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ELECTRICAL NEWS
AND
STEAM ENGINEERING JOURNAL

OLD SERIES, VOL. XV.—No. 6.
NEW SERIES, VOL. V.—No. 4.

APRIL, 1895

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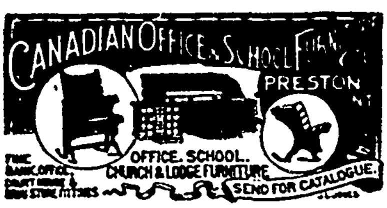

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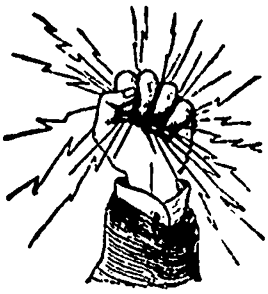

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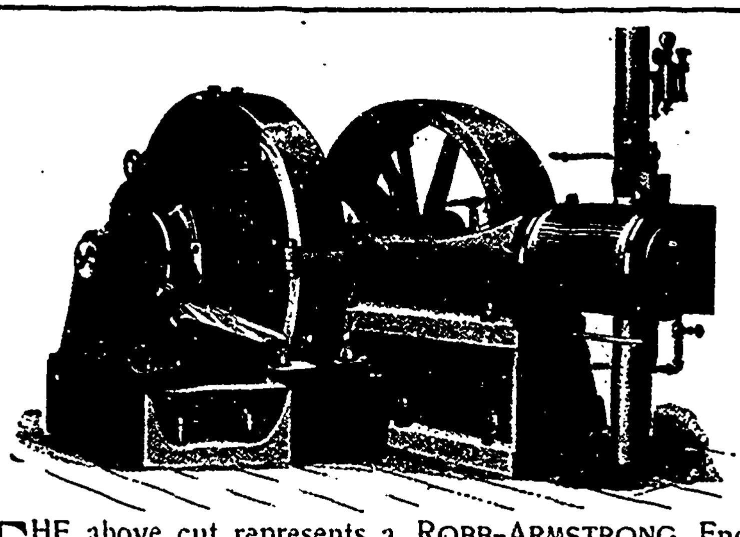

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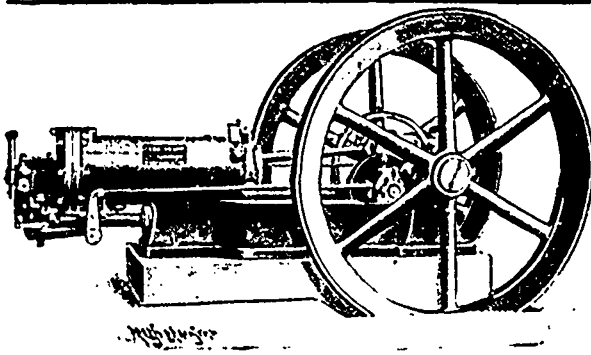
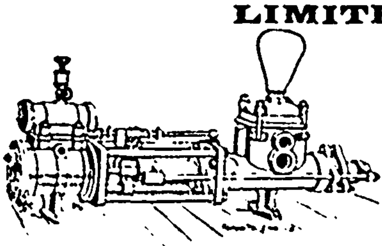
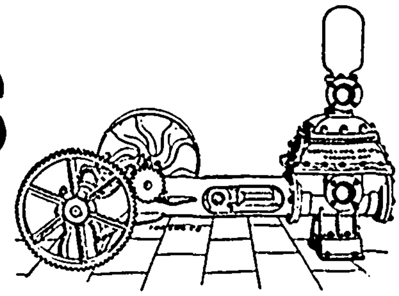
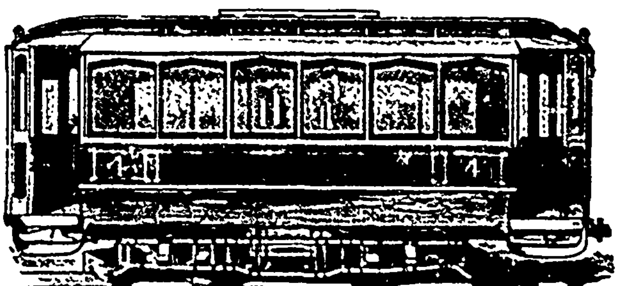








CANADIAN

ELECTRICAL NEWS

AND

STEAM ENGINEERING JOURNAL.

