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CANADIAN
ELECTRICAL NEWS
AND
STEAM ENGINEERING JOURNAL.

Vol. VIII. FEBRUARY, 1898 No. 2.

MR. E. H. KEATING.

Mr. E. H. Keating, who for the past six years has been city engineer of Toronto, resigned that position on January 31st last to assume the management of the Toronto street railway. Mr. F. L. Wanklyn, who had been acting as manager of both the Toronto and Montreal railways, found that his duties in Montreal would require his undivided attention, and hence the need of a resident manager in Toronto.

While Mr. Keating's resignation as city engineer was the subject of general regret by Toronto citizens, there were also heard many expressions of pleasure that his connection with the city was not to be entirely severed; on the contrary, in his new field the citizens may rely upon every consistent effort being put forth to afford both quick and comfortable transportation. The company alike must certainly feel that in Mr. Keating they have an officer possessed of executive ability of the highest order.


Mr. E. H. Keating,
Manager Toronto Street Railway Company.

The subject of this sketch has had a varied civil engineering experience. He was born in Halifax, N. S., in the year 1844, and completed his education at Dalhousie College. After graduating, he served for some time under George Wyhtman, the Government engineer. He took part in the survey of the Pictou Railway in 1867, under that famous engineer, Mr. Sandford Fleming. A little later he was appointed assistant engineer of the Intercolonial, and for a short time was draughtsman on the Windsor and Annapolis railway, returning to the Intercolonial during the construction period.

In 1870, when the work of surveying was entered into on the highlands between Hudson Bay and Lake Superior, for the Canadian Pacific Railway, Mr. Keating again engaged under Mr. Sandford Fleming, and did good service in this particular work. In the same year he accepted the position of City Engineer of Halifax. This position he held from 1871 to 1890, having charge of the construction of many important civic works, particularly the waterworks and the Halifax graving dock. During this time he also practised as consulting engineer, and evidence of his skill and ability in engineering directions is scattered throughout the province of Nova Scotia. In 1890 he was offered and accepted the position of City Engineer of Duluth, remaining there until July, 1892, when he became City Engineer of Toronto. In this capacity he carried out some of the most important contracts ever undertaken by the city, and acquitted himself in such a manner as to prove beyond a doubt his exceptional ability. While the street railway system was being changed to electric traction, his services were frequently called into requisition in the interest of the city. In this way he became quite familiar with the working of the system, and obtained an experience which should serve him to advantage in his present position.

PROGRESS OF THE KOOTENAY POWER PLANT.

The work of developing the water power available at the Falls of the Kootenay river, in British Columbia, which has been undertaken by the West Kootenay Power and Light Company, is nearing completion. The machinery is now being installed, and early in March the company hope to be supplying electric power for the various mining operations within a radius of fifty miles of Rossland.

As already stated in this journal, the promoters of the enterprise are Sir Charles Ross, the Scotch baronet, Messrs. C. R. Hosmer, Frank Paul, Wm. Doull, and other well-known capitalists. In a recent interview Sir Charles Ross gave some interesting particulars of the undertaking and proposed operations of the company.

The power house of the company is situated at Bennington Falls, about 10 miles below Nelson, on the Kootenay river. Water is conducted to the reservoir from the Kootenay river by a canal-way 30 feet deep and 27 feet wide, cut out of the solid rock for a distance of 640 feet. The dam, which is of concrete, is 32 feet high and 18 feet thick at the base. It extends for the full distance across the fore-bay, some 54 feet, and is reinforced on the sides by huge abutments of concrete. The average rise of the Kootenay river is 22 feet, and the highest flood on record was 32 feet above the minimum height of the stream. The dam, therefore, is calculated to withstand the severest floods which it is likely to encounter. From the fore-bay the water is carried to the turbine wheels by three steel pipes, two of which are nine feet in diameter, while the third is a foot larger. At present only the two former tubes will be used. The wheels will develop 1,450 horse power each, so that their united force is 2,900 horse power. Each wheel weighs 40,000 pounds.

The turbine wheels are attached direct to the generators, without the use of gearing. The gates for regulating the supply of water are electrically governed. The electrical apparatus, which was furnished by the Canadian General Electric Company, is of the three-phase alternating type, similar to that installed at Montreal for the Lachine Rapids Hydraulic & Land Company. There are two generators, having together a capacity of 2,500 h.p., giving a voltage of 1,040 when revolving at 180 rev. per minute. The exciters used in connection with the generators are operated by two special turbine wheels of their own. The generators are connected by heavy cables to a marble switchboard, from which the current is connected to the step-up transformers, which increase the pressure from 1,040 to 20,000 volts. The electrical current is conducted to the sub-station at Rossland over a three-wire line 30½ miles long. The local sub-section, which is situated on the Monte Cristo ground, is equipped with a high potential switchboard, a distributing switchboard and a series of transformers, which reduce the pressure from 20,000 to 2,080 volts. From the sub-station power will be conducted to the various mines, and where necessary, still further reduced for transmission to the motors.

The president of the company is Mr. Oliver Durant. Mr. Robert Jamieson, formerly engineer for the Lilooet, Fraser River & Caribou Gold Fields Co., is general manager and chief engineer, and Mr. L. A. Campbell installing expert for the Canadian General Electric Company.

MICA PRODUCTION IN CANADA.

The immense quantities of mica found in Canada, and its increasing use for electrical and other purposes, is attracting capitalists to the mica properties of this country. The United States and Great Britain use our mica quite extensively, and with the growth of the electrical business the demand promises to become much greater. As early as 1863 Sir William Logan referred to the deposits of "muscovite," or "white mica," then known to exist on Yeo's Island, Cape Tourmente, and other sections of the province of Quebec. Mention is made in his Geology of Canada of the phlogophites or "amber" mica at Grenville, Quebec, and in North and South Burgess, Ontario, in all of which the mica is obtained in large sheets, which, being transparent and free from flaws, are wrought and employed for the same purpose as the "muscovite" or potash varieties. An early producer was the Sydenham property, in the Kingston district, and the important deposit of "muscovite," particularly referred to by Dr. A. R. C. Selwyn, C.M.G., F.R.S., director of the Geological Survey of Canada, in the report of the Royal Commission on the Mineral Resources of Ontario, has been opened up at Villeneuve, in Ottawa County, while at Templeton, about 16 miles from the city of Ottawa, several extensive deposits of first-class amber mica, notably on the Wallingford property, have been worked. Dr. Selwyn's opinion of the Villeneuve "muscovite" mica is fully confirmed by another well-known Canadian expert, Prof. F. Cirkel, who has also reported in high terms on the Wallingford and Lake Girard properties.

Mica is a crystalline mineral, which, in association with several other minerals—as pyroxene and felspar—forms the rocks we know as gneiss and granite, and is capable of being cleaved into elastic plates of extreme thinness. Both its color and commercial value are greatly influenced by the mineralogical peculiarities of the rock in which it occurs or has been associated, and also by the manner in which it has been deposited after the decomposition of the rock in which it originally occurred.

In Great Britain the incandescent gaslight companies are largely using it for chimneys, instead of glass. The insulating power of mica is superior to that of any other substances applicable to armatures and commutators. An advantage peculiar to itself is its even laminated structure. The builders of armatures can split sheets into any desired and uniform thickness with great ease and accuracy. A valuable property of mica in connection with commutator insulation is its degree of hardness; it does not wear away too rapidly under the action of the brushes. Of all substances, mica is probably the best material for insulation in certain parts of armatures if it is desired to obtain not only efficient electric insulation but also durability under the influence of heat. The highest temperature to which an armature is subjected, even by short circuits or bad constructions, will have no injurious effect on mica, thick or thin. It may be held in a gas flame without burning or melting. It has been proved that a sheet of 4 in. in thickness will stand the strain of a voltage of close upon 5,000 volts. Mica being infusible, tough, non-combustible, and, when split in sheets, transparent, has a multiplicity of industrial uses.

The mineral is somewhat extensively used in the manufacture of mica grease. As a lubricant for railroad purposes, bicycles, etc., its value lies in its absolute anti-friction, and it is claimed that with its use hot boxes or journals are impossible. A profitable employment of the immense quantities of scraps and fragments of waste mica is the substitution of mica for glass in spectacles worn by workmen (such as electric welders and stone and metal workers) to protect their eyes from sparks, chips or splinters. These mica glasses are concave, in the shape of watch glasses, and are about 1-25th of an inch in thickness. The advantages gained by this utilization are greater than would at first be imagined. Mica spectacles have the advantage over glass that they cannot be broken. Pounding with a sledge hammer merely flattens them, nor does a splash of molten metal coming in contact affect the mica eye-shade.

One of the most recent uses to which mica is commercially applied is in the manufacture of "micanite," by which large quantities of scrap or inferior qualities are utilized, and, by means of a patented process, small pieces of waste mica are built up into sheets 40 in. square, and larger if necessary. This product can be made in any desired form, and is also largely supplied to the electrical trade for insulating purposes. As a covering for boilers mica possesses various advantages over any other material. Many other ways of utilizing mica might be given, but enough has been said to show that there is an ample market for a material with which the electrical industry is already very familiar.

WELL PLEASED.

Mr. William T. Frizzell, Chief Engineer Consumers Cordage Co., Dartmouth, Nova Scotia, in renewing his subscription to the Electrical News, writes: "Please send me January's copy, as I do not wish to miss a number. I am well pleased with the paper. I think it is growing more interesting."

BY THE WAY.

The woman has now invaded the electrical field. Word comes from Syracuse, N. Y., that a new opera house there has just been wired by Mrs. W. J. Blackburn, wife of a theatrical electrician. She had full charge of the work, which was quite complicated, and included 1,250 incandescent lights for the auditorium, stage and lobby. Mrs. Blackburn is said to make a specialty of designing switchboards, and has assisted her husband in many important contracts. She is believed to be the only woman in America engaged in this class of work.

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In a certain Canadian city a widow and her two sons kept store on a leading thoroughfare. We will call their name Jones. The sons' initials are respectively R. J. and J. W. The former after a time decided to leave the paternal roof, and commenced business on his own account on the same street. This was the starting point of keen business rivalry. R. J. Jones transposed his initials in order to have his name appear first on the Telephone Company's list of subscribers. Before the next issue of the book, his brother had caught on to the scheme, and notified the manager of the Telephone Exchange that the name was not correctly printed, and that it should appear in its proper alphabetical order further down the list. Soon after the new directory list containing this correction was published, R. J. called the telephone manager's attention to the fact that the business with which his brother was connected belonged to his mother, and that consequently the name in the directory should be "Mrs. J. W. Jones." R. J.'s star is thus once more in the ascendant, and the telephone manager is quietly waiting to see what is to be the next move on the board.

THE KINGSLEY WATER TUBE STEAM BOILER.

This boiler, which has been installed in a large number of steam plants in Canada during the last year, stands with the highest records and recommendations from its users.

Perhaps its merits cannot be better summarized than by quoting from the report of this boiler made by the American Institute of New York: "We submit herewith a report of test made by us, assisted by Messrs. Jacobus and Treber, of Stevens Institute of Technology, and while making the same, discovered the following points, which are worthy of special commendation, viz.: The large amount of power developed in the small space occupied; rapid steam formation in the small space occupied; rapid steam formation without any foaming; very dry steam from water of evaporation. The construction of the boiler is such that it can be built to withstand any pressure desirable, and all parts are readily accessible for cleaning and repairs when necessary. The tubes are very readily removed and new ones replaced."

The Franklin Institute of Philadelphia reported after their tests that the Kingsley boiler does one-third more work per pound of coal than does the return tubular boiler.

The tubes are perfectly free from sediment at all times, as can be verified by all boilers now in use, and they have withstood the hardest service for many years.

This water tube boiler can be sold at a moderate price, and is now manufactured by several of the foremost shops in Canada. The advertisement appears in this issue, and next month we will fully describe and illustrate the boiler.

MACHINES.*

A machine is an instrument by means of which a force applied at one point is able to exert at some other point a force differing in direction and intensity. It has been usual in treating of simple machines to call the applied force the power, but the word power is now in use with an entirely different meaning, and so we shall accordingly speak of this applied force as the effort. The force exerted or effective resistance overcome is usually called the weight. This resistance may be the earth's attraction, as in raising a heavy body, or it may be the molecular attractions between the particles of a body as in stamping metal or dividing wood, or it may be friction as in drawing a heavy body along a rough road.

Besides the effective resistance, the effort is employed in overcoming the internal resistances chiefly due to friction which always exists between the different parts of a machine. The effort may be just sufficient to overcome these two kinds of resistance, or it may be in excess of what is necessary or it may be too small. If just sufficient, the machine once in motion will remain uniformly so, or if it be at rest it will be on the point of moving, and the force applied or effort will be in equilibrium with the effective and internal resistances. If the effort be in excess the machine will be set in motion, and will continue to move with an accelerated motion. If the effort be too small it will not be able to move the machine, and if the machine be already in motion it will gradually come to rest. When the effort is just sufficient to overcome the resistance, the ratio of the resistance to the effort is called the modulus of the machine. In this case it is evident from the law of Conservation of Energy, that the work done by the effort has its equivalent in the work done against the effective resistance to be overcome, and against the resistance due to the friction between the parts. This is the general law of machines in motion or in equilibrium.

The ratio of the effective resistance which we call simply the resistance to the effort is equal to the ratio between the distance through which the effort acts, and the distance through which the resistance is overcome at the same time; or in other words, is equal to the ratio of the velocities of the points of application of the effort and resistance, or if we take equal distance and uniform motion, we see that what is gained in force is lost in time.

Simple machines, sometimes called the mechanical powers, may be considered under three heads: 1, a solid body movable around a fixed point; 2, a flexible string; 3, a hard inclined surface.

Under No. 1 come machines acting on a lever and wheel and axle, such as the crowbar, etc. In this case the difference between the power and fulcrum is greater than the difference between the fulcrum and weight. In the case of the wheelbarrow, row-boat, etc., the power is at one end, the fulcrum at the other and the weight between the two. In the human arm the weight is at one end, the fulcrum at the other, and the power between.

Under No. 2 come pulleys. In the case of the single pulley the power exerted must be equal to the weight; it simply changes the direction of the force. Where more than one pulley is used as in one block, the first one would support the whole weight, which we will say is 100 lbs., the 2nd pulley would support one-half of what is supported by the first, or 50 lbs., the third would hold or support one-half of what is supported by the second, or 25 lbs.; the force therefore required to lift the 100 lbs. would only be equal to 25 lbs., but as it has already been said, what is gained in force is lost in time.

No. 3, inclined surfaces, includes the wedge and screw. To take a weight up an inclined plane, the weight and height must be equal to the power and length. In the screw, the power and circumference, equals the weight, and distance between threads.

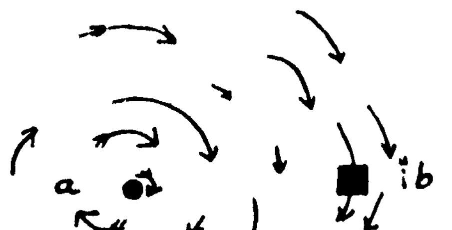
* Paper by Jas. Gill, Teacher in Physics at Normal School, read before Hamilton No. 2, C.A.S.E., January 11th, 1898.

ELECTRICITY IN MODERN BUILDINGS.

By "ELECTRICIAN."

IN the construction of a certain class of building a steel framework, filled in with stone or other material, is being very largely used, and as electricity is rapidly becoming the means of distributing light and power, and to some extent, even heat, throughout the halls, corridors, offices, etc., of any building which proposes to offer all the best modern conveniences, it may be worth while to consider whether there will take place any interaction between the steel framework, considered as a conducting network of comparatively low resistance, and the electrical circuits which distribute the lighting and power currents. It is, of course, evident that such a steel framework will offer a path of comparatively low resistance to any current that may be set up in it, and it is the purpose of this article to formulate those conditions which will tend to the setting up of such currents, and their physical effect on the building materials.

Regarded as a conducting network, currents may be set up in the steel framework by either induction or by direct contact (leakage being included as a contact). The diagram shows in section an electric light wire "a" through which a current is flow-



ing, and a conductor "b" of some kind of conducting material—"a" and "b" being fairly close to each other, and more or less parallel during their length. At the instant of starting a current through "a" the whole space around "a" becomes an inductive field of rapidly increasing intensity, which will include the space surrounding "b," and this is a necessary and sufficient condition for the setting up of a current in "b," so that it will appear that actual contact is not required in order that a current may flow in "b". Similarly at the moment of stopping the current flowing through "a," a current will be induced in "b". If the current in "a" be stopped and started, or reversed in direction rapidly, or even made to wax and wane—that is, to merely fluctuate without actual reversal—currents will under all these conditions be induced in "b," and their strength will be proportional to: The conductivity of "b"; the strength of current in "a"; the rate of variation or fluctuation of the inductive field; the length of the conductor "b" that is in the inductive field—their distance apart. It is therefore conceivable that very considerable currents can be made to flow in "b" without any contact with "a." They will probably be currents of low voltage, but still capable of effecting considerable electrolytic damage. It is sufficiently obvious that contact between a conductor carrying current and a steel beam, whether it be direct mechanical contact or indirectly through a leak caused by damp, etc., will result similarly.

Suppose we have a steel frame building with a complete system of electrical distribution—for lighting, elevators, fans, heaters, etc.—it can easily be imagined that there may be set up inductively a most complicated and interlinked system of active currents in the various uprights and horizontals forming the frame, and that they may be of quite considerable magnitude. This can occur not only in the steel frame itself, but in the piping for the heating or auxiliary gas lighting services. With a direct current distribution for lighting only, these induced currents would probably have a negligible effect, as it is only at the moment of make and break that inductive action would take place, although even in such a case a direct current, though continuous in direction, will have sufficient very small fluctuations in strength (owing to the fact that the number of coils in the armature is not infinity) to keep up a continual alternating current in all the pipes and beams parallel to it and within the sphere of its influence. But in very many cases current is distributed for elevator and motor purposes, and here we find not only the small fluctuations due (as mentioned above) to the armature construction, but also that fluctuation due to the varying demands of the elevator and motor services, which, while not so rapid, will have an enormously greater ampitude, and so a much greater inductive influence. There are very many buildings, moreover, that employ an alternating current for lighting, the influence of which requires no pointing out. So that it appears that there will always be some circuits induced in such buildings, whether in the frame or the piping.

An electric current flowing in a circuit must produce one effect and may produce more. It must heat the conductor and may decompose it. The heat generated in the conductor depends on the amount of current flowing, and on the resistance offered to it, and in a circuit of varying conductivity the greatest heat will be generated at the point of greatest resistance. In a circuit composed of beams the points of junction will be those of highest resistance, and will therefore be the heating points. Just how far the expansion and contraction due to heating and cooling may be expected to work with the natural vibration to loosen the joints, is a matter that affords a very interesting field for discussion and experiment. But if it be granted that it does have the effect of so loosening them, then such loosening will tend to promote the decomposing action of the current flowing, with the assistance of whatever slight amount of moisture has condensed out of the atmosphere (or elsewhere) on the opposing faces of the loose joint. This latter action of the current is probably of greater importance than the former, as its tendency is to loosen by decomposition, and just where the utmost rigidity and permanence is desired, viz., in the foundations. The electrolytic injury would take place just at the base of a steel pillar, where the current was able to escape to earth, and the effect would be to eat away the metal, as the iron of water pipes is eaten away by the passage of railway currents. The electrolysis of gas and water pipes might be even a serious matter unless precautions be taken to minimise its effect.

While it seems impossible to so arrange as that there shall be no induced currents in framework or piping, still it is possible, and in most cases would be well, to adopt such precautions as will confine them within such small limits that they may become negligible. It would be well to thoroughly ground the entire steel structure by copper wires of large section leading from various points to the earth, and making good contact there with permanently moist soil. It would also be advisable in laying out circuits to so arrange that all those wires carrying the main current shall be as far removed as possible from any of the structure, and as close together as insurance regulations will permit. If it be necessary for the main wires to be close to a pipe or pillar, and to run parallel to it, then they should be placed one on each side of it so as to neutralize each other's effect.

PUBLICATIONS.

The publishers of Power, of New York, have eclipsed all previous efforts by their issue for December. It is replete with interesting articles on engineering subjects, while the advertisements many of them printed in various colors, present an attractiveness not often equalled. The frontispiece is especially worthy of mention.

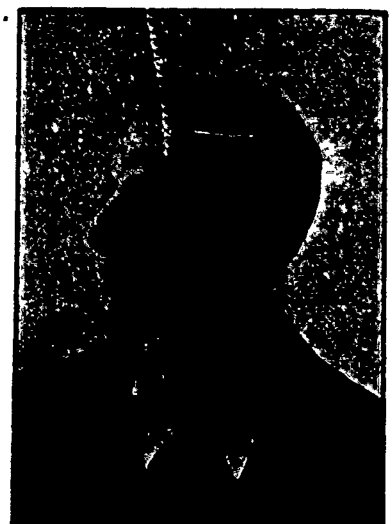
The Canadian General Electric Company have issued an artistic lithograph calendar, in which blue and gold are the predominating colors. The figures of the calendar are large and clear. Above them is a female figure holding aloft in one hand an incandescent lamp, while with the other she draws aside a curtain, revealing in perspective a view of the company's works at Peterborough, Ont.

A valuable addition to the literature of British Columbia is the year book which has just been published by Mr. R. E. Gosnell, Legislative Librarian, with a copy of which we have been favored. Of the many works which reach our table, most of them of considerable merit, the credit for the most complete work of this character yet received must be given to the author of the British Columbia Year Book. Besides the facts and figures relating to the natural resources of the province, there is sufficient of an historical, political and sociological character to render the book interesting and instructive to all. There are over 500 pages of letterpress and illustrations, so arranged as to present a most pleasing appearance. To even mention the interesting features would involve more space than can here be given, suffice it to say that among them are the following: An historical review, including portraits of early navigators and explorers; a group of pioneers and early legislators; portraits of members of parliament; illustrations of government buildings; a treatise of 100 pages on mines and mining, with illustrations; a description of the fisheries and maps of different districts in British Columbia.

THE ARNPRIOR ELECTRIC LIGHT PLANT.

THE power house of the Arnprior Electric Light plant is a substantial stone building, 70 x 40 feet, two storeys high, and fitted for both water power and steam, which may be used either separately or in conjunction. The water wheel is a 100 horse power turbine, and the engine a 100 h. p. Warwick. The boiler room is separated from the other rooms of the building by solid brick walls, fitted with fire-proof doors.

The generators consist of a Thomson-Houston 1,000 light generator and two Ball arc dynamos, the switch-board being fitted with Thomson-Houston instruments.



MR. S. SHEPPARD.

One of the principal features of this plant is the fitting of the shafting with friction clutch pulleys, thus enabling the instantaneous throwing on or off of any of the machines. Another ingenious arrangement of the electrician in charge of the plant is a mirror suspended on a bracket at the side of the volt and ampere meter, with strong magnifying glasses on a swinging arm, so that the voltage can be read from any part of the room or from the outside of the doorway opening into the operating room.

The company have installed 24 arc street lamps and about 1,000 incandescent lights, and are giving a very satisfactory service.

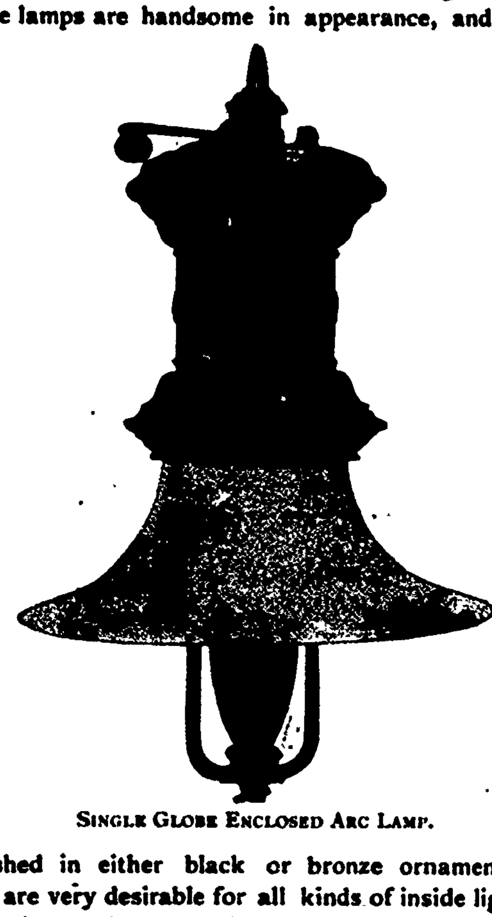
Mr. S. Sheppard, the electrician, whose portrait we present, is a native Canadian, and was born in Ottawa, May 11th, 1873. He is a thoroughly qualified electrician, and keeps the plant in first class condition. After leaving school Mr. Sheppard entered a machine shop, and after a couple of years entered the employ of the Ottawa Electric Co., with which firm he was engaged for five years, a greater part of the time in their repair and manufacturing department, leaving that company in April, 1896, to accept his present position.

FELT MATS FOR ENGINES.

WOOL fibre seems to be about the only material that can be formed into a substance so firm and solid that it can be given the absurd name of "iron felt." In the manufacture of this material, London Engineering says that the best long wool fibre is first impregnated with petroleum grease, and further to a certain depth with glue, which is rendered insoluble by the addition of bichromate or formaldehyde; in certain cases the surface is prepared with vulcanite rubber and then vulcanized. The stuff is very highly compressed and supplied in plates up to 2 feet square and more, from 0.4 inch to 2 inches in thickness. The plates are elastic; withstand, according to tests conducted at the Reichsanstaldt, a pressure of about 9 tons per square inch; do not rot, and the surface is said to be so hard that the edges of rails and bolts do not cut into it. The mats are placed under the rails of tramways, etc., in order to deaden the noise and clatter. For the same reason, a layer of this felt may be interposed between the foundations and the base plates of engines, and underneath the bearing of shafting in workshops. The mats must not overlap, and may be applied in layers. In the case of workshops it may also prove profitable to provide the respective joists and girders with mats. That the material is electrically an insulator would be an additional advantage. The chief question is, of course, whether the elasticity of the felt will last long enough to justify its practical adoption in engine rooms and workshops, where we do not like to risk experiments.

SINGLE GLOBE ENCLOSED ARC LAMP.

THE Canadian General Electric Company, Limited, Toronto and Peterboro', has recently placed upon the market a new type of enclosed arc lamp, for indoor use, an illustration of which we give herewith. This lamp is made for both direct and alternating (60 or 125 cycles) circuits, and for three and five amp. currents. In many cases the three amp. lamp can be used with advantage, on account of the greater volume of light produced as compared with the double globe lamp. These lamps are handsome in appearance, and can be



SINGLE GLOBE ENCLOSED ARC LAMP.

furnished in either black or bronze ornamentation. They are very desirable for all kinds of inside lighting, and their combined qualities of simplicity and economy should commend these new improved lamps to all central station men and owners of isolated plants. Further particulars can be obtained from the above company.

The Robb Engineering Company, Ltd., of Amherst, N. S., recently suffered slight damage by fire. The loss is covered by insurance.

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.

MR. J. W. Marr, the popular secretary of Toronto No. 1, who had been in the employ of the T. Eaton Company for some time, has accepted a position in the power house of the Metropolitan Street Railway Company. His address is Box 155, Davisville.

The regular meeting of Toronto No. 1 was held on January 19th, when there was a good attendance and one initiation. The committee reported regarding the annual At-Home. It had been found necessary to draw on the Association funds for furnishing and decorating the hall, the insurance not being sufficient to cover the cost of the necessary repairs. On February 8th Mr. A. M. Wickens continued his lecture on "The Indicator."

On Thursday evening, Feb. 3rd, the Engineers' Hall, 61 Victoria street, was the scene of gay festivities, the event being the third annual At Home of Toronto No. 1. The engineers and their friends to the number of 150 had assembled there to participate in the evening's entertainment, which included a first-class musical programme, dancing, etc. The following contributed: Piano, Master Huggett; songs, Mr. Dimmock, Miss Lewis, Mr. T. Vice, Mr. G. T. Pendrith, Mr. Newton; reading, Mr. C. H. Fielding. The accompanist was Mr. A. E. Harding. Refreshments and an impromptu dance followed the above programme. The affair was quite a success.

TORONTO NO. 2.

A new branch of the Canadian Association of Stationary Engineers has been formed in Toronto, to be known as Toronto No. 2. On Saturday evening, January 15th, the following officers were installed by the Executive President, Mr. E. J. Phillip, assisted by the officers of Toronto No. 1: Past President, P. Trowern; President, John Dixon; Vice-President, John H. Venables; Recording Secretary, Thos. Graham, 570 King street west; Financial Secretary, J. Richardson; Treasurer, Joseph Hughes; Finance Committee, F. Tushingham, E. Thomas, T. L. Holmes; Trustees, John Dixon, J. McMulken, P. Trowern; Conductor, M. Connoley; Doorkeeper, H. Brown.

Immediately after the installation ceremonies, President Dixon delivered his maiden speech, and in conclusion invited the visiting brethren from Toronto No. 1 to partake of refreshments, when ample justice was done to the elaborate supper which had been prepared by the wives and daughters of No. 2.

BRANTFORD NO. 4.

At the last meeting of the Telephone City association, all the former officers excepting the treasurer were re-elected. General business comprised the chief work of the evening.

KINGSTON NO. 10.

At a recent meeting of Kingston No. 10, a committee was appointed to wait upon the members of the Dominion government to solicit their support in behalf of the Steam Boilers' Act, which provides for the proper examination of engineers and the inspection of boilers. The government will also be asked to appoint a resident examiner in the Kington district. Since the meeting, the Association have received the promise of the local members to support the bill, which will shortly come before the House.

TORQUE AND SPEED OF MOTORS.*

BEFORE we go into the matter of torque, it may be beneficial to go over, briefly, some of the units of electrical measurement:

FORCE is that which produces motion or change of motion in a body. The unit of force is that force which, when acting for one second on a mass of one gramme, gives it a velocity of 1 centimeter per second. It is called the DYNE. The force with which the earth attracts any mass is usually called the weight of that mass, and the force with which a body gravitates, i.e., its weight (in dynes) is found by multiplying its mass (in grammes) by the value of g.

WORK is the product of a force and the distance through which it acts. The unit of work is the work done in overcoming unit force through unit distance, i.e., in pushing a body through a distance of one centimeter against a force of one dyne. It is called the ERG. The force with which gravity pulls a mass of one gramme is 981 dynes (981 centimeters = 32.2 feet). Therefore, to lift a mass of one gramme through a distance of 1 centimeter is = 981 ergs of work or g ergs.

POWER is the rate of working. The unit of power is the WATT, and is $= 10^7$ ergs. per second.

1 foot = 30.479 centimeters.
1 lb. = 7000 grains.
15.432 grains = 1 gram.

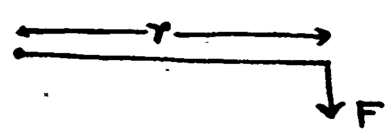
$$\therefore \frac{7000}{15.432} = 453.59 \text{ grams, or 1 lb.} = 453.59 \text{ grams.}$$

1 foot pound $= g(30.479 \times 453.59) = 13825$ g ergs,
$= 1357235$ ergs.,
generally written 1.356×10^7 ergs.

From which is readily deduced:

1 h.p. = 550 ft. pds. per second,
$\therefore 550 \times 1.356 \times 10_7 =$ ergs in 1 h.p.,
but 10^7 ergs. = 1 watt,

$$\therefore \frac{550 \times 1.356 \times 10^7}{107} = 746 \text{ watts.}$$



Fr = Torque = T.
V = Velocity in centimeters per second.
F = Force in dynes.
W = Work in ergs.
N = No. of revs. per second.
W = Vf, but $V = 2\pi r n$.
$\therefore W = 2\pi r n f$, but fr = Torque, $\therefore W = 2\pi n T$.

As already stated, 1 pd. foot $= 1.356 \times 10^7$ ergs, or 1.356 watts.

Since electric power is C E, and mechanical power is the speed multiplied by torque, we will now consider if there is any relation between the two.

$$\text{Watts} = E\,C = 2\pi NT \times 1.356$$

where E = EMF in armature
C = total current.

The E.M.F is proportional to the speed if the magnet flux N is constant.

$$\text{i.e., } E = \frac{\text{Rev. per second} \times Nc \times N}{10^8}$$

Where Nc = No. of conductors in armature
N = Total flux
$E = 10^8$ lines cut per second.

If we substitute the value of E in E.C we get

$$\frac{R.p.s \times Nc \times N \times C}{10^8} = 2\pi NT \times 1.356$$

but R.p.s = N = Rev. per second

$$\text{by cancellation we get } \frac{Nc.N.c}{10^8} = 2\pi T \times 1.356$$

$$\text{and by transposition } T = \frac{Nc.N.c.}{2\pi \times 1.356 \times 10^8}$$

By this we readily see that the torque T does not in any manner depend on the speed, but that it depends on the flux N and on the current, which shows very clearly that if we wish to make a motor have a large torque the flux must be large, and as this formula is applicable to generators, it shows that to make a slow speed dynamo generate the requisite E.M.F, N must also be large.

From the torque can easily be determined the total peripheral

* Paper by Mr. James Milne, read before Toronto No. 1, C.A.S.E.

force, and from the peripheral force the pull on each conductor can be calculated, as follows:

$$\text{Total peripheral force} = \frac{\text{Torque.}}{\text{Radius in feet}}$$

$$\text{Average pull per conductor} = \frac{\text{Total peripheral force}}{\text{No. of conductors}}$$

As a rule the number of active conductors is [illegible] of the total conductors; those conductors in the gap of course are not cutting the lines and must be deducted.

∴ [illegible] of total conductors = No. of active conductors

$$\therefore \frac{\text{No. of active conductors}}{\text{Total peripheral force}} = \text{Pull in pounds on each}$$

The torque of a motor is a maximum when motor is standing still and gradually decreases, and is zero when the counter E.M.F is the E.M.F. of supply, which can be proved as follows:

$$T \text{ (in dyne centimeters)} = \frac{Nc.\ N.c}{2\pi}$$

$$\text{but C in a motor is} = \frac{\text{E M F of Supply} - \text{Counter E M F}}{\text{R (Restance of Armature)}}$$

Substitute this value for C in the equation, and we get:

$$T = \frac{Nc.\ N.c}{2\pi} \times \frac{E^1 - E}{R}$$

but the counter E M F or E is precisely the same as in a generator = Nc. Rps. N. We are dealing in absolute units at present, and to bring this to volts or practical units would have to be divided by 10^8.

By substituting Nc. Rps. N for E, we get:

$$T = \frac{Nc\ N}{2\pi} \cdot \left(\frac{E^1 - Nc.\ Rps.\ N}{R}\right)$$

When $\frac{E^1 - Nc.\ Rps.\ N}{R} = E$, or when the C. E M F = E, there is no torque, or T = o.

T is a maximum when $\frac{Nc.\ N}{2\pi}\left(\frac{E^1 - O}{R}\right) = \frac{Nc.\ N.\ E^1}{2\pi R}$, i.e., when there is no counter E M F, or in other words, when the motor is standing still and current on.

From the above we get:

$$T 2\pi R = Nc.\ N\ (E - Nc.\ Rps.\ N) = Nc.\ N\ E - N^2c.\ N^2 r.p.s.$$

$$r.p.s. = \frac{Nc.\ N\ E - T 2\pi R}{Nc^2\ N^2} = \frac{E}{Nc.\ N} - \frac{T 2\pi R}{Nc^2\ N^2}$$

and to reduce same to practical units, we have:

$$r.p.s. = \frac{E \times 10}{Nc.\ N} - \frac{T 2\pi R \times 10^9}{Nc^2\ N^2}$$

The following example taken from actual practice may be found interesting: In a Fensom elevator the speed where $E^1 = 230$ volts, N = 1,400,000, current 60 amperes, 1000 conductors, find the torque.

$$T \text{ in pound feet} = \frac{60 \text{ amp.} \times Nc. \times N}{10^8 \times 1.356 \times 2\pi} = \frac{840}{8.52} = 100 \text{ pd. ft., nearly.}$$

The resistance of the armature of this motor was .435 ohms, from which we could easily determine the revs. per second as follows:

$$R.p.s. = \frac{E.M.F.}{Nc.N} - \frac{2\pi T\ R}{Nc^2\ N^2}$$

The torque being given in pound feet, it must be reduced to dyne centimeters by multiplying by 1.356 x 107,

$$\therefore \text{revs. per second} = \frac{230 \times 10^8}{1000 \times 1400000} - \frac{2\pi \times 1.356 \times 10^7 \times T.R \times 10^9}{1000^2 \times 1{,}400{,}000}$$

which when worked out give 14.5 revs. per second = 870 revs. per minute.

This motor is in the R. Simpson Co.'s store, running one of the elevators. For those who wish to go into this further, they are requested to consult Sylvanus P. Thompson or other good works on the subject.

The calculations are extremely interesting, and it can readily be proved that the maximum work that can be got out of a motor is when the current is one-half that which flows when the armature is standing still, and that the efficiency is one-half, or 50 per cent.

COMPARATIVE EFFICIENCY OF ILLUMINANTS.

Of the total energy supplied, a candle consumes 86 watts per candle; oil lamp, 57 watts; butterfly gas burner, 93 watts; incandescent lamp, 3.5 watts; arc lamp, .8 watt. Thus, if gas is used in a gas engine having an efficiency of 20 per cent., it will produce about five times more light from incandescent lamps than if burned direct in jets.

THE OILS OF THE ENGINE ROOM.*

Oil is the main factor in the reduction of that element of waste, friction, and in proportion as you apply oil of the proper kind and in the proper way, just so much do you economize in fuel, wear and tear, and consequently in the loss of power.

Oils are usually divided into two classes, drying and non-drying. To the latter class belong lubricating oils, which are the oils of the engine room. We will first consider the conditions under which the oils are applied. The first point that comes to our notice is that the oils are placed between two metal surfaces to keep them apart, and therefore the oils themselves sustain the pressure of the lever, at one end of which is the weight (which is the work of the machine) and the compounding power which is equal to the weight; we find, therefore, that the oil has to withstand an enormous pressure according to the kind of machine it is in. As we have observed, the oil is between two metal surfaces which are very close together, and the deduction would be that the oil should be quite free from hard particles which might abrade these two surfaces. Usually one surface is hard and the other soft, and were particles of a gritty nature allowed to pass into the oil, the two surfaces—which we will after this call the bearings—the consequence would be that they would become imbedded in the soft part and would cut the hard surface or the shaft. The idea which you will gather from these remarks so far is that oils should be clean.

We will now come to find that we have another condition which will be as important as the previous one. The oil is used at two different temperatures, a low and a high temperature, the first cold bearings and the second hot bearings. We will consider the cold bearings first; these include nearly all bearings, there being but three or four hot bearings on one individual engine, and taking the shaftings, hangers and all other journals as parts of the machine, by far the larger proportion are cold bearings. The temperature of an engine room will average 70 degrees, and the bearing will be exposed from this down, in cases of shaft passing from one building to another, or in processes where the buildings are not heated to zero. It will here be apparent that oil must be useful at low temperatures. You are all aware that certain oils are solid at the freezing point of water; it would be plain to you that such a condition would prevent the oil moving to the point where it would be required even if the action of the parts would make it of use if it were in place. We must therefore require that oils should flow at the temperatures to which the bearings are exposed.

It is also required that oils should be stable at the highest temperature to which they will be exposed—allowing this to be 100 degrees, this being the temperature at the hanger level in a hot work room. Stable in that they will not evaporate and let the bearing go dry, which is called gumming. This is a characteristic of vegetable oils. It is also necessary that the oil should not turn rancid with the formation of acid and a consequent loss of lubricating quality. This is a condition which ensues with animal oils, also to some extent with vegetable oils.

We have up to this point considered the circumstances, conditions and requirements of the oils, and we have found that they should be clean, capable of withstanding pressure, workable at low temperatures, not volatile, non-drying, not rancid. Oils are divided under the following heads: Olive, cottonseed, linseed, palm, castor and fish oil.

(To be Continued)

A NEW COMBINATION OF STEAM ENGINE AND BOILER.

A new combination of steam engine and boiler is proposed by W. Schmidt, of Ballenstadt, Germany, the construction in this case being considered a valuable improvement on that class in which the cylinder of the engine is either partially or wholly arranged in the boiler. The objects aimed at and believed to be accomplished is for a steam boiler and engine capable of yielding a high effect, requiring repairs only at very long intervals and not necessitating continual attention. These advantages are attained by arranging the cylinder of the engine within the interior of the boiler, with the lower end projecting into the fire-box. The cylinder serves as a stay to the crown sheet. The engine is single-acting, and the valve is placed in the steam and water room of the boiler. Still further to secure efficient results by means of this arrangement, there are provided, in addition to the heating surface furnished by the fire-box, a number of drop tubes, which add very much to the steam generating capacity of the boiler.

*Paper read at open meeting of Hamilton No. 2, C.A.S.E., January 18th, 1898, by J. W. Williams, chemist for Winer & Co., wholesale druggists.

CORROSIVE AND SCALE-FORMING AGENTS IN BOILER FEED WATERS.

By. Wm. Thompson.

(Article 2).

When we understand what is taking place during the act of pitting, it becomes comparatively easy to suggest a remedy. What is required here is a substance on which the corrosive agent can exhaust itself; and probably the best remedy is a slight coating of lime scale, which can be easily obtained by the use of lime water or milk of lime.

This theory has not, however, been universally accepted as the true cause of pitting (although in the writer's opinion it appears very rational). The cause of this trouble has been attributed by many writers to electrolytic action set up between the impurities of the iron and the iron of the boiler itself, which, being electro-positive to the impurities, gradually disappears while the impurities remain to further the disintegrating action. In support of this theory it became a common practice to suspend zinc in boilers subject to pitting and corrosion, on the assumption that since zinc is chemically more powerful than iron, it would become electro-positive to the iron and thus protect the boiler against electrolytic action at the expense of its own metal. If such is the case, then it becomes very necessary for us to note what may be expected to take place when zinc is suspended in the boiler as suggested.

To get as clear an understanding as possible of this process, let us briefly illustrate what takes place in a voltaic cell, which is practically what we are converting our boiler into with zinc and shell as electrodes and water and its impurities as electrolyties. To this end let us examine the process known as electrolysis, taking for example a dilute solution of hydric chloride, subjected to decomposition by means of electrolysis in a glass vessel so that process may be noted. We find chlorine evolved at the positive pole and hydrogen at the negative pole, the gases being perfectly pure and unmixed. If, while the decomposition of the hydric chloride is rapidly proceeding, we examine the intervening liquid carefully, no apparent movement or disturbance of any kind can be perceived, and nothing in the shape of currents in the liquid or transfer of gas bodily from one pole to the other can be observed, and yet two portions of the hydric chloride separated by two to six inches are actually seen to evolve pure chlorine and pure hydrogen.

There seems but one method of explanation of this singular phenomenon, which is applicable to all similar cases of electrolytic decomposition, and that is to assume that each of the particles of hydric chloride intervening between the electrodes or poles, and by which electric current is conveyed, simultaneously suffer decomposition, the hydrogen travelling in one direction and the chlorine in the other. The neighboring elements being in close proximity to each other, unite to again form hydric chloride and destined to be again decomposed by a repetition of same change. Thus it is each particle of hydrogen may be made to travel in one direction by becoming successively united to each particle of chlorine between itself and the negative pole; and when it reaches the latter, finding no disengaged particle of chlorine for its reception it is rejected, so to speak, from the series and thrown off in a free state.

Exactly the same thing happens to the chlorine which is travelling in the opposite direction, consequently a succession of particles of hydrogen are thrown off at the negative pole and a corresponding succession of particles of chlorine at the positive. The power of the current is exerted with equal energy in every part of the liquid conductor, though its effects become manifest only at the terminals. The action is purely of an internal nature, and the metallic electrodes or terminals of the battery simply serve the purpose of completing the connection between the latter and the liquid to be decomposed.

Like hydric chloride, all electrolytes, when acted upon by electricity, are split into two constituents, which pass in opposite directions. Substances of the one class, such as chlorine, iodine, oxygen, etc., are evolved at the positive pole, and those of the other class, such as the metals and hydrogen, at the negative pole. It is, though, important to remark that oxygen salts, such as the sulphates and nitrates, when acted upon by the current, do not divide into acid and basic oxide, but into a metal and compound substance or group of elements. Thus sulphate of copper ($Cu\,SO_4$) does not split into SO_3 and $Cu\,O$, but into metallic copper (Cu) and sulphione (SO_4) sulphuric acid ($H_2\,SO_4$) dividing into the same compound and hydrogen. In a similar way it is seen that the part of the electrolyte passing to the negative pole may be a compound consisting of several elements. An illustration of this change is the commonly used sal ammoniac ($NH_4\,Cl$) which is decomposed in such a manner that the ammonium (NH_4) goes to the negative pole, when it is resolved into ammonia (NH_3), the pure hydrogen and the chlorine going to the positive pole.

We must, nevertheless, draw a distinct line between true and regular electrolysis and secondary decomposition brought about by the reaction of the bodies eliminated upon surrounding liquid or upon the substance of the electrodes. When, for example, potassium sulphate ($K_2\,SO_4$) is electrolysed, hydrogen appears at the negative pole together with its equivalent quantity of potassium hydroxide (K OH), because the potassium which is evolved at the electrode immediately decomposes a portion of the water there present. The chemical reaction takes place as follows:

$$K_2 + 2\,H_2\,O = 2\,K\,OH + 2\,H.$$

At the same time the sulphione ($S\,O_4$) which passes to the positive pole takes up hydrogen by decomposing the surrounding water forming sulphuric acid ($H_2\,SO_4$) and liberating oxygen according to following reaction:

$$SO_4 + H_2\,O = H_2\,SO_4 + O.$$

In like manner the sulphuric acid itself is resolved by the current into hydrogen and sulphione, which latter decomposes the water at the positive pole reproducing sulphuric acid and liberating oxygen just as if the water itself were directly decomposed by the current into hydrogen and oxygen. This explains a circumstance that was very puzzling to our early experimentors upon the chemical action of a voltaic battery. The true source of these compounds was traced by Davy in 1807, who showed very clearly that they proceeded from impurities in the water, or the vessel which contained it, or from surrounding air. He redistilled water at a temperature below boiling, and found when marble cells were used to contain the water intended for decomposition hydric chloride appeared at the negative pole and sodium at the positive, but derived from sodium chloride present in the marble as an impurity. This manifestly proves that water in a pure state is not an electrolyte and is incapable of conveying current, but is enabled to do so if even a trace of saline matter is present.

We have now, I hope, clearly expounded the principles of the voltaic cell. Now, let us consider its practical application for the purpose we have in view. Suppose we have a wire conducting an electrical current; cut this wire and place both ends in a cell containing water to which we have added some sulphuric acid to add to its conductivity. It will be observed that bubbles of gas are forming on the ends of the wires. These bubbles are simply hydrogen and oxygen obtained as already described. Let us now select for our poles, zinc and wrought iron, to get as nearly as possible the conditions existing within our boiler. If our zinc is pure no perceptible action will take place on immersion in the cold solution. We next immerse our wrought iron plate, and find chemical action is at once set up, hydrogen bubbles rising and metal gradually wasting away. Let us now connect the two wires from the source of electrical energy to the dry ends of our plates, and a complete change of conditions at once takes place. The hydrogen will still be seen to rise from the wrought iron plate, but the plate itself will cease to dissolve. But the zinc plate will gradually disappear, and just as long as any part of it remains in contact with the water and in electrical contact with the iron, the iron will be protected from decomposition at the expense of the zinc. We can now, I think, perceive clearly the reason for the gradual wasting away of the zinc or positive pole. As the water is decomposed by the passage of the current, the oxygen is attracted to the positive pole, and being practically electrolytic, oxygen or ozone attacks the metals, very actively and destructively, and we find them more or less rapidly wasting away.

We have now before us information to enable us to understand the action of zinc in boilers, and can readily see that zinc can only be successfully used where certain conditions pre-exist. We must first have some solution that makes a good electrolyte, and next see that contact between zinc and shell of boiler is electrically good; further, we must be sure that galvanic action is set up within the boiler. I think it has been amply proven in engineering practice that galvanic action is set up within the boiler due to many causes, such as difference in temperature in different parts of the boiler, thereby causing a current, and generating electricity due to friction; also galvanic action is set up between the different kinds of metal used in and about a boiler, such as composite fittings and steel shell, etc. It is also quite possible to create galvanic action between different parts of the same boiler when a certain portion of the metal is homogeneous, while another is poorly made, due to bad iron, etc. In fact, galvanic action may be set up in a multitude of ways, and it is this very fact that makes the use of zinc in boilers, especially in fresh waters, rather to be condemned than approved, especially when action is not clearly understood. It has lately become a very common practice, especially in marine work, to purposely set up galvanic action within the boiler, by the aid of an external current, to prevent not only corrosion, but the formation of scale, and the system has met with a great deal of success, as it very properly would when conditions are favorable. Marine engineers are, however, exceptionally favored in this respect. Not only does their feed water contain a large quantity of saline matter, but also a certain proportion of free acid, making the solution within the boiler an excellent electrolyte; consequently they have only to see that contact between their zinc and iron electrodes is correct and galvanic action set up to secure good results.

The first essential required is a thorough knowledge of action of zinc in boilers, and secondly, a knowledge of conditions pre-existing. Before leaving this subject I wish to point out to the reader that nothing but the purest zinc must be used. Ordinary commercial zinc contains many impurities, and especially must lead be absent. If lead is present it will be found after zinc has wasted away, and a new condition of things will exist; the shell of the boiler will become electro-positive and the lead negative, and the cure becomes worse than the disease.

GENERAL CORROSION.

This form of corrosion is in some localities a very common one, and is a peculiarly difficult one to explain in a general way. It is largely due to the presence of free acids, which may be present in the feed water, or may exist as a result of the use of some of the vile nostrums sold as boiler compounds, prepared frequently by people who do not know the first requirements of the substance they sell, except that it will take off scale. When carbonates are absent, free sulphuric acid may be present, especially in mining districts, and chiefly derived from the oxidation of pyrites and sulphides. This acid is also often found in streams passing through manufacturing districts, owing to the refuse from dye works, galvanizing shops, chemical factories, etc., having been discharged into them.

Another fruitful source of free sulphuric acid is the use of kerosene, which is now so commonly used. Kerosene is produced by one of a series of distillations of petroleum, and in its first and crude state is a turbid liquid, having a strong odor and a bluish tinge. To remove these, the refineries give the kerosene a course of treatment with sulphuric acid. Part of this, together with impurities, precipitates as a heavy black sludge. The purified oil is next treated with caustic soda, to neutralize any free acid, and then washed with water. Like many other processes of a similar nature, work is not always well done, and free sulphuric acid remains in solution. The oil itself vaporizes very readily when in the boiler and passes off with the steam. The sulphuric acid being non-volatile, remains behind, and finally becomes sufficiently concentrated to attack the boiler, and corrosion sets in.

A very prolific source of corrosion is also caused by the presence of hydrochloric acid in the water. This is a very fruitful source of trouble in waters containing magnesium chloride in solution, and is often caused in waters containing other salts of magnesia by the use of compounds which reduce salts of magnesia to magnesium chloride. At all temperatures of present boiler practice, magnesium chloride decomposes in presence of water in accordance with following chemical equation:

Magnesium Chloride.		Water.		Magnesium Hydrate.		Hydrochloric Acid.
$Mg.Cl_2$	+	$2H_2O$	=	$Mg.O_2H_2$	+	$2H\,Cl$.

Reference has been made to the formation of magnesium chloride, and consequently the liberation of hydrochloric acid by the use of compound resolvents. A striking example of this is the practice of adding sal ammoniac, $NH_4\,Cl.$, to the feed water to dissolve carbonate of lime, the reaction in this case being:

Sal Ammoniac		Carbonate of Lime.		Chloride of Lime.		Carbonate of Ammonia.
$2NH_4\,Cl.$	+	$Ca\,C_2O_3$	=	$Ca\,Cl_2$	+	$(NH_4)_2\,Co_3$.

The final result is that a soluble salt added to a water containing an insoluble salt, the insoluble salt is rendered soluble, and consequently no precipitation takes place. Unfortunately, the reaction does not stop here; waters containing carbonate of lime invariably also contain carbonate of magnesia, and the following reaction is set up between the sal ammoniac and the carbonate of magnesia:

Carbonate of Magnesia.		Sal Ammoniac.		Carbonate of Ammonia.		Chloride of Magnesia.
$Mg.Co_3$	+	$2NH_4\,Cl.$	=	$(NH_4)_2\,Co_3$	+	$Mg.Cl_2$.

This latter salt undergoes a secondary decomposition as follows:

Chloride of Magnesia.		Water.		Hydrate of Magnesia.		Hydrochloric Acid.
$Mg.Cl_2$	+	$2H_2O$	=	$Mg.O_2H_2$	+	$2H\,Cl$.

The action of hydrochloric acid differs materially from the action of the sulphuric acid, owing to the fact that it volatizes very readily, and as a vapor passes off with the steam; thus, not only will the boiler itself be attacked, but also the steam pipes, and even the engine. This acid, at temperatures higher than boiling, even in dilute solutions, attacks iron very readily, and is a fruitful source of corrosion and its companion troubles.

Vegetable acids, or properly speaking, organic acids, while of a feebler nature, still attack iron to some extent, and particularly since these acids are derived from waters usually taken from swamps containing a great deal of vegetable organic matter with very little lime salts. In cold climates the water is also apt to contain a considerable quantity of free oxygen, which adds materially to the corrosive action of the acids present. The presence of the slimy organic precipitate common to waters of this class seems to add to, rather than retard, the work of corrosion.

Whole chapters might be written on the best methods of treating troubles of this kind, but I consider the best advice is to consult some one thoroughly trained in this particular subject, who is not only able to suggest a remedy, but can determine accurately the nature and cause of trouble, and the slight expense incurred will never be regretted.

(To be Continued)

MOONLIGHT SCHEDULE FOR MARCH.

Day of Month.	Light.	Extinguish.	No. of Hours.
	H.M.	H.M.	H.M.
1....	P.M. 11.50	A.M. 5.40	5.50
2....	" 12.00	" 5.40	5.50
3....	A.M. 12.40	" 5.40	5.00
4....	" 1.50	" 5.40	3.50
5....	" 3.00	" 5.40	2.40
6....	No Light.	No Light.	.....
7....	No Light.	No Light.	.....
8....	No Light.	No Light.	.....
9....	No Light.	No Light.	.....
10....	P.M. 6.30	P.M. 9.50	3.20
11....	" 6.30	" 11.10	4.40
12....	" 6.30	A.M. 12.20	5.50
13....	" 6.30	" 1.20	6.50
14....	" 6.30	" 2.30	8.00
15....	" 6.30	" 3.30	9.00
16....	" 6.40	" 4.20	9.40
17....	" 6.40	" 5.00	10.20
18....	" 6.40	" 5.10	10.30
19....	" 6.40	" 5.10	10.30
20....	" 6.40	" 5.10	10.30
21....	" 6.50	" 5.10	10.20
22....	" 6.50	" 5.10	10.20
23....	" 7.00	" 5.10	10.10
24....	" 8.00	" 5.10	9.10
25....	" 9.10	" 5.10	8.00
26....	" 10.10	" 5.10	7.00
27....	" 11.10	" 5.10	6.00
28....	" 11.10	" 5.10	6.00
29....	" 11.50	" 5.10	5.20
30....	....	" 5.10	4.30
31....	A.M. 12.40	....	
		Total......	188.60

A civil engineer has been examining the feed water of boilers, and has come to the conclusion that the presence of an acid in a boiler can be accounted for in this manner: Internal corrosion is not only caused by the acids with which some canal, pit and other waters are impregnated, but is also due to the acidity resulting from the decomposition, by high temperatures in boilers, of chlorides of lime, magnesia and sodium, and of sulphates of lime and magnesia, the former sometimes developing hydrochloric and the the latter sulphuric acid. If steps are not taken to neutralize these acids by introducing some substance for which they have a greater affinity than the material of the boilers, the latter becomes pitted or wasted more or less rapidly.

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

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

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Canadian Electrical Association. IN our next issue we will inform our readers fully as to the excellent work done by the Committee on Legislation of the Canadian Electrical Association, and the progress made toward securing such changes in the law as will place electric and gas companies on a more equitable footing than they at present occupy with respect to municipal lighting.

Cheap Power. AN indication of the economical possibilities of an up-to-date steam plant for the generation of electricity is to be seen in the offer of the Toronto Electric Light Co. to supply electric power, ten horse power and over, ten hours per day, at 2 cents per h.p. per hour. Such an offer is calculated to iuduce close figuring on the part of projectors of long-distance power transmission schemes.

Gigantic Electrical Undertaking. AN electrical undertaking which has heretofore been unequalled in magnitude is about to be carried out in New York, and is attracting world-wide attention. It is the conversion of the overhead railway from steam to electric power, which will involve an estimated outlay of at least seven million dollars. Four of the largest manufacturing companies, namely, the General Electric, Westinghouse, Walker and Sprague, are now figuring on the proposition, which is calling into requisition the skill of the most talented engineers in the country.

Electrical Apparatus for the Parliament Buildings. MUCH unfavorable comment has been made upon the action of the Minister of Public Works in awarding the contract for lighting the Parliament Buildings at Ottawa without inviting tenders. At the last session of the Dominion Parliament an appropriation of $75,000 was set aside for lighting the buildings by electricity and increasing the fire protection. It was generally supposed that the usual course of publicly inviting tenders would be followed, and that all Canadian manufacturers of electrical apparatus would be given an opportunity of figuring on the work. The government, however, considered it wise to enter into a private contract for four Westinghouse 40 horse power electric motors and four Worthington fire pumps, and also for the necessary current to light the building throughout. In justification of the course pursued, the claim is made that by the agreement entered into a saving of several thousand dollars a year will be effected. It is difficult to understand just how this estimate is reached. Granting that current can be purchased more economically than it could be generated by a plant placed in the buildings, there seems no reason why tenders should not have been invited for such apparatus as was purchased. This method undoubtedly secures the best results and gives most general satisfaction.

Power for Street Railways.

IT has been rumored for some time past that the Montreal Street Railway Company were considering the question of buying the necessary power for the operation of their system. This report was recently strengthened by an inspection of the Chambly power plant made by Messrs. F. S. Pearson, chief engineer of the Metropolitan Traction Company of New York; E. H. Keating, manager Toronto Street Railway, and F. L. Wanklyn, manager Montreal Street Railway. These engineers will, it is said, make a report to the directorate of the company, and upon this will depend future negotiations. The Montreal Street Railway Company at present generates its own power, using about 9,000 horse power per day. The cost of producing this power is estimated at $42 per horse power, which represents an annual expenditure of over $360,000, while, according to reports, the Chambly Manufacturing Company have offered to furnish the necessary power at $32 per horse power. This would mean an annual saving of $90,000. Granted that these figures are correct, the saving thus effected would very soon pay for the street railway plant now utilized, and which would have to be discarded or sold at a great reduction below first cost. It might, however, be found necessary to retain the plant as an auxiliary.

Some Important Experiments.

PROFESSORS Callender and Nicholson, of McGill University, Montreal, have been making some experiments in connection with the steam engine which promise to be of great practical value. They have presented to the English Institution of Civil Engineers a paper on the subject, which we hope to publish in our March issue. The object of the experiments was to ascertain the exact temperature of the steam in the cylinder at different points of the stroke, it having been known to change as much as 100 degrees Fahrenheit in one second. These changes were too rapid to permit of being recorded by mercury thermometers. Professor Callendar has, therefore, devised an electrical resistance thermometer, by means of which it is possible not only to ascertain the temperature at any point of the stroke, but to follow it exactly throughout its entire course. The thermometers are fixed both inside the cylinder walls and in the head of the piston, and as the latter is carried up and down, continuous readings on the galvanometer can be observed. The professors are now continuing their experiments on the large compound engine in the Montreal Street Railway Company's power house, which is probably the largest engine in the world coupled to a single generator. This engine is said to be well adapted for test purposes on account of the very complete arrangements for steam-jacketing the various parts of the cylinders. Some valuable as well as interesting results may be expected.

Improved Conditions.

THE business outlook in Canada at this moment is most encouraging. The combination of a bountiful harvest with unusually high prices for agricultural products appears to be the greatest factor in bringing the return of prosperous conditions. The rich gold discoveries of the Klondyke have turned the eyes of the world towards Canada, and as a result the tide of immigration and of capital is beginning to flow into the Dominion. The period of more rapid advancement which Canadians have been looking and hoping for is undoubtedly at our doors. We should keep in mind the words of Shakespeare, "There is a tide in the affairs of men which, taken at the flood, leads on to fortune." This is true of nations as well as of individuals. Every advantage should be taken of the unusually favorable conditions now prevailing to push forward the development of the nation, its commerce and industries. Comparatively good progress was made by the electrical industries even during the recent period of depression, but a large number of projected undertakings could not be proceeded with owing to the difficulty of securing the required capital. It may fairly be anticipated that, with capital seeking investment, many of these enterprises will go forward to completion during the present year. The electric railway field is by no means fully occupied, but is capable of great extension. The city of Toronto might well be made the centre of a system of radial lines, which would make it the trade centre of a large and wealthy agricultural district. Electric railways intersecting the country in all directions, having facilities for the transportation of both passengers and freight, would be a most effectual check upon exorbitant freight and passenger charges by the two great steam railroad corporations. If this object is to be served, however, care must be taken to prevent the absorption of the electric by the steam roads. In the matter of electric power transmission Canada already stands in the very front rank, and we look for the utilization in the near future of many valuable water powers which are available for this purpose in all parts of the Dominion. Constant development and improvement is taking place in electric lighting, notwithstanding that only by the exercise of the greatest skill and economy can a reasonable return be secured from the capital invested.

A remarkable instance of the efficiency of roller bearings was recently made on a steel wheel weighing 130 pounds and 14 inches in diameter, which was speeded up to 10,000 revolutions per minute, and continued revolving one hour and a half after suddenly disconnecting the source of power. This was accomplished with absolutely no detriment to the bearing, when the plain bearing would have been ruined under such conditions.

THE RELATIONS BETWEEN THE CUSTOMER, CONSULTING ENGINEER AND THE ELECTRICAL MANUFACTURER.*

By S. Dana Greene.

The subject which I have chosen for this paper is an eminently practical one, and I shall endeavor in my remarks to call attention to certain causes of friction which at present exist between the parties in interest, and to suggest certain remedies which may serve to bring about a better understanding and to lessen this friction, which is, in my opinion, entirely unnecessary.

In order to discuss intelligently present conditions, it is advisable to trace briefly the development of the electrical business, and to do this one need hardly go back more than a dozen years. At that time electric lighting was still an experiment (from the commercial standpoint), electric railroading had not begun, and electric power transmission was discussed as one of the possibilities of the future. Very few of our institutions of learning had established separate electrical courses, and such a thing as a consulting electrical engineer hardly existed in this country. The few men who had some theoretical knowledge were eagerly caught up by the manufacturing companies, who had difficulty to find men capable of solving the many pressing practical problems with which they were confronted when they began to sell electric machinery. Thus the development of a practical generator and incandescent lamp immediately created a demand for suitable conductors and materials for outside and inside wiring, safety devices, etc., as well as close regulating engines, proper station appliances and many other things which are to-day regarded as "standards" in the business. It was less than a dozen years ago that the first fireproof switchboard was installed in the Broadway Theatre. The specifications were drawn by a consulting engineer—a naval officer by the way—calling for a fireproof structure, and the manufacturer no doubt accepted the order thinking that he could use what had always been used before, viz., a wooden framework. In this he was mistaken, however, and after a year's wrangling a slate board was installed, much to the manufacturer's disgust, and at great expense to him. It is hardly necessary to say that this form of switchboard became standard immediately, and several years after, the manufacturer, happening to meet the naval officer, said to him, "Someone was a d——d fool about that switchboard, and you were not the man." I well remember when I left the navy to join the Sprague Company in June, 1887, I found that the technical force of the company consisted of Mr. Sprague, an ex-naval officer, and Lieut. Crosby, who had just left the army. Upon explaining to the former how modest was my store of knowledge on the subject of "electric street railways," he at once assured me by saying that we were all in about the same boat! My opportunity came sooner that I expected when, about July 1st, I was charged with the execution of a contract for the equipment of a 40-car road in Richmond, Va., which, under the terms of the contract, was to be in full and complete operation on the first of the following October.

Doubtless most of those present to-night can recall the remarkable growth of electric lighting and railway work during the next five years, from 1887 to 1892—a growth that can fairly be called tropical. Plants sprang up in nearly every city and town in the country, and manufacturers sprang up with equal rapidity. There seemed to be unlimited money ready to invest in electrical enterprises, and the anticipated profits were such as to make the old established manufacturing industries seem very poor investments. During this period, which may be called the "forced expansion period," purchasers usually had to take what they could get, and consulting engineers were few and far between. Specifications for apparatus or installations, when there were any, were generally prepared by the manufacturer, and the purchaser rarely knew whether they had been fulfilled or not. By the close of this period, however, the colleges and technical schools began to turn out men who had taken special courses in electricity and who naturally looked for a chance to make an honest living. The first great demand of the manufacturing companies for technical assistants having been satisfied, many of these young men found their way into local operating companies, or else established themselves as consulting or contracting engineers, in which positions they found plenty of work, for by this time the imperfection in the earlier installations and types of apparatus had become plainly evident to the purchaser as well as to the manufacturer, and there was a general demand for better workmanship and more rigid requirements in installation. It may be here noted that much of the "anticipated profit" of the business, both of the operating and manufacturing companies, was spent subsequently in making good these early defects, and while the business as a whole profited largely by this reconstruction process, it naturally dampened the enthusiasm of the early investors.

In 1893 came the panic, and for the past four years there has been a wonderful record of savings and economies, both in electrical manufacturing and operating companies, as well as a great improvement in quality of product. It has been, in fact, the "economic and reconstruction period." The operating companies have learned that they, too, are manufacturers of a product, electricity; and as these hard times have forced down the price of their product, they, like the manufacturers of apparatus, have to keep their heads above water and their companies out of receivers' hands by the introduction of more economical and improved methods of manufacture and of administration. During the past year there has been a marked improvement in the electrical business; it is to be hoped that this improvement is permanent, and that the past four years of retrenchment and economy have paved the way for a normal and steady growth on conservative lines—in other words, for a period of "natural expansion." The business to-day is on much the same basis as in other industries, where prices are close, competition keen, and where a better article is furnished for less money than ever before.

The manufacturers of apparatus and the manufacturers of current are dependent upon each other to a large extent, and their relations should be close and friendly. The consulting engineer, as in other engineering trades, is a necessary and proper connecting link between the two, and I can say frankly that I believe he has a proper and permanent field of usefulness. Broadly speaking, his function is to see that his client who buys apparatus and installs it selects, first, that system best suited to his particular local conditions, and then, in purchasing, secures the best—not necessarily the most—for his money. It is equally the duty of the consulting engineer

* Paper read before the New York Electrical Society, January 21, 1898.

to learn what the manufacturer can reasonably be called upon to make, to consult with him freely and to obtain the benefit of his experience; to give him credit for work well done, and to insist that bad work shall be promptly corrected. Many consulting engineers, especially those who have recently commenced practice, seem to think that it is improper for them to consult with the manufacturer, or to examine his plant, or to ask him for information or advice. Their idea seems to be that, by so doing, they may be accused of partiality or undue bias, or with lack of proper care for the interests of the purchaser; or they may feel that it is derogatory to their own dignity as independent engineers. The inevitable result is that specifications often contain provisions which are a source of annoyance and expense to the manufacturer and purchaser alike, and which have no compensating advantages from either the engineering or commercial standpoint. In fact, some of these provisions are impossible or impracticable of fulfillment; and in such cases the honest manufacturer who wishes to meet the specifications and guarantees required finds himself forced to ask the engineer or the purchaser (sometimes both) to modify them. This is a proceeding which is always difficult and delicate to undertake, and often results in friction and trouble for all concerned. I am satisfied that if every consulting engineer would take advantage of opportunities as they occur, to visit manufacturing establishments, see the work there in progress and confer with the engineers, he would find himself well repaid for the visit, and his own work and practice benefitted thereby. I am equally satisfied that no reputable manufacturing establishment would refuse admittance, but on the contrary would welcome such visits as beneficial to both parties. The day of mysterious methods of manufacture, carried on behind closed doors, is passed in the electrical business, and I appeal with confidence for an indorsement of the opinions just expressed, to those consulting engineers who have already tried the plan suggested. I have said that I thought the engineer would find himself repaid by such visits. I think, also, that he will find himself in a better position to advise his client intelligently. A purchaser usually knows little or nothing of the relative technical merits of apparatus, and his final decision is governed largely by price and by paper statements and guarantees, which may mean much or little. The consulting engineer who has seen the apparatus in process of manufacture can advise not only as to whether the various bids comply with the specifications, but also what make or makes of apparatus are, from their design, construction and factory inspection and test, most likely to give the least trouble and expense in continuous service.

Some engineers seem to measure their value to the purchaser by the length of their specifications, and some of these formidable documents strike terror to the heart of a busy man confronted by a desk full of mail. The specifications not only specify what the conditions of service are, what apparatus is required and what tests shall be applied to it for acceptance, all of which are quite proper, but also how it shall be built, which is another matter. The electrical manufacturers of this country, following the admirable precedent which has given American manufactured products (particularly machinery) a world-wide reputation, have endeavored to establish standard lines of apparatus, whenever the permanency of type and the size of the demand warrant it. This practice not only tends to reduce cost (and with it price), but also enables the purchaser to secure quickly and at a minimum of expense duplicate parts which are really duplicates, and which can be fitted without the aid of a skilled mechanic. It is the American system of standard lines of machinery and interchangeability of parts, which has stood the test of time and which holds its own against all competitors. This system, however, is possible only where the same article is manufactured in quantity, since the expense of designs, drawings and patterns, special tools, jigs, dies, etc., is prohibitive unless spread over a large production. On the other hand, if special apparatus is required it means a relatively large expense for these items, which cannot be charged to a standard product, and which thus constitutes a handicap both to the manufacturer and the purchaser. A machine is "standardized" only after long experience, both in manufacture and service, and other manufacturers (the builders of engines, trucks, etc.) as well as the users, are invariably consulted before such standardization. It would appear to be to the interest of both seller and buyer to use such standard machines wherever and whenever possible; and yet it seems to be a fact that the demand for special machines is increasing, rather than decreasing, as apparatus becomes more generally standardized. To prove this I can cite the experience for the past year of one manufacturing company with which I am familiar. During this period the designing engineers were called upon for estimates on special apparatus as follows:

Direct current:	
Number of estimates	300
Number of kilowatts of apparatus involved	31,000
Alternating current:	
Number of estimates	300
Number of kilowatts of apparatus involved	131,200

These estimates were all embodied in formal propositions. Besides these there were between two and three times as many preliminary estimates required to answer inquiries of customers, which the engineers had to prepare.

This was in addition to their regular work on standard lines of apparatus, of which there are over thirty. Some of this work was undoubtedly due to new developments in the business and to new methods and inventions, a condition which, although unfortunate from the manufacturing standpoint, must exist for many years to come; but a great deal of it was also due to the fact that specifications call for special apparatus, or methods of construction, where standard apparatus and methods would do equally well. This experience I find is common among electrical manufacturers, and I attribute it largely to lack of touch between the manufacturer and the engineer drawing the specifications, whether he be regularly employed by the purchaser, or retained in an advisory capacity. Let the engineer see more of the manufacturer and his work, and let him hold the latter responsible for results, as determined by proper tests, leaving the details of construction where they belong—in the manufacturer's hands.

G. T. Simpson, electrical supplies, Hamilton, is reported to have assigned to J. W. Vandyke.

Messrs. Hodge & Walley, of Sherbrooke, Que., want tenders for the supply of 50,000 electric railway ties.

The Canadian General Electric Company recently issued a writ against the Street Railway Company of Brantford for $230,000, on an old construction account, and judgment has been secured for the amount and placed in the sheriff's hands for execution.

SPARKS.

The British Columbia Oil Co., Vancouver, B.C., has been incorporated.

An electric light plant has been put in the St. Francis Xavier College, Halifax.

An electric light plant has been installed in a new summer hotel at Gore's Landing, Ont.

The Bushnell Oil Co., at Sarnia, Ont., now have their works lighted by a private electric light plant.

The Hull Electric Company have placed an order for five new summer cars with the Ottawa Car Company.

The Mountain Tramway & Electric Co., of Victoria, B.C., is seeking incorporation. The C. P. R. is interested.

The capital stock of the Yarmouth Amalgamated Telephone Company has been increased from $10,000 to $25,000.

The toboggan slide constructed by the Hull & Aylmer Electric Railway Company, at Aylmer, Que., is said to be well patronized.

The Welland Aqueduct Power Company has been organized, with a capital stock of $24,000, to supply electricity for light, heat and power.

The C. O'Dell Electric Light Company, of Annapolis, N S., is seeking incorporation. The company consists of Carman O'Dell, Jos. Foster, and others.

J. W. Robbins, one of the engineers at Beatty's foundry, Welland, Ont., died suddenly of heart failure shortly after returning from his work on Tuesday, December 4th.

The city engineer of Halifax, N. S., has been making surveys with a view of ascertaining where a sufficient water power can be obtained for operating an electric light plant.

The electric light company of St. Stephen, N. B., has purchased a 275 h. p. engine and three 100 h. p. boilers. This plant will be utilized upon the failure of the water power.

The Hamilton city council have resolved to engage an expert to examine the boilers at the city hall, with a view to putting in such apparatus as will reduce the consumption of fuel.

The Taylor Hydraulic Air Compressing Company, of Montreal, are installing a 500 h. p. plant at Ainsworth, B. C. The power is to be distributed to mines within a radius of five miles.

The taxpayers of Barrie, Ont., have voted in favor of purchasing the waterworks by arbitration. It is thought that an agitation for municipal control of electric lighting will follow this movement.

Acetylene, it is said, can be neither manufactured nor sold in Great Britain now save by express permission of the Home Secretary, the prohibition being made in a recent order-in Council.

Messrs. John Starr, Son & Co. have lately equipped an electric light station at Antigonish for Messrs. MacCurdy & Co., of that town, and are now fitting up the light in a number of stores and houses.

The Massey Station Telephone Company propose to construct a telephone line from Spanish Station to Spanish Mills, Ont. Henry L. Glover and T. J. Millen, of Massey Station, are interested.

A company has been formed at Maniwaki, Que., for the purpose of supplying electric light. The directors are: Messrs. Chas. Logue, J. P. Trambley, Dr. Mulligan and Rev. Father Laporte.

The National Carbon Company, of Cleveland, Ohio, manufacturers of carbons and battery cells, have favored us with a copy of their calendar for 1898, which contains also the moonlight schedule for the year.

Doran's new hotel at Windsor, now nearly completed, is being fitted up by John Starr, Son & Co. with an entire outfit of electric light wirings and fittings, as well as electric annunciators and bells and speaking tubes.

The Montreal Belt Line Railway have established a freight office at Moreau street, Hochelaga, for transportation purposes. This is likely to prove a great accommodation to farmers and others shipping produce to the Montreal market.

The Bell Telephone Company of Canada has announced the connection of its system of long distance lines with that of the American Telegraph and Telephone Company and other telephone companies in the United States, thus establishing telephone connections with Boston, Portland, New York and intermediate points.

It is reported that an effort will be made at the coming session of the Manitoba legislature to remove from the municipal act the clause which prevents the citizens of Winnipeg from voting on a Sunday street car by-law without the consent of the legislature.

The Berlin Telegraph of recent date says: The extension of the Galt and Preston Electric Railway to Berlin is likely soon to be an accomplished fact. Mr. Todd, the president, states that the work on the proposed extension will be commenced with the least possible delay.

McLaughlin & McDiarmid, of Lindsay, Ont., have given notice of application for the incorporation of the Tamagamingue Railway Company, to construct a steam or electric railway from a point on the C. P. R. in the townships of Springer, Caldwell or Kirkpatrick, to some point on Lake Tamagamingue.

The Electric Storage Battery Co., of Philadelphia, has just closed a contract with the Chicago Edison Company for a storage battery plant with a capacity of 7,436,800 watt hours. This will be the largest battery installation ever made. The contract includes switchboard and all the auxiliary apparatus, and will be completed in March, 1898.

Mr. D. A. Starr, manager of the Cornwall Electric Railway Company, submitted to the town Council of Peterboro', Ont., at its last meeting, a scheme for the construction of an electric railway from that town to Chemong and Lakefield. The company propose to lease the Chemong and Lakefield lines from the G. T. R., convert them into electric roads, and take over the freight business. The cost is roughly estimated at $350,000.

Dr. E. J. Edgar, of North Hatley, has formed a partnership with W. O. Roy, of Montreal. They have acquired a water power on the Massawippi river, a little below the village of that name, and purpose furnishing electric light and power to North Hatley, Eustis and Waterville. A contract has been made with the Jenckes Machine Co., of Sherbrooke, Que., for developing the power, and the whole plant will be put in at once.

John Starr, Son & Co., Ltd., Halifax, are now fitting up the St. Mary's Cathedral with a system of electric lighting which is said to be the most perfect of any hitherto installed in Canada. The wires, which have double insulation, are enclosed throughout in enamelled steel tubing, and the fittings are most elaborate. When completed this, with the decorations and artistic paintings lately finished, will make St. Mary's one of the handsomest church edifices in Canada.

In his inaugural address to the City Council of London, Mayor-elect Wilson stated that as the contract for electric street lighting would expire during the year 1899, he considered it expedient to secure all information possible on this question with a view of submitting to the ratepayers a by-law to provide for the corporation undertaking the work of furnishing its own light. In his opinion a committee should also be appointed to report on the advisability or otherwise of renewing the Bell Telephone Company's franchise.

The Edison & Swan United Electric Light Company, of London, Eng., are introducing a new high efficiency incandescent lamp, which takes 2¼ watts per candle, and has a practically constant efficiency and light during its whole life of between 400 and 500 hours. In short, the "smashing" point is said to be never reached with this lamp, as the filament ruptures before the light has sensibly diminished. At present the new lamps are made only in the 16 candle-power size, but the other standard sizes will shortly be put on the market.

Mr. W. Hawley, who is interested in the application of electrical power to canal transportation, states that electricity will be introduced as the motive power upon all the canals of the state of New York, the Champlain canal to be the first to be equipped. At the next meeting of the Board of Directors of his company he will recommend the offer of a prize of $25,000 for the best plan submitted for the utilization of an electric current to the propulsion of the canal boat. The electric current is to be transmitted in armoured cables in the ground along the canal lands.

The Crow's Nest Pass Coal Company is said to have given out orders for electrical coal mining machinery in the cities of Montreal, Toronto and elsewhere, to the value of $100,000, while the company will also erect about fifty beehive coke ovens at Coal Creek for the purpose of supplying the article to the proposed smelter at Robson, B.C. Mr. Blackmore, chief manager of the company, has visited the leading mining centres in the

United States and Canada, with the result that the most improved electric coal cutting machinery will be started in the Pass mines.

The annual meeting of the Montreal Telegraph Company was held in the city of Montreal on the 13th ultimo. The annual report presented showed assets of $2,263,030 and an excess over shareholders' capital of $151,823.85. The contingent fund was stated to be $70,800.11, and a resolution was passed that when the contingent fund reached such a figure that it would yield an annual revenue of $5,000, then this amount should be divided among the shareholders. A dividend of $40,000 was declared, and directors elected as follows: Andrew Allen, president, Hector Makenzie, Jesse Joseph, William Wainwright, Henry Archibald, Wm. J. Withall and Hugh. A. Allan.

The power house at St. Henri, Que., erected about five years ago by the Citizens' Light and Power Co., but recently purchased by the Lachine Rapids Hydraulic and Land Co., was totally destroyed by fire last week. It was a one-story brick building 125 feet long by 40 feet in depth, with boiler house in the rear. Through this building the current of the Lachine Rapids Hydraulic and Land Company was distributed to the various suburbs and to the city. The machinery included nine arc light machines, three incandescent machines, motors, exciters, engines and boilers, the whole being valued at $100,000. No decision as to rebuilding has as yet been announced.

A dispatch from New York states that one of the most remarkable conversations on record recently took place in that city. It was carried on over a telephone wire. At one end of the wire was Captain Charles Jacques, superintendent of the Holland Submarine Boat Company, in the New York office of that concern. At the other end of the wire sat Simon Lake, in the cabin of the submarine boat Argonaut, eight miles out in Baltimore harbor and sixty-five feet under water. A fairly stiff gale was blowing up above, but Mr. Lake's wonderful craft crawled along steadily on its submarine way, paying out its cable as it went, and Mr. Lake's voice could be heard in New York just as clearly as if the speaker was on dry land.

An electric horn has just been placed upon the market which is capable of making a prodigious noise, sounding much like a marine fog horn. This electric horn is the invention of Mr. A. Trudeau, of Ottawa. The need of a horn of this kind suggested itself to the inventor after the late disastrous fire at the Ottawa College, where a serious calamity might have taken place had the fire occurred at night. These electric horns, of a specified size, may be utilized as a morning signal or a fire alarm for waking pupils in the dormitories of scholastic institutions, or for any other purpose where a whistle might be used where there is an electric current available. The horns can be placed in different parts of a building and all set tooting at once by turning on the current.

In order to ascertain whether higher voltages could be commercially employed, the high tension plant at Utah was experimentally run for a couple of days at the extraordinary high voltage of 30,000 volts. The length of the line was 73 miles, and the test lasted 72 hours, during the most trying climatic conditions, comprising heavy rain and severe lightning storms, during which the lightning arresters discharged repeatedly, but without causing a flickering in the light circuits. The line runs normally at 15,000 volts, but the transformers were connected up to give 30,000. No trouble in the insulation was experienced. Over 1000 horse power was delivered over the 73-mile line with a loss of but less than ten per cent., including the transformers at both ends.

According to newspaper reports an important discovery was made by the Bell Telephone Company while testing wires in the city of St. Louis, Mo. It is claimed that the electric current operating street cars can be taken from the earth into which it passes from the rails, and used again for light and power without the use of special electrical machinery. No dynamos and converters are necessary. General Manager Durant, of the Bell Company, said: "That the current from the street car ground wires remains in the earth, and travels underground, we have demonstrated beyond a doubt, and we are certain this force can be used again. We find that a single wire with the simplest kind of a connection will suffice to produce light from this earth current. I can see no reason why the current could not be carried through motors and dynamos in the same way. If the actual current as it comes from the earth were not sufficient it could first be gathered into storage batteries and thus intensified."

PERSONAL.

Mr. Wm. Kennedy, a well known engineer of Kingston, Ont., died in that city on the 27th ultimo, of pneumonia, at the age of 61 years.

Upon the occasion of his recent marriage, Mr. A. Lafebvre, of the Comptroller's staff of the Montreal Street Railway, was waited upon by a large number of confreres and presented with a complimentary address and well filled purse.

The friends of Mr. George C. Robb, chief engineer of the Boiler Inspection & Insurance Co., will regret to learn that he has been indisposed for some time past as the result of an accident just before Christmas. Mr. Robb was rendered unconscious by a fall on an ice covered sidewalk, and is still suffering from the effects.

We are pleased to announce that Mr. J. A. Kammerer is now believed to be on the road to recovery. His illness, referred to in our last issue, has been of a most critical nature, and until about one week ago his recovery was somewhat doubtful. It will require several months to entirely overcome the ravages of the disease and regain his former health.

While on a visit to Hamilton recently, Mr. John Knapman, manager of the Bell Telephone Company at Peterboro', Ont., was being shown through a large warehouse, when he stepped on the false flooring of the elevator shaft, which gave way, precipitating him to the basement, a distance of 40 feet. Mr. Knapman was badly shaken up, but no bones were broken. His companion, Mr. Peter Hamilton, of the Peter Hamilton Manufactur- Co., received injuries from which he died in the hospital a few hours later.

LEGAL.

The Court of Review has confirmed the judgment of the Superior Court in the case of Richmond County Electric Company vs. Sherbrooke Telephone Co. The plaintiffs claimed that the defendant company erected poles in the town of Richmond for their telephone business, and strung wires thereon across and about one foot above plaintiff's wires. The plaintiffs alleged that the defendants allowed their wires to remain in dangerous proximity to plaintiff's wires, and that defendant's wires had sagged and come in contact with those of the plaintiff, producing a short dead circuit, by which plaintiff's dynamo was wrecked and other damage caused. The Electric Light Company were awarded damages of $218.

WALLACE VS. CITY OF OTTAWA.—Judgment on appeal by plaintiff from judgment of Meredith, J., at the trial at Ottawa, dismissing the action which was brought against the city corporation and the Ottawa Electric Street Railway Company for damages for injuries sustained by plaintiff by reason of the alleged negligence of one or other or both of defendants on the evening of the 7th December, 1896, whereby plaintiff was overtaken and run into by a tramway car in Sparks street, in the city of Ottawa, there being a very narrow passage for foot travellers between a fence erected outside the sidewalk, where there had been a fire, and a tramway line and an obstruction on the passage, and no warning having been given of the approach of a car. Plaintiff contended that there was negligence of both defendants, no contributory negligence on the part of plaintiff, and abundant notice to defendants of the condition of the roadway, etc. The learned judge, while dismissing the action, assessed the plaintiff's damages at $350, and directed a reference as to damages for loss of business, etc., in the event of an appellate court finding negligence proved. Appeal dismissed with costs.

HE KNEW IT WAS HER.

MR. and MRS. J. came to town the other day, says a Louisville paper. The madam is a large, muscular-looking woman, and is evidently the boss of the ranch, while Mr. J. is a cowed, effeminate-looking creature, who seems to be afraid when the madam is around. While Mrs. J. went into Goldnamer's to do some shopping, the little man slipped off to Bell's to get a drink. While he was down there he heard the telephone ring and enquired what it was. The mysteries of the instrument were explained, and Mr. Bell offered to call up his wife at Goldnamer's and let him talk to her. This seemed to please him very much, but just as he got the trumpet to his ear the lightning struck the wire and knocked him down. Staggering to his feet he said, "That's her; it sounds just her."

Rev. John Wilson, of Fitzroy Harbor, Ont., in renewing his subscription, writes: "Although I take several New York electrical journals, I do not like to be without the ELECTRICAL NEWS."

EDUCATIONAL DEPARTMENT

INTRODUCTORY

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

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

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

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

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

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

WM. THOMPSON.

(ARTICLE X.)

DROP IN POTENTIAL AND SIZE OF LEADS FOR MULTIPLE ARC CONNECTIONS.

SUBSIDIARY leads or branch leads are taken from larger sized mains of constant E.M.F., or from terminals of generators with constant E.M.F. to supply current to one or more lamps, motors or other appliances requiring a constant E.M.F.

There is a drop of potential in the leads to be provided for so that the appliances may have to work at a reduced E.M.F. The E.M.F. of the leads is known, and the required E.M.F. of the appliance to be supplied with current, also its resistance, and a rule is required to calculate the size of wire in the lead to secure proper results.

The resistance of the leads supplying any lamp or appliance for a desired drop within the leads is equal to the reciprocal of the current of the lamp or appliance multiplied by the desired drop in potential expressed as volts. This principle is based on the fact that the drop in potential in portions of circuits varies with the resistance.

Example 10: A 110-volt lamp having a resistance of 220 ohms is to be placed 50 feet distant from a main having a constant E.M.F. of 115 volts. What must be the resistance of the line to maintain a constant E.M.F. of 110 volts at the lamp?

The lamp current is found by the formula:

$$C=\frac{E}{R}=\frac{110}{220}=.5, \text{ or } \tfrac{1}{2} \text{ ampere.}$$

The reciprocal of the current then is $\frac{2}{1}$. This multiplied by desired drop 5 volts $=\frac{2}{1} \times 5 = 10$ ohms, required resistance of leads.

For two or more lamps in parallel similar rules are applied.

In this case the E.M.F. of the terminals or main leads, the factors of the lamps, and their distance from the point of connection with the main leads require, to be given.

Example 11: A pair of subsidiary leads are to be run a distance of 150 feet from main leads, and to carry current for ten 50-volt lamps having a resistance of 100 ohms. The main leads have a constant E.M.F. of 55 volts. What is the resistance required in subsidiary leads, and what size of wire B & S gauge?

The combined R of lamps is found by formula:

$$R=\frac{R}{N}$$

Then $\frac{100}{10}=10$ ohms, combined resistance of 10 – 100 ohm lamps in parallel, $\frac{50}{10}=5$ amperes current to be supplied to lamps. The reciprocal of $5=\frac{1}{5} \times 5 = 1$ ohm resistance required by line. Length of lead 150 ft. x 2 = 300 ft., total length of line. Required resistance 1 ohm ÷ 300 = .0033 ohms per foot, equivalent to No. 14 gauge wire as per table.

Or this may be worked out on the principle that the resistance of the leads is equivalent to the combined resistance of the lamps multiplied by the percentage of drop and divided by 100 minus the percentage of drop; which we can express in formula thus, using x as representing the required quantity:

$$x=\frac{R \times \%}{100-\%}$$

The percentage of drop is found by dividing required drop in E.M.F. by initial E.M.F. on mains, and $\frac{5}{55}=9\%$. The required resistance of the leads then is $\frac{100}{10}$ = combined R of lamps.

$$\frac{10 \times 9}{100-9}=\frac{90}{90}=1 \text{ ohm, required R of leads.}$$

STRENGTH OF BOILERS.

The Steamboat Inspection Act, 1882, ss. 4, provides "that the areas of diagonal stays are found in the following manner:"

Find the area of a direct stay needed to support the surface, multiply this area by the length of the diagonal stay, and divide the product by the length of a line drawn at right angles to the surface supported to the end of the diagonal stay; the quotient will be the area of the diagonal stay required.

Example: Find the area required in a diagonal stay supporting 1 square foot of surface, boiler pressure being 75 pounds per square inch, length of diagonal stay 12 feet and length of line 9 feet, stress allowable per square inch of section on direct stay being 6,000 pounds.

```
  12
  12
 144 square inches surface supported.
  75
 720
1008
10800 total stress on direct stay.
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10,800 ÷ 6,000 = 1.71 square inches, required area of direct stay.

```
1.71 area of direct stay.
  12 length of diagonal stay.
```

20.52 = 20.52 ÷ 9 length of line = 2.27 square inches, required area of diagonal stay.

When the tops of combustion boxes or other parts of a boiler are supported by solid rectangular girders, the following formula may be used for the purpose of finding the working pressure to be allowed on the girders, assuming that they are not subjected to a temperature greater than that of the steam and are supported by hanging stays.

Formula:

$$\frac{C \times d^2 \times T}{(W-P)\, D \times L}=\text{working pressure.}$$

Where W = width of combustion box in inches,
P = pitch of supporting bolts in inches,
D = distance between the girders from centre to centre in inches,
L = length of girder in feet,
d = depth of girder in inches,
T = thickness of girder in inches,
C = 500 when girder is fitted with one supporting bolt,
C = 750 when fitted with two or three,
C = 850 when fitted with four.

The working pressure for the supporting bolts and plate between them is determined by rules for ordinary stays already referred to.

The pressure allowed on plates forming flat surfaces is found by the following formula:

$$\frac{C \times (T+1)^2}{S-6}=\text{working pressure per square inch.}$$

Where T = thickness of plate in sixteenths of an inch,
S = surface supported in square inches,
C = 100; but when the plates are exposed to the impact of heat or flame, and steam only is in contact with the plates on the opposite side, C must be reduced to 50.

Example: Find safe working pressure of a flat-bottomed boiler whose stays are pitched 15 inches apart and thickness of plate is ½ inch.

$$\frac{C+(T+1)^2}{S-6}=\frac{100\times(8+1^2)}{225-6}=\frac{8100}{219}=37 \text{ lbs. safe working pressure.}$$

To find required thickness of plate we must reconstruct the formula:

$$\frac{S-6\times P}{C}=(T+1)^2 \text{ and } \sqrt{T+1}=T.$$

Example: Find the required thickness of plate for a flat-bottomed boiler, whose stays are pitched 12 inches apart and steam pressure is 50 pounds per square inch, and depth of water in boiler is 7 feet. Also, what must be the diameter of stays if they are not allowed to carry more than 6,000 pounds per square inch of section?

Pressure due to water $=.433\times7=3.031$ lbs.
Pressure due to steam $=50.$
Total pressure per square inch $=53.$ lbs.

Then

$$\frac{S-6\times P}{C}=\frac{(144-6)\times53}{100}=\frac{7314}{100}=73.14.$$

And $\sqrt{73.14}=8.55$. $8.55-1=7.55$ or $\frac{15}{32}$, required thickness of plate in sixteenths or thirty-seconds of an inch.

Stays are pitched 12 inches apart, and therefore must support a surface of $12\times12=144$ square inches.

$144\times53=7,632$, total weight each stay is called upon to support.

$7632\div6000$ stress allowed per square inch of section of stay $=1.272$ square inches, required area of stay.

$\sqrt{1.272\div.7854}=1.25$ (nearly), required diameter of stay.

It sometimes occurs that the stays of a boiler are to be fixed with cottars, and it is necessary to know what size the end of the stay must be swelled to so as to have the same strength as the stay. For this purpose the following formula is used:

$$D=\left(1+\frac{.08}{N}+\frac{.4}{\sqrt{N}}\right)d$$

Where d = diameter of stay in inches.
D = increased diameter.
N = depth of cottar in terms of its width; that is, if cottar is ½ an inch wide and 1½ inches deep, N would be 3, since depth of cottar is 3 times the width.

Example: The stays of a boiler are to be fixed with cottars ½ an inch thick and 2 inches thick, the diameter of stay being 1½ inches, what size must the end be made so as to have uniform strength with stay?

$D=\left(1+\frac{.08}{4}+\frac{.4}{\sqrt{4}}\right)\times1.5=(1+.02+.2)\times1.5=1.83$ required diameter of end of stay.

SPARKS.

The Guelph Light & Power Company have just installed a new dynamo.

M. S. Cornell, of Stanbridge East, Que., will probably install an electric light plant next spring.

The Cardinal, Ont., Electric Light Company has been incorporated, with a capital of $20,000.

The Deseronto car works have turned out an electric snow plough and freight motor for the Kingston Street Railway Company.

Rev. D. B. Marsh, of Black Heath, Ont., inventor of the Marsh stethophone, is taking out patents in the United States and European countries.

The proposal submitted to the ratepayers of the town of Annapolis, N. S., to raise the sum of $12,000 to install an electric light plant, was recently voted down.

The works of the Toronto Electrical Works Company, Adelaide street west, Toronto, were recently damaged by fire to the extent of $10,000, the loss being partially covered by insurance.

The General Electric Company, of Schenectady, N. Y., have just received an order for 32 electric locomotives for the Central London underground railway, at London, England.

The city clerk of Chatham, Ont., is open to receive applications until the 15th instant for the position of city engineer, to take charge of the public works, electric light plant and city water works.

The town council of Napanee, Ont., have accepted a proposition made by John R. Scott to supply electric light. Mr. Scott agrees to install an incandescent and arc light plant within one year.

The Central Electric Light Company, of Portage La Prairie, Man., have elected officers for the ensuing year as follows:—President, Thos. W. Taylor, of Winnipeg; vice-president, T. B. Millar; secretary and manager, M. Blake; other directors, Judge Ryan, Hon. Robt. Watson, and Wilson Bell. The reports presented showed a prosperous year's business.

The expenses of the municipal electric light plant at Lachine, Que., amounted in 1897 to $3,282, for a service of 850 incandescent lights and 43 arc lights. The receipts for the same year amounted to $3,066.

A meeting of the shareholders of the New Glasgow Electric Company, New Glasgow, N, S., was held recently for the purpose of authorizing the company to issue bonds for the sum of $35,000, with which to wipe out its present indebtedness.

On February 1st fire was discovered in the premises of Ness, McLaren & Bate, manufacturers of telephones and electrical supplies, Montreal. The stock and machinery on the third and fourth floors were almost totally destroyed, the loss being about $15,000.

The Dechenes Electric Light Company, of Dechenes Mills, Que., are having plans prepared for the construction of dams at Dechenes Rapids, intended to furnish 3,000 horse power. A new power house will also be erected, the contract for which will be let at an early date.

The charge of boodling brought against an alderman of Chatham, Ont., in connection with the installation of an eleetric light plant, has been dismissed without argument by Judge Housten. It is said that proceedings will now be taken against the persons instigating the prosecution.

The largest contract for electric lighting ever gived in London, Ont., was recently let by Messrs. McGaw & Winnett to the London Electric Company. The contract calls for the lighting of the Tecumseth House throughout, for which purpose between 600 and 700 lights will be required.

A new proposition for the supply of electric power to the city of Toronto has been made by the Georgian Bay Ship Canal and Power Aqueduct Company. The price quoted is six mills per electric horse power per hour, the company agreeing to supply 2,000 horse power within two years from the date of contract.

A live question now before the City Council of Ottawa, Ont., is whether the Deschenes Electric Light Company will be permitted to compete for electric lighting in that city, in opposition to the Ottawa Electric Company. Before deciding the question the aldermen are taking steps to secure as much information on the subject as possible.

Mayor Ovens, of New Westminister, B. C., referred in his inaugural address to the rapid growth of the electric light business, and pointed out the necessity of increasing the existing electric light plant, which is owned by the city. Two propositions are submitted, one to increase the present plant, and another to utilize some convenient water power and carry the current to the city by cable. The latter plan is recommended.

By a recent decision of the Supreme Court of Nova Scotia the act by which the Sabbath Observance Society sought to stop the operation of street cars in Halifax on Sunday was declared to be ultra vires of the Provincial Legislature. The Sabbath Observance Society had officers of the Halifax Electric Tramway Company summoned to the Police Court for employing men to perform labor on Sunday. The company asked the Supreme Court for a writ prohibiting the Police Magistrate from going on with the case on the ground that the act was ultra vires.

The city of Winnipeg, Man., recently invited tenders for electric street lighting for a period of years, also for furnishing an electric light plant. In response the following tenders were submitted: Goldie & McCulloch Co., Galt, steam plant, $10,310; Western Electric Company, Chicago, $20,850, $21,950 and $21,800; Robb Engineering Company, Amherst, N. S., $19,330, $20,480 and $21,200; McDonald Bros., Winnipeg, poles, wiring, etc., $22,500, steam plant, $9,068; Manitoba Electric Light and Gas Company, Winnipeg, from 47c. to 45c. per light per night for 121 lights for one year, for a period of from two to five years and for 200 lights, 39c. per light per night; Northwest Electric Light Company, Winnipeg, 121 to 200 lights, 40c. per light per night; W. A. Johnson Electric Company, Toronto, 200 lights, $19,265, including everything for supplying 250 lights $33,366; Fort Wayne Electric Corporation, Fort Wayne, Ind., electric plant, $9,285; Royal Electric Company, Montreal, electric plant, $10,000; installing and bricking in, $9,500 extra (this company submitted a supplemental tender of $12,050); Canadian General Electric Company, Toronto, electric plant, $13,540. No award has as yet been made, and it is probable that an electrical expert will be engaged to report on the tenders submitted.

ELECTRIC RAILWAY DEPARTMENT.

ANNUAL MEETING OF TORONTO STREET RAILWAY COMPANY.

THE annual meeting of the Toronto Railway Company was held on January 19th last. The report presented stated that the net profits of the year 1897 were $332,022. From the profits two dividends, at the rate of 1¾ per cent. each, had been declared, amounting to $210,000, leaving, after the deduction of pavement charges, the sum of $62,022.50 to be carried forward. The gross earnings for the year showed a most satisfactory increase over the corresponding period of 1896. Apart from the increase due to the operation of the company's system on Sundays since 23rd May, receipts show steadily augmenting increases, and the directors have every reason to trust that same will continue throughout the present year. The average earnings on Sunday since that date were $1,277, which, on the whole was considered satisfactory, having in view the limited nature of the service.

The policy of keeping the plant in a high state of efficiency was maintained. The increased business having called for additional rolling stock, ten closed and twenty open motor cars were built in the company's shops, 31 iron trucks and 50 standard electric motors were added to the equipment, and in anticipation of further increased business the company have under consideration the building of additional cars for the current year. The appointment of Mr. E. H. Keating as manager of the company, to succeed Mr. Wanklyn, was sanctioned. The financial statement showed gross earnings of $1,077,612 and operating expenses of $525,801, leaving the net earnings for 1897 $551,811. There were carried 25,271,314 passengers, and 8,169,022 transfers were granted. The total assets of the company are valued at $9,957,159.

The board of directors was elected as follows: William Mackenzie, James Ross, F. L. Wanklyn, W. D. Matthews, James Gunn, C. E. L. Porteous, G. A Cox. At a subsequent meeting of the directors Wm. Mackenzie was elected president and James Ross vice-president.

THE QUEBEC DISTRICT RAILWAY.

DURING the year 1897 the citizens of Quebec and vicinity were afforded the means of quick transportation, the Quebec District Railway Company having put into operation some twenty miles of electric road. The old horse car system was taken over and electrified, and other extensions made wherever the traffic would seem to warrant. The power for operating the road is supplied by the Montmorency Electric Power Company, from their magnificent station at Montmorency Falls, a description of which has already appeared in the ELECTRICAL NEWS.

The whole equipment of the road, with the exception of the rails, was furnished by Messrs. Ahearn & Soper, of Ottawa. The rolling stock consists of 30 vestibule cars, upholstered in best Wilton, cherry finish, mounted on Taylor trucks, each car equipped with two 12-A 30 h. p. Westinghouse motors, with multiple series controllers. Each car is lighted with fourteen lamps, and heated by Ahearn & Soper electric heaters, which are placed beneath the seats and are invisible. The cars are exact duplicates of those in use on the Ottawa system, including the same method of collecting fares and registering. There are five electric snow sweepers, each sweeper equipped with three 12-A 30 h. p. Westinghouse motors.

The overhead construction includes iron poles throughout. The trolley wire is No. 00 and the feeders are 500,000 circular mils. The rails are of the T pattern, 72 lbs. per yard in weight, and the whole track construction is of most substantial character.

Owing to the narrow streets in Quebec a great deal of the road is single track, thus necessitating a large amount of bracket work. The brackets were specially designed by Ahearn & Soper, and are of the most practical and substantial character. It is stated that the Quebec road is operated at 30 per cent. of its gross receipts.

The manager and chief engineer, under whose direct supervision the road has been constructed, and to whom the success of its operation is due, is Edward A. Evans, C. E. The officers of the company are as follows: President, Andrew Thomson; vice-president, E. W. Methot; secretary treasurer, J. R. H. White.

The steepest grade at present in use at Quebec is on Crown street, and is 15¼ per cent. Heavily loaded cars ascend this grade without difficulty.

BRITISH COLUMBIA ELECTRIC RAILWAY COMPANY.

THE British Columbia Electric Railway Company, which is composed of British capitalists, issued a circular to the shareholders recently, in which the secretary says:

My directors desire me to convey to you the working results of this company for the first half-year of its existence. The directors particularly wish to draw your attention to the fact that the period under review is two weeks less than the full six months, the properties having been taken over on April 15th, and the books made up to September 30th. For that period the results were as follows:

	Gross Earnings.	Working. Expenses.	Net Profits in British Columbia.
April (15 days)	$10,992.55	$ 7,900.58	$3,091.97
May	21,604.54	15,741.31	5,863.23
June	23,305.24	16,443.28	6,861.96
July	23,435.74	16,361.44	7,074.30
August	26,739.61	17,730.20	9,009.41
September	24,665.91	17,336.17	7,329.74
	$130,743.59	$91,512.98	$39,230.61 = £8,072

Deducting expenditures in London, Eng., the surplus for the complete six months is given as £2,300.

This satisfactory result is due to steady improvement in business, fairly evenly distributed amongst all the branches, and little benefit, if any, has as yet been derived from the various improvements which are at present being carried out with the capital derived from the issue of the income bonds. Of the improvements, to carry out which the issue of income bonds was made, the extension to Stanley Park, and the improvements on the Westminster branch have been satisfactorily completed, and the economy of £3,500 per annum expected from them should shortly commence to show in the returns. The installation of water-power at Victoria is in course of construction, and, the board anticipate, will be finished about March 31st. Before finally making this important expenditure of capital, the board decided to call in still further expert advice, and secured the services of Mr. J. M. Campbell, of Toronto, electrical engineer of very high standing, and of long experience in this class of business. The board is glad to state that Mr. Campbell not only confirmed the opinion of the previous expert, but put the increased annual profits to be derived by substitution of water power for steam power, and the other improvements in Victoria now in hand, at £9,000 per annum. The installation of water power at Vancouver has been deferred for the present.

SPARKS.

The S. Hadley Lumber Company, of Chatham, Ont., are supplying the ties and poles for the electric street railway at St. Thomas, Ont.

Mr. A. J. Corriveau, the promoter of the Montreal and South Shore railway, states that the work of construction will be pushed ahead early in the spring.

The experiment of laying a telegraph cable from Port Angelos to Victoria, B. C., is deemed impracticable, owing to the tremendous strain that would be exerted on the line by the heavy tides and extremely rough water.

For injuries received in a street accident, Mrs. Gage and Mr. John T. Gage, of Hamilton, were awarded damages of $900 and $300 respectively. Their suit against the Hamilton Street Railway Company was for $5,000.

The car barns of the Metropolitan street railway, North Toronto, were destroyed by fire on the 23rd ultimo. All the rolling stock of the company excepting one car was burned. The loss is about $10,000, fully covered by insurance.

Last year the Galt, Preston & Hespeler Electric Railway carried 221,674 passengers, an increase of 2,027 over the previous year. The total freight carried was 12,973 tons, an increase of 4,663 tons. The increased earnings were $1,900. President Todd has been re-elected.

The Hamilton & Barton Incline Railway Company held its annual meeting a fortnight ago, at which a dividend of three per cent. was declared. Directors were elected as follows: George E. Tuckett, president; John Dickenson, vice-president; L. Bauer, secretary; W. Hendrie and John Clark, directors.

The Hamilton Street Railway Company, at its annual meeting last month, re-elected the board of directors as follows: Messrs. Wm. Gibson, M.P., president; Edward Martin, Q.C., vice-president; F. W. Fearman, W. J. Harris, B. E. Charlton, I. Beer, John A. Bruce. Mr. J. H. Griffith was re-appointed manager. No dividend was declared.

Ahearn & Soper, of Ottawa, have built for the Hamilton, Grimsby & Beamsville railway a new palace car, which is claimed to be one of the finest in Canada. It is built in full Pullman style, and capable of seating 60 passengers. The interior is finished in black oak, with monograms on every window, electric bells for the passengers, and adjustable card tables for use when desired. The cost was about $4,500.

The York County Council are taking steps to secure legislation from the Ontario government placing the control of street railways in the county under the jurisdiction of the county council, with the rights of appeal by any local municipality to the Lieutenant-Governor-in-Council. This would enable the county to build railways along the various highways notwithstanding objections on the part of any municipality.

The annual meeting of the Hamilton, Grimsby and Beamsville Railway Company was held at Hamilton on January 24th. It is said that the meeting was by no means harmonious. The management claim an increase in receipts over the previous year of 21 per cent., this being partly accounted for by the Beamsville extension and the connection with the C. P. R. for fruit carrying purposes. The former directors were re-elected.

At the recent annual general meeting of the Ottawa Electric Railway Company, the annual report showed that 4,762,082 passengers were carried during the year, and 1,538,836 miles covered, and that four quarterly dividends of two per cent. were paid. A satisfactory increase in receipts was reported, especially since the month of September. The following were re-elected directors: Messrs. J. W. McRae, T. Ahearn, G. P. Brophy, Warren Y. Soper, Thos. Workman, Peter Whelan and William Scott. Mr. J. W. McRae was re-elected president, and Mr. T. Ahearn vice-president and managing director.

According to the statement presented at the recent meeting of the London Street Railway Company, there were carried during 1897 a total of 2,558,000 passengers, and nearly one million car miles were traversed. The gross earnings were $101,365, and the operating expenses 56.7 per cent of the earnings. There was an increase of 158,000 in the number of passengers carried. The officers were re-elected as follows: President, H. A. Everett, Cleveland; vice-president, C. W. Moore, Cleveland; directors, Messrs. Everett, Moore, C. W. Wason (Cleveland), Holt (Montreal), T. H. Smallman (London); secretary-treasurer and general manager, C. E. A. Carr.

During the year 1897 the Bout d'Ile Electric Railway Company carried out considerable construction work in the vicinity of Montreal. The system was connected with the Canadian Pacific railway freight yards on Moreau street. This new branch, which brings the Chateauguay and Northern into immediate connection with the C. P. R., embraces about 1½ miles of track, the rails being 60 lbs. to the yard, so that goods can now be billed from any part of the C. P. R. to any point on the electric road in question. There are two fine sidings on the new extension and the equipments appear to be all first-class. The poles are 35 feet high and 100 feet apart, while overhead the bracket system has been used. The trolley wire is 21½ feet from the rail, so as to permit a standard railway traffic, as it is expected that a great quantity of freight will be interchanged from one road to the other. Overhead of this are three wires, one a large feeding wire, which extends all the way from Charlemagne Ferry to the Canadian Pacific, while the other two are the metallic telephone circuit.

TRADE NOTES.

The contract for all the work in connection with the lighting of the Parliament Buildings at Ottawa has been placed with Ahearn & Soper, of that city.

The Globe File Mfg. Co., of Port hope, Ont., have recently added to their extensive plant what is known as the steel rope drive system for operating their machinery, in place of the old cog-wheel system. The work was carried out by the Dodge Wood Split Pulley Co., of Toronto.

Messrs. Ness, McLaren & Bate, manufacturers of telephones and electrical apparatus, Montreal, whose premises were recently seriously damaged by fire, are now located in temporary quarters at 761 Craig street, where they are in a position to fill all orders with the same promptness as in the past. After rebuilding, they expect to locate at their former address, 749 Craig street.

A very complete electric light plant has lately been installed by John Starr, Son & Co. in the factory of the Truro Condensed Milk Company, which is giving perfect satisfaction. This consists of a dynamo of capacity of 150 lights, which also furnishes current for heating the soldering irons in the can factory. The same firm have also connected the different departments with their "Unique" warehouse telephones.

The General Engineering Company of Ontario is in process of formation in Toronto, to purchase the assets of the Weeks-Eldred Co., of Toronto, Limited. The objects of the new company are to buy, sell, manufacture and deal in mechanical stokers and other steam, electrical, heating and ventilating appliances and general machinery, and to carry on a general contracting business. Mr. James Milne, manager of the Weeks-Eldred Company, is chief promoter of the new enterprise.

The Dodge Wood Split Pulley Company, of Toronto, have issued a most complete catalogue of their patent wood split pulleys and power transmission appliances. It contains nearly 300 pages, in which are to be found many valuable tables and numerous illustrations. The preface says: "Our aims and efforts are constantly directed towards the perfecting of power transmitting machinery and the advancement of the practice governing the usages of this very important branch of mechanics. The present age is one of progress and economy; it therefore behooves every owner, or prospective owner, of a power plant to familiarize himself with the best practice in transmission engineering. Money saved at the coal pile means larger dividends for the stockholders."

To the Royal Electric Co., of Montreal, belongs the credit of having produced one of the most useful and best designed calendars which has yet come before our notice. It is a blotting pad, of convenient size for an office desk. In the upper right hand corner is a neat calendar, and directly below a pocket in which an engagement book is designed to slide, leaving visible only the word engagements. This book is dated for the entire year, and on the left hand pages appear Frund's and the National moonlight schedules, together with valuable wiring tables, price lists, and other information. The announcements of the well known "S.K.C." generators, motors, transformers, etc., are made in gilt letters, which appear to good advantage on the dark brown background.

The T. & H. Electric Co., successors to the Kay Electrical Mfg. Co., report the following recent sales: Messrs. Hallman & Co., Berlin, 12 h.p. motor; Toronto Cold Storage Co., 5 light dynamo; Journal Printing Co., St. Catharines, 5 h.p. motor; Geo. Membery, St. Catharines, 3 h.p. motor; Toronto Ornamental Iron Co., 1000 gal. plater; Messrs. Meakins & Co., 1 h.p. motor; R. N. Grundy, Guelph, 200 gal. plater; Berlin Felt Boot Co., 150 light dynamo; A. R. Woodyatt & Co., Guelph, 250 gal. plater; J. C. Harris, Toronto, one 15 h.p. and one 10 h.p. motor; McKinnon Building, Toronto, one 15 h.p. and one 10 h.p. direct connected motors and controllers; Garrioch & Goddard, Ottawa, one 2 h.p. and one 4 h.p. motor; Berlin Shirt & Collar Co., 4 h.p. motor; D. W. Karn & Co., Woodstock, Ont., automatic organ blowing machine, besides several machines in Victoria, B. C., and Woodstock, N.B.

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The following are the results of Competitive and Ordinary Working Tests made at the Terauley street Station of the Toronto Incandescent Light Co. between the Improved Jones' Underfeed Mechanical Stoker and EXCELLENT Hand Firing:

GO OVER EACH ITEM CAREFULLY

Points Observed.	Competitive.		Ordinary.	
	Jones'.	Hand.	Jones'.	Hand.
Duration of test in hours	94.2	93.75	18.	18.
Total coal burned, including wood equiv., in lbs.	74447.	81770.	13600.	15000.
Water evap. from temp. of feed, in lbs.	621080.	593945.	126113.	112338.
Average steam pressure	159.7	158.5	158.	158.
Total ash	6158.	8998.	Not	weighed.
Actual evap. per lb. coal from temp. of feed in lbs.	8.3426	7.262	9.227	7.489
" " " comb. " " " "	9.081	8.161	....	....
Equiv. " " coal from and at 212°, in lbs.	9.832	8.121	10.3342	8.3876
" " " comb. " " " "	10.147	9.127	....	....
Percentage ash	8 2	11.	....	....
Relative economy	114.78	100.	123.2	100.

QUESTION—If the above results are obtained with Excellent Hand Firing, what would the results be with Indifferent and Poor Firing? Think on this and then ask yourself if you can afford to be without the Stoker. It is the ORDINARY WORKING Test that tells the tale, not the COMPETITIVE.

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