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CANADIAN ELECTRICAL NEWS AND STEAM ENGINEERING JOURNAL

OLD SERIES, VOL. XV.—No. 6.
NEW SERIES, VOL. VIII.—No. 5.

MAY, 1898

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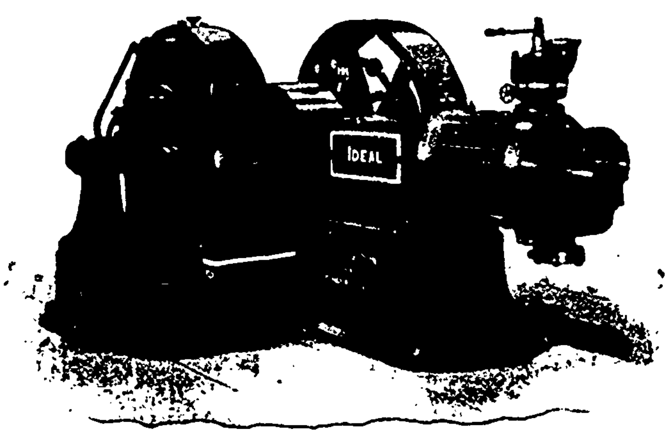

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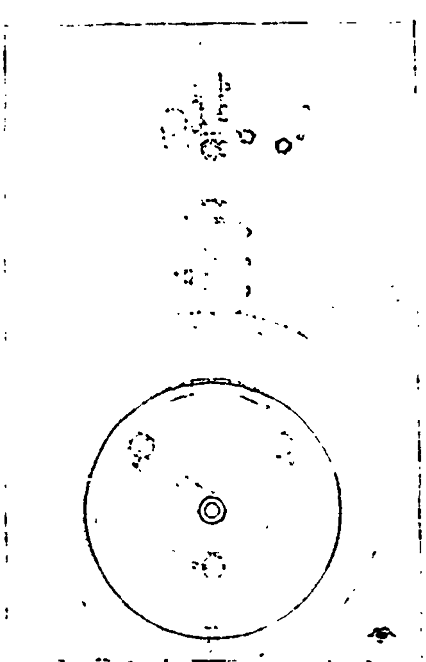

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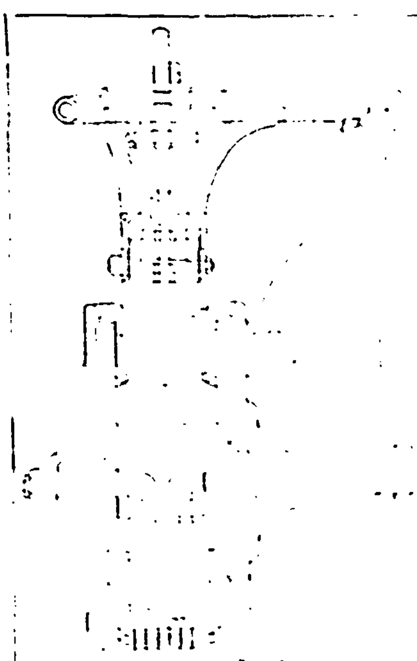


CANADIAN

ELECTRICAL NEWS

AND

STEAM ENGINEERING JOURNAL.

VOL. VIII. MAY, 1898 No. 5.

ELECTRICAL PLANT OF MACDONALD ENGINEERING BUILDING, McGILL UNIVERSITY, MONTREAL.

THE lighting and power electric station of McGill University, Montreal, has, during the past year, undergone extensive enlargement and up-to-date alterations. The dynamo room is located in the basement floor of the Workman Technical Building, beside the boiler plant. The room is 36 ft. by 34 ft., with stone walls, covered by coats of cement. The floor is of Mosaique, presenting a well-finished appearance.

GENERATING PLANT.

The equipment of the generating plant comprises a 35 k.w. Edison-Hopkinson dynamo, direct coupled to a high speed Willans engine; a 35 k.w. Siemens dynamo, also driven by a Willans engine, and a 75 k.w. multipolar General Electric generator, driven by a 100 h.p. Goldie & McCulloch horizontal engine. Space is reserved in the dynamo room for doubling the present capacity of the station. Beside this, two sets of storage batteries of 55 cells each, of the Crompton-Howell type, 800 amperes-hour capacity, render useful service in lighting the buildings at night or on holidays. A 5 k.w. motor generator (Lundell) is used as a booster for charging these batteries.

FOUNDATIONS.

The foundations for engines and generators are substantially constructed. The floor rests on bed rock, upon which is placed 18 inches of concrete, two ply of tar paper and asphalt, then again six inches of concrete, and one inch thick of Mosaique pavement. The foundations for the 75 k.w. generator are carried 6 feet below the floor level; the rock was picked out and solid concrete masonry put in place; 1½ in. bolts are sunk 3 feet deep in best cement concrete. The foundations above the engine room floor are made of enamelled bricks placed on edge, with corners of dark red marble. Those for the Willans engines and generators were simply laid on the rock, the facing above the level of the room being of light color enamelled brick, with corners of marble.

ELECTRICAL PLANT AT McGILL UNIVERSITY.—VIEW OF SWITCHBOARD.

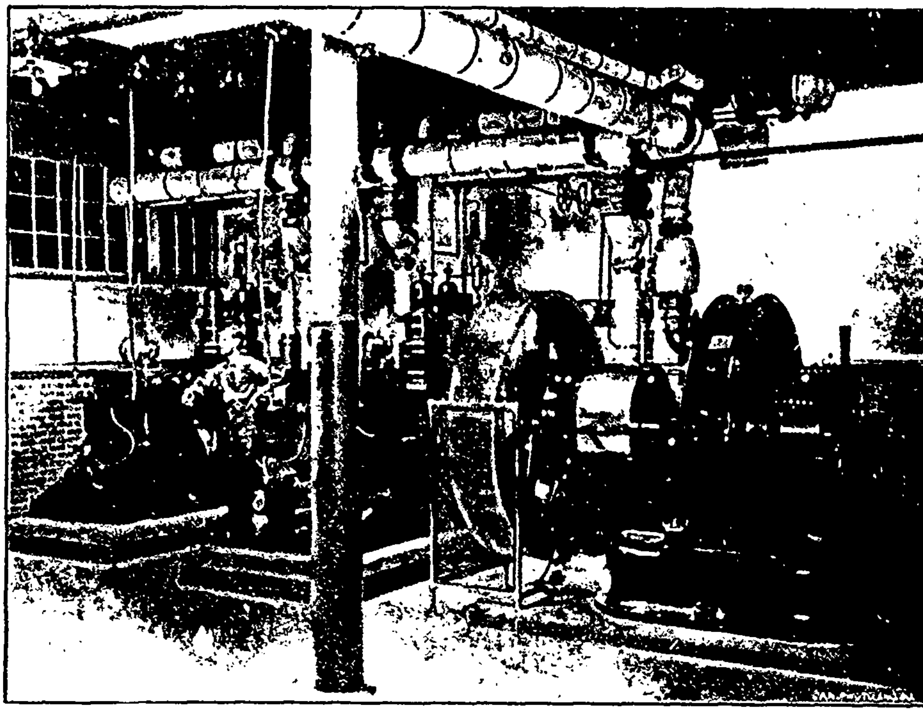
THE SWITCHBOARD.

The switchboard, as shown herewith, is 16 ft. long by 8 ft. high, and supported on pedestals 18 ft. above the floor. The board is of polished black enamelled slate 2 inches thick, made up in four panels, viz.: The lighting generators panel, the distribution panel, the power panel, and the storage battery panel. As this board will sometimes be left to the care of inexperienced people, it is so arranged that no harm can be done to the machines or apparatus by improper handling.

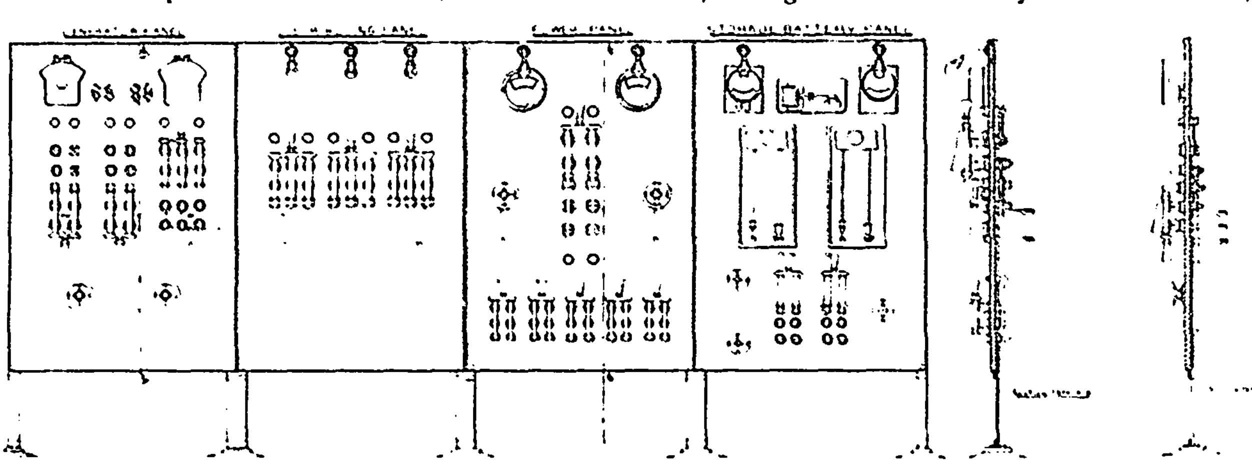
The lighting panels are so arranged that the buildings, containing three thousand lights, can be lighted by the two 35 k.w. dynamos in series, or, if the load is light, by one of them running on the two-wire system, or by accumulators.

The power panel is fed from the multipolar General Electric generator, at 125 volts, there being a separate switch for each distinct power service.

The storage battery panel enables the two sets of batteries to be charged in multiple ; there is an automatic circuit breaker, and Aaron watt meters to measure the charges and discharges from the batteries. Each machine possesses its amperemeter and voltmeter, and Thomson recording wattmeters are placed behind the board to measure the power demanded by each university building. Carpenter enamelled rheostats are used



Electrical Plant at McGill University.—View of Generating Room.



Electrical Plant at McGill University.

THE LIGHTING SYSTEM.

The buildings receiving light and power from this plant are the following : The MacDonald Engineering Building, the Workman Technical Building, the MacDonald Physics Building, the MacDonald Chemistry and Mining Building, and the Observatory. The lighting is obtained by the combination of arc and incandescent lamps. The large laboratories and testing rooms, together with the foundry and the forge, are lighted by General Electric enclosed arc lamps and long-burning lamps of different makes.

There are at present a dozen of these lamps installed. The total number of incandescent lamps is approximately 3,000. The feeders for lighting and for power are entirely separate and distinct. The motors, with the exception of fan motors, are not allowed to be placed on the lighting mains, while the general arrangement of the feeder system for light and power is such that each building has entirely separate sets of conductors from the switchboard. The going-out feeders are carried through a vertical recess, built over the switchboard, leading to the roof of the dynamo room. These, fourteen in number, are led to the different buildings on iron brackets and steel poles. In entering the buildings the feeders are run in iron-armoured conduit to main switches, so as to be able to cut out the buildings entirely from the mains.

THE MOTOR SYSTEM.

The motors used for driving the various classes of machinery in the different buildings vary in size from 1 to 25 h p. In the Engineering building electric motors are made to drive pumps, crushing machines, elevators, fans and shafting of all kinds, for ordinary work and experimental purposes.

In the Mining and Chemistry building the entire equipment of machinery is driven by electric motors. In the Physics building a battery of storage cells, for experimental purposes, is charged from a motor-generator. Electric motors are also in use to run fans and machines of different kinds. The total horse power in electric motors is estimated at 135 h.p.

The Engineering building, the Workman building and Physics building are wired on the three-wire system. The Mining building is of the ordinary two-wire system. When the load is light, i.e., during the day, the multipolar 75 k.w. is run alone to supply both light and power to the buildings. The pressure for the motors is 125 volts, but this is reduced for the lights to 105 volts through a dimmer. When the load for light exceeds 50 amperes, the lighting load is thrown on one of the Willans engines running on the two-wire, or with the two Willans running on the three wires.

The motors are all stopped at five o'clock, the multipolar generator being then available for lighting purposes. If, therefore, the load has exceeded the capacity of the two Willans engines, either one of the buildings can be thrown on this new machine. The plant has now been in operation one year, and has given entire satisfaction.

MR. L. A. HERDT, E.E., MA.E.

The total capacity of engine is 200 h.p.; of generators, 145 k.w. The rated capacity of all motors installed is 135 h.p., and there are 3,000 incandescent lamps put up and a dozen arc lamps. During this time the load at the switchboard has been approximately 50 h.p. during day-time, increasing to a maximum of 100 h.p. from 4.30 to 6.30 p.m.; at that time the batteries are thrown in. The two batteries are placed in parallel when the demand exceeds 100 amperes. If the load is very light, one battery alone is placed in circuit, but an electro-magnetic device will put in circuit the other battery if the first should show signs of being discharged or of failing to do the work. These batteries, situated in a well-ventilated room beside the dynamo room, have been in operation for the last five years, and though some difficulty was experienced with them at the start, they are now working very satisfactorily. Daily records of power produced are taken ; this is recorded by wattmeters placed in circuit both on the machines and batteries. It is impossible, however, to determine the actual consumption of the plant, for the same boilers provide steam for other purposes than that of the lighting plant. A large amount of electric power is also absorbed by experimental work done in the electrical laboratories and experimental dynamo room.

L. A. HERDT, E.E., MA.E.

The total electrical plant was designed and all the details of the engineering drawn up by L. A. Herdt, E.E., Ma.E., Lecturer in Electrical Engineering, McGill University, and under his supervision the equipment was installed.

Mr. Herdt, a portrait of whom we present, graduated in the mechanical engineering course, with honors, in 1893. He was laboratory assistant in the Laboratoire Central d'Electricite, Paris, and then took a course in electrical engineering at the Electro-Technical Institute, Montefiore, Liege, Belgium, taking the degree of E. E. with highest honors. In September, 1894, he was appointed assistant chief electrical engineer to the Thomson-Houston International Company, and one year later accepted the position of demonstrator of electrical engineering at McGill University, with charge of the electric light plant. In the succeeding year he was appointed lecturer in electrical engineering. During the summer holidays he is engaged in consulting engineering work. The degree of Master of Engineering was conferred upon him at the last McGill University convocation.

OTTAWA ELECTRICAL ASSOCIATION.

A COUPLE of informal meetings have been held by a number of Ottawa electricians for the purpose of forming an association which will be of interest technically and socially to those engaged in electrical pursuits in and about the city of Ottawa. A committee, with Mr. B. Nolan as chairman and Mr. E. O'Reilly secretary, has been appointed to draft a constitution and by-laws and report to another general meeting, at which officers for the Ottawa Electrical Association will be elected. It is the intention of the prime movers in this matter to complete all preliminary arrangements during the coming summer and to start work in earnest early next fall. The reading of papers, lectures by prominent electricians, and discussions on current topics, intermingled with social features, comprise the proposed programme for next winter. The mutual advancement of members will not be lost sight of, and a proposition to incorporate a beneficiary clause in the constitution will be dealt with at the next meeting.

The Laurentide Pulp Company, of Grand Mere, Que., have ordered two 55 kilowatt direct connected generators from the Canadian General Electric Company.

The Brantford city council has invited tenders for lighting the city by 120 arc lights of 2,000 candle power and 80 incandescent lamps of 32 candle power, and also for furnishing a municipal plant.