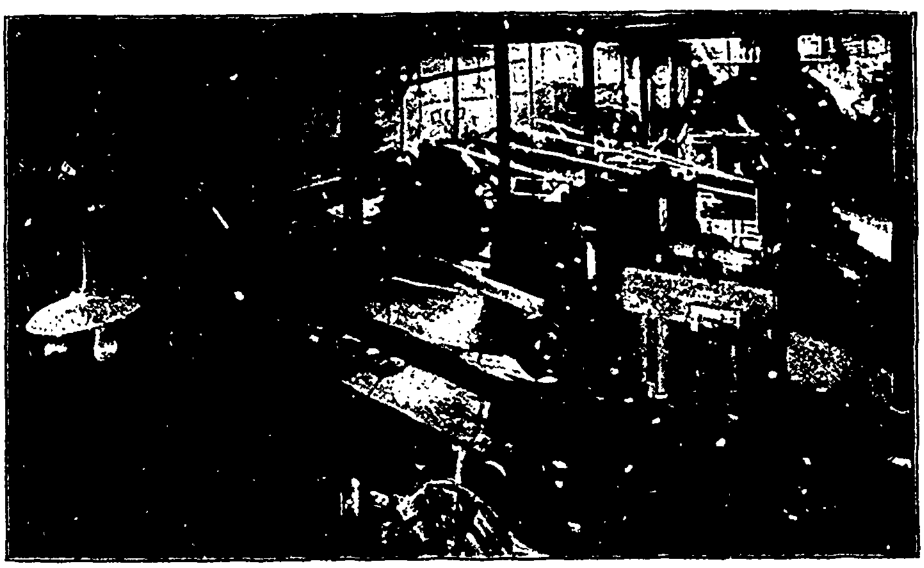
VOL. V. APRIL, 1895 No. 4.

THE INCANDESCENT LIGHT CO. OF TORONTO.

WE illustrate and describe herewith the central station of the above company. The building was erected in 1889 and the foundations rest on good solid clay. It does not cover the entire lot, which has a frontage of 100 feet and a depth of about 175 feet, enough ground having been left for future extensions.

The boiler room occupies a space at the rear or west end of the building 56 feet wide by 65 feet long, and is separated from the engine and dynamo room by a solid brick wall. There are eight boilers six return flue and two Babcock & Wilcox water tube, the former being rated at 175 h. p. each and the latter at 400 h.p. each, making a total of 1850 h.p. Each boiler is provided with a separate damper and in the breeching is placed another damper controlled automatically.

Coal is delivered direct from the teams into the coal hole, and descends by gravitation to boiler room floor, and is then wheeled to the various boilers as required. It is carefully weighed and each fireman keeps accurate account of the amount of coal burned during his run. The ashes are removed by an endless belt with steel buckets driven by a 2 h p. motor, and are raised a height of 20 feet and dumped into a chute which conveys them outside the building.



THE INCANDESCENT LIGHT CO OF TORONTO—FIG 2

There are three feed pumps, viz., two duplex and one tandem compound. The feed water pipes are so arranged that water can be taken from either of the main pipes indicated on ground floor plan Fig. 1, and also from the well outside of the building. The drips from all the engines run into this well, and whatever heat is got from same is utilized. The water is pumped through Wainright exhaust steam heaters and enters the boilers at about 200 Fah. Water is supplied from the city mains by meter measurement. There are two smoke stacks, the positions of which are shown on Fig. 1, their heights being 100 feet and 150 feet respectively. At present the two water tube boilers are connected to the latter, which is of sufficient capacity for at least 2,500 h. p. in boilers.

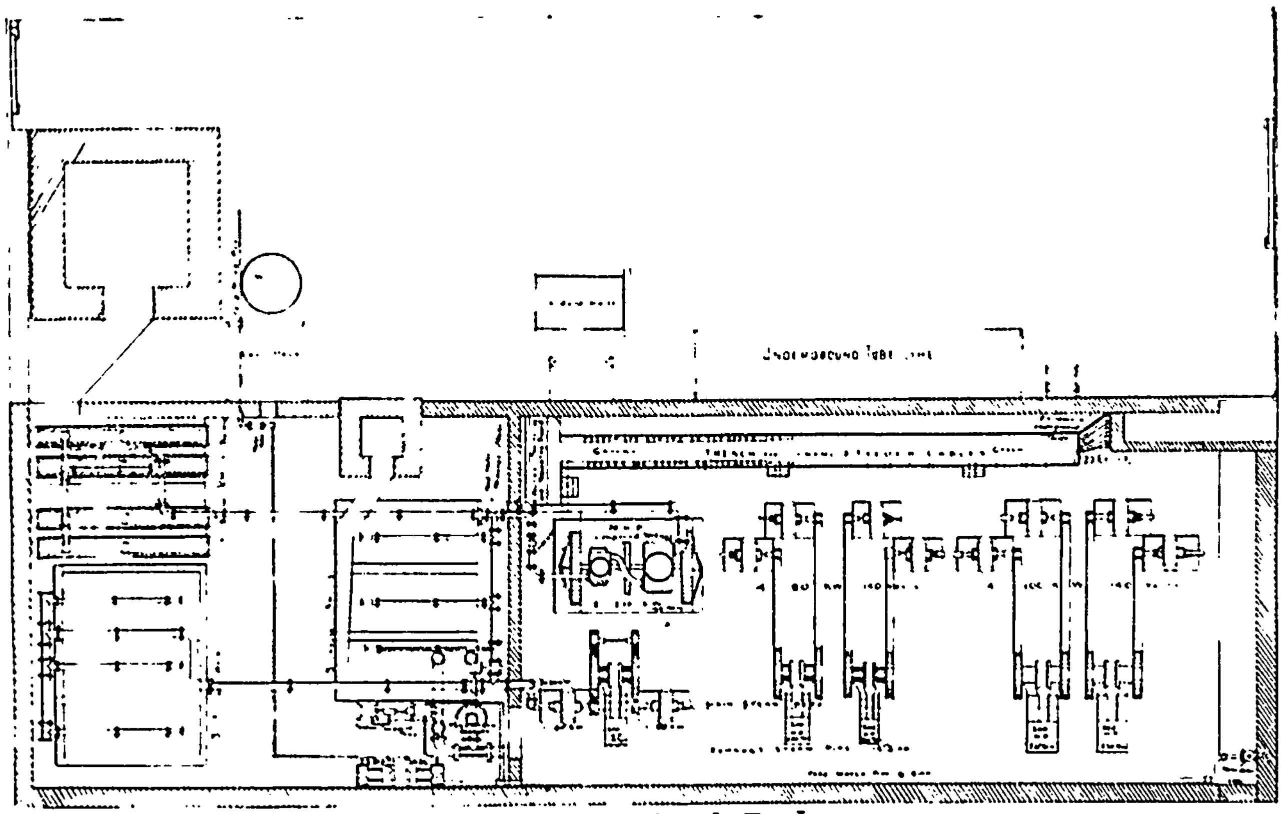
The engine and dynamo room is 56 feet wide by about 115 feet long. Fig. 1 shows the general layout of the plant and Fig. 2 shows a general view taken from one end of the room. The engines are six in number, viz, two Straight Lines, three Armington & Sims, and one Lake Erie Cross Compound. Owing to the station being situated fully a mile from the lake, the plant is entirely non-condensing. The figures show the arrangement so plainly that a detailed description is unnecessary.

The generators are of the Edison type throughout the two 250 k. w. direct connected being the latest addition, having been made by the Canadian General Electric Company at Peterboro'. These machines have been running right along since they were installed over eighteen months ago, and running at times up to 300 k. w., have given the best possible satisfaction, and are certainly a credit to the builders and also to those in charge for the care that appears to have been taken in keeping them in their present first-class condition. It may be mentioned that these were the first of this kind made at Peterboro'. The dimensions of the vertical engine are 19 x 38 x 22 inch stroke, 130 revolutions per minute.

The switch board shown in Fig. 4 is divided into three sections all switches on the positive side of system in one section, all negative switches in another, and the neutral in another. The position of same is shown in Fig. 1 and Fig. 2 It is arranged that two different pressures can be run, but owing to the peculiarity of the load, and the distribution of same at times, three different pressures are run by dividing the auxiliary bus. We described in our February, 1894, issue, the manner in which Mr. Milne, the general superintendent, arranged the switchboard for running at 500 volts for street railway purposes, together with the three-wire system. It might be well for our readers to refer to that again and take in Fig. 4 in conjunction with same, seeing we have now a more general description of the plant. Fig. 3 represents diagrammatically the generators and their connections to switchboard the generators, commencing from the left hand side, being connected in pairs to their respective engines, and are 1st pair, two 250 k w.; 2nd and 3rd pairs, 100 k. w. each, and the remaining three pairs 80 k w. each. By tracing out the connections it will be clearly seen how the three-wire system was run in connection with the 500-volt system. Recording volt meters are used which record the pressure at the junction boxes throughout the city. A careful record is kept of the ampere output, which is plotted on a chart and kept for reference.

All current is sold by meter. The dayload is composed chiefly of motors, there being almost 1000 h p connected to system. The total number of lights connected is about 25,000 The station has run day and night since it commenced, February, 1890, without interruption. It is a model of cleanliness, and everything appears to be in the best order, and speaks well for those in charge. The service given by the company is of excellent character.

Among the directors of the company may be mentioned W. D. Matthews, President; W. R. Brock, Vice-President; H. P. Dwight, Frederic Nicholls, Managing Director.



GROUND PLAN

THE INCANDESCENT LIGHT CO. OF TORONTO FIG. 1

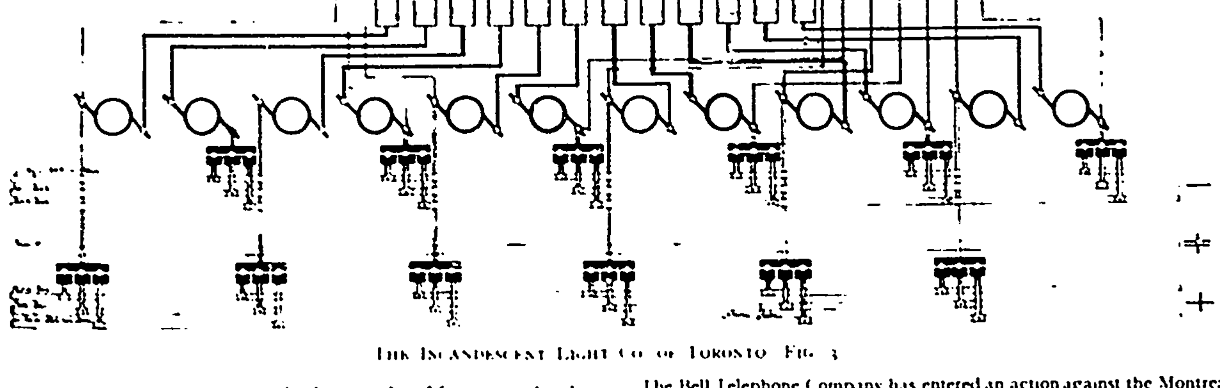
Mr. James Milne, the general superintendent, in point of natural ability and education, is undoubtedly one of the most efficient electricians in Canada to-day.

TRANSMISSION.

The transmission of power by ropes has been largely resorted to in England, the preference being given to what is known as the Lambeth cotton rope, which is made of four strands, the centre or core of each strand being bunched and slightly twisted, the outside of the strand having a covering of yarns that are firmly twisted. The four strands are further laid with a core in the centre to form a rope and twisted in the same way as any four stranded rope. In this way a rope is formed possessing extreme flexibility, and the fibres will not break by bending on each other when run on pulleys, the rope also standing elongation or stretching some twelve inches in a length of fifty inches before breaking.

ROPE DRIVES.

For rope drives, the common rule is not to make the diameter of the smallest pulley less than thirty times the diameter of the rope, and even larger than this is to be preferred. For wire rope it should be still more, and from 50 to 100 times the rope diameter is the common practice when these are used. Excepting for very long transmissions, the wire is seldom used in regular driving, as its weight is objectionable, and its advantages are not enough to make it popular over manilla or cotton ropes.



THE INCANDESCENT LIGHT CO. OF TORONTO FIG. 3

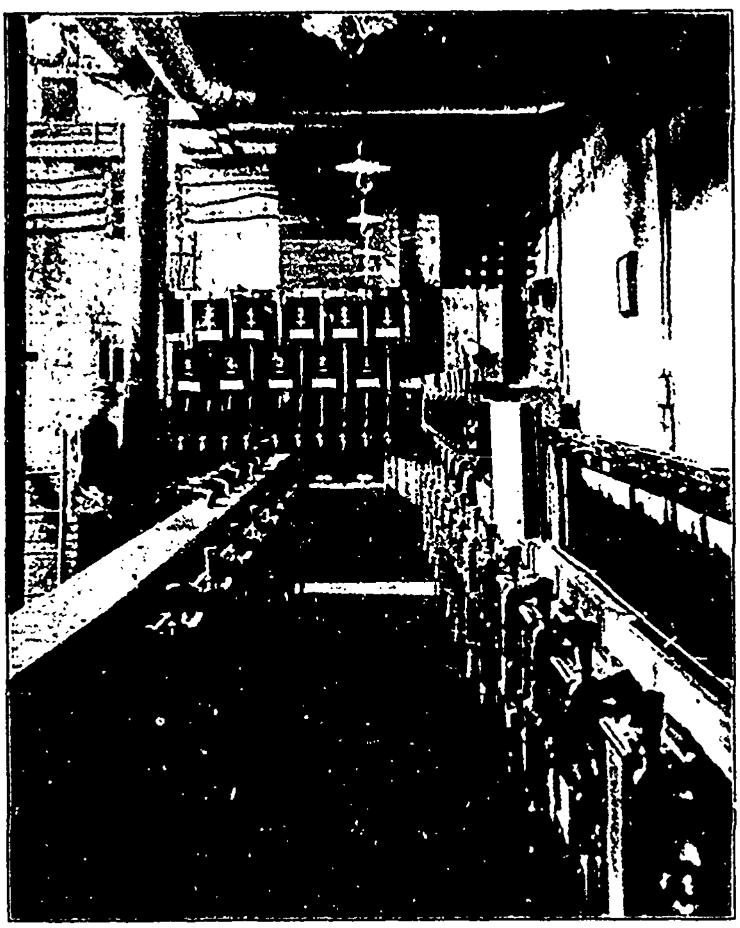
The Bell Telephone Company has entered an action against the Montreal Street Railway Co., claiming the sum of $27,000 damages by reason of interference with the working of their lines, by disturbance from inductive currents from the railway company's lines. The railway company's defence is that they have not gone beyond the rights conferred on them by their charter and their contract with the city. The case is still in progress.

LIGHTING AND ELECTRIC LIGHTING AS A BUSINESS.

By George White Fraser, E.E.

"APPLICATIONS for the position of electrician and fireman to operate the waterworks and electric light systems, are invited, etc." This is an advertisement that no doubt has been seen by every one in a weekly paper recently; and has electricity, the baby of yesterday and the giant of to-day, the science of Kelvin, Hertz, Helmholz, Edison, turned out to be such a quack that the duties of "fireman and electrician" can be efficiently performed by one man? It is almost difficult to decide from what stand point to criticize this combining of services, whether from that of economy or from that of practical engineering, theory or practice. From whichever side it be looked at so many weak points are presented that it really seems a waste of energy to attack it at all. The fact, however, that the municipal authorities of a certain reputable town propose to operate the combined departments in the manner indicated, opens up such a vista of disastrous mismanagement that for the credit of electricity as an illuminant, and for the electrical engineering profession at large, some efforts should be made to bring about a better comprehension among those interested in lighting stations, of the principles of lighting as a business, and more especially of the economics of electric lighting.

If these principles and economics received any study at all, a most radical and comprehensive change would shortly be observed in the methods followed in the operation of every electric plant in Canada, always excepting some few honorable examples of thoroughly up-to-date practice in the large towns and cities. As an example of the violation of one of the most thoroughly established principles of lighting—most common in electric light service—why is almost every incