and the latter is a young Italian who showed some of his apparatus to Preece and secured his co-operation in the experiments. The method used by these men is precisely that described above--by means of electric waves.

A general diagram of the apparatus is given in Fig. 9, the upper part showing the transmitting, the lower part the receiving apparatus. The radiator is the same as that illustrated in Fig. 5. Its two spheres, A, B, are of solid brass, four inches in diameter, each projecting into an enclosure filled with oil. The induction coil, shown in Fig. 9, which produces the spark discharge between the spheres and thus excites the electric waves, is a very powerful one, capable of giving a twenty-inch spark. K is a key for starting and stopping the coil.

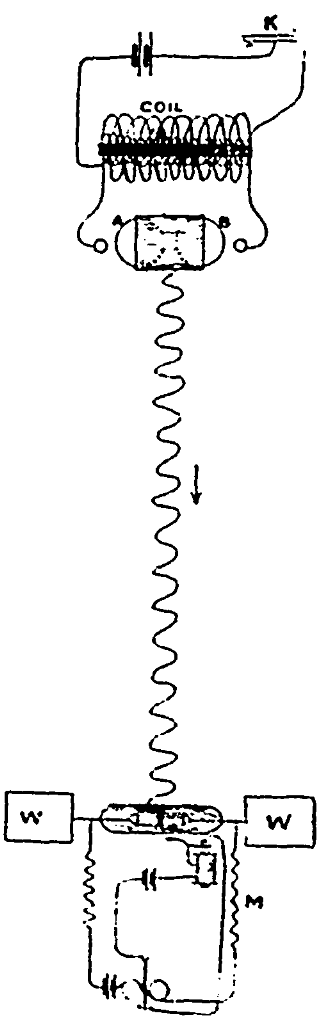


Fig. 9.

Marconi's receiver is a slight modification of that in Fig. 6. It consists of a small glass tube 1¾ inches long, into which two silver polepieces are tightly fitted, the ends being about 1-50th of an inch apart. This narrow space between the ends is filled with a mixture of nickel and silver filings mixed with a trace of mercury. The tube is then pretty well exhausted of air and sealed up. Thus constructed the receiver is very sensitive. From each end of the tube extends metallic wings, W, W, which assist in collecting the radiation, in 'tuning' the receiver to the radiator, and perhaps in other ways not yet explained.

In place of the galvanometer in Fig. 6, is put a sensitive telegraph relay, which "clicks" when the waves reach the receiver tube. To "decohere" the particles in the tube and make it ready for a second signal, the current which works the sounder is also arranged to work a small hammer (shown in Fig. 9), which taps the tube and produces the desired effect.

For short distances, where nothing obstructs the passage of the waves to the receiver, no great difficulty is experienced in transmitting signals; but when the space to be traversed is great some new arrangement is required. Sometimes the radiator or receiver is raised to a sufficient height, or the expedient exhibited in Fig. 10 is adopted. Here the wing W, W are removed and an aluminum wire runs up from the receiver to the kite. This wire has the power of 'picking up' the waves and sending on the disturbance to the receiving tube, and thus producing the signal.

Using these two instruments, excellent signals have been transmitted between Penarth and Brean Down,

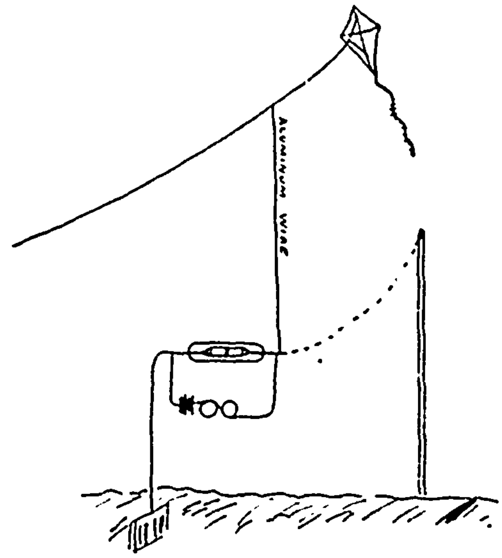


Fig. 10.

near Weston-super-Mare, across the Bristol Channel, a distance of nearly nine miles.

Marconi found that his receiver responded even when enclosed in a perfectly tight metallic box, and this fact has given rise to the rumor that he could blow up an ironclad. The difficulty which might be experienced in putting such an apparatus into the powder magazine of an enemy's ship seems to have been entirely ignored.—Methodist Magazine and Review.

ONTARIO LIGHTING PLANTS.

MARKHAM ELECTRIC LIGHT PLANT.

This plant, owned by Mr. W. J. Fletcher, of Alliston, was installed in July, 1896, and is managed by Mr. Wm. Trueman. The plant consists of a Royal 500 light generator, with skeleton switchboard, furnished with Royal instruments. Power is supplied by a 50 h. p. Wheelock engine and a 60 h. p. boiler. There are installed at present about 400 incandescent lights, and a contract with the town calls for thirty-one 32 c. p. street incandescent lamps.

CANNINGTON ELECTRIC LIGHT PLANT.

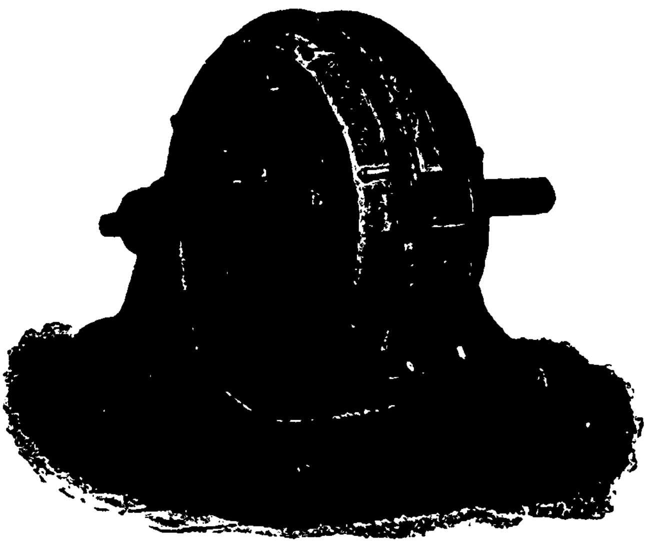
The lighting plant at Cannington, Ont., is owned and controlled by Messrs. Dobson & Son. It is situated in a substantial brick power house, adjoining the firm's woollen mills. Besides the arc and incandescent system, this firm have just installed a 25 h. p. Weston dynamo to furnish power to a carriage factory, printing office and bakery in the town. In addition to this dynamo the plant consists of a 750 light Fort Wayne generator and 50 light Ball arc machine, skeleton switch-board and Canadian General instruments. Power is supplied by a 45 h. p. Wheelock engine. This company have about 400 incandescent lights and 10 arc street lamps. The arc system was first installed in 1891, and the incandescent system added two years ago.

The Hamilton & Dundas Railway Co. have ordered a 200 k.w. 500-volt railway generator from the Canadian General Electric Company.

ELECTRICAL MACHINERY AT THE MERRITON CARBIDE WORKS.

The Willson Carbide Works Company, at Merriton, Ontario, is probably the only enterprise engaged in the manufacture of carbide of calcium, which is turning out that much discussed product, daily, up to its full capacity, and at a profit. The electrical apparatus used in this plant is of the most interesting character, having been specially designed by the General Electric Company to suit the peculiar conditions under which the manufacture of carbide can be successfully carried on.

The company have at present in operation four machines of 150 kilowatts capacity each, and have recently placed an order for two more of the same size, which will be in operation in the course of a couple of months. These generators are of the revolving field type, with stationary armatures, and are designed to run continuously twenty-four hours a day, at a load considerably in excess of the rated output, without a noticeable rise in temperature. The characteristics of these machines are such as to enable them to supply a proper amount of current for a furnace at the proper voltage,



150 K.W. C.G.E. GENERATOR FOR THE MERRITON CARBIDE WORKS.

no matter what the resistance conditions of the arc may be, and they may be short circuited repeatedly or even run on a short circuit without injury. The location of two of the power houses renders necessary a transmission at 1000 volts, and in this case step-down transformers of the Niagara type are used to reduce the current to the proper voltage for supplying the furnaces.

Altogether the detail and operation of this plant is most interesting, and its success in turning out carbide of calcium on a commercial basis is in marked contrast to the operation of several plants, on a much more ambitious scale, which have been established in the United States.

DIRECT-CONNECTED ARC UNITS FOR THE LACHINE COMPANY.

The Lachine Rapids Hydraulic & Land Company have ordered from the Canadian General Electric Company two direct-connected units for furnishing arc lighting from the citizen's station, from which they are at present supplying some 400 arc lamps, generated from steam power, with small arc machines of the "Wood" and "T-H" type. These new units will consist of synchronous motors of the three phase, revolving field and stationary armature type, each of which will be direct connected to two 125 light "Brush" arc machines. The motors will be wound to take current at 4,000 volts, direct from the primary circuit of the Lachine company, thus saving the cost and loss in operation entailed by the use of step-down transformers. The motors will be self-starting, and are designed to operate at a very low temperature up to the rated load. The efficiency of the arc plant, operated in this way, should be very high, that of the 125 light Brush arc machine being not less than 86% to 88% at full load.

QUESTIONS AND ANSWERS.

"BACKWOODS" writes: Sir,—As there are many in the backwoods like I am, I think it would not harm us if some of our societies would send you a list of the questions brought up for explanation at their meetings, and the answers given. Kindly insert this, and oblige.

"ECONOMY" writes as follows: Please say if using a dimmer decreases the amount of current used when decreasing the light. Does the dimmer not use up the decreased light? Would a lighting company allow me to put in a dimmer between the meter and transformer?

SIR,—In answer to James McPherson: I have had the same trouble myself, and don't know yet what is the cause. I found that graphite and a little cylinder oil cured it almost entirely. I did away with the sight feed lubricator, and made two cups out of pipe fittings and globe valves, and they work fine. If a good cup sight feed for graphite could be got, it would be so much better, and I would like to know of one.

"GEORGE."

"ONTARIO" writes, in reply to Mr. Wickens, that the pumps are for ordinary water pumping; one is 200 feet from boiler and has a pressure regulator to govern its working. The drying room is common live steam coils. Referring to Mr. Thomson's reply he says: My engine, a 9½" x 12", drives one 200 ampere 125 volt dynamo, and has a load of about 50 amperes for seven hours a day. Would I gain by lowering the pressure during that period to 50 lbs.; at present we carry 80 lbs.

"SUBSCRIBER" would like to ask Mr. Thomson how it is that in the "Green Economizer" tests they can have a sufficiently good natural draft, with a temperature of 200° after it has left the economizer. Would the pipes last long, or would they be giving out all the time if put inside? Is there any real economy in using live steam to heat feed water for the boilers?

"J. G." writes, in reply to Mr. Wickens: My building is already piped, and we can make no alteration in piping. We have a steam drum in boiler room, from which nine mains rise and go up to the different floors; also a return drum, where all the water comes back into, and then into a trap.

The author of a paper presented to an English society says that in the only case of a split steam pipe within his recollection the accident was caused by the boiler water having been allowed to prime into it, producing, probably, sudden contraction. It is difficult to see how water of the same temperature as the pipe could produce contraction. Water hammer would be a better explanation.

DYNAMO TROUBLES AND HOW TO OVERCOME THEM.*

By Percy Domville.

With modern uses of electricity the increase in the demand for light and power has, in many cases, proven too much for modern power stations to meet. These plants, installed ten or fifteen years ago, when the general application of electricity to purposes of illumination first became evident, have now become obsolete, or so far behind the times as to be unable to furnish a satisfactory service These same installations under ordinary circumstances, to the uninitiated, apparently give perfectly satisfactory results, and the question is often asked by directors of companies: "Why purchase new machinery when we are filling the bill with the old? have had a few mishaps, it is true, and the power has been shut off for short times now and then, but what does it matter if we do stop for a few minutes, or even hours, if we give all that is necessary during the rest of the time." Now, the consumer of the present day, when he pays for a thing, expects to get it. So it is with the man who is depending on the electric company to light his house or to furnish power to run his shops, as the case may be. It is in nine cases out of ten that the power is shut off at a critical moment; hence it is that these companies with obsolete machinery fail to keep their consumers, many of whom feel compelled to install the more isolated plant.

With the introduction of so many of these plants, it becomes necessary for the stationary engineer of the present day who is called upon to take charge of dynamos and motors in connection with his engineering duties, not only to be thoroughly posted as to the care and running of his engine and boilers, but to be somewhat of an electrician as well. Many times he is compelled, when he takes a position, to run chances of the machinery not getting out of order, and how often is he censured for the apparatus getting out of order when the injunction has been laid against him not to meddle with any portion of the machine or its adjustments. No engineer can take charge of an engine and boiler until he has passed a thorough examination as to his fitness. Still, machinery far more delicate and liable to get out of order is forced upon him. A mischievous person with a little smattering of electricity can give him no end of trouble when, if the engineer thoroughly understands the machinery, he could easily locate or determine the same.

It is not essential that he should cram his head full of the theory of that "mysterious force," but he should endeavor to post himself thoroughly as to the care and running of any electrical apparatus which may be placed under his charge. The modern dynamo is, as a rule, a well built machine, and if proper care be taken should require very little attention; but accidents will happen, and many dollars have been lost through the engineer not knowing what to do in case of an emergency. I therefore will endeavor to give you a few hints as to the care of a dynamo and an idea of some accidents which are likely to occur, and the best way to look for and repair the same.

POSITION OF THE DYNAMO.

To begin with the position of the dynamo cannot be too well looked after. More often than not, little consequence is attached to this important point, the dynamo being pushed into some dark, out-of-the-way corner, where not only is it next to impossible to see, should anything go wrong, but where it cannot be kept clean. It is most desirable that the position chosen should be in a cool, dry place, free from dust, where the machine can be readily seen and of easy accessability. This condition is not difficult to fulfil, and the engineer will benefit by it in the end. Plenty of room on all sides should be allowed, as it is not the most pleasant thing in the world to handle in cramped corners a dynamo which may be running at a high rate of speed and voltage.

In choosing a place for a dynamo the switchboard must not be forgotten. It is true that there may be but one switch and fuse block, but it is important to have them where they can both be seen and reached without loss of time. If possible, place the switchboard and dynamo where they and the engine can be readily seen from one point, and where, in case of emergency, they may be reached with the least possible delay. For instance, if a fuse blows out it should be in a position where it would be quickly noticed. The chief object in selecting a place for the dynamo which is free from dust is that dirt is one of the electrician's greatest enemies, and it can be safely said that over fifty of the so-called diseases of dynamos may be traced to this cause. A dynamo, in fact, any kind of electrical apparatus, cannot be kept too clean. In cleaning, merely a general wiping is not sufficient, but thorough inspection of every part, for it is the dirt in the out-of-the-way corners which gives the trouble.

THE COMMUTATOR.

In cleaning and inspecting a dynamo, perhaps the most important part to be attended to is the commutator. This, if it has been properly looked after, should have a dark polished surface, and every effort should be made to keep it in this condition. This can only be acquired by cleanliness and proper adjustment and care of the brushes. FIRST: See that no dirt has lodged between the segments or between the lead wires where they join the commutator bars. (A stiff dry brush is useful for this purpose). This is important, as many an armature coil has been burned out owing to short-circuiting at the commutator, caused by dirt or copper dust accumulating at the points mentioned. SECONDLY: The commutator may be running sparkless, and no fear of trouble suggest itself to the engineer. When the machine is stopped, however, careful inspection may show signs of burning along the bars. This should be remedied at once, for if allowed to remain the result will be badly sparking brushes and development of flats in the commutator. A fine file should be used to smooth the burnt parts, or if too far gone the commutator should be slightly burned down. This latter practice is nearly always necessary in the use of flats. It is difficult to explain just how these flats occur; there are three or four causes possible: (1) One of the bars may be of softer copper than the rest, and so wear away faster, but this is not likely; (2) a partial disconnection in the armature at the part connected to the particular flat bar, will cause a spark at every half revolution, so biting away the bar. The trouble in this case will, in all probability, be found where the lead wires join the commutator; (3) another cause of flats is a badly balanced armature, which, vibrating badly when running, will cause the brushes to jump and spark, burning away one or more of the segments. If the commutator is a new one, particular attention should be paid to keeping the segments firmly held in position. This can be done by tightening the nut or nuts at the end of the commutator. The commutator should frequently be smoothed with fine sandpaper and oiled until a finely polished surface is obtained.

As before mentioned the proper adjustment of the brushes plays an important part in the care of the commutator. There is no part of the dynamo that will give the novice more trouble than the brushes, and here again let me impress upon you the importance of cleanliness. A clean, well trimmed brush, properly adjusted in its holder, screwed down to bear against the commutator with just sufficient force to prevent jumping and consequent sparking and yet not so hard as to cause excessive wear, should give little trouble, provided the commutator is in good condition. See then that each brush is properly trimmed; that is, cut square across, and if copper, filed off at the proper bevel. If carbon the brushes should first be placed in the brush holders and a coarse piece of sandpaper inserted between them and the commutator. Then by rocking the rocker-arm the brushes are worn away to the shape of the commutator.

There is no general rule for the thicknesses of brushes, but one and one-half the thickness of the commutator bar is near the mark. The object is to have the brush wide enough to short circuit each section of winding for a certain brief time, in order that the current may be reversed; the power of the entire machine being dependent, of course, upon the principle of a rapidly opened and closed circuit creating an induced current. It is much easier to go astray in the thicknesses of brushes when copper is used, as the angle at which they are set is apt to vary. A very good practice is to make a cross section of the commutator, and brush holder full size. Then by drawing in the brush the proper angle can be found, and a piece of wood the shape of the brush can be cut for a template. In adjusting the brushes in the holders, take care that all the leaves, if copper, are in contact the whole width of the brush; if not the result will be a spark, and the longer the machine is allowed to run in this condition the worse it will get. This can be prevented by marking the length on your template and making a guage to set your brushes to. The same care should be taken to see that the brushes bear on precisely opposite bars of the commutator, or if a four pole dynamo, that they bear on bars that are a quarter of a circumference apart. A very good way is to mark the commutator bars with a centre punch, so that this adjustment may be verified. Having properly cleaned, trimmed and adjusted the brushes, seeing, of course, that they are all firmly screwed to the holders, they should be raised from

* Paper read before the Hamilton Association C. A. S. E., by Mr. Percy Domville, of the Westinghouse Company

the commutator by the hold-off catches, and left in this position ready for running.

Outside of the commutator and brushes a general cleaning up is necessary. Remove all traces of dirt from the frame, look carefully over all insulators of brush holders, binding posts, switches, field coil, ends, etc., also between the armature and pole pieces, inside the pulley and around the foundation. Turn the armature round by hand to see that nothing catches, and no loose wires or waste are adhering to it, and that the binding wires are loose. See that the oil cups are full and drip properly. If self-oiling, see that the oil wells are full. Then, seeing that all terminals are screwed down tight, the dynamo is ready to run.

STARTING THE DYNAMO.

Just a word about starting the dynamo. First, run your machine with the brushes raised and main switch open to see that all is right mechanically. Before closing the main switch make sure that the voltage is correct and brushes do not spark. To correct the latter fault rock the brushes forward or backward till a sparkless place is found, then close the main switch. I might here mention that it is also important to see that all dirt is removed from the switchboard and connections. Examine and clean occasionally the field rheostat contact and contact shoe.

MISHAPS AND BREAKDOWNS.

It would take too much time to go into all details of the mishaps and breakdowns which are likely to happen in the running of a dynamo, but I will mention a few most likely to occur.

BURNING OUT OF ARMATURES.—It is almost impossible to give any definite rules for the prevention of the burning out of armatures, owing to the probable cause of the trouble being difficult to foresee. Still there are a few points which should be remembered in this connection. As before mentioned, short-circuiting at the commutator is one cause. Burning of insulation under the binding wires will short-circuit the conductors. Short-circuiting in the armature itself is another cause which cannot be foreseen. All that can be done is to let the coil burn out and repair it afterwards. In drum armatures, and in those forms of ring armatures, which are so connected that the windings cross one another, this evil may occur in consequence of the abrasion of the insulation. Short-circuiting between an imperfectly insulated wire and the iron core beneath it is again a fruitful source of trouble.

FIELD MAGNETS.—As a rule, field magnet coils give little trouble, but when they do the difficulty is hard to locate owing to their compactness. Disconnections and short circuits are most common. When there is a disconnection the machine will probably refuse to excite itself. To make sure, the coils should be disconnected at the ends and tested. A common electric bell will tell you if the wire is continuous. If the wire is broken below the surface, the only way to get at it is to unwind it. A short-circuit between any two of the windings will have the effect of keeping the short-circuiting part cool whilst the rest is hot. The coil may be short-circuited on the frame, which can be tested with the bell.

SPARKING BRUSHES.—Any of the following will cause sparking brushes; copper or carbon dust between sections of commutator; copper or carbon dust or oily matter on brush holders causing leak to frame; open circuit in armature, overload, brushes not at neutral point; brushes covering too many segments; brushes not making good contact or loose in brush holder; flats in commutator; too weak a field wire of armature touching pole pieces.

A dynamo that has been giving little trouble suddenly ceases to generate. On examination everything is apparently in good order, and yet it is impossible to get a spark from it. First, look for an open circuit. This may be done with the electric bell, although it is not always a sure test, as a ring may be obtained when a wire is broken and held together only by insulation. Here dirt may play an important part. Look closely for it under the coupling screws, binding posts, and between the brush holder and brush holder rod. A very small particle may be responsible as the following will show: An arc lighting dynamo ceased to generate, in the manner mentioned. By short-circuiting the brushes it was found possible to obtain a flash, while outside of the brushes this was impossible. It was plain, then, where the trouble lay. The brush holder had already been examined, but on again looking, one of the insulators was found to be charred close to the rod for about an eighth of an inch. This was caused by dirt lodging between the insulators and brush holder. It was little, but enough to grind the brush holder on the frame. Other causes for machines failing to generate are explained as follows: A dynamo standing idle for some time may fail to light when wanted, through a wire in the field circuit being broken and held together only by insulation; or after the connections have been taken apart for the purpose of cleaning, and put together again, trouble has been caused through crossing connections to the field. An expert leaves an engineer in charge of an arc machine, and is called back without loss of time, as the machine will not work, and he finds the switch open in the field circuit. When closed the trouble ceases. In this case the trouble is caused by a matter so trifling as to escape the mind of the instructor.

During a thunder storm a flash was noticed at a dynamo following a vivid flash of lightning, and immediately all lights went out. The dynamo field refused to generate, giving the engineer in charge the mistaken idea that it was burned out. On investigation it was found that the flash had been caused by one of the binding posts short-circuiting on the frame, the result of lightning striking the line.

An engineer, after cleaning the brushes of a dynamo, could not obtain a spark from it. He had forgotten to screw the lower brushes against the commutator. Another, after hunting for a long time, took the cover off the fuse block and found the fuse blown. These experiences, likely to be met with at any time with any dynamo, are worth remembering.

These are a few of those difficulties which will come to every one in the responsible position of electrical engineer. There are many points about every machine which should be carefully watched, and faults to be remedied before they become serious. There is much that can be gained by experience, but a conscientious worker, giving all his mind to his duties, will find himself the gainer, for each day's experience will teach some new point, and what is learned in this way is not soon forgotten.

SPARKS.

The Kingston electric street railway will be extended to Kingston Junction at once.

The Hamilton & Dundas Street Railway have purchased a four motor G. E. 1,000 equipment from the Canadian General Electric Company.

Robert Patterson, who resigned his position as engineer at the Hamilton General Hospital to go to the Klondyke, was drowned in the Athabasca.

Mr. Jacob Morley, of New Hamburg, Ont., has placed his order with the Canadian General Electric Co. for a new 300 incandescent light dynamo, to be run in connection with his present system.

Wiarton is to have incandescent light. Messrs. Young & Crawford have closed a contract with the Canadian General Electric Company for a 35 kilowatt single phase alternator. Work on the installation of the plant is proceeding rapidly, and light will be turned on in about two weeks.

The Teeswater Electric Light Co., which has taken over the operation of the waterworks and electric light systems at Teeswater, has decided to install an incandescent electric lighting system, and for this purpose have placed an order with the Roya Electric Company for one of their 500-light S.K.C. generators with transformers, etc., the work of installation to begin at once.

The Willson Carbide Works Company, of Merritton, Ontario, have recently ordered two additional 150 kilowatt revolving field single phase alternators from the Canadian General Electric Company. These machines will be installed in their No. 3 power house, and with the four already in operation, of the same type, will give a total capacity of 900 kilowatts to be used in the manufacture of carbide of calcium.

The Imperial Electric Light Company supply electric light and power to customers in the eastern part of Montreal. An agreement was announced last month by which the Lachine Rapids Hydraulic and Land Company will supply the Imperial Company with the power necessary to supply this service. The power will be brought from Lachine to the Imperial Co.'s station on Rachel street for distribution.

The Light, Heat & Power Company, of Lindsay, have added to their incandescent plant a 120 kilowatt standard single phase alternator of the Canadian General Electric Company's latest type, with revolving iron-clad armature and compounded to secure automatic regulation. The Lindsay Company have already a 60 kilowatt and 30 kilowatt machine of the same type in operation for several years past, and with their new apparatus will have ample capacity to supply the incandescent lights, numbering between six and seven thousand, connected to their circuits.

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.

TORONTO NO. 1.

Toronto Association No. 1 desire to call the attention of engineers to the fact that they intend holding open meetings on the third Wednesday evening of each month. At the meeting in November a lecture will be given by Mr. J. J. Main, the well known boiler maker, on the construction of boilers, which promises to be very interesting. All engineers and manufacturers are invited to attend.

HAMILTON NO. 2.

Hamilton association are holding open meetings of instruction twice a month during the fall and winter. The association is quite prosperous. At the meeting on October 12th an interesting paper on "Dynamo Troubles, and How to Overcome Them," was read by Mr. Percy Domville, of the Westinghouse Company, which will be found on another page. A paper by Mr. E. J. Phillip, Toronto, is also printed elsewhere.

KINGSTON NO. 10.

The meetings of the above association are very instructive and profitable, and much interest is taken in the question box. It is the intention to prepare a set of models of boilers for the purpose of instructing the members in boiler construction, and to show how they should be stayed to strengthen them.

EVAPORATIVE CONDENSER OR COOLING TOWER.

At an open meeting of Hamilton Association C. A. S. E., Mr. E. J. Philip, chief engineer for the T. Eaton Company, Toronto, read by request the paper on "Condensers" presented at the recent annual meeting of the association at Brockville, supplemented by the following:

EVAPORATIVE CONDENSER OR COOLING TOWER.

The evaporative condenser or cooling tower is made to operate where the supply of water is limited, or where it has to be bought. This apparatus is in every way the same as an ordinary condensing plant, except that in addition to the air pump and condenser there is a tower for cooling the water after it has been heated by condensing the steam; its construction will be taken up later on. This apparatus is the outgrowth of the increasing number of steam power plants in recent years with vastly increased capacities, which has of necessity raised the price of the lower grades of coal. Whenever fuel goes up in price, or where the quantity is increasing, due to increased load, the steam user begins to look around for some means of reducing the rising fuel account. During the last few years engineers have had every opportunity to put in what may be called ideal plants, and others have had the opportunity to improve the plants under their control. How far many have succeeded is known only to themselves; if any part is a success it becomes known and is copied or improved on. The principal improvements during the last few years have been due to higher steam pressures, increased number of cylinders, and where water was at all available, running non-condensing; and the absence of water in sufficient quantity to use for condensing purposes at a point where it is desirable to locate a power plant has caused it to be located at some remote or less desirable point. The necessity of having water for condensing purposes being so necessary, it left no alternative.

The cost of running condensing and using water from a city main is out of the question, as it costs more for water than is gained by condensing. This being the case, it formerly left no alternative but to run non-condensing or build the plant where there was an abundant supply of water without regard to the disadvantage of the location. This has been overcome by improvements in an apparatus that has been used for years in a crude form for other purposes. The first purpose it was used for was for cooling water that had been used for cooling beer. This form of tower was simply a square frame work, filled with brush or limbs of trees; the water was pumped to the top through a sprinkler, and in falling over the loose brush, it spread out in thin sheets over the surface of the wood and was acted on by the air, the warm water causing a current of air to circulate through the filling. The present tower is simply an improvement on the first idea, and when used in connection with a steam engine it takes the place of a natural source of water supply.

With this apparatus a plant can be made to run condensing, with less water than it can run non-condensing. The reason of this I will explain after a description of the tower, which will now be in order: The cooling tower is usually square or rectangular in form, but it is sometimes made round, and is filled with partitions. The partitions may be made of any material. The Worthing tower is filled with tile. The Barnard tower is filled with wire netting, the Gradier with wood, and sheet iron has been used by different parties. Any material that will give a large surface will do, the object of the partitions being to spread the water out in thin sheets over the surface. The partitions do not extend to the bottom of the tower, but a space is left below them into which a fan discharges air. At the top of the tower a distributer is attached to distribute the water over the partitions. Now, the action is this: Imagine an engine condenser and taking its injection water from the bottom of the tower, (into which a quantity is put when the tower is first started). Now, when this water has condensed the steam, and passes on to the air pump, instead of to the pump discharging the water to the sewer, it discharges it to the top of the tower into the distributer, where it is evenly distributed over the filling. It spreads out in a thin film or sheet, and passes slowly down the partitions. The fan is running and its air is passing up between the partitions and acts on the water in three ways, thereby cooling it by the time it reaches the bottom of the tower sufficient to again condense more steam.

The way in which the water is cooled is: First, the water loses some of its heat by radiation from the piping between the tower and condenser, also from the sides of the towers. Next, the air is raised in temperature carrying off heat in this manner, and the last, and by far the greatest cooling effect, is obtained by the air evaporating a certain quantity of the water, carrying off heat in the vapor as latent heat.

I made the statement that with this apparatus a plant could be run condensing, with less water than it can be run non-condensing, and I will try and prove this. Take an engine running non-condensing, and using say 25 pounds of steam per h. p. hour, and taking its water from the city main; if it is say 100 h. p. it will use 2500 pounds per hour. Now, this water is being exhausted out into the air in the form of steam. If we attach a condenser and cooling tower to the engine, and it saves at the engine, say 20%, the engine will use 20% less water, which will make the water consumption 20 pounds per h. p. per hour, or 2000 pounds per hour for the 100 h. p. When condensing, instead of the water passing off as exhaust steam, it is pumped into the cooling tower, and for every pound of water evaporated by the air sufficient heat is carried off to cause a cooling effect sufficient to condense one pound of steam. If all the cooling effect that took place was due to evaporation, there would be water, neither gained nor lost, as there would be as much evaporated as condensed, but as I said before, a certain cooling effect by radiation takes place, and the water cooled in this way can do the work of condensing and is not evaporated. Then the rise in temperature of the air carries off considerable heat without evaporating any water, so that between these two sufficient water is saved to cause a slight overflow from the tower all the time, and as the boilers are using 20% less water, it follows that in this way you are running condensing with 20% less water than you can run non-condensing.

The tower that was built this summer where I am employed is a rectangular structure, 19 feet high, with a vapor stack on the top 9 feet in diameter and 26 feet high, the body of the tower being 10 x 12. It has an 18 inch water space at the bottom and two five foot fans. The filling is 12 feet long. The distributer is made of pipe, and works very nicely. The tower runs in conjunction with a 500 h. p. surface condenser with combined air and circulating pumps, built by the Northey Co., of Toronto. The condenser has 800 brass tubes 8 feet long, making over a mile of tubing, with 1600 stuffing boxes. The water leaving the condenser has a temperature of 120° to 128; it cools in the tower down to 68° to 80, according to conditions. It has been cooled down to 10° below the outside atmosphere, and by supplying plenty of air this could be done at anytime.

SPARKS.

The village of Sutton, Ont., will be lighted by electricity.

A new dynamo will be placed in the Russell House, Ottawa.

Leonard Ervin, electrician, Halifax, N. S., is announced to have assigned.

The electric plant at Magog, Que., will be completed before the end of the present month.

We understand that the Eastern Mining Syndicate, of Rossland, B. C., will install a complete electric plant.

The ratepayers of Cote St. Paul, Que., have decided to have electric light. A plant will be put in next summer.

Mr. R. B. Angus has succeeded Mr. G. C. Cunningham as a director of the Montreal Street Railway Company.

Mr. A. H. Deike, of Guelph, Ont., has invented an acetylene gas generator, for which he claims many advantages.

Mr. J. A. Cokers, manager of the Bell Telephone Company at St. Johns, Que., has put in a new long-distance telephone.

The Bridgewater Electric Light Co., Limited, Bridgewater, N. S., has been succeeded by the Bridgewater Power Company.

The Woodstock, N. B., Electric Light Co. is said to have been fined $50 for failing to register under the electric light inspection act.

W. H. Green, of Wingham, has been given the contract for electric lighting for Listowel, Ont., and will erect the power house and put in the plant at once.

An English syndicate, with large capital, is said to be negotiating for the purchase of the franchises of Canadian lighting companies, both gas and electric.

The Bushnell Oil Company have just completed extensive works at Sarnia, Ont. The works cover over 13 acres of ground, and cost upwards of $175,000.

The Canadian General Electric Company are installing a 200 light direct current incandescent plant for the North American Bent Chair Company, Owen Sound, Ont.

William Peterson & Company, Limited, of Brantford have put in a 200 16 c.p. light dynamo. It is a 100-volt machine, manufactured by the Stevens Mfg. Co., of London.

The Lake of the Woods Milling Company at Keewatin have ordered a 25 kilowatt, steel frame, multipolar, direct current generator from the Canadian General Electric Company.

The Dominion Electric Heating & Supply Company, of Ottawa, have made a proposition to supply light and power to the village of Papineauville, Que. An exclusive franchise for 35 years is asked for.

The earnings of the Toronto Street Railway Company for the months of July, August and September show an increase of $35,323 over those for the same period last year, due to Sunday cars and conventions.

Prof. James J. Guest, recently assistant professor of mechanical engineering at McGill University, Montreal, has been appointed professor of mechanical engineering in the Polytechnic Institute at Worcester, Mass.

The formal opening of the street railway at Sherbrooke, Que., took place on November 1st. The service of the road will be about twenty minutes in the city and forty minutes to Lennoxville, a total length of five miles.

The German post-office is experimenting with an invention, an electric typewriter apparatus, which, at a cost of $125, can be connected with a telegraph wire, and messages which are typed off on the keyboard at one end reproduced at the other end.

The bankrupt stock of C. W. Henderson, Montreal, has been purchased by Geo. Cline. The electrical supplies, amounting to $2,639, sold for 44 cents on the dollar; manufactured goods, amounting to $1,081, 32 cents; and the machinery, value $801, at 76 cents.

Mr. W. C. McDougall, a well-known mining man, is reported to have organized an English company to build smelters at Grand Forks, B.C., in connection with which electric tramways will be employed for carrying the ore. The company is capitalized at $2,000,000.

The Chatham Gas Co., of Chatham, Ont., who have been operating an arc and incandescent plant in that town for the last ten years, have decided, owing to the corporation installing a plant and doing the street lighting, to go more extensively into incandescent lighting, and for this purpose have purchased a 2,000-light alternating dynamo from the Royal Electric Co., which is to be installed at once.

The City Council of St. Thomas, Ont., has decided to submit a by-law to the ratepayers on Tuesday, November 30th, to guarantee the bonds of the street railway to the amount of $50,000 and pay the first year's interest, in consideration of the horse car railway being electrified.

The village of Iroquois, Ont., defeated a by-law last month to borrow $8,500 to purchase an electric light plant, the majority being twelve votes. There is said to be a good opening there for a private company to put in a plant, as the corporation have a wheel pit, intake pipe and tail race.

It is rumored that Mr. H. B. Spencer will resume his former position as assistant superintendent of the eastern division of the C.P.R. Mr. Spencer's position as manager of the Hull Electric Railway is being temporarily filled by Mr. John Brown, the superintending electrician.

The Minister of Public Works proposes to ask parliament for a large vote for extending the government telegraph lines in the Northwest and British Columbia, where already the Dominion government owns 700 miles of telegraph lines. The department is at present considering whether it will be better to extend the present line from Quesnelle, B. C., to Dawson, which will be a long way through a wild and unknown country, or simply to build a short line, about 70 miles in length, across the Chilcoot pass, connecting Dyea with Teslin lake.

The annual meeting of the Standard Light & Power Company was held in Montreal last month. The agreement made by the directors for the purchase of the 1,000 horse power from the Lachine Rapids Company was ratified, the power to be distributed by the Standard Company in the centre of the city. The following board of directors was elected: Messrs. J. H. Burland, Peter Lyall, W. S. Evans, W. McLea Walbank, L. H. Henault, Ste. Cunegonde; F. Dagenais, St. Henri, and M. P. Davis, Ottawa. At a subsequent meeting of the board the following officers were elected: Mr. W. McLea Walbank, president; Mr. J. M. Burland, vice-president; Mr. E. Craig, secretary.

Mr. Adam Rutherford, formerly secretary-treasurer of the Hamilton, Grimsby and Beamsville Electric Railway Company, recently entered action against the company claiming $5,000 damages for alleged wrongful dismissal from the position of secretary-treasurer, and $833 salary in arrears. Mr. Rutherford was the promoter of the company, and was awarded $2,000 stock in payment of his services, and subsequently engaged as secretary-treasurer at a salary of $800 a year, to date from March 1st, 1894. The defence alleged that the grant of stock covered payment for his services until a year later. After a conference between the parties a settlement was arrived at under which Mr. Rutherford received $233 and each side paid its own costs.

The Electrical Engineer states that figures recently compiled from nearly 1,100 plants, with 300,000 lights, scattered over 46 states, and including stations of all sizes under all conditions, show the general average contract price for arc lights, burning 3,326 hours a year, with coal costing $3.03 per ton, to be $101.18. In Pennsylvania, where coal costs $1.56 per ton, the average price is $85.75, while in Ohio, with coal at the same price, the average cost is $78.87. But in Pennsylvania the average burning is 3,931 hours per year, whereas in Ohio it is only 3,350 hours. In California, with coal $7 per ton, the average price per light is $119.68, while in Colorado, with coal at only $3.18, the lamp price reaches $129.31. It will thus be seen that the average price of arc lighting depends largely upon local conditions, cost of labor, fuel, etc.

The term 'horse power' when applied to a boiler is always misleading, says Power, besides being a misnomer to start with. A hundred horse power boiler will supply steam for a modern engine to develop 200 horse power. The term should be avoided when speaking of boilers whenever it can be gracefully done, and we notice with gratification that an English writer says of water-tube boilers that 'the approximate cost erected is £96 per 1,000 pounds evaporation.' That is to say, you can buy and erect for £96 enough boiler to evaporate 1,000 pounds of steam per hour. You can use the steam in a pump at an expense of 200 pounds per hour per horse power, making the boiler supply five horse power, or in a compound engine at an expense of 13 or 14 pounds, making the boiler supply 70 horse power, or you can it for boiling glue and generate no horse power at all.

ELECTRIC RAILWAY DEPARTMENT.

ELECTRIC POWER FOR TRUNK-LINE RAILWAYS.

The subject of the application of electric power on trunk-line railways, and the extent to which this power is likely to be employed in the near future for trunk lines of considerable length, is just now attracting much attention from electrical engineers, manufacturers and capitalists. In the Engineering Magazine for October the subject is very ably dealt with by Mr. George Forbes, the designer of the Niagara power plant. After pointing out that in many cases the circumstances differ, and that the amount of suburban traffic, facility of obtaining water power for generating electricity, and other special features must all be considered in weighing the advantages of the electric over the steam road, he makes the following reference to the Niagara Falls Park and River Railway, as being constructed and operated on the same principles as a steam railway :

"This railway is 12 miles long, of double track, resembling in every way the standard adopted by the Canadian Pacific Railway. The maximum speed attained is 30 miles an hour. Trolley wires are used. There are two motor houses ; one at the falls, worked by water power, the other a small auxiliary station at the Queenstown end of the road, with steam plant. There is 15 minutes' headway between cars, the average speed, including stoppages, being 13 miles an hour. Locomotives, in the ordinary sense of the term, are not used, but twenty-two motor cars supply this service, and are followed by trailers, etc. Some of the cars, when fully loaded with passengers, weigh more than twenty tons. There are eight regular stopping-places along the line, furnished with platforms. This railway has been referred to, not because of any special merit which it possesses, but because it is not a street railway, and because it shows a method of working. In fact, reference is made to it partly to draw attention to the extremely objectionable feature of it. When water power was available, it was not good policy to use steam power at a distance of 12 miles. Of course, if the electric pressure were only 500 or 600 volts, there would be a great waste of energy or an enormous expenditure of copper in carrying the current to even that short distance ; but there would have been no difficulty in transmitting electrical power at high pressure, transforming it down, and converting it into a continuous current. This would have saved nearly the whole expense of working the steam plant. It is important to give attention to this matter of the use of water power on trunk railways. There has been an absurd hesitation to undertake the transmission of power to great distances. If engineers who have had experience in the transmission of power and in the conversion of alternating into continuous currents would look into this question, they would be convinced that where water power is available it is generally economical to transmit electrical power hundreds of miles for working railways. As an example, it can be proved that, if the railway companies of Scotland were to combine to work their trunk lines by means of electric locomotives, the electric current being developed by the water power which exists in that country, then the whole of that service might be carried on without the use of steam locomotives. Another lesson to be drawn from a careful consideration of the subject is that the waste of coal on steam locomotives is not by any means compensated by the extra cost and loss of power in electrical transmission. Estimates have been prepared which show that not only is the cost of copper prohibitive, but that the efficiency of the electric system renders the consumption of coal with stationary engines about as great as with locomotives. This is certainly not the case. The cost of electric transmission, when properly effected, is not comparable with what it is as calculated on the lines adopted in the past ; and, on the other hand, the efficiency of dynamos and motors has not been sufficiently considered in street railway practice in the United States. A very large part of the success of the Liverpool Overhead Railway is due to the high efficiency of the electrical machinery."

Reference is then made to the Baltimore tunnel, operated by electricity, the Liverpool overhead railway, and the City and South London electric railway, each of which possesses distinguishing features, and in the operation of which electric traction has been successful in competition with steam.

The reason why trunk lines have not been worked by electricity is claimed to be because the cost of transmitting electric power has been considered too great. The author points out that in a great deal that has been written on the subject it has been assumed that the electric pressure upon the feeders is only some 600 or 700 volts, while it is an indisputable fact that the feeders may be supplied with current at 10,000 volts or more, which may be in the form of continuous current, but which is more manageable as an alternating current.

At different stations along the line it would be reduced in pressure by means of transformers, and converted into continuous current by means of a commutating machine. It is in this point that machinery for working the proposed system has been the least developed. The commutating machine now on the market, introduced first by Mr. Shuckert in Germany, and applied in various factories at the Niagara works, is usually called a rotary transformer. It does its work admirably, but it is expensive, cumbrous, and requires continual attention. This last fact renders it impossible to lay such machines along a trunk line at distances of a few miles. But I have prepared the designs for a transforming and commutating machine free from all the defects referred to, which can be manufactured at small cost. After wide experience and laborious study of the whole question, the opinion of the present writer is that, as a rule, electric locomotives, with the power developed by steam, would, if the work were carried out on proper lines, be cheaper than the steam railroad up to a distance of between 40 and 50 miles from the power station. If water power were available for generating the electricity, the distance at which steam power would begin to be the cheaper on a busy line is several hundred miles. These statements are the result of calculations with coal at a dollar and a half per ton. This economy arises from the well-known fact that in the best trial tests of locomotives five pounds of coal are required for the h.p. hour, and from the fact, equally well known, that so good a result is rarely attained, in nearly every case the consumption of coal being several times as much as that indicated. These conclusions, however, do not give much encouragement for the substitution of electricity for steam, except in special cases. A time may come when special railroads will be built over long distances to be worked electrically, and in that case there are advantages of a totally different character which will favor electricity, depending upon the fact that the locomotive will be abolished and power applied to every axle of the train.

The conclusions arrived at by Mr. Forbes, from many years of study, are as follows :

(1) In cases where water power is always available within a few hundred miles of a trunk line of railway, it is probable that economy would be served by introducing electric traction.

(2) In the case of an independent system of railway to be constructed in a new country utterly unaffected by the traffic from steam railroads, power can be applied to every axle of the train ; wherefore it will be economical in such a case, in construction and in operation, to use electric propulsion in preference to steam.

(3) For desert railways, where water cannot be obtained, electric traction is eminently suitable.

(4) In underground railways, such as the Baltimore tunnel and the London underground system, where economy is not so important as convenience and comfort, electricity must be employed ; and, where such railways are to be constructed, economy makes electricity advisable.

(5) In cases of suburban traffic electricity would help to overcome the competition with street railways by supplying the public with separate and independent cars running at very frequent intervals on a well-maintained track.

CREATING TRAVEL ON ELECTRIC RAILWAYS.

A MANAGER of a successful street railway, referring to the working up of excursion business on trolley roads, says :

"On a steam road the company asks its patrons to spend dollars, while on a trolley system we ask them to spend nickels, so how much more will they be open to persuasion? A resort to which a steam road carries passengers costs at least a dollar to reach, and it is an excursion people think about before taking, and they do not take it very often. With a nearby resort, reached by a trolley line, a man will make up his mind on an instant, perhaps, on seeing an advertisement. He can reach there in an hour or less, and it only costs 5 cents, and with a few more nickels he can spend an enjoyable evening. There are thousands of people who have a quarter, or 50 cents to spend who will go to a nearby resort in the evening if they think they can have a good time, and many of them have families they will take with them. It is my business to tell them where to go and what to do when they get there. For that purpose I keep in touch with all the proprietors of the summer resorts around the city, and just as soon as a novelty is introduced I let the people know of it, either by means of placards on the cars or else I fix up some sort of an attractive circular, always striving to avoid the commonplace." - Street Railway Review.

The receipts of the Hull Electric Railway for this year have exceeded those of last year by $31,000. The company contemplate building a fine boating and bathing house at Queen's Park, Aylmer, next spring.

SPARKS

There is talk in Brantford of [illegible] ric road to Paris, a distance of seven miles.

Toronto capitalists are said to contemplate the construction of an electric railway between Woodstock and Ingersoll.

This year the Montreal Street Railway Company have placed 36 new cars on their lines. About 200 cars all told are now in use on the company's lines.

The street railway in Victoria, B. C., is being greatly improved. Government street is being double-tracked, and a large number of new motors brought into use.

The Sarnia Gas & Electric Company are installing a 60 kilowatt Canadian General Electric single phase standard alternator to meet the demands of their rapidly increasing incandescent lighting business.

The number of passengers carried by the Quebec electric railway is said to have reached 243,000 during September. The new stock of $80,000 issued to raise the total stock to $400,000 was at once taken by the former stockholders.

A movement is said to be on foot in Peterboro for the purchase from the Grand Trunk Railway Company of the lines of railway extending from that town to Lakefield and Chemong, with a view to their conversion to electric roads.

The electric street railway is a great benefit to Ottawa. The average number of men employed is 300 and the pay roll $10,000 per month. When the company commenced business three years ago they had eight cars, now 100 are necessary to conduct the traffic of the road.

It is rumored that a movement is on foot to construct an electric railway from Oshawa to Toronto, equipped to carry passengers and farm produce to the city. The promoters aim to interest prominent men in the municipalities along the route in the enterprise and induce them to become stockholders.

Mr. H. A. Dauphin, manager of the Bell Telephone Company, at Quebec, recently received from Hamburg a submarine cable to replace the one between Quebec and Levis, which was destroyed last winter. The new cable rolled up formed a cylindrical mass four feet wide and eight feet in diameter, and weighed 18,000 pounds. It was 3,000 feet long, 2¼ inches in diameter and contained six wires.

A suit for $100,000 damages was recently begun at Osgoode Hall, Toronto, by the Toronto and Richmond Hill Street Railway, against the township of York. The suit arises out of the failure of the township to permit the company to build its railway through the township to Richmond Hill. Four miles of track were laid, and ten or twelve miles remained to be completed. The people of the township voted for the issuing of $60,000 in debentures, and afterwards the council failed to carry out their decision.

The Montreal Street Railway Company have declared a semi-annual dividend of four per cent., and in addition a bonus of one per cent. It is said that the forthcoming statement will show that the company has made during the past year a good sized decrease in operating expenses. The expense of operation in 1895 was 59.20, and in 1896 was cut down to 56.48. This year it is not expected to be within two per cent. of as much as last. The earnings, over and above all dividends, expense of operation, etc., last year amounted to $102,106.79.

The Chateauguay & Northern Railway at Montreal are making preparations to handle an extensive freight business in connection with the Canadian Pacific Railway. They have ordered from the Canadian General Electric Company, four motor G.E. 1,000 equipment, with four motor controllers and commutating switches. This outfit, though of less capacity, is similar to the large locomotive recently supplied by the Canadian General Electric Company to the Hull Electric Company, which has handled as many as thirty-three cars on a shunt.

A company is said to have been organized at Hamilton under President Myles, of the Hamilton, Grimsby and Beamsville railway, with a capital of $200,000, to extend the electric railway from Beamsville to St. Catharines, a distance of 12 miles. The line will follow down the Queenston stone road, and be commenced, if nothing prevents, in the spring. Much activity is also being shown among the promoters of the electric road between Hamilton and Guelph. Mayor Hewer, of Guelph, is in correspondence with the authorities at Hamilton. This road would have been built months ago, but for the opposition of the farmers of Waterdown and Mountsburg.

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 this series of tests complete in every particular.

WM. THOMPSON.

[ARTICLE VII.]

STRENGTH OF BOILERS.

A STANDARD boiler, constructed in accordance with the Canada Steamboat Act, is assumed to have a maximum working pressure of one hundred pounds to the square inch and be forty-two inches in diameter, and, if made of best refined iron plate, shall be at least one-quarter inch thick, made in the best manner.

If boiler is made of steel, a maximum working pressure of one hundred and twenty-five pounds to the square inch is allowable; diameter and thickness of plate as above.

The tensile strength of the material for iron is to be taken as 48,000 pounds per square inch of section with the grain, and 42,000 pounds per square inch across the grain, and for steel 60,000 pounds per square inch. And when boiler and all joints are constructed in best manner, four may be taken as a factor of safety.

From the foregoing standard it at once becomes apparent that the required thickness of plate varies directly with the diameter of the boiler, and the safe working pressure varies inversely with the diameter.

From this we might construct the following formula to obtain the safe working pressure of any boiler:

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

Where TS = tensile strength of material,
2T = twice thickness of plate in inches,
D = diameter of boiler in inches,
FS = factor of safety,
P = safe working pressure.

It becomes evident, however, that since plate must be somewhat weakened by having holes drilled or punched in it to receive the rivets by which the plates are fastened together, and that the rivets themselves must have a direct effect on the strength of the seam, it is necessary first to determine the strength of the punched plate at the joint as compared with the solid plate, and also the strength of the rivets as compared with the solid plate.

The well-known axiom that the strength of a chain is its weakest link is borne out here in a remarkable degree, and the weakest part of a boiler is certainly the strength of that boiler.

Consequently, before we can determine the safe working pressure of a boiler, its required diameter or required thickness of plate, we must first determine strength of all rivetted seams.

It is self-evident that the strength of any section of plate must be its width multiplied by its thickness, multiplied by the weight required to break it.

For example, let us assume we have a piece of boiler plate one inch in width and one-quarter inch thick, and that it broke when a weight equal to 48,000 pounds per square inch of section had been applied to it. We should require to exert a force equal to $1'' \times .25'' \times 48000 = 12000$, which is the greatest possible strength we may expect to get per sectional inch of this plate.

Suppose, now, we drill a hole in the centre of this plate, we clearly reduce its sectional area and consequently its strength. Obviously, then, both the pitch of the rivets and their diameter must be taken into consideration in computing strength of plate at seams as compared with the solid plate, and we might say that width of plate in inches minus diameter of rivets, multiplied by number, and difference multiplied by thickness of plate in inches, multiplied by tensile strength of plate per square inch of section, will equal strength of plate at joint, or

$$p - (d \times n) \times T \times TS = s;$$

and since we want to know what percentage of strength punched plate bears to solid plate, we may modify this formula and get the formula required by Board of Trade Rule:

$$\frac{(p - d) \times 100}{p} = \text{percentage of strength of plate at joint as compared with the solid plate.}$$

We now have found the strength of plate when prepared for the rivets, and must now consider the strength of the rivets employed to fill up these holes, so that the operation of making the seam may be completed.

As already seen, the plate has been weakened by having had holes made in it. We now proceed to fill up these holes with rivets, and I need hardly point out that if the strength of the plate is greater than the strength of the rivets, and the boiler loaded to the strength of the plate, the rivets will give out by shearing across. We endeavor to get as strong a joint as possible, and for this purpose put in as many rivets as practicable in a seam. Suppose, however, we put the whole of the rivets in one row, we have reduced the plate area, and the stronger our rivet section becomes the weaker becomes the sectional area of the plate at the joint.

Therefore it is customary to divide the rivets into two, three or more rows, as by doing this the same strength of rivets is retained and the rivets are pitched a reasonable distance apart, enabling a fair percentage of strength to be obtained in the plate.

Then, if we knew the shearing strength of rivets per square inch of section, we may say that $d^2 \times .7854 \times Ss$ = shearing strength of rivet when only one row of rivets is used. Then $d^2 \times .7854 \times Ss \times N$ = shearing strength of rivet when two or more rows are employed.

Where d^2 = diameter squared,
.7854 = constant,
Ss = shearing strength of rivets,
N = number of rows of rivets.

Then,

$$\frac{d^2 \times .7854 \times Ss \times N \times 100}{p \times T \times TS} = \text{percentage of strength of rivets as compared with solid plate.}$$

Since both shearing and tensile strength of plate may be considered as equal, we may cancel these and proceed to get strength of rivets by formula adopted by Board of Trade:

Where

$$\frac{a \times N \times 100}{P \times T} = \text{percentage of strength of rivets as compared with solid plate.}$$

Where a = area of rivets,
N = number of rows,
P = pitch in inches,
T = thickness of plate in inches.

From these two formulae, then, may be ascertained both the strength of plate and rivets as compared with solid plate, and it follows that the least of these percentages is the strength of the joint.

NOTE: When rivets are exposed to double shear, percentage of strength obtained from foregoing formula may be multiplied by 1.75.

Example (1): Find the strength of plate at the joint as compared with solid plate if the rivets are ½ inch in diameter and pitched at 2½ inches.

$$\frac{P - d}{P} \times 100 = \frac{2.5 - .5}{2.5} \times 100 = 80\%,$$

strength of plate at joint as compared with solid plate.

Example (2): Suppose that pitch and diameter of rivets in a double-rivetted joint are same as in example No. 1, and thickness of plate equals half an inch, what will be the strength of rivets as compared with solid plate?

$$\frac{a\ \ n}{P\ \ T} \times 100 = \frac{5^2 \times .7854 \times 2}{2.5 \times .5} \times 100 = \frac{.393}{1.25} = .3144 \times 100 = 31.44\%,$$

strength of rivets as compared with solid plate.

As a rule it is understood that diameter of rivets may be same thickness as plate, but with thin plates this rule will not hold good, as in the present case it is evident that strength of rivets at joint is far too weak, and it would simply be absurd to construct a joint on these proportions. To increase strength of rivets we must either decrease pitch or increase diameter of rivets. It is considered good practice to have the percentage of strength at the joint or seam 70% of the strength of the solid plate. We can therefore decrease the percentage of strength of the plate by increasing the diameter of the rivet to ¾ of an inch, and at the same time increase the strength of the rivets.

Then,

$$\frac{P - d}{P} \times 100 = \frac{2.5 - .75}{2.5} \times 100 = 70\%,$$

percentage of strength of plate at seam as compared with solid plate, and

$$\frac{a\ \ n}{P\ \ T} \times 100 = \frac{.8834}{1.25} \times 100 = 70\%,$$

strength of rivet as compared with solid plate.

It will be readily seen that the most economical joint is one in which the plate and rivet sections are equal in strength. As already pointed out, if one section is stronger than the other it creates a decided disadvantage, as the weakest part of a joint must be its strength, and in a case like the foregoing we might with advantage put half the difference between the strength of the section on to the weakest section.

The easiest way to arrive at this, then, is to equate the formula for the rivet section to that for the plate section:

$$\frac{P - d}{P} = \frac{d^2 \times .7854 \times n}{P \times T}$$

We can now, by a simple transposition of formula, find a pitch that will give equal percentages:

$$P = \frac{a \times \text{No. in one pitch}}{T} + d.$$

Example: What pitch will the rivets of a double rivetted seam have to be so as to secure an equal percentage of strength in rivets and plates at the joints, shell plate being half inch and diameter of rivets ¾ inch?

$$\frac{d^2 + .7854 \times 2}{.5} + .75 = \frac{.8834}{.5} = 1.76 + .75 = 2.50 = \text{pitch}.$$

Proof:

$$\frac{2.50 - .75}{2.50} \times 100 = 70\%.$$

$$\frac{.75^2 \times .7854 \times 2}{2.5 \times .50} \times 100 = 70\%.$$

I will again repeat these two most important formulæ, and recommend the student to commit them to memory:

$$\frac{(\text{Pitch minus diameter of rivets}) \times 100}{\text{Pitch}}$$

equals percentage of strength of plate at joint, as compared with solid plate, and

$$\frac{(\text{Area of rivets} \times \text{No. of rows}) \times 100}{\text{Pitch} \times \text{thickness of plate}}$$

equals percentage of strength of rivets, as compared with the solid plate.

APPLICATION OF OHM'S LAW.

An examination of the preceding article on Ohm's law establishes three important rules, viz.:

1. The current varies directly with the electromotive force or potential, and inversely with the resistance.
2. The resistance varies directly with the electromotive force, and inversely with the current.
3. The electromotive force varies directly both with the current and resistance.

For practical operating engineers, these rules, based on Ohm's law, are the fundamental principles underlying most electrical calculations. It is important that the principles be thoroughly understood, and I regret that, in a work of this kind, full details cannot be given, for want of space. Before proceeding to an exposition of these principles by mathematical problems, I wish particularly to point out to my readers the desirability of their acquiring literature dealing with fullest details of Ohm's law.

Bearing in mind the fact that these articles are written especially for engineers operating electric plants, I shall content myself with giving principles and formula especially adapted to their requirements.

It may be well to mention that whatever is included in a circuit forms a portion of it. Be it the generator itself, convertors, meters, or any apparatus in connection with the generation or transmission of an electric current, and the resistance of both line and apparatus, must necessarily be included in resistance of circuit.

The resistance of a generator is nearly always referred to as internal resistance, and that of the outer circuit or line as external resistance, to distinguish between them, and the two resistances added together from the total resistance of the circuit, or the R of the formula.

Example (1): An electric generator having an internal resistance of 5 ohms and an E.M F. of 50 volts, sends a current through a line of copper wire whose resistance is 25 ohms; what is the current?

$$C = \frac{E}{R}, \text{ then } 5 + 25 = 30 \text{ ohms total R, and}$$

$$\frac{50}{30} = 1.66 \text{ amperes.} \qquad \text{(Rule 1.)}$$

Example (2): A difference of potential (E.M.F.) of 110 volts is maintained in an electric circuit, and a current of 250 amperes is the result. What must be the resistance of the line?

$$R = \frac{E}{C}, \text{ then } \frac{110}{250} = .44 \text{ ohm.} \qquad \text{(Rule 2.)}$$

Example (3): A generator having an internal resistance of 1 ohm sends a current of 50 amperes through a circuit having an external resistance of 2.5 ohms? What is the electromotive force of the generator?

$$E = R\ C, \text{ then } 1. + 2.5 = 3.5 \text{ ohms total R,}$$

$$\therefore 3.5 \times 50 = 175 \text{ volts.}$$

MOONLIGHT SCHEDULE FOR DECEMBER.

Day of Month.	Light.	Extinguish.	No. of Hours.
	H.M.	H.M.	H.M.
1....	P.M. 11.10	A.M. 6.10	7.00
2....	....	" 6.10	6.10
3....	A.M. 12.00	....	
4....	" 1.30	" 6.10	4.40
5....	" 3.00	" 6.10	3.10
6....	" 4.00	" 6.10	2.10
7....	" 4.20	" 6.10	1.50
8....	No Light.	No Light.	.....
9....	No Light.	No Light.	.....
10....	No Light.	No Light.	.....
11....	P.M. 5.00	P.M. 8.40	3.40
12....	" 5.00	" 8.40	3.40
13....	" 5.00	" 9.40	4.40
14....	" 5.00	" 10.50	5.50
15....	" 5.00	A.M. 12.00	7.00
16....	" 5.00	" 1.00	8.00
17....	" 5.00	" 2.00	9.00
18....	" 5.00	" 3.10	10.10
19....	" 5.00	" 4.30	11.30
20....	" 5.00	" 5.50	12.50
21....	" 5.00	" 6.10	13.10
22....	" 5.00	" 6.10	13.10
23....	" 5.00	" 6.10	13.10
24....	" 5.00	" 6.10	13.10
25....	" 6.00	" 6.10	12.10
26....	" 6.00	" 6.10	12.10
27....	" 6.00	" 6.10	12.10
28....	" 6.00	" 6.20	12.20
29....	" 6.00	" 6.20	12.20
30....	" 6.00	" 6.20	12.20
31....	" 6.00	" 6.20	12.20
		Total......	229.50
		Grand total......	2187.25

Specifications have been prepared by Mr. George White-Fraser, of Toronto, for the electric light plant to be installed at Fort William, Ont.

I. J. Gould, of Uxbridge, Ontario, is equipping his plant for the supply of incandescent lighting, and has made a contract with the Canadian General Electric Company for a 30 kilowatt single phase alternating plant.

TRADE NOTES.

Belding, Paul & Co., of Montreal, have ordered a 25 k.w. generator from the Canadian General Electric Co.

Capt. Mann, of the Hillsdale Conservatory, has purchased a thirty horse power boiler from the Goldie & McCulloch Company, of Galt.

The Canadian General Electric Company are installing an isolated direct current plant for the Raymond Mfg. Company, Guelph.

The Canadian General Electric Company are installing a 60 kilowatt single phase alternating incandescent plant in the town of Magog, P.Q.

The Clayton Air Compressor Works, of New York, have issued a very complete catalogue of their air compressors, containing numerous illustrations, tables and testimonials.

The Canadian General Electric Company are installing a single phase alternating plant for incandescent lighting, for Jacob Morley, of New Hamburg, Ont.

The attention of our readers is called to the announcement in our advertisement pages of the Victoria Tripolite Co., of North Sydney, C.B. This company manufacture Victoria Fossil metal covering for boilers, pipes and all heated surfaces. Their claims for the advantages to be derived from using this material are supported by testimonials of a number of well-known manufacturing concerns.

The Canadian General Electric Co. have sold a $17\frac{1}{2}$ k.w. steel frame multi-polar dynamo to the Ottawa Gold & Silver Mining Co., of Keewatin, Ont.

Messrs. Duclos & Payan, St. Hyacinthe, Que., have ordered a 200 light direct current incandescent plant from the Canadian General Electric Company.

The large Brodie mills at Hespeler, Ont., are to be lighted by electricity, a contract for a 140 arc light plant having been given to the Stevens Mfg. Company, of London, Ont.

The Robb Engineering Company, of Amherst, received a cable from England a fortnight ago ordering three more Robb-Armstrong engines. They are, it is thought, for a new electric railway in Sheffield.

La Cie Electrique de Roberval, Chicoutimi county, Quebec, have placed an order with the Canadian General Electric Company for a 60 kilowatt single phase alternating machine of the company's standard iron-clad armature, compound type.

CANADIAN GENERAL ELECTRIC CO.

(LIMITED)

HEAD OFFICE: **65 FRONT STREET WEST, TORONTO, ONT.**

Factories: *PETERBOROUGH, ONT.*

BRANCH OFFICES AND WARE-ROOMS:

1802 Notre Dame St.	MONTREAL.	Main Street	WINNIPEG.
138 Hollis Street	HALIFAX.	Granville Street	VANCOUVER.

NELSON, B. C.

NIAGARA FALLS LIGHT & POWER CO.—
TWO 120 K.W. SINGLE PHASE STANDARD ALTERNATORS.

OUR SINGLE PHASE

Revolving Armature Compounded Alternators are the Recognized Standard where Incandescent or Arc Lighting Service is required from Alternating Currents.

WE MANUFACTURE . .

THREE PHASE APPARATUS
TWO PHASE APPARATUS
MONOCYCLIC APPARATUS
SINGLE PHASE APPARATUS
DIRECT CURRENT APPARATUS

SPARKS.

Instruction in electricity is now given by the Y.M.C.A., Hamilton, Mr. Hamilton being instructor.

The contract for lighting the village of Glencoe, Ont., by electricity has been awarded to W. Gordon.

The Valleyfield Electric Company have ordered two 500 light direct current generators from the Canadian General Electric Company.

The city council of Montreal is taking action against the Montreal Street Railway Company for not having built their line up the Cote des Neiges Hill.

Mr. George White-Fraser, of Toronto, has submitted a proposition to the town council of Orillia, Ont., to supply the town with electric light and power from the falls at Washago.

The Whitney Electrical Instrument Company, of Penacook, N. H., and Sherbrooke, Que., have transferred the manufacture of their apparatus for Canada to Mr. C. E. Shedrick, of Sherbrooke, Que., who will have full control of the manufacture and sale of the well-known Whitney electrical instrument.

The se .ices of Thomas Gisborne, superintendent of Dominion government telegraph lines in the Northwest and British Columbia, have been dispensed with on the grounds of efficiency and economy.

The Sherbrooke Gas & Water Co., of Sherbrooke, Que., are making extensive additions to their incandescent lighting system, and have added another 180 k.w. S.K.C. machine to their plant. They have now two 180 k.w. and two 60 k.w. S.K.C. machines, from which they are furnishing both light and power.

Mr. F. S. Barnard, managing director of the British Columbia Electric Railway Co., Limited, has closed a contract to furnish power to the Esquimalt Waterworks Co. A power house, with Pelton water wheels and generators, will be erected at Goldstream, at which point the waterworks company will furnish the electric railway company with a sufficient quantity of water under an effective working head to develop electric power. The power will be transmitted a distance of twelve miles to the sub-station of the company in Victoria, and there stepped down and applied to the various purposes for which it is required.

The Duryea Motor Company, now known as the Canada Manufacturing Company, of Cataract, N. J., are endeavoring to manufacture the Duryea motor in Canada. A company has been formed, with a capital of $250,000. The promoters are S. F. McKinnon, Geo. W. Yarker, Samuel Rogers, Timothy Eaton, and H. E. Ficken, all but the last named being Toronto men.

John Phillip, of Grand Valley, who has heretofore been operating an arc and incandescent lighting plant in that town, has decided to go into electric lighting more extensively, and for this purpose has purchased from the Royal Electric Company one of their S.K.C. two-phase alternating current generators with 300-light capacity of transformers and supplies. The work of construction is being proceeded with.

The annual statement of the Montreal Street Railway Company showed the total net earnings for the twelve months ending September 30th last to be $507,885.60. Out of this a four per cent. dividend was paid in May last amounting to $160,000, and another in November of 4 per cent. amounting to $166,666.67. With the latter was a bonus of $41,666.66, making a grand total of $368,333.33. This leaves a surplus of $139,552.27, which, when added to last year's surplus, gives a total of $340,245.51. During the year the company carried no less than 32,000,000 passengers.

The Deschenes Electric Company, Limited, have taken out a license to supply electric light and power in the city of Ottawa and county of Carleton. The above company was organized in July last, under a Dominion charter granted in January, 1896. The directors are: Messrs. W. J. Conroy, R. H. Conroy, Alex. Fraser, David Maclaren and Charles Magee. Mr. W. J. Conroy is president and Alexander Fraser vice-president. The company obtained a lease from the Dominion government to lay cables from the Ottawa river, at the foot of the locks on both banks of the Rideau canal, to the canal basin and head of the deep cut. For this privilege they will light up the canal free.