The Cataract Power Company have made a proposition to the city of Hamilton to pump the water supply by electricity. The city engineer has reported against the acceptance of the offer, but the council has decided to engage an expert to report on the relative cost of steam and electric power for pumping purposes.

The Electric Reduction Co., of Buckingham, Que., have ordered from the Canadian General Electric Company a 1000 h.p. three-phase revolving field generator. This machine is of the same general type as those supplied for Lachine and West Kootenay, except that it is wound for the very low potential of 75 volts. It will be direct connected to the jack shaft, running at 165 revolutions per minute, and will be by far the largest generator now in use in Canada for electrolytic purposes.

THE COMPARATIVE ADVANTAGES OF STEAM AND WATER POWER.

By "Economy."

Now that the attention of the public is being closely directed to the possible utilization of the many valuable water powers which we have in Canada, it may be of interest and advantage to consider their value in comparison with the best known alternative method of generating energy, viz., by steam. The practical side of the question may almost be neglected, because modern science has so improved hydraulic machinery that the best classes of water wheels may be placed about on a par with steam engines as regards regularity of service and general satisfactoriness. The main interest will center in the commercial features of the comparison and might take the form of the question, "Under what circumstances is water power a more economical prime mover than a steam engine?" which leads to the next question "Can there be conditions which will cause steam power to be more economical than water power?" Both steam and water power, in what may be called their "raw" state, must be rendered available for use by more or less expansive processes, including in many cases the transmission of the energy from the point of production to the point of utilization; and it will be evident that there may be many conditions, physical and commercial, which may have considerable effect in modifying the value of one form of energy in comparison with the other.

Our rivers and steams are most of them short, and the country through which they run being denuded rapidly of forests. Hence they are very sensitive to the precipitation and respond very rapidly to it, being swollen shortly after rains, and carrying off large volumes of water in a short space of time. Similarly, after a period of dry weather they shrink to sometimes a very small proportion of their maximum flow. Even those streams which rise in marshy localities which absorb and retain moisture better, largely depend on the character of the fall weather. Should there be a considerable snowfall before the severe cold sets in to freeze the ground, then the stream will keep a more steady, even flow during the winter than it will if the hard frost sets in before the snow. And if the somewhat exceptional condition be met with of a dry summer, with little precipitation, followed by an early and severe frost without snow until late in the fall, then it is probable that many streams would dry up almost completely for several weeks, if not months. Water, therefore, as a source of power, can not be considered always satisfactory in point of reliability, unless some means can be taken for averaging up the flow, storing up the excess in times of flood, and letting it go in times of low water. This expedient is well recognized and frequently adopted, but the expense of the storage reservoirs is likely to be so great that only peculiar commercial conditions would justify it. The cost of development of a water power also is an item that may become very serious. It is but seldom that the favorable condition is found of plenty water and a large direct fall. As a rule the large streams, particularly in Ontario, have a somewhat slow current, and a high head could be obtained only by carrying the water in a long canal, which would cost heavily.

It is therefore evident that, taking everything into consideration, the first cost of a water power plant to render available a certain definite, continuous horse power, depends on the cost of machinery, dams, and perhaps storage reservoirs. If the power required does not exceed the minimum flow, then the reservoirs are not required, but they will be if the average flow is necessary. Hence it is quite possible that the total first cost of a water power enterprise, including the wheels, may be even largely in excess of the total first cost of a steam plant of the same horse power capacity. In fact, unless the circumstances be altogether exceptional, it is not likely that water first cost will compare at all favorably with steam first cost. After the first cost of the two systems comes in a very important consideration purely commercial in its character. Manufacturing establishments using power require transporting facilities for their raw material, and for their finished product, and just in proportion as these are bulky or heavy, so does the cost of their transport become a more potent factor in deciding whether cheap power or low freight is of greater importance. More especially is this so in establishments that do a principally foreign trade, and hence require convenient access to a sea or lake port. It is a somewhat unfortunate circumstance, but in the nature of things, that the largest commercial and transporting centers are far from any considerable and swift streams. We all know of the observant traveller who remarked on the peculiar coincidence that there was always a navigable stream close to a large manufacturing city, and therein lies the answer to the question why cities are not near water powers; because navigable waters are very generally of greater importance than very inexpensive power. Hence the value of a water power largely depends on its position with regard to railways, canals, or navigable streams. Here, however, comes the very important fact that we have several distinct means of transmitting power over considerable distances, so that although the best place for generating hydraulic power may be distant from the most convenient shipping point, the intervening space may be bridged. Readers of the NEWS are, of course, more especially interested in the electrical transmission of energy, so only that method will be considered.

Power laid down in form convenient for use at any particular spot costs money to develop, and more money to operate; and whether steam or water power is the better for any particular case can only be arrived at after careful estimate of their respective total costs per year. These total costs may be divided into fixed and variable expenses. Among the former are interest on money invested, maintenance and depreciation, insurance, wages, and the like; among the latter are fuel, oil, and the like. Every enterprise is expected to pay a fair rate of interest on the investment; most have some bonded indebtedness which is a first charge on income, and therefore interest on investment is a fair charge in making the comparison. No machinery, building, construction, or apparatus of any kind can be expected to last forever, so that estimating its life at whatever length may be proper in the light of experience, it is only sound business to lay by every year out of the gross income a sum equal to the yearly deterioration in value, so that at the end of the plant's useful life it may be found to have paid back the money invested in it. This yearly sum may be expressed in terms of a percentage of the total cost, the actual percentage varying with the class of construction or apparatus. A sum must always be allowed for maintenance, repairs, &c., and for insurance, and the wage account is always a very considerable proportion of the expenses of operation. All the above items can be calculated very closely, and placed at a pretty accurate yearly sum. Variable expenses can also be estimated sufficiently close for purposes of estimate. This is an expense which is saved in water power enterprises for the most part, and as fuel is generally one of the larger expenses, the great advantage of water comes in here. To compare the above item by item: Whether steam or water power be used, the interest percentage will be the same, so that the respective charges on this account depend entirely and solely on the respective costs of the two methods. If the whole hydraulic construction be more expensive than the equivalent steam plant, then the hydraulic interest charge will be greater than steam interest charge, and similarly. This requires a mere comparison of estimates of investment. In the depreciation account this equality is not preserved. The hydraulic plant will probably be far more durable than the equivalent steam plant. The dams will last all the longer as they are more solidly built, and a small sum spent yearly in inspection and repairs will cause them to last indefinitely. Besides which a "second hand" dam and water privilege is just as valuable as one brand new, if it has been properly maintained, which cannot be said for a second hand steam plant. Probably a fair depreciation on the whole dam, gates, tail race, &c., can be placed at 2%. Of the hydraulic plant, wheels, regulators, shafting, &c., a reasonable life of 25 years may be expected, with the consequent depreciation percentage of 4%; building 2%, if of solid brick or masonry construction. The insurance charge will be considerably less in a hydraulic than in a steam plant, and will be smaller as the building is less fireproof. It must also be remembered that the first cost of the hydraulic building will very probably be quite appreciably less than that of the steam building.

The same items in a steam plant may be reasonably taken at: For boilers, a life of 10 to 15 years, depreciation percentage, 10%; engines, shafting, journals, piping, 20 years, percentage 5%; insurance probably 25 cents per $100 higher than with water. As to the wages charge, it is probable that a hydraulic plant can be operated just as efficiently as a steam plant, with fewer men, and consequently smaller wages expense. The larger the plants the better for the hydraulic, for while one man cannot properly attend to more than so many boilers and keep good steam, owing to the work increasing as the battery is large, the additional size or number of water wheels imposes no greater work on the operators. It may be fairly pointed out that there are labor-saving devices, such as automatic stokers, which increase the work efficiency of the firemen very greatly, enabling one man to keep good steam on a number of boilers, but at the same time it is wise to remember that all such devices increase the complexity of a steam plant, raise the probability of accident, and render advisable the *employment of higher class engineers at greater expense*. In plants of a certain capacity it is necessary to employ both engineer and fireman, one man not being sufficient. In a water power one man would be quite capable of looking after the entire plant, hence the other man's wages are saved; and one superior mechanic can do the work of two and save considerable. The great importance of this item will be evident when it is considered that the saving of $1 per day or $300 per year (about the usual wages of a fireman) will pay the interest at 5% on $6,000. This means that a water power plant may cost $6,000 more than a steam plant of equal size, and be an equally good investment, if thereby one fireman's wages can be saved.

The most important item among the variable expenses is undoubtedly *the fuel, which will vary very greatly according to* locality, kind of business, state of markets, etc. In coal mining localities refuse can be obtained for almost nothing - for the expense perhaps of carting it from the pile; in others good steam coal costs as high as $6, $7 or $8 per ton. Wood varies according to locality from 75 cents to $2.50 a cord. Oil or gas fuel can be obtained in certain favored localities. It is of course obvious that as fuel -whether coal, wood, oil or gas -is less expensive, so does the value of a water power become less in comparison with that of steam. Another very important commercial consideration —coal fields are always well supplied with railroad facilities, sometimes even with canals - so that the two most important manufacturing advantages are found together: easy transport and cheap power. Nature herself seems to place obstacles in the way of hydraulic power, for just as a large stream has a greater fall along its course, so does it become more difficult for railways to follow it, owing to the grades. Hence it is generally necessary to *transmit hydraulic power* for some considerable distance to a convenient shipping point, and this means larger fixed charges to offset the entire elimination of the fuel charge. It is obvious that assuming a sufficiently low cost of fuel at the shipping point, and an expensive water power and transmission plant, there may easily be *conditions which will make a water power of no value* whatever in comparison with steam. For instance, in a recent case, to develop and render available a certain water power for use 12 hours a day for 365 days a year, required the damming of some storage lakes, and the *transmission electrically* of about 150 h.p., in all about $20,000. The expenses in connection with this enterprise, for interest, depreciation, wages, etc., were estimated at $2,700 per year. The cost of a steam plant to do the same service was estimated at $8,000. Now, taking the above percentages and allowing two men for the steam at $800 wages, the same expenses without fuel would come to about $1,500. Thus $1,200 are allowable for fuel in order that steam and water (electrically transmitted) may be equally good investments. This allows $8 per horse power year for fuel. Or allowing 4 lbs. of coal per h.p.h. (condensing) comes to the equivalent of 1080 tons of coal per year. Coal, or equivalent, at $1.11 per ton would make either plant an equally good investment; at $1.12 would be more expensive than water power; at $1.10 would be more economical than water.

Now, if this water power had been situated about 100 miles from where it was, and placed as near a Nova Scotian coal mine as it was to its distributing point, then culm could have been obtained at 25 cents per ton, and allowing even 4 tons of culm to give as good effects as one ton of good steam coal, even then the steam plant would have been the better investment. At the distance of 32 miles from the above coal mine, culm cost $1 laid down, so that the fuel for the above plant would have greatly exceeded the $1,200 allowed. Here we have a very clear illustration of the way in which the comparative values of steam and water power vary. At one end of a 32 mile line the water power was worth *nothing* at all; at the other end it would have been a good investment for $25,000.

The kind of business to be done will also largely affect the comparison. There are many products that require heat in the various processes, for bleaching, cleaning, bending, drying, and what not. In the present state of our knowledge of electrical matters, it is not wise to predict what may or may not be done in the next few years in the way of electrical heating, but we do know that water power will not develop heat without its transformation into electrical energy; so that unless this transformation is made, a water power plant will have to be supplemented by a steam heating plant in all cases where heat is required. If not a steam heating, then hot air, stoves, &c., which all mean fuel.

Now, if steam is to be used at all, it might just as well be used as economically as possible, and to raise steam to a high pressure costs less *proportionally than it does to generate a low* pressure. If, therefore, high pressure steam be used in steam engines, and their exhaust be availed of for drying or heating purposes, it might very well be that the expense incurred would compare very favorably with the total interest and other expenses of a combined water power and steam heating plant. And the comparison would be all the more favorable to steam as steam became necessary in larger quantities for drying and less comparatively for power. There are other industries again which necessarily produce combustible refuse, which they must consume in some way, such as tanneries, planing and saw mills, and other wood working industries. Unless they have some local demand for such refuse it becomes very necessary to burn it up to get it *out of the way*. In all such cases it is questionable whether water power would have any value at all.

In appraising the comparative values, therefore, of a water privilege in relation to steam working, it becomes necessary to regard the whole question from a strictly commercial standpoint. The total first cost by the two methods must be reliably estimated, with their probable maintenance and operating costs. Due consideration must be given to the cost of extra haulage and handling, where the water power is not on the transport line, and be *debited against it. The heating problem is a factor, and the cost* of fuel and if the careful discussion of the matter leads to the result that steam is the more economical, then no arguments based on the "sin of wasting power at our doors" should be allowed to influence it. It is obvious that no particular rules can be laid down by the application of which the value of water power can be determined from tables like a logarithm. Every case must be determined on its merits, and the above illustration showing how the merits may vary widely in 32 miles, serves to emphasize the importance of careful investigation and *logical calculation*.

MOONLIGHT SCHEDULE FOR JUNE.

Day of Month	Light	Extinguish	No of Hours.
	H.M.	H.M.	H.M.
1	A.M. 12.40	A.M. 3.40	3.00
2	No Light.	No Light.	.. .
3	No Light.	No Light.	.
4	No Light.	No Light.	.
5	No Light.	No Light.	
6	P.M. 7.50	P.M. 10.50	3.00
7	" 7.50	" 11.30	3.40
8	" 7.50	A.M. 12.30	4.40
9	" 7.50	" 12.50	5.00
10	" 7.50	" 1.00	5.10
11	" 7.50	" 1.20	5.30
12	" 7.50	" 1.50	6.00
13	" 8.00	" 2.20	6.20
14	" 8.00	" 2.50	6.50
15	" 8.00	" 3.20	7.20
16	" 8.00	" 3.30	7.30
17	" 8.00	" 3.30	7.30
18	" 8.00	" 3.30	7.30
19	" 8.00	" 3.30	7.30
20	" 8.00	" 3.30	7.30
21	" 8.20	" 3.30	7.10
22	" 8.40	" 3.30	6.50
23	" 9.10	" 3.30	6.20
24	" 9.40	" 3.30	5.50
25	" 10.00	" 3.30	5.30
26	" 10.30	" 3.30	5.00
27	" 10.50	" 3.30	4.40
28	" 11.00	" 3.30	4.30
29	" 11.30	" 3.40	4.10
30	" 11.50	" 3.40	3.50
		Total	147.50

Some of the ratepayers of Springhill, N. S., favor the purchase by the town of the electric light plant. The price now paid is $20 per light for 28 lights for a part night service.

The Canadian Motor Syndicate is looking for a site for a factory, the purpose being to manufacture motor vehicles. This is the company in which Mr. A. H. St. Germain is interested.

The Coaticook Que., Electric Light Company has elected the following directors: President and treasurer, H. Lovell; secretary, W. L. Shurtleff; managing director, F. E. Lovell; P. T. Baldwin, J. H. Morgan and W. L. Shurtleff. A semi-annual dividend of 3 per cent. was declared.

TORONTO TECHNICAL SCHOOL EXAMINATIONS.

The Toronto Technical School has just closed a very successful term, the classes being largely attended. In the "Electricity" and "Steam" courses (Mr. Harris P. Elliott, B. A. Sc., Lecturer) the following students successfully passed their examination:

Junior Electricity Class I. M. Watts and I. F. Jackson (equal); A. J. Watkins and W. A. Ratcliffe (equal); D. T. Brown, H. Hargreave; R. Yeomans and H. J. Lillie (equal); G. H. Pargeter and W. K. Greenwood (equal). Class II. A. H. McBride, H. B. Jewett, A. A. Strathdee; C. W. Moir and T. C. McAree (equal); H. Buck and T. S. Buck (equal). Class III. R. G. Archer, J. Stevenson.

Senior Electricity Class I. Alex. Gerry, T. Brown; John A. Whyte and J. E. B. Hancock (equal). Class II. G. H. Robinson. Class III. W. K. Greenwood, S. J. Evason, K. A. McKae.

Steam and Steam Engine (junior). Class I. Alex. Gerry and J. B. Hancock (equal). Class II.—D. T. Brown, John A. Whyte. Class III. T. Steels, R. Quinn, T. C. McAree, G. D. Bly.

Steam and Steam Engine (senior). Alex. Gerry, T. C. McAree.

Below will be found a copy of the examination papers in the above subjects:

ELECTRICITY AND MAGNETISM.

1. Define: Magnet, Consequent Poles, Magnetic Induction, and give the Laws of Magnetism.

2. What is the nature of the so-called lines of force? What do they represent? How would you determine their presence and direction?

3. Two bar magnets are placed on a table with their north poles pointing towards each other and about 1½ apart. A sheet of glass is placed over these and iron filings are sprinkled upon it. Show how these arrange themselves, and explain clearly why they do so.

4. What are the essential parts of a voltaic cell? What is polarization? Describe any single fluid and any double fluid cells which do not polarize.

5. Give several methods of showing the presence of a current in a wire. How could you determine its direction?

6. Two copper plates of equal weights are placed in a solution of copper sulphate and a current of 5 amperes is passed through from one end to the other for 10 hours. What is then the difference in weight? Electro chemical equivalent of copper 0.0003261.

7. If the plates in the previous question were of platinum, describe exactly what would take place if the current were passed through as long as possible. What would stop it?

8. Describe any form of galvanometer. What points in its construction make it sensitive?

9. What is meant by self-induction? Show how it affects the action of the induction coil and how this effect is partly got rid of by the use of a condenser.

10. State Ohm's law. Explain it fully.

11. Twelve incandescent lamps, each having a resistance of 200 ohms, are put in series across the terminals of a 500 volt circuit. What current passes?

12. What is the best method of grouping 12 cells, each having a resistance of 3 ohms and an E.M.F. of 2 volts, in order to get the greatest possible current through a lamp whose resistance is 4 ohms. What is the current?

13. Twenty pounds of copper is made into a wire 1,000 feet long, having a resistance of 1.5 ohms. If it had been made into a wire 2,000 feet long, what would have been its resistance?

14. Three wires have resistances of 5, 10 and 15 ohms, what is the combined resistance in series and in parallel?

15. Describe any method of measuring resistance.

16. Describe a simple telegraphic circuit, showing the instruments and how connected.

17. Give a diagram showing the connections on an induction coil.

18. Describe any form of telephone transmitter and receiver.

SENIOR ELECTRICITY.

1. Name various methods of producing Electricity. Why is the method of induction so important?

2. Describe briefly how to demonstrate the laws of induced currents by means of the following apparatus. A galvanometer, two coils of wire, a battery, a bar magnet and a bar of soft iron.

3. In all cases of electro-magnetic induction the induced currents have such a direction that their reaction tends to stop the motion which produces them. A current flowing contra clockwise produces a north pole, and the lines of force are considered to be proceeding from a north pole. From the above facts deduce a rule similar to Fleming's.

4. Upon what does the E.M.F. of a dynamo depend? Deduce the rule

$$E = \frac{N.C.n.}{10^8}$$

5. Explain the cause of sparking at the brushes of a dynamo. How does shifting the brushes prevent it? When is it impossible to prevent it by this means?

6. Why does a shunt-wound dynamo not give a constant voltage? What arrangement is used to make it do so?

7. Give a practical method of determining the number of series turns required to compound a given dynamo.

7. Obtain the formula for the efficiency of a shunt dynamo in the form

$$\text{Efficiency} = \frac{C\,A}{(B+C)(A+B+C)}$$

$\frac{1}{B}$ = Shunt resistance.

$\frac{1}{A}$ = Armature resistance. $\frac{1}{C}$ = External resistance.

9. Explain: Friction, Hysteresis and Eddy current losses. What point in construction reduces the latter to a minimum?

10. An iron ring has a cross-section 10 square C.M. and a diameter of 20 C.M. We wish to send around it 120,000 lines of force. How many ampere turns must be provided?

$$\frac{B}{H} = 1000$$

11. Give any method of measuring resistances.

12. Several of the wires in a lead-covered telephone cable are found to be grounded. How will you determine the position of the fault?

13. Why does weakening the field of a shunt motor cause it to run faster? How is it that a shunt motor supplied with current at a nearly constant voltage can be made to run at a nearly constant speed?

14. Describe any form of electric meter, mentioning its good points and also its defects.

15. What is the external characteristic of a shunt-wound dynamo? Make a diagram showing how apparatus could be arranged to get the characteristic of a small Edison machine wound for 110 volts.

STEAM AND STEAM ENGINE (SENIOR.)

1. Define: Super saturated, saturated, and super heated steam, total heat, heat of the liquid and heat of vaporization.

2. A boiler was found to evaporate 15,000 pounds in a 10 hours run. The feed water was raised to a temperature of 200 F. by means of the exhaust. The average gauge pressure was 85 pounds. Find the equivalent evaporation from and at 212.

3. What is meant by a standard boiler horse power? In the previous question what standard B.H.P. was developed?

4. How does the production of wet steam affect the efficiency of a boiler?

5. Describe any modern type of water tube boiler, and name some of the advantages claimed for it.

6. Give rough sketches of various water tube boilers to show the arrangement of the parts; indicate by arrows the direction of the water circulation and of the hot gases. Show the position of the feed water pipe.

7. A marine boiler is to be 20' in diameter, and to withstand an internal pressure of 125 pounds per square inch, allowing a factor of safety of 4 and a tensile strength of 60,000. What material would you use and what thickness, assuming that the ends are stayed and made as strong as the shell?

8. An engine is to cut off at ¾ stroke, to have a maximum port opening of ⅝" and lead of ⅛". The exhaust is to open at 90 of the stroke. Show how to find the inside and outside lap of the slide valve, the throw and the advance angle of the eccentric.

9. How would you set the slide valve in the above engine to give it an equal lead at both ends? How would you set it to get twice the lead at the head end as at the other?

10. Draw a card such as might be taken from a Corliss engine, and explain how to determine from it the steam used per I.H.P. per hour.

11. Explain fully the effect of condensation by the cylinder walls on the efficiency of an engine. What methods are used to reduce this effect?

12. Define Work, Power, Horse Power. A hoist is to elevate one ton (2,000 lbs.) of coal 50 feet high in 3 minutes. What horse power is required?

13. If you know the dimensions, speed, valve motion and working steam pressure of a given engine, how will you compute its probable I.H.P.?

14. Two exactly similar locomotives are put on a level track and made to pull against each other. They stand still with their wheels revolving at the rate of 300 R.P.M. The drivers are 6 in diameter and a spring which is used to couple the engines shows that they pull against each other with a force of 1,500 pounds. Find what horse power is being developed by each.

John A. Coryell, C.E., Midway, B. C., has been making surveys for the proposed utilization of the water power of the Kettle river at Cascade Falls. Quite lately the Cascade Development Company disposed of their rights in the water power to an English syndicate, which is represented by C. K. Milbourne, Nelson, B.C., and for them the work has been done. A large power plant is projected.

THE MARITIME ELECTRICAL ASSOCIATION.

A Maritime Electrical Association was duly organized at a meeting held at the Halifax Hotel, Halifax, N. S., on the 12th of April. There was a good attendance and all seemed to realize the need of such an association and were unanimous in their support of what had been done. A constitution was adopted, and the following officers were elected :

President, F. A. Bowman, New Glasgow, N. S.; Vice-President, H. Colpitt, city electrician, Halifax, N. S.; Secretary-Treasurer, J. H. Winfield, local manager Nova Scotia Telephone Co., Ltd., New Glasgow, N.S., also a representative executive committee from the three provinces.

It was decided to hold the first regular convention in Halifax some time in September.

We have the privilege to present to readers of the Electrical News brief personal sketches and portraits of the executive officers, under whose experienced guidance the new organization may be expected to prosper, and prove of much advantage in advancing the welfare of the electrical industry in the provinces by the sea.

MR. FRED. A. BOWMAM, M.A., B.E.,

President of the new association, is a native of Nova Scotia, having been born at Windsor, and has had a

Mr. Fred. A. Bowman, M.A., B.E.,
President Maritime Electrical Association

varied and valuable experience in engineering and electrical work. He is a graduate in arts and mining engineering at King's College, in his native town, and worked a couple of years at mining and kindred work. He was afterwards employed in the locomotive shops of the I. C. R. and in the office of E. Vassnack, M. E., Halifax. He subsequently took the expert course at the Thomson-Houston Works at Lynn, Mass., and also held a position with the New York office of the same company. Mr. Bowman spent a year in the employ of the Royal Electric Company of Montreal. Since 1892 he has occupied the position of superintendent of the New Glasgow Electric Light Co., Limited, of New Glasgow, N. S. Mr. Bowman is an associate member of the Canadian Society of Civil Engineers, and a member of the American Institute of Electrical Engineers.

MR. H. COLPITT,

Vice-President, was born at Forest Glen, New Brunswick, in 1861. Immediately after leaving school a few years were spent on the road as a commercial traveller. He entered the employ of the Halifax Electric Light Company shortly after the inception of electric lighting in the maritime provinces. When the company was sold out to the gas company Mr. Colpitt's services were retained, and after two years he was appointed superintendent of the electric lighting plant. This position he held until 1897, when he received the appointment of city electrician for Halifax. Mr. Colpitt, although quite

Mr. H. Colpitt,
Vice President Maritime Electrical Association.

a young man, is entitled to be regarded as one of the veterans of the electric light business, having had an experience therein extending over thirteen years.

MR. J. H. WINFIELD,

Secretary-Treasurer, is a native of Derby, England, and was educated in London. He took the electrical engineering course at Peoples' Palace, and received a good mechanical training in the shops of Hammersley Bros., scientific instrument makers, Barnsbury, London. In the fall of 1891 he came to Nova Scotia and accepted a position in the Halifax office of the Nova Scotia Telephone Co., Ltd. In March, 1893, he was transferred to New Glasgow, to take charge of the company's exchange there. In October he was made superintendent

Mr. J. H. Winfield,
Secretary Treasurer Maritime Electrical Association.

of their eastern division, with headquarters at New Glasgow, which position he still retains.

Sixteen thousand dollars is said to be the record price paid for a cablegram, that price having been paid for a message sent by Heniker Heaton to Australia in behalf of the British Parliament.

CANADIAN ELECTRICAL NEWS
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ST. LAURENT BRANCH NO. 2.—Meets every Monday evening at 43 Bonsecours street, Montreal. R. Drouin, President; Alfred Latour, Secretary, 306 Delisle street, St. Cunegonde.

BRANDON, MAN., BRANCH NO. 1.—Meets 1st and 3rd Friday each month in City Hall. A. R. Crawford, President; Arthur Fleming, Secretary.

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OTTAWA BRANCH NO. 7.—Meet every second and fourth Saturday in each month, in Borbridge's hall, Rideau street; Frank Robert, President; T. G. Johnson, Secretary.

DRESDEN BRANCH NO. 8.—Meets 1st and Thursday in each month. Thos. Steeper, Secretary.

BERLIN BRANCH NO. 9.—Meets every Friday evening. G. Steinmetz President; J. Heyd, Vice-President; W. J. Rhodes, Secretary, Berlin, Ont.

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

Employment of Competent Electricians. IT occasionally happens that a slight defect in some part of an electrical plant, which could probably be remedied in the simplest possible manner, results in the condemnation of the entire machinery, owing to lack of knowledge on the part of the person in charge of the plant. It is not unusual to hear of the manufacturers being called in to adjust some difficulty, only to find that the trouble was of the most trifling nature, and such as should have been readily ascertained and put right by the electrician. The cause of such a condition of affairs is frequently to be found in the low salaries paid to superintendents and operatives. These salaries offer no inducement to competent men, possessing the knowledge requisite for the efficient operation of an electric light plant, and hence the engineer with a smattering of electrical education is employed to do the work. It is not to be wondered at that so many so-called breakdowns occur. It is false economy to buy an up-to-date plant and place an inexperienced person in charge. This fact is rapidly becoming recognized, and the result will be a greater demand for properly qualified electricians.

Canadian Electrical Association. As the date for the annual convention of the above Association at Montreal draws near, interest in the event is deepening. At the last meeting of the Executive a considerable number of new members were elected. Other applications are constantly coming in to the secretary. Each individual member of the Association should endeavor to add new members to the roll and assist in swelling the attendance, so that the coming convention shall be an unqualified success. Montreal, aside from its many other attractions as the chief city of Canada, is the point of greatest interest to persons connected with the electrical industries. The headquarters of the Bell Telephone Company's extensive system, the large manufactory and up-to-date lighting stations of the

Royal Electric Co., the electric transmission plants at Chambly and Lachine, McGill University, with its elaborate electrical and engineering departments, will all be thrown open to the inspection of the members of the Association who may attend this convention, and will in themselves be found well worth the time and expense incidental to the visit. All the arrangements for the meeting are making satisfactory progress. The Executive will meet towards the close of the present month to receive the reports of the various committees, complete all arrangements, and arrange for the immediate publication of the programme.

Cable vs Electric Tramways. In the Dominion of Canada cable tramways are practically unknown, but in Great Britain this method of propulsion has been adopted by some of the largest cities. The Edinburgh cable tramways were supposed to have been eminently successful, and are frequently referred to as a model system. It would seem, however, that they have not been the success which is *generally* supposed, as when the question of an extension was under consideration recently, several members of the city council advocated the adoption of electric traction, and the question was referred to Professor Kennedy, F.R.S., for a report. With the improvements being made in electrical apparatus, and its greater application for special purposes, electric traction promises soon to supersede all other systems.

Dangers of Acetylene. A Woodstock, Ont., paper reports the blowing to pieces of an acetylene gas generator in that city recently. The generator had been on exhibition in the rear of a cigar store. Owing to the fact that there was very little gas in the machine at the time of the accident, no serious damage was done except to the generator itself, but the tenants of the adjoining buildings got a bad scare. Over the back door of the room in which the generator was placed an overflow pipe extended out from the building. A young man who was standing in the doorway, in raising his hand to throw down a match, ignited the overflow gas. The flame travelled quickly along the gas pipe and entered the generator, causing the explosion. But for the fact that the machine was being prepared for removal and contained little gas, the consequences might have been serious.

Efficiency of Lamps. It is supposed that incandescent lamps, when old, take more power than when new. A lamp when new may give one-third candle per watt, and after this same lamp has been burning for about 400 hours it may give one-sixth candle per watt. Lamps, as a rule, will take less energy after burning awhile than when new, but owing to the fact that the candle decreases with the life, the power per candle is greatly increased. Therefore it is more correct to say that more power is required for a given quantity of light, and as it is light that is sold, not power, it stands to reason that when maximum candle power for minimum expenditure of power is required that lamps must be renewed about once every 350 hours. In a test recently made with several makes of lamps, where each of the various lamps started with an illuminating power of about one-third candle per watt, at the end of 300 hours some of them were only giving one-ninth candle for the same expenditure of power. Truly, there is room for improvement still in the incandescent lamp.

Car Lighting. The lighting of railway cars is a subject which has received much attention of late from both railway companies and manufacturers of electrical machinery. Many systems have been devised, but so far none have given entire satisfaction. The equipment which has recently been placed on the sleeping car Winchester by the Canadian Pacific Railway Company probably comes nearer a solution of the problem than any other, the results produced giving promise of ultimate success. The current is generated from the axle by the motion of the train, and the surplus current is stored in a battery, which maintains regular current and provides also for stoppages. It is said that there is little flickering or irregularity in the light, although in some respects the system is not all that could be desired. That electricity will furnish the future light for railway cars is now almost certain.

Municipal Control. As regards the advantages derived from municipal ownership and operation of public services, the New York Post, one of the ablest public journals of the United States, says: "Municipal ownership is one of those phrases which, in a certain order of mind, take the place of reasoning, investigation, common sense. It is invested with a magic, a miracle-working, power which makes anything claimed for it credible. The city gas works in Philadelphia were long the substitute for argument in the mouths of advocates of municipal ownership. But their recent abandonment, after confessed losses and scandals, has led the champions of municipal operation of the public lighting and transit services to look more and more abroad for comfort, and Glasgow is the city whence they have derived most of it. So wild have been the romances set afloat about the immense profits derived by Glasgow from its control of public franchises that the Lord Provost has been compelled to issue the following circular letter:

"The Lord Provost of Glasgow has received communications from all parts of America desiring confirmation of a statement to the effect that the citizens of Glasgow would be free from all taxes or rates in consequence of the profits derivable from their gas, water, electric lighting, and other undertakings of the government. I have accordingly been requested by the Lord Provost to inform you that this statement has no foundation in fact. There is no probability of this city being exempt from taxation.

"John S. Samuel, City Chambers."

Thus is the socialistic millennium adjourned again. Taxes are not yet abolished, even by municipal ownership. Yet there is little doubt that if municipal ownership were given free course, it would ultimately make an end of taxes, for it would make an end of property to be taxed."

Electricity in Mexico. It is reported that the valuable water powers which abound throughout Mexico are rapidly being taken possession of with a view to their profitable utilization. The cataract at Juanacattan is said to be second on this continent to that of Niagara. There has recently been installed an extensive plant costing $700,000 to convey electricity for power purposes from the Cascade of Regea to several mines and factories fifteen miles distant. The hydraulic force is utilized by means of Pelton water-wheels, driving five tri-phase dynamos, each of 400 h.p., one of which is kept as a reserve, and two exciters. The tension of the current, as received from the dynamo, is 700 volts, which by means of step-up transformers is increased to 10,000 volts for transmission. Three bare conducting copper wires about one-third of an inch in diameter, carry the current. The loss in transmission is stated to be only ten per cent. In view of the activity in engineering work of this character, Canadian manufacturers of electrical apparatus might profitably enquire into the possibilities of the Mexican market.

Coal Consumption. In a test made in a large institution recently, it was shown conclusively that it took 12½ lbs. coal per indicator horse power per hour. This engine was used for driving dynamos for lighting the institution. The method of driving was from engine to jack shaft and then from jack shaft to dynamos. Taking the readings with reliable volt and ampere meters, there was a loss of 40 lbs. between the engine and switchboard, showing that there was a coal consumption of 20 lbs. coal per E.H.P. at the bus. The question now arises how many more plants are there in the country taking the same coal consumption. One thing certain, this is not the only one. A plant of this kind is dear at any price, in fact it would not pay one to accept it for nothing. Let buyers of certain electric plants have certain guarantees as to the efficiency of same, and let them engage good reliable engineers to make the test to see if they have fulfilled the guarantees, and when we come to this method of doing business better results will be obtained all around.

Electrical Apparatus for Mining. Reliable reports from British Columbia state that the development of the gold mines in that province is being steadily proceeded with, and that there is more machinery being purchased than ever before. There is being employed a large quantity of electrical apparatus for the operation of hoists, drills, etc., and light and power companies now installing plants report the outlook for business as very promising, one favorable feature being that the demand is chiefly for large units, usually above fifty horse power. One of the largest contracts has just been closed with the proprietors of the War Eagle mine. An air compressor with a capacity of forty drills will be driven by a 300 kilowatt motor and an electric hoist by a 300 h. p. induction motor, the average working load of the hoist being eight tons. This plant is said to be the first of its kind to be used in Canada, but it will undoubtedly prove to be only the forerunner of many others, as mining development in British Columbia now seems to have reached a solid basis. There exists, we believe, the misapprehension that machinery of American manufacture is largely used in mining work. Instead of this being the case, we are informed that Canadian machinery is almost exclusively employed, and this notwithstanding that many of the mines are owned and being developed by Americans.

The work of constructing the C. P. R. telegraph line between Montreal and Vancouver was commenced on April 14th last.

The British Columbia Bullion Extracting Company, of Rossland, B. C., have ordered from the Canadian General Electric Company a 100 h.p. three phase synchronous motor and a 50 h.p. three phase induction motor to operate their works.

The Bell Telephone Company have commenced work on their new exchange in Quebec. The structure will be 30 x 88 feet, and will be built of granite, surmounted by a cornice of red copper, and will cost over $17,000. The switchboard, which is now being made in Montreal, will accommodate 3,000 subscribers. It is expected that the new building will be ready for occupation by the month of July.

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

ANNUAL DINNER OF HAMILTON NO. 2.

The eleventh annual dinner of Hamilton No. 2 was held in the Commercial Hotel on Thursday, April 7th. The attendance was as large as usual, and included Messrs. Wickens, Mooring, Moseley, Fox, Eversfield, Blackgrove and Bain from Toronto No. 1, and Messrs. Dixon, Richardson, Graham and Hughes from Toronto No. 2. R. Mackie presided. The menu was excellent and received due attention, after which came the following toast list: "The Queen," responded to by the company; "Canada, Our Home," by A. Hartwell; "Mayor and Corporation," by Ald. Fernside and Pettigrew; "Manufacturers," by J. McLaughlin, Toronto; "Educational Interests," by J. S. Williams; "Executive Head," by E. J. Philip and A. M. Wickens; "Sister Associations," by G. C. Mooring and J. Dixon; "Hamilton No. 2," by R. Mackie; "The Ladies," by O. P. St. John; "Host and Hostess," by Mr. Maxey.

During the evening music was rendered by the Eolean Club, and Messrs. Dixon, Stanley, Hastings, Childs, Blackgrove, Mitchell and Maranett, Mr. J. Bain acting as accompanist. A pleasant feature of the evening was several selections on the gramophone, operated by Mr. Morrice. The banqueting committee consisted of R. Mackie, chairman; J. Ironside, secretary; P. Stott, W. K. Cornish, W. Stevens, R. C. Pettigrew and R. E. Chillman.

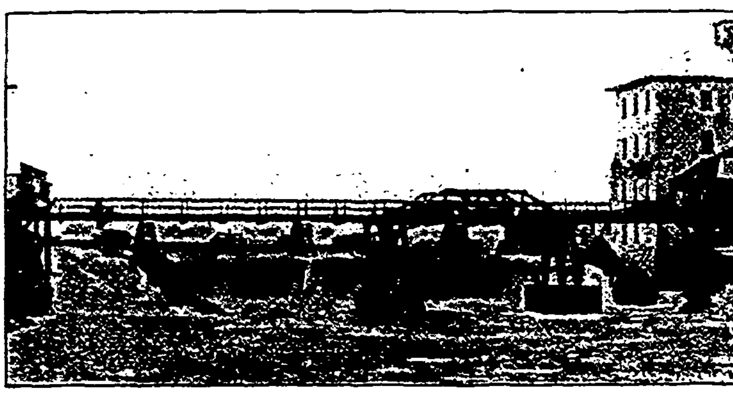
LONDON NO. 5.

A member of the Forest City Association, referring to the competition inaugurated by Mr. G. B. Risler, a past president, writes as follows: "Mr. D. G. Campbell, Pottersburg, president of London branch, has received the first prize of $8, and Duncan McKinley the second prize of $5. Both men are active members of the association, and their efforts are to be commended. They have not been awarded cash prizes, but the amounts are placed to their credit with the International Correspondence School of Scranton, and is to be taken out in tuition. The question papers have had the desired effect the competitors were compelled to make themselves acquainted with arithmetic, and to reason and study and they frankly admit that it was hard work; but on the other hand they claim it was beneficial to them, and the prizes were received with the greatest of pleasure. The examining board consisted of Messrs. Risler, Bright, Goldart and McLean. Mr. Norris, president of Hamilton branch, is now with London No. 5, having accepted a position as engineer with the London Street Railway Company, of which Mr. Potter is chief engineer and superintendent. Mr. Norris has already made himself esteemed by the members, having given some good lectures on steam engines, boilers and electricity. He received a letter of regret from Hamilton branch, at the same time congratulating him on his success. London No. 5 is doing well, reorganized Nov. 19th, 1890, with 6 members, and now we are 27 members strong. Our meetings are held on the first and third Saturday of each month, at 7.30 p.m., in Sherwood Hall."

The Philadelphia Electrical Exposition Company propose holding an electrical exhibition in Philadelphia, commencing June 6, 1898, and continuing for one month. It is expected that a number of the exhibitors at the New York exhibition will remove their goods to this exhibition.

FENELON FALLS ELECTRIC TRANSMISSION SCHEME.

A COMPANY is in process of formation for the development of the energy of Fenelon Falls, Ont., and the transmission to Lindsay of all the power that can be used in that town. The Fenelon river connects Cameron lake and Sturgeon lake, and gives a head of 24 feet at the Fenelon village, with sufficient water to render available well over 2,000 horse power in the dryest season of the year. The distance to Lindsay is nearly 16 miles, and the promoters claim that nearly 1,000 h. p. can be counted on there—not taking into account any new enterprizes that may be attracted by the cheaper power. The representatives of the company are reported to have acquired the entire control of the water power from the Smith Estate, and from Messrs. Macdougall & Brandon (who operate the Fenelon electric light plant), and have also made some important contracts in Lindsay for the supply of power, including the contract for the street lighting. It is also contemplated to energetically push the lighting business in Lindsay. The complete plans have not yet been formulated, but reports say that all machinery and apparatus will be of the highest class, and some interesting engineering features will be introduced. The engineering is in the hands of Mr. George White-Fraser, of Toronto, and the secretary pro tem is Mr. J. Alex. Culverwell.



VIEW OF FENELON FALLS.

ELECTRICAL APPARATUS FOR THE WAR EAGLE MINE.

THE War Eagle Mining and Development Company, of Rossland, B. C., have closed a contract for electrical machinery to operate the new plant which they are installing at their mine. The plant in question will consist of a 40 drill Ingersoll-Sergent air compressor and a double drum mining hoist, both to be supplied by the James Cooper Mfg. Co., of Montreal. The shaft will be double compartment, and the hoist will have a capacity sufficient to handle two loaded skips, to be raised from a depth of ultimately 2,700 feet, at the rate of 1,000 feet per minute; this will be the severest duty so far undertaken by any electrical mining hoist in the world.

The electrical machinery is to be supplied entirely by the Canadian General Electric Co. The compressor motor will consist of a 300 kilowatt three phase synchronous motor, operating at 200 revolutions per minute, and operating the compressor fly wheel directly by a rope drive without intermediate shafting.

The hoist will be operated by a 300 h. p. induction motor, capable of operating up to 600 h. p., operating in synchronism at 300 revolutions per minute, and handled by a regulator similar in style to the street railway controller. By use of a large external resistance any desired variation in speed may be obtained up to synchronism. The operation of an alternating hoisting motor of this capacity is a very nice engineering problem.

Power to operate this machinery will be obtained from the three phase circuit of the West Kootenay Power Company. In connection with the latter, it may be mentioned that the two large 1,000 h. p. revolving field generators supplied by the Canadian General Electric Company are now in position. The line, with step-up and step-down transformers, is completed, and the plant is expected to commence operation within the next two or three weeks.

CORROSIVE AND SCALE-FORMING AGENTS IN BOILER FEED WATERS.

By WM. THOMSON.

[ARTICLE 5]

HAVING determined the nature of impurities contained in the feed water, it next becomes an important consideration as to what will be the nature of scale formed when impurities are precipitated, or what effect the water will have on boiler parts provided no scale-forming material is present.

It is quite obvious that a water containing *such impurities* as those in sample No. 1 described in last month's issue cannot form scale except at very high degrees of concentration, or when water within the boiler has become *completely saturated*; *then, of course, crystallization* will begin, but crystals will again dissolve when unsaturated molecules of water are brought into contact with the crystals. This form of scale *will never be met with* except in cases of extreme ignorance or carelessness, and need not be discussed at any length. As will be observed, however, the whole of the impurities in this water are non-volatile in the *presence* of heat at temperatures met with in ordinary boiler practice, and consequently as water evaporates into steam impurities are left behind, and a gradual increase in density takes place. The impurities, being soluble in water, remain in solution, and water in boiler becomes more and more saturated. Impurities being alkaline in reaction, a very high degree of alkalinity is in course of time reached. While the alkalies do not, as a rule, attack iron very readily, they attack brass alloys vigorously, reducing the metallic elements and causing a great deal of trouble, and in many cases serious damage has resulted.

Another very important reaction that sets in in waters of this kind is the formation of magnesium chloride, as mentioned in earlier articles, and as a consequence, free hydrochloric acid is liberated, which, being very corrosive even when diluted, no part of the system from boiler to exhaust on engine is quite free from danger of corrosion from this source.

The conditions under which a boiler feed water is to be used plays a very important part in the treatment required and the effect a water will have on the boiler parts. For instance, where good water is scarce, or in plants where economy has been carefully studied, it has become a common practice to use surface condensers, draining condensed water to a hot well and returning therefrom to boiler, using over and over again. In thoroughly equipped plants loss by evaporation is very small and quantity of fresh water used small, consequently the water may be returned to boilers many times daily. Waters that are low in dissolved solids in the first instance deposit very little scale-forming material. Condensed water from hot well *being practically* a distillate from original water, contains no scale-forming agents, and is, in the absence of oil, practically pure. This may, at first glance, be considered a very happy condition of things; unfortunately, practice has shown it to be *in many cases the reverse*. *Instead of* scale forming, the boiler parts are very often found to have suffered from pitting and corrosion. Explanation of this condition appears difficult, and corrosion of boilers has often been charged *to presence of organic acids, when*, as a *matter of fact, the purity* of the water itself may be said to be responsible. When water is sent to hot well it is brought into contact with atmospheric air, and, being pure, readily absorbs or takes into solution some of the gaseous elements contained therein. Reference to my first article on this subject will readily explain the cause of pitting or corrosion due to the presence of free oxygen in the water.

We have already seen that the most troublesome scale-forming impurities held in chemical solution are the salts of lime and magnesia as usually met with in feed waters.

As conditions of use vary, so will nature of scale formed vary. Particularly is this the case with scale formed from the salts of magnesia. These salts in many cases are peculiarly unstable, and this fact is not sufficiently taken into account either by chemists or engineers. The carbonates of lime are, except in very exceptional cases, always accompanied by a certain proportion of the carbonates of magnesia. Personally, in my experience I have never found carbonate of magnesia entirely absent from a natural water when carbonate of lime was present. I have, as would naturally be expected, found carbonate of magnesia present when the entire lime was present as sulphate.

In examination of a boiler scale, it occasionally happens that the general appearance of a scale is such as would lead the engineer to suspect the presence of a strong bonding agent, such as sulphate of lime, while complete analysis shows the scale to be practically free from sulphates. While the carbonates of lime and magnesia form in presence of organic matter, and especially in high pressure boilers, hard compact scale in many cases, analysis of scale will show that the whole of the bases of these metals cannot be combined with carbonic anhydride. The reason for this is evidently the reducing of part of one of the compounds to an hydro-oxide. Since magnesia is the least stable of the two bases, it is the writer's opinion that the magnesium carbonate immediately in contact with the boiler plate is reduced from a carbonate to an hydrate, and carbonic acid gas liberated. When this occurs in presence of sulphate of lime a particularly obnoxious scale is formed.

A sample of scale sent to my laboratory of a very troublesome nature, being very hard and tenacious, and having very high power as a non-conductor of heat. While it was, according to sample, less than ¼ inch thick, still its construction made it extremely dangerous. Subsequent analysis proved it to have the following composition:

Silica	9.66%
Alumina and peroxide of iron	3.44%
Sulphate of lime	57.37%
Carbonate of magnesia	27.12%
Magnesium hydro-oxide	2.07%
	99.66%

In this case a portion of the magnesium carbonate through the action of heat had been reduced according to following equation:

$$MgCO_3 + heat = MgO + CO_2,$$

the oxide of magnesia thus formed then combining with water to form the hydro-oxide, which is only partially soluble in water.

$$MgO + H_2O = Mg(OH)_2.$$

The hydro-oxide is extremely fine, and under conditions existing within the boiler forms a ready bonding material, and especially so in presence of sulphate of lime.

The carbonates of lime and magnesia when precipitated at such at low temperature, form porous, easily-removed scale, having very low specific heat, consequently cannot be classed as equally dangerous with those scales of more compact construction. Some idea of nature of scale formed can be arrived at from a study of the physical and chemical properties of the following samples of scale analyzed in my laboratory.

The first is a sample of scale formed from water containing salts of both lime and magnesia, and both hard and tenacious, containing the following parts in 100:

No. 1. Supplied from Montreal, Que.:

Silica	1.56
Alumina and peroxide of iron	4.30
Carbonate of lime	26.95
Sulphate of lime	52.65
Carbonate of magnesia	14.20

No. 2. Sample of scale from New Toronto, Ont. Shows a rather uncommon condition of scale forming. As seen by composition of scale, a large quantity of mud (greatest portion of which must have been held in mechanical suspension) was present; this, combined with sulphate of lime, formed a particularly troublesome scale. The composition of impurities in the water from which this scale was formed is illustrated in sample No. 6, last month's issue, and is worthy of remark for two important reasons: First, analysis of water shows very little alumina present, consequently very little mud was held in suspension, while scale shows a large quantity of alumina. This difference is accounted for by the fact that weather conditions had much to do with the presence of mud, and sample sent for analysis showed water under best possible conditions; secondly, it will be observed that water contains both carbonates of lime and magnesia, while carbonate of lime is entirely absent from scale. This circumstance at first somewhat puzzled the writer, until he ascertained that the engineer in charge was using refined coal oil to remove scale. As is very often the case, oil contains excess of free sulphuric acid acquired during process of refining in sufficient quantity to reduce the whole of the carbonate of lime to sulphate and also a portion of the carbonate of magnesia to sulphate of magnesia, which latter, being soluble in water, does not appear in the scale.

This sample of scale contains the following parts in 100.

Silica	3.98
Alumina, with traces of peroxide of iron	33.80
Sulphate of lime	53.52
Carbonate of magnesia	8.78

No. 3. Sample of scale from Walkerton, Ont.—Light, porous and easily broken or removed, a typical type of carbonate scale formed at low temperatures. Composition:

Acid insoluble	.38
Alumina and peroxide of iron	1.10
Carbonate of lime	92.08
Carbonate of magnesia	5.60

Carbonate in presence of organic matter form in many instances very hard scales, degrees of hardness varying with nature of organic matter present.

No. 4. Sample No. 4, received from London, Ont., is an excellent type of scale of this kind, being very hard and tenacious. The organic matter present in this case was largely composed of oil, which by action of heat has become carbonized, and although scale was not more than ¼ inch thick, it was of a very dangerous type. Composition:

Acid insoluble	.70
Aluminum and peroxide of iron	.75
Sulphate of lime	2.33
Carbonate of lime	80.07
Carbonate of magnesia	9.91
Organic matter	6.04
	99.80

Another sample of scale with nearly the same composition, thicker, but much coarser in granular construction, due to difference in nature of organic matter, yielded on analysis:

Acid insoluble	.30
Alumina and peroxide of iron	.70
Sulphate of lime	3.32
Carbonate of lime	83.75
Carbonate of magnesia	6.20
Organic matter	6.01
	100.28

The loss occasioned by allowing such formations as above to remain on the sheets and tubes of a boiler is so important a factor in economy that it is almost impossible to estimate it. It has been stated on good authority that the formation of an incrustation 1/16 of an inch in thickness will increase the fuel consumption 12% over a boiler working under similar conditions with clean shell and tubes. This statement is, however, obviously in error, since scale of different composition has different heat conducting powers, and loss must vary in accordance with composition of scale, as well as with variation in thickness. The fact remains that the incrustation formed within a boiler has a very much lower conductivity than has the plate of the boiler itself, even under most favorable conditions, so that loss is bound to occur if incrustation is allowed to accumulate; and loss is not only loss of heat and consequently loss of fuel, but serious damage to boiler may occur. Such is the non-conducting power of many even very thin scales that plates are liable to become over-heated, while scale has a high non-conductivity, when interposed between boiler shell and water it has very low tensile strength; consequently, when plates become overheated, internal pressure forces the affected part outward, and boiler is badly damaged, even if serious explosion does not occur.

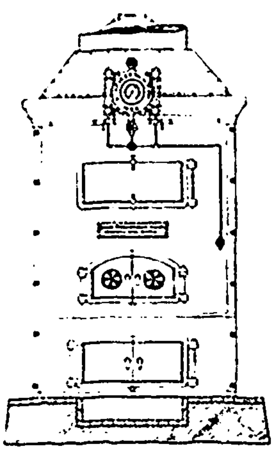
(To be Continued.)

The question of a franchise for electric lighting in Ottawa is still unsettled. It appeared that the offer of the Ottawa Electric Company would be accepted, but it is now proposed to refer the matter back with a view to ascertaining on what terms and conditions the plant and property of the Ottawa Electric Light Company can be acquired by the corporation.

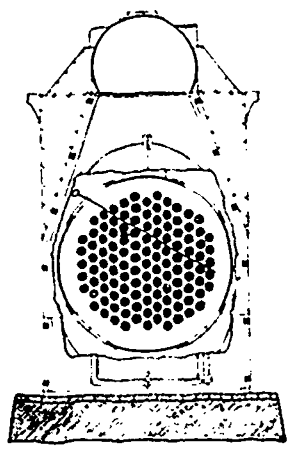
MUMFORD'S IMPROVED BOILER.

ON this page we illustrate a new boiler intended to meet the demand for greater economy and efficiency than are obtained from the ordinary brick set boiler. The water circulation is similar to that of a water tube boiler, and for very high pressure it is built with a corrugated furnace. It was designed by Mr. J. A. Mumford, and is manufactured in Canada by the Robb Engineering Co., of Amherst, N. S., and in the United States by a large concern in Erie, Pa.

The furnace has ample room for mixing the gases



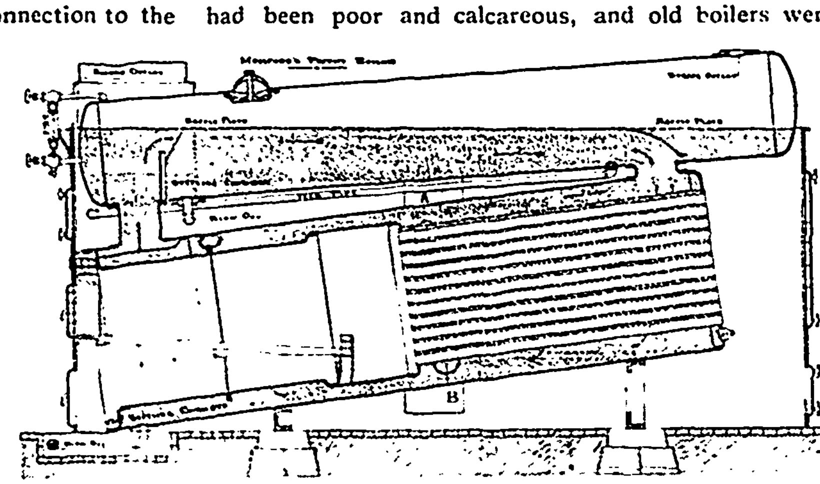
FRONT VIEW OF MUMFORD'S IMPROVED BOILER.



END ELEVATION OF MUMFORD'S IMPROVED BOILER.

and is surrounded by water, so that the direct and radiant heat of the fire is readily absorbed. The heated gases pass directly through well proportioned tubes and return around the shell of the boiler and underneath the drum, making every square foot of the boiler effective as heating surface, and enter the smoke stack with sufficient temperature remaining to produce good natural draft. By covering the case and drum with a non-conducting material the loss of heat usually found in the setting of boilers may be reduced to a minimum.

The water circulates continuously from the front to the back of the boiler, up the back connection to the drum, where the steam freely separates from the water, and down the front connection to a point below the fire. This positive circulation admits of using forced draft, increasing the horse power of the boiler without foaming or priming, the increased temperature increasing the speed of the water circulation without any evil effects.



SECTIONAL VIEW OF MUMFORD'S IMPROVED BOILER.

Special arrangements are made to avoid trouble with bad water. The feed pipe enters the drum near the back end, and part of the sediment is deposited in a settling chamber at the front end of drum and may be blown out. Additional impurities that are carried down the front connection are deposited in another settling chamber below the furnace. This leaves very little, if any, impurity to form scale on the furnace and tubes, and it may be removed by a scraper inserted through hand holes in the shell, the tubes being spaced so that all can be cleaned. Doors are placed in the casing opposite these hand holes, which also give facilities for cleaning the outside of the shell.

The Robb Engineering Company inform us that they have already installed two of these boilers in Montreal and others in Lethbridge, Fort William, Ont., Parrsboro, N. S., while a number more are ordered.

FIFTY THOUSAND VOLT TRANSMISSION.

IT is a fact not generally known, says the Electrical Engineer, that a transmission of 50,000 volts was some time ago tried for a period of two weeks from the water power plant at Telluride, Col., to the Gold King stamping mills there. The Telluride transmission is well known as one of the earliest in this country. The first plant consisted of a single-phase 3,000-volt alternator with direct transmission to a synchronous motor three miles away. This has since been replaced by a three-phase transmission, with step-up and step-down transformers. It was about the time that the change was made that the experiment was tried of transmitting at 50,000 volts three-phase alternating current. The transformers used were those now employed on the three-phase transmission there, said transformers being arranged to give a number of different voltages from 50,000 down according to the way they were connected.

As said before, this transmission at 50,000 volts three-phase current was kept in service for about two weeks, and no accidents occurred during the time. The line consisted of galvanized iron telegraph wires supported on glass insulators. It was found that the self-induction afforded by the iron wire had a beneficial effect in counteracting the capacity of the line. The experiment was not continued for a longer time because a rainy season came on and proper provisions against lightning were not at hand. The transmission line is three miles long, and runs up a steep mountain-side and over a very wild country.

PURE WATER AND NEW BOILERS.

THE corrosive powers of pure water on new or unscaled boilers was illustrated in the city of Glasgow when a new water supply was introduced from Loch Katrine, one of the purest waters in the world which are available for city consumption. The former supply had been poor and calcareous, and old boilers were much coated with lime scale. To the dismay of the users those who had put in new boilers or new tubes found them rapidly corroding, while the old scaled and coated boilers remained as before. Those, too, who had removed every possible trace of old incrustation from their old boilers by mechanical means, intending thus to get, as they expected, the full benefit of pure water, were also badly troubled by corrosion, and even the old boilers, as the scale was gradually removed by the unvarying soft and pure water from the lake, were more or less corroded when no means were taken to prevent it.

THE NORTHEY GAS ENGINE.

Of late years the gas engine has attracted considerable attention as a motive power, and although we do not predict that the day of steam engines is passing away, the fact cannot be disputed that for certain work the gas engine has some points in its favor. As to the efficiency of the gas engine in comparison with steam, we are not prepared to talk up the cudgels in favor of the former, but it can safely be said that it occupies small space, removes the necessity of handling bulky fuel, produces no ashes, dirt or refuse, and requires but a very little water supply.

The Northey Manufacturing Company, of Toronto, have for some time been manufacturing a gas and gasoline engine, for which they report a growing demand, chiefly for engines of from 4 to 6 horse power. The accompanying illustration shows a gasoline engine belted to a dynamo. The details of construction of the engine, as given by the manufacturers, are as follows: It consists, broadly speaking, of a base, cylinder, piston, connecting rod, crank shaft, fly wheels and valve gear. The base and cylinder are substantial castings of proper weight to insure durability and freedom from vibration, and are made of high-grade cast iron. The piston is very long to give large wearing surface, and is made of special iron, fitted with spring rings. The connecting rod is fitted with a phosphor bronze bearing at upper or wrist pin end, so arranged as to take up wear easily. The other end is fitted with babbitted boxes of the marine type. The crank shaft is of steel, finished to gauge. The valves are of the poppett type, and lift squarely off their seats without friction. The valve gear is enclosed in an iron housing absolutely dust and grit proof, and runs constantly in oil, thus insuring perfect lubrication and great durability.

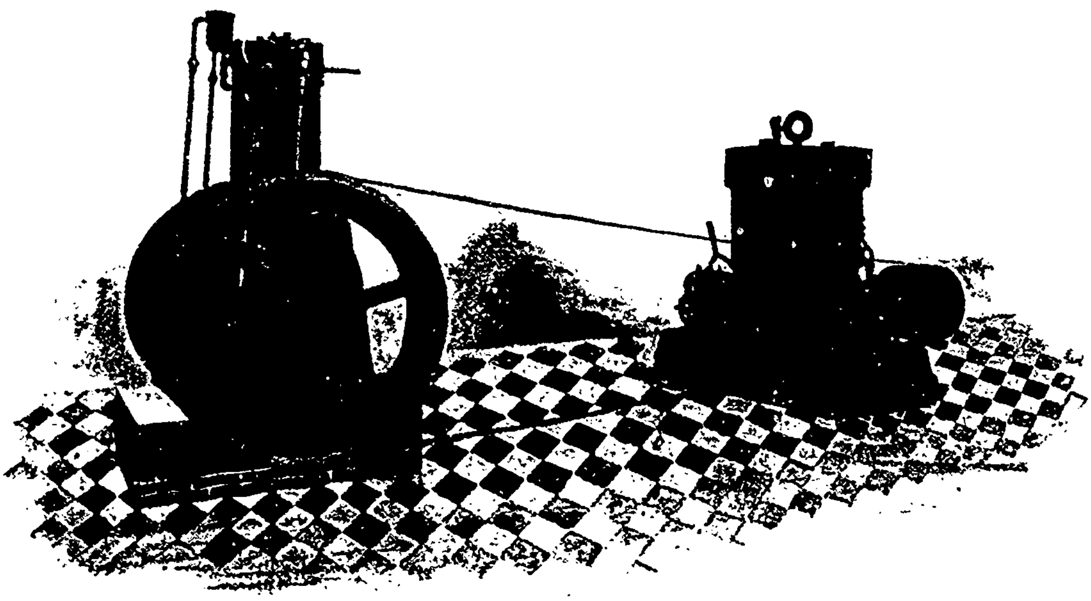
The engine is fitted with two fly-wheels, which is claimed to be the only method which puts equal wear on both bearings. If only one fly-wheel is used the bearings must wear unevenly, as the box on the fly-wheel side wears downward, and the box on the opposite side upward.

The irregular speed, such as is met with in most governors, is overcome by a graduated charge governor, which controls the amount of the charge admitted to the cylinder in proportion to the work being done, and allows the engine to use only what is actually needed. If engine is running light the charge is cut off to what is necessary only to keep engine up to speed, and if engine reaches a few revolutions over the regular speed, the charge is cut off altogether, and thus there is no possibility of engine running away.

The arrangements for keeping the engine from becoming overheated are very complete; a heavy galvanized iron tank is supplied with each engine, to hold water sufficient to keep engine at proper temperature. The water is circulated through this tank by the heat of the engine cylinder, the warmer water going to top of tank, and the cooler portion coming from bottom.

All engines are fitted with electric or incandescent tube igniter. The electric igniter has a positive motion, giving a wiping contact above and below a small wire electrode, which can be replaced from outside of engine in the simplest manner. A battery of eight cells furnishes the small amount of current needed, and is maintained at a very low cost.

The gasoline supply is stored in a heavy galvanized iron tank, which is placed outside the building, and connection made direct from tank to engine by ¼ or ⅛ inch pipe. A small and very simple pump on base of engine draws the gasoline from tank and delivers it to engine cylinder, so that at no time is the gasoline exposed to the action of the outer air.



Northey Gas Engine Driving Dynamo.

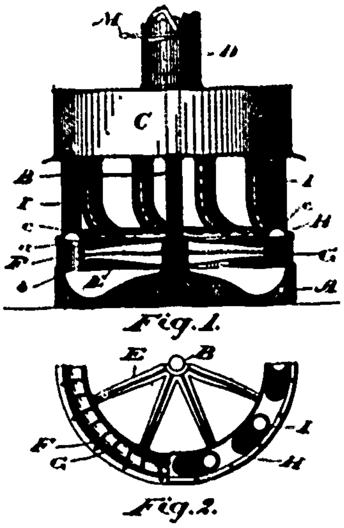
The gas engine is claimed to be specially adapted for electric lighting, the graduated charge governor ensuring the even, steady speed indispensable for such work. Small plants installed in opera houses, buildings, mines, etc., are said to show a great economy over the use of gas for illuminating purposes, as if the gas is used in the engine for motive power, it will produce twice the light in incandescent lamps, and if arc lights are used the difference is still greater in favor of the gas engine.

As to the cost of operation, it is guaranteed that the consumption of gas will not exceed from 18 to 22 feet, or one-tenth of a gallon of 74 degrees gasoline, for each horse power produced per hour. With gas at 90 cents per 1,000 feet, the cost would be about 18 cents per horse power for ten hours work.

The Northey Manufacturing Company will gladly furnish any further particulars desired by interested persons.

RECENT CANADIAN PATENTS.

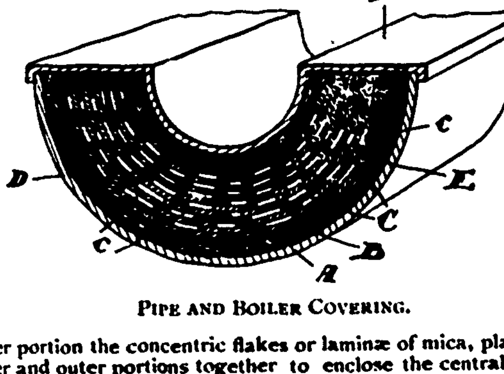
A PATENT has been granted to Mr. John Sharp, of Gravenhurst, Ont., for a water wheel, as shown by the accompanying cut. The claim is for a wheel secured to a vertically journalled shaft, and a series of radial buckets inclined from the vertical at substantially an angle of forty-five degrees, and secured to the rim, in combination with a frame surrounding the buckets, a cover therefor provided with a series of openings, each extending over two or more buckets, and a curved conductor connected with each of the said openings and with a source of water supply, the arms in the conductors being such as to discharge the water at substantially a right angle to the surfaces of the buckets; a curved conductor connected with each of above said openings, a tank with which



TURBINE WATER WHEEL.

the said conductors are connected, a flume connected with the tank, a cut-off valve in the said flume, and a cut-off valve for each conductor, substantially as set forth.

Mr. Henry C. Mitchell, Toronto, has obtained a Canadian patent, No. 58,788, for a pipe and boiler covering, as herewith illustrated. It is claimed to be a non-conducting covering, comprising centrically arranged flakes or laminæ of mica, forming multitudinous hollow non-communicating interspaces and a suitable binding medium permeating the outer portion of the layers and forming at the inner an irregularly formed surface, whereby the covering is held in shape and position, etc. A method of forming a non-conducting covering for boilers and the like, consisting in spreading upon suitable backings for the outer and inner portions of the covering, a composition comprising a damp or wet binding medium, intermixed with mica particles, superimposing upon the



PIPE AND BOILER COVERING.

outer portion the concentric flakes or laminæ of mica, placing the inner and outer portions together to enclose the central laminæ, and finally subjecting the whole to a suitable drying process whereby the binding medium is hardened and permeates into the mass, as and for the purpose specified.

NEW CABLE ACROSS THE GULF OF GEORGIA.

THE C. P. R. recently completed the laying of a new cable across the Straits of Georgia, from Vancouver, B. C., to Departure Bay, on Vancouver Island. The distance, as the crow flies, is about 32 miles, but it was found that the bed of the gulf was broken up by innumerable hills, mountains and gulleys, nearly 8 miles of wire being used in covering this irregular space, making the cable 40 miles in length.

The cable was made by the Telegraph Construction and Maintenance Company, of London, Eng. It weighs about 320 tons, and its total length when it left the manufacturers was 45 miles. Some idea of the difficulty experienced in handling it may be had from the fact that it took the crew of the Tartar two days and a half to get it on board at Southampton. The duty on the cable was $10,000, and by the time the company received it in Vancouver it cost them considerably over $50,000. In diameter the cable is slightly more than an inch and a half, and it contains three wires or cores, which provide three distinct services or connections. Each of these cores is about the size of a lead pencil, and each contains fine copper wires packed in jute and insulating material. Inside of this they are armored with 14 galvanized steel wires, wound spirally. Inside of this again is the final covering of tarred jute canvas.

The old cable which it replaced was a single core, or single wire, and was laid in March, 1881. Since that time it has been broken several times, and has given much trouble.

From shore to shore the cable was laid almost without a hitch, the steamship Tartar being employed. The receptacle for the cable was a steel tank about 35 feet in diameter and 12 feet high. In the centre was a circular spool-like frame, around which the cable was coiled. The work was carried out under the supervision of Mr. F. B. Gerrard, assistant superintendent of the Commercial Cable Co., of Canso, N.S., and Mr. J. W. Wilson, superintendent of C.P.R. telegraphs in Vancouver.

PERSONAL.

The death is announced on the 22nd ultimo, at his residence in Toronto, of Mr. Benjamin W. Stokes, late engineer and electrician at Centre Island, in his 43rd year.

Mr. J. A. Kammerer, of the Royal Electric Company, has returned from Atlantic City, so far improved in health as to be able to put in part time at his office. He is steadily gaining strength, and, assisted by the returning warm weather, will no doubt soon be entirely himself again.

Mr. P. A. Dickson died at Brantford, Ont., on April 25th, at the age of 40 years. Deceased was for a number of years electrician for the Brantford Electric Power Company, leaving there last summer for British Columbia, where he contracted a severe cold, which resulted in his death.

Much regret is felt at the removal to England of Prof. Carus-Wilson, of the Engineering Department of McGill University. Prof. Wilson sailed with his family from New York on the Campania on April 23rd, and on arrival in England will reside at Hanover Lodge, Kensington Park, London, W.

Professor H. L. Callendar, of the Physics Faculty of McGill University, has received the appointment to the chair of Physics at University College, London, England. Prof. Callendar's work at McGill has been greatly appreciated, and general regret is expressed at his forthcoming departure. The results of some interesting experiments on the condensation of steam conducted by him appeared in our April issue.

Mr. W. J. Creen, who for many years has occupied the position of local agent for the Canadian Express Co., Bell Telephone Co., and Grand Trunk Railway Co., at Walkerton, Ont., has recently removed to Berlin, where he will fill the position of local manager for the Bell Telephone Co. Before leaving Walkerton Mr. Green was presented by the Mayor, on behalf of the citizens, with a handsome gold watch, and Mrs. Green with a beautiful chair, accompanied by an address expressive of the good wishes of the community. Mr. Green was also presented on behalf of the Masonic fraternity with a past master's jewel. The people of Berlin will require from Mr. Green no better recommendation than the spontaneous expressions of esteem bestowed upon him by those who best know his worth.

Mr. L. A. Campbell has been appointed manager of the West Kootenay Power & Light Company, and has left for British Columbia to take up his new duties. Mr. Campbell has had an extensive experience in electrical work, having been connected with the Fort Wayne and Edison General Electric Companies in the early days of the industry in Canada. Since the formation of the Canadian General Electric Company he has been employed on the construction and engineering staff of that company, and, on the departure of Mr. W. Rutherford, chief engineer of the company, for England, eighteen months ago, succeeded him in that position. The installation of the West Kootenay Power Company's plant has been carried on under Mr. Campbell's personal supervision; he is therefore thoroughly acquainted with the conditions under which it can be most favorably operated, and his selection to fill the position of manager is a very fortunate one for the company. His many friends in the electrical business in the east will join in wishing him the best possible success in his new field of labor.

TRADE NOTES.

James Pender & Co., St. John, N.B., have put in a new 15 h.p. Goldie & McCulloch engine.

A. Bobson, Esq., Beaverton, has purchased a 400 light incandescent dynamo from the Canadian General Electric Company.

Mr. T. E. McLellan, manager of the Berlin and Waterloo Street Railway, has resigned his position to go to the Klondyke, and will be succeeded by Mr. H. Hilborn, of Montreal.

The British Columbia Iron Works Co. have ordered a 6 kilowatt incandescent dynamo from the Canadian General Electric Co. for a steamer which they are building for the Klondyke trade.

The Jones & Moore Electric Company, of Toronto, have just installed a lighting plant on the steamer "Northern Belle," comprising 80 16 c.p. lights, and fitted with marble switchboard and first class instruments. The work was done at Collingwood, the installing expert being Mr. J. H. Ward.

The Hudson Bay Company have placed a contract with the Canadian General Electric Co. for two 100 light incandescent equipments, to go on their new steamers, running from Vancouver and Victoria to the Stickeen river.

The Eugene F. Phillips Electrical Works, Montreal, have been given the contract to supply all the trolley, bond and feed wire required in the construction of 25 miles of electric railway at Jamaica, West Indies. This is the new road with which Mr. Holgate, formerly manager of the Montreal Park and Island Railway, is connected.

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 co[illegible]trary, 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 [illegible] the requirements, to make his series of tests complete in every particular.

WM. THOMPSON.

THREE-WIRE SYSTEM.

In the three-wire system the lamps are really arranged in sets of two in series. The two outer wires have double the potential of the lamps, and since, owing to the lamps being in series, one-half the current only is required as compared with multiple arc two-wire system; therefore, to carry one-half the current with twice the difference in potential or double the E.M.F., a conductor with one-quarter the area of cross-section suffices.

Dynamos are frequently set in series in large buildings, and their terminals wired out on the three-wire system to save copper. Since each of the wires is but one-quarter the size of the wires in the ordinary two-wire system, it remains clear that the weight of copper required on the three-wire system is but ⅜ of that required on ordinary two-wire systems. The formulæ already laid down for two-wire work apply to three-wire calculations as regards size of mains, if denominator of formula be multiplied by 4.

$$\text{C M or } d^2 = \frac{21.58 \times \text{L N} \times (100 - \%)}{\text{R} \times \% \times 4}$$

This formula gives required cross-section of mains in circular mils, using commercial copper wire as a conductor.

ALTERNATING CURRENT SYSTEM.

In alternating systems we have two sets of mains to deal with, primary and secondary, both of which have different E. M. F.'s.

Theoretically, the rules deduced from Ohm's law are not correct as applying to this system of generation, because calculations must be made to allow for conversion from primary to secondary current. The ratio that the primary E.M.F. bears to the secondary E.M.F. is expressed by dividing the primary E.M.F. by the secondary E.M.F., and is termed ratio of conversion. Thus,

$$\frac{\text{E primary}}{\text{E secondary}} = \text{Ratio of Conversion.}$$

The current in the primary is equal to the current in the secondary divided by the ratio of conversion.

Example: On an alternating circuit whose primary E.M.F. is 1,000 volts and secondary E.M.F. 50 volts, there are 500 lamps, each having a resistance of 50 ohms, what is the primary current and what the secondary?

$\frac{1000}{50} = 20$, ratio of conversion.
$\frac{50}{500} = .1$, combined R of lamps.
$\frac{50}{.1} = 500$ amperes current on secondary.
$\frac{500}{20} = 25$ amperes current on primary.

Current being determined, rules deduced from Ohm's law apply exactly as shown for direct current calculations.

Example: An alternating generator has 4,000 feet of primary main attached with an E.M.F. across the terminals of the machine of 1040 volts; it is decided to allow a drop of 40 volts on the primary at the convertor. The secondary main has attached to it 750 16 c.p. lamps at an E.M.F. of 50 volts, each lamp having a resistance of 50 ohms. What is the resistance on the primary wire?

$1040 - 40 = \frac{1000}{50} = 20$, ratio conversion.
$\frac{50}{50} = 1$ amp., current each lamp.
$750 \times 1 = 750$ amps., total current on secondary.
$750 \div 20 = 37.5$ amps. current on primary.
$\frac{1}{37\frac{1}{2}} \times 40 = 1.06$ ohms resistance on primary.

To obtain the required size of primary mains in circular mils, calculate by formula for two-wire direct current, and divide the result by the square of the ratio of conversion. Or

$$\text{C M} = \frac{21.58 \times \text{L N} \times (100 - \%)}{\text{R} \times \% \times \text{R C}^2}$$

Example: An alternating current generator has an E.M.F. across the leads of 1040 volts, and current is delivered 4,000 feet from station, E.M.F. at terminals being 1,000 volts; current consists of 1,000 lamps, having a resistance of 50 ohms each on a 50 volt secondary circuit. What should be the cross-section of the primary mains in circular mils, and what is resistance of same main to allow a drop of 40 volts as shown?

$$\frac{1000 = \text{E.M.F. at terminals of primary}}{50 = \text{E.M.F. on secondary}} = 20 \text{ R.C.}$$

$40 \div 1040 = 3.84\%$ drop in potential.

$$\frac{21.58 \times 4000 \times 1000 \times (100 - 3.84)}{50 \times 3.84 \times 20^2} = 108{,}079 \text{ C. M.}$$, required cross-section of primary main in circular mils.

Total current on secondary $= 1000 \times \frac{50}{50} = 1000$ amps.
$1000 \div 20 = 50$ amps. secondary current.
$\frac{1}{50} \times 40 = .8$ ohms resistance, primary main.

HORSE POWER CALCULATIONS.

The power or force required to do a certain mechanical work is usually referred to as foot pounds. That is, one pound raised one foot high is called a foot pound, without reference to the time required to do the work. Therefore, if we want to find force or energy required to be expended to do a certain work expressed in foot pounds, we require to multiply the weight required to be raised by the distance in feet through which weight has to be lifted.

A horse power is fixed as the work performed in raising 33,000 pounds one foot high in one minute, or what is exactly the same thing, raising one pound 33,000 feet high in the same period of time. Here we have time required to do a certain work, and note of this must be taken in our calculations.

Then to reduce force exerted at the piston of a steam engine, and to express this force in horse power, we require to know effective pressure against the piston throughout the stroke, and distance travelled in feet by the piston per minute. And to do this use the following established rules:

1st. Find area of piston in square inches.

2nd. Find the total pressure in pounds on the piston by multiplying the area by the mean effective pressure per square inch.

3rd. Find the distance in feet traversed by the piston per minute by multiplying the length of stroke in feet by twice the revolutions per minute.

4th. Find the energy exerted by the engine expressed in foot pounds per minute by multiplying the total pressure in pounds against the piston by the travel in feet per minute.

5th. Find the horse power by dividing total foot pounds per minute by 33,000.

From this, then, we can construct the following simple formula:

$$\frac{\text{A.N.P.S.}^1}{33{,}000} = \text{H.P.}$$

Where A = Area of piston in square inches.
N = Number of strokes per minute (revolutions multiplied by two.)
P = Mean effective pressure per square inch.
S^1 = Length of stroke in feet.

Example: Find the horse power of an engine 9.5 inches by 12, running 280 revolutions per minute, mean effective pressure throughout the stroke being 35 pounds per square inch.

$9.5^2 \times .7854 = 70.88$ square inches area.

70.88 × 35 =
70.88
35
35440
21264
2480.80 total pressure against piston.

280 revolutions per minute.
2 strokes per revolution.
560 strokes per minute.
1 length of stroke in feet.
560 feet travelled by piston per minute.

2480.8 pressure on piston.
560
1488480
124040
1389248.0 foot pounds per minute.

33000)1389248.(42.09 horse power.
132000
69248
66000
324800

We have in this formula two constants, .7854 constant multiplier to find area, and 33000 constant divisor to find horse power, consequently by dividing .7854 by 33,000 we get a constant multiplier as a result, and thus shorten our method.

.7854 ÷ 33000. = .0000238, which becomes a constant multiplier, and our formula then becomes $(d^2 \text{ N P S}^1) \times .0000238 = \text{H. P.}$

Example: Using this formula find horse power of an engine, dimensions, etc., as per last example.

9.5 = diameter of piston.
9.5
$90.25 = d^2$
560 = strokes per minute.
5415 00
45125
50540.00
35 = mean effective pressure.
252700
151620
1768900
.0000238 = constant multiplier.
14151200
5306700
3537800
42.0998200 = H. P.

CALCULATING HORSE POWER FROM INDICATOR DIAGRAMS.

An indicator diagram is practically a record of the action of the steam on the piston throughout the stroke of an engine, and if we are enabled to ascertain the area of the diagram, having the length of the diagram and scale of spring used before us, it becomes an easy task to find the mean effective pressure of the steam throughout the stroke.

The area of the diagram is easiest found by use of a small instrument called a planimeter, which should be set to a natural scale, that is, area of diagram should read in square inches. *Knowing the area and dividing by length of diagram in inches*, will give us height of a regular body of an equal area.

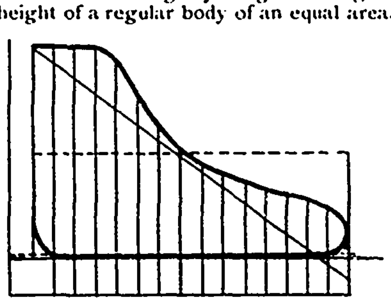


FIG. 7.

Fig 7 represents a diagram 3 inches in length, and the irregular body has an area of three square inches. If we reduce this area to a regular body with at least two of its sides equal, we get a diagram, as shown by dotted lines, exactly one inch in height; multiplying this by scale of spring used, we get *M.E.P. throughout the stroke*. Therefore, we can construct a formula as follows to calculate M.E.P. from an indicator diagram:

Area ÷ Length × Scale of spring = M.E.P.

The horse power calculation can be very much shortened by using what is known as an *engine constant; that is*, the power developed by an engine with M.E.P. of 1 pound per sq. inch, and is particularly useful where horse power calculations are being constantly made from same engine.

Abreviated the formula would then read:

Engine constant × M.E.P. = H.P.

Example: Using engine constant and M.E.P. find I.H.P. of a single cylinder engine 9½" x 12" running 280 revolutions per minute. Diagram measures 3 inches in length, and planimeter shows area to be 2.625 sq. inches, scale of spring used in indicator being 40 pounds per inch of compression.

First, find power developed by engine with a mean effective pressure of one pound per square inch:

$9.5^2 = 90.25$
90.25 × 560 = 50540
50540 × .0000238 = *1.2 H.P.*

Then power developed by this engine with steam pressure on piston equalling one pound per square inch of area is 1.2 H.P., which is our engine constant. Next find mean effective pressure shown by diagram:

Area ÷ Length = 2.625 ÷ 3 = .875 average height in inches.
.875 × 40 scale of spring used = 35. M.E.P.
Then 1.2 × 35 = 42. horse power.

In the absence of a planimeter, it becomes necessary to devise a method of arriving at area of diagram. To those engineers who

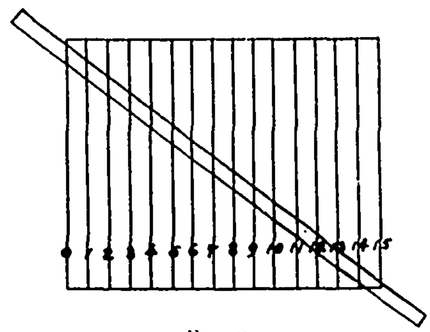


FIG. 8.

are unacquainted with geometry this is sometimes difficult to do.

With every indicator is sent out a number of rules graduated in such a manner that the divisions between each inch correspond exactly with scale of spring used; by the aid of these it becomes comparatively easy to subdivide into equal divisions. For instance, suppose we wish to divide Fig. 7 into 15 equal parts by using a graduated scale laid across diagram at an angle so that the divisions 1 and 15 shall exactly coincide with lines at each end of diagram, and marking off at each division on scale intervening by erecting at each of these points an ordinate at right angles with atmospheric line, we get 15 exact divisions. It now remains for us to ascertain the pressure represented in the centre of each of these divisions, and finding the mean pressure by adding the pressures together and by dividing the total by number of ordinates erected, we get total mean effective pressure calculation of H.P. *It then becomes a simple repetition of examples* already described. To convey meaning clearly Fig. 7 is reproduced in Fig. 8.

[THE END.]

SUPERIOR BOILER COMPOUNDS.

The advertising pages of this issue contain the announcement of the Canadian Chemical Compound Company, and as this company is probably unknown to some of our readers, being of recent organization, a few words of introduction may here be given. The personnel comprises Messrs. *A. M. Wickens, E. J. Philip and* D. J. LeRoy. The headquarters of the company are in the Temple Building, Toronto, where nicely fitted and convenient offices have been secured; while the Montreal office is located in the Street Railway Chambers. The factory is at 66 River St., Toronto.

As implied by the name, the company are manufacturers of chemical compounds for boilers, and being composed of thoroughly practical men, it is not to be wondered at that they are producing an article second to none in the market. The manufacture of the compound is under the supervision of Messrs. Wickens and Philip, who have given the matter very careful study for some time past, while Mr. LeRoy has charge of the sales department. From a neat booklet just issued, we learn that the company have made a somewhat new departure, in that they are manufacturing three distinct brands to meet the necessities of different waters, this step being determined upon after making a large number of analysis of various waters used in Canada.

Their "Canadian" brand is suitable for the water in our Great Lakes, and all waters of a like quality. It is claimed to prevent internal pitting and corrosion of the boiler and all apparatus it passes through. Their "Automatic" brand is specially prepared for waters carrying heavier and harder sulphates, such as some of the river waters and some spring well waters. This brand is more active than the "Canadian," and is exceptionally good for water tube and other rapid steaming boilers used under hard and continuous firing. Their "Zinkolene" is said to be the outcome of a large number of carefully conducted tests with the most difficult waters *in Canada, and will, it is said, succeed where all others fail.* It is sharp and active and must be used according to special directions sent with each package, which are not sent to allay its sharpness, but to assist it in the loosening of very hard and difficult scale.

The compounds made by this company are liquid and purely vegetable, containing no acids or other injurious material, and are readily fed into the boilers. They are the results of years of experience by a practical engineer, assisted by a first-class chemist.

To show the importance of steam users looking to the prevention of boiler scale, it is estimated by eminent engineers and fully borne out by actual experience that $\frac{1}{16}$ inch of scale causes a loss of 13% of fuel, ¼ inch 38% and ½ inch 60%. The best of waters for steam boilers contains about 8 grains of scale-making properties per gallon.

ELECTRIC RAILWAY DEPARTMENT.

THE HAMILTON STREET RAILWAY.

The Hamilton Street Railway Company recently made application to the City Council for an amendment of the present agreement with the city under which the company has to pay over $13,000 a year for percentage and mileage. A meeting of the Finance Committee was held on April 4th to consider the matter. The company's solicitor presented figures which showed that there had been a falling off in receipts last year, and that no dividends had been paid since 1895. He attributed the falling off in receipts to the building of the radial railways, which cut into the local business, and stated that at the present time the company could not operate under the conditions. He proposed that the by-law should be amended to provide for the removal of snow from the track; the company to sell nine instead of eight limited tickets for 25 cents, and to extend the time from 6.30 a.m. to 8 a.m., 11.50 a.m. to 1.30 p.m., and 5 to 6.30 p.m.; to carry children between 5 and 12 years of age for 3 cents, or sell ten children's tickets for 25 cents; also to allow its tracks to be used by radial railways entering the city, on terms to be agreed upon. In lieu of these conditions the company asked that the franchise be extended to 1928, the mileage abolished, and the percentage be rearranged as follows: Receipts up to $200,000, 5 per cent.; receipts over $200,000, 8 per cent. Mr. Martin also submitted an alternative proposition to abolish mileages and percentages, and after paying expenses, etc., to equally divide the surplus between the city and the company until each receive $10,000 a year, then the city to receive the percentages under the by-law, the franchise to be extended to 1928, and radial railways to be allowed to use the company's tracks on the terms to be agreed to.

The Finance Committee submitted several questions to the company, which were answered in the following words: "The actual cost of the Hamilton Street Railway is represented by the capital paid up in cash, $204,704.40, and the bonds issued in 1894, $500,000; total, $704,704.40. The company's charter does not permit it to sell the railway, nor can the company control the shares of the shareholders, or bind the bondholders to agree to a sale, neither has the city power to purchase the railway. Very special legislation would, therefore, be required to enable such a purchase to be made, and it would take almost two years to obtain such legislation and pass the necessary by-laws. If the city decides to purchase the railway, and will now make a definite offer which the company can recommend to its shareholders, with a view to obtaining their assent to applying for the necessary legislation, the company will take that step, provided the interests of the company are properly safeguarded in the meantime by the franchise being extended till 1928 substantially upon the terms of the draft by-law now submitted (or the alternative offer), it being further provided that the city shall have the option to purchase out the company at the agreed price within, say, two years, should the requisite legislation and authority have been obtained in the meantime."

Some of the members of the Council are in favor of the city acquiring the railway, but there is a great difference of opinion as to the wisdom of municipal ownership, and the matter has been laid over for further consideration.

The Canadian General Electric Co. have closed a contract with the owners of the War Eagle mine, Rossland, B. C., for the electrical apparatus for operating a compressor plant and elevator.

A survey is being made for a short line of railway from Flower Station, Ont., to the mines of the Hamilton Smelting Company, Andrew Bell, C.E., of Almonte, having charge of the work. It may be an electric road.

The Halifax Tramway Company have recently finished the installation of a second 5000 light monocyclic alternator, which they are installing for their electric lighting service. This makes a total of 10,000 lights capacity in monocyclic apparatus installed by the Canadian General Electric Company in Halifax.

SPARKS.

The Vankleek Hill Electric Company, Limited, has been incorporated, with a capital of $15,000.

The Metropolitan Railway have placed an order with the Canadian General Electric Company for three additional G. E. 1,000 equipments.

The Canadian General Electric Company are installing a 110 kilowatt direct current railway generator for the Longue Pointe Asylum, Quebec.

Francis Lapointe, of Montreal, is promoting a scheme to build a bridge over the Lachine canal, to be operated by two electric motors of 50 horse power each.

The corporation of Port Arthur, Ont., have purchased a motor car complete with G. E. 1000 motors from the Canadian General Electric Company.

The annual meeting of the shareholders of the City of Birmingham Tramways was held last month, at which a dividend of 5 per cent. was declared and £33,000 carried to the reserve. Mr. Jas. Ross, of Montreal, presided.

The Manitoba Gas & Electric Company have ordered from the Canadian General Electric Company all the apparatus required for their new plant, including a 6000 light direct connected single phase alternator, and a 125 light Brush arc machine.

The Hamilton Radial Electric Railway Company have elected directors for the ensuing year as follows: A. Turner, President; W. A. Wood, Vice-President; John Moodie, Treasurer; Stuart Malloch, Secretary; James Dickson, Adam Zimmerman.

At a recent meeting of the Board of Canadian Underwriters, the best method of securing proper insulation of electric wires was discussed and various suggestions made. In Western Ontario there is an inspection, but in Eastern Ontario and Quebec there is none. A committee was appointed to report at the June meeting.

Mr. J. R. Scott, of Napanee, has placed the order for electrical apparatus for his transmission plant with the Canadian General Electric Company. The generator will have a capacity of 100 kilowatts and will be of the revolving field type, with stationary armature, wound for 4000 volts, three phase. The distance from the generating station to Napanee is 8 miles.

It is announced that the Chinese government has decided to construct an electric tramway to Pekin, the contract being given to the Japanese branch of the German firm, Siemens & Halske. An engineer will be despatched by Siemens & Halske, of the Tokio branch, to supervise the work. The electric tramway will run from the terminus of the government railway to the wall of Pekin.

The city engineer of Toronto has been negotiating with a company of Buffalo capitalists for the transmission of power to Toronto. The company offer to supply electric energy at $40 per horse power per year if the city guarantees that it will use 10,000 horse power. The company purposes to operate from a point 30 miles nearer Toronto than the Falls. The city could scarcely guarantee to take that amount of power.

Mr. Elisha Moore, of Meductic, York county, N.B., has invented an alternating switch for street railways, which can be operated from the car by simply pressing a button. The device obviates the necessity of stopping the car and does away with switchmen, which means a great saving to railway companies. Mr. Moore has had his device patented both in Canada and the United States, and will ask for European patents.

The shareholders of the Hamilton, Grimsby and Beamsville railway held their quarterly meeting recently. The quarterly financial statement, as presented by Superintendent Nelles, showed an increase of 10 per cent. in gross earnings over those of the corresponding period of last year. The directors were empowered to issue debentures to pay off the floating debt of $20,000. The present debenture debt of the road is $85,000, payable in thirty years.

A special general meeting of the shareholders of the Quebec, Montmorency and Charlevoix Railway Company will be held in Quebec on May 14th, when the following matters will be considered: The acquisition of the franchise and property of the Quebec District Railway Company; the conversion of the existing line of the company between Quebec and Cape Tourmente into a line operated either in whole or in part by electricity, the construction of a branch line from Quebec to the west side of the Falls of Montmorency, operated by electricity.

The appeals of the Montreal Street Railway Company from the judgments of the Superior Court, awarding Mr. Jacquemin $300 for injuries resulting from being struck by a street car while crossing Craig street, in December, 1895, and Miss Chartier damages for injuries resulting from a similar accident on Notre Dame street, were last week dismissed by the Court of Appeal, the decision in each case being based upon the violation by the Street Railway Company's employees of the city by-law ordering that the speed of the cars must never exceed eight miles per hour, and that at all street crossings cars must be slowed up to the pace of a horse walking. The court held that as long as this by-law remained in force it would have to be observed, and the company will have to be held responsible for all damages and accidents resulting from its violation.

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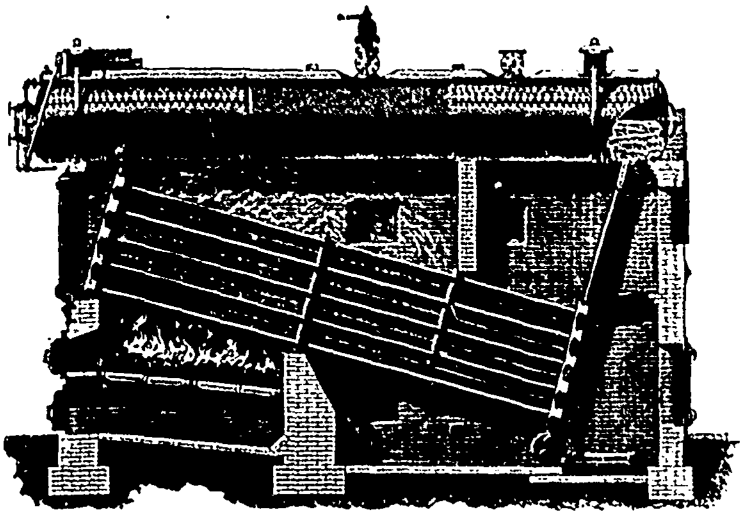

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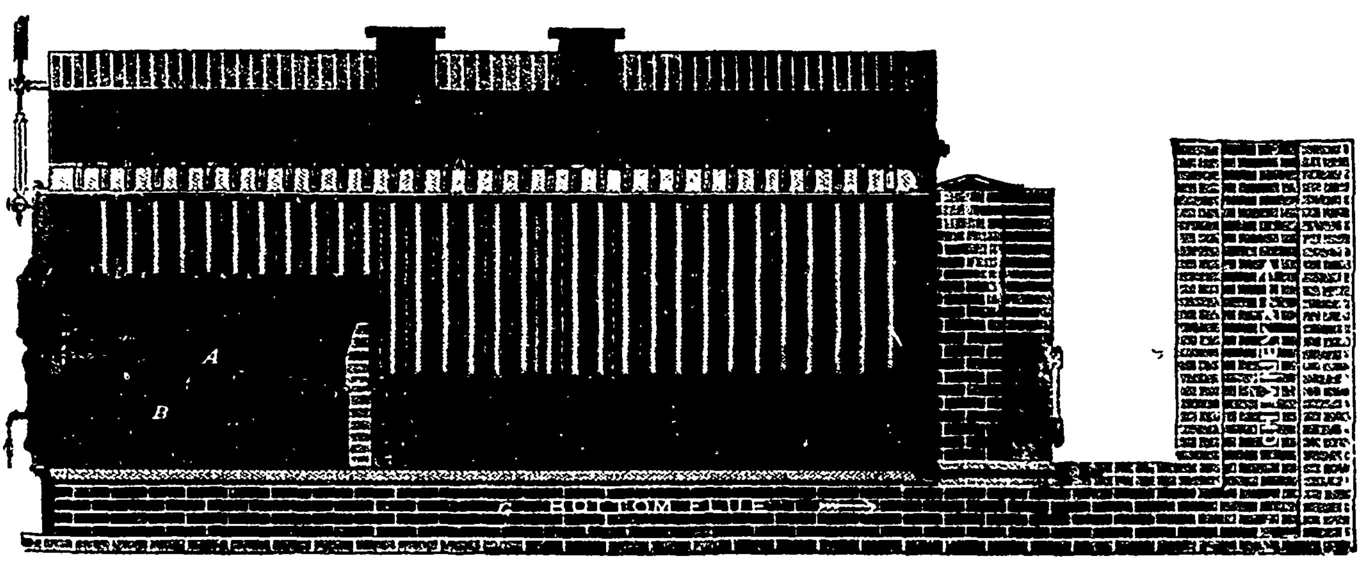

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CATALOGUE FREE

SPARKS.

The town of Woodstock, N.B., will install an electric fire alarm system.

The Centre Star mine at Trail, B. C., is about to install an electric hoist.

Baird & Son, of Parkhill, Ont., are putting in an incandescent lighting plant.

Larkin & Sangster, of Iroquois, Ont., have put in a small electric light plant.

The city of Chatham, Ont., will call for tenders for an electric fire alarm, to cost $2,000.

An electric light plant will likely be installed at Maniwaki, Que., for public and private lighting.

Robert Whitelaw, of Woodstock, Ont., has secured the right to manufacture the Shepherd vertical engine in Canada.

The Star mine at Rossland, B. C., is said to be taking estimates on a compressor plant, to be operated by electricity.

Paris, Ont., has made a contract with the Paris Electric Light Co. for street lighting at twenty-three cents per light per night.

The Brussels Electric Light Co., Brussels, Ont., has been succeeded by Robert Mainprize, who continues under the old name.

The Citizens' Electric Light Company closed down its plant at Watford, Ont., last month. There was not sufficient business for two companies.

Ottawa, Ont., has taken the first steps towards the establishment of a technical school, a committee of the Board of Trade having been appointed to devise ways and means.

The city clerk of London, Ont., has received information from several cities in the United States and Canada relative to the cost of operating municipal electric light plants.

At the last city council meeting in St. Thomas, Ont., the advisability of establishing a municipal lighting plant was discussed. The present contract expires in October, 1899.

It is stated that the Electrical Construction Co., of London, Ont., may remove to Kingston in order to secure enlarged premises necessitated by increase of business.

The Golden Cache Mines Co., Limited, of Vancouver, B. C., have invited tenders for water wheel and governor, electrical machinery, compressor plant and drills, 10-stamp battery, etc.

The Montreal Street Railway Co. has just had printed 15,000,000 car tickets, the cost of printing being $1,100. The company is said to have received $3,000 for advertising on these tickets.

A committee of the city council of St. John, N.B., has recommended the purchase of a dynamo and additional lamps for the North End electric light station, at an estimated cost of $1,000.

The International Radial Railway Co. will apply to the Dominion parliament for incorporation, and for permission to extend the time in which to commence the construction of its proposed road.

Mr. C. Bethel, late of H. W. Petrie & Co., Toronto, has connected himself with the Laurie Engine Co., of Montreal. He will have charge of their city warehouse and salesrooms at 321 St. James street.

Mr. McNamara, of Goderich, Ont., has received a letter regarding the Hurontario Electric Railway, which states that there is still hopes of securing the construction of a railway from Walkerton to Flesherton.

The city of Victoria, B.C., recently accepted the following tenders: Dynamo, W. A. Johnson Electric Co., Toronto, $2,285; carbons, National Carbon Company, $855; globes and pulleys, Thomas Watson, $179.

A boiler in Miller's tannery at Orillia, Ont., exploded on April 9th. The explosion blew the southern end out of the building, and scattered large pieces of iron, bricks and stones all round for a couple of hundred yards.

The Toronto Electric Light Company has offered to furnish electric lights for the Island at 25 cents per light per night, terminating at midnight. A proposition made by Ald. Hanlan to operate a private plant is under consideration.

Arrangements have been completed for the installation of two electric plants, one at Napanee and the other at Newburgh, for the purpose of lighting the villages of Yarker, Newburgh, Camden East, Napanee Mills and Napanee.

The Sarnia Gas & Electric Light Co. recently closed a contract for a complete set of modern gas appurtenances with the Western Gas Construction Co., of Fort Wayne, Ind. The company have appointed Messrs. Baxter & Lynn, of Detroit, consulting engineers.

Saxby & Dryden, of Kingsville, Ont., are building their power house, in which will be installed a 500-light alternator, 50-light arc machine, 60 h.p. steel boiler and 50 h.p. engine, with pump and heater. The engines and boilers have been purchased from E. Leonard & Sons, of London, Ont.

The city of Kingston recently entered an action against the Kingston, Portsmouth & Cataraqui Electric Railway Co., to compel the latter to keep their cars running over the whole of their system during the entire year, pursuant to agreement. A decision in the case has not yet been given.

Messrs. P. A. P. Lariviere, J. M. Nunns, Dame Genevieve Thiverge, and Eulalie Lariviere, of Melbourne, Que., and H. F. W. Bellow, of Montreal, have asked for a charter as La Compagnie d'Aqueduc de Richmond. The powers asked are extensive, including electric light, motive power, etc. The capital stock is $100,000.

The Tree Rotary Engine Company, of Woodstock, Ont., held their first meeting of shareholders on Thursday, April 7th. The following officers were elected: Louis Kaufmann, president; A. J. Wilson, vice-president; J. A. McKay, secretary-treasurer. Messrs. Kaufmann and McKay are managing directors.

The Canadian General Electric Co. have a contract for supplying three direct connected units for the C.P.R. steamers which are to go on the Stickeen route. These units will consist of a 4 kilowatt 70 light incandescent dynamo, direct connected to a vertical high speed engine, running at 600 revolutions per minute.

The proprietor of the Stayner Electric Light Works has made a proposition to light the streets of Acton, Ont., offering to place 40 electric lights and maintain them for $450 a year. It is estimated that the necessary plant and building would cost $6,000. Before deciding, the councillors will investigate the outlook for a municipal plant.

The officers of the International Exhibition, to be held in Turin, Italy, have offered a prize of 15,000 lyre (about $3,000) for the best invention or machine devised for the application of electricity to industrial purposes. The competition is open to all nations, and a committee of international authorities will be appointed to award the prize.

It is not often that we hear of farm houses having telephonic communication. At Goulbourne, Carleton County, there are three sons and two daughters in the Healy family, all living on different farms, and they have their houses connected by telephone. Each has a number, and although when a phone is rung all can hear the ringing, there is no confusion, for each one knows his or her number of rings, whether one, two, three, four or five.

The Canadian General Electric Co. are installing a direct connected lighting unit on board the C.P.R. steamship Athabasca, consisting of a 500 light incandescent dynamo, direct connected to a 50 h.p. high speed "Ideal" engine. This unit, which is very compact, occupies a floor space of 6 x 9 ft. The dynamo is of the latest steel frame multipolar type, with ventilated armature. A marble switchboard, on which are mounted a standard equipment of instruments, is also part of the new equipment, which, when finished, will be the most complete on any of the steamers now running on the upper lakes.

The New York Court of Appeals has given a decision which, according to report, makes the electric street railway trolley patents public property. Under patents granted to Vandepoel, the General Electric Co. has for years held the exclusive right of manufacturing trolleys. Some time ago the Walker Company began the manufacture and sale of an electric trolley on an extensive scale, resulting in a series of suits against that company by the General Electric Co. In his last statement of the assets of the General Electric Company, President Coffin included an item of $1,000,000 as the value of the Vandepoel trolley patents.

Mayor Shaw and other representatives of the Toronto City Council visited Niagara Falls recently for the purpose of inspecting the electric power works which have been established on the American side by the Niagara Power Company. Questioned regarding the possibilities of transmitting power to Toronto, Mr. W. B. Rankine, manager of the company, stated that the loss in transmission to Buffalo was 12½ per cent., and a further loss of 6 per cent. was incurred in distribution in the city. What the loss would be in the longer distance to Toronto he did not know, but Mr. Stillwell, the electrician of the company, estimated that it would be at least 25 per cent.

The British Columbia Electric Railways Company, of Victoria, B.C., are having installed a complete plant for developing the water power at Goldstream, for operating the street railway and the electric light plant. The work is being done under contract by Hasson & Hunt, mechanical engineers, of San Francisco, Cal., and the plant is expected to be in operation by midsummer. The power house will be stationed at Goldstream, about twelve miles from Victoria. The contracts for the electrical and hydraulic machinery have been closed, and the construction is being pushed with rapidity. The electrical apparatus will be of the Canadian General Electric three phase type, using rotary convertors and transformers to distribute over the line as the two phase with a voltage capacity of 11,000. Two Pelton water wheels will be used, with a capacity of 600 horse power each, delivering 1,000 horse power in Victoria. Provision is also being made for 600 additional horse power if required. The power delivered in Victoria will be sufficient to operate the street railway, electric lighting system, commercial and municipal, and also to furnish considerable power for the operation of stationary motors for manufacturing purposes, elevators, etc.

SPARKS.

There is a movement on foot at Bradford, Ont., in favor of securing electric light.

The Windsor Hotel, Montreal, are installing two 1000 light Canadian General Electric Company incandescent dynamos.

La Compagnie D'Electricity De Soulanges, of Coteau Landing, Que., has applied for incorporation.

The Doherty Organ Co., at Clinton, Ont., have purchased a 500 light incandescent plant from the Canadian General Electric Company.

The Board of Works of the London, Ont., city council recently struck out the recommendation to purchase a boiler for the city hall.

The town of Granby, Que., will submit a by-law to the rate-payers to raise $50,000, a portion of which is intended for the purchase of an electric light plant.

The Ontario Rolling Mills Company, Hamilton, Ont., have purchased an incandescent lighting plant from the Canadian General Electric Company.

The Linde British Refrigerating Co., of Montreal, have placed an order for 115 h.p. capacity in induction motors with the Canadian General Electric Company.

It is stated that the directors of the Cataract Power Company, of Hamilton, Ont., have already under consideration the enlargement of their canal from DeCew's Falls.

The Canadian Pacific Navigation Co. have purchased from the Canadian General Electric Co. a 125 light incandescent plant for one of their steamers, running from Vancouver to the Stickeen river.

The Brandon Electric Light Co., of Brandon, Man., has placed an order with the Canadian General Electric Co. for two 65 kilowatt incandescent dynamos, of their latest and most approved direct current type.

The Canadian Development Co., of Victoria, of which Mr. H. Maitland Kersey is managing director, have ordered three incandescent light equipments for their new steamers from the Canadian General Electric Co.

The London Electric Company are increasing their plant, and have ordered from the Canadian General Electric Company a 6,000-light single-phase alternator and two 160-kilowatt direct connected direct current generators.

The Toronto Electric Light Company have just completed the installation of four 4,000-light, single phase, revolving armature alternators, for which an order was placed with the Canadian General Electric Company some time ago.

The town of Barrie, Ont., has invited tenders, to be received by June 6th, for a complete electrical plant, consisting of 2,000 c.p. arc plant, 65 lamps, 2,000 lamp incandescent plant, power service plant and a 325 h.p. steam plant, with all necessary fixtures.

Mr. J. T. Taylor, representative of the Canadian Underwriters Association, is at present making a personal inspection of the wiring in the central stations, isolated plants, public buildings and large business places in Ottawa, and will shortly visit Toronto for the same object.

The Montreal Cotton Company are increasing their power plant, which at present consists of two 400 kilowatt three-phase Canadian General Electric alternators, and 1000 h. p. capacity in induction motors, by the addition of two more 600 h.p. generators of the same type and 1200 h.p. in induction motors.

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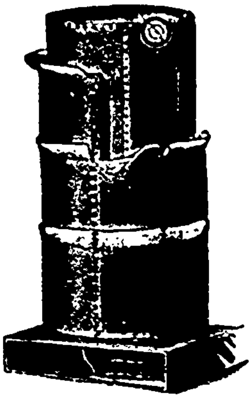

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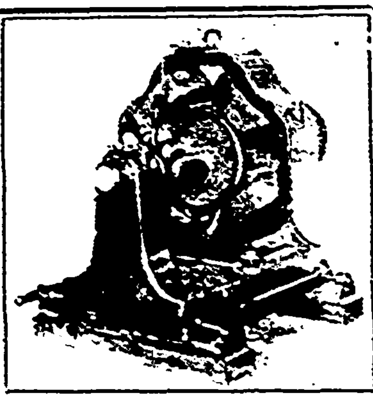

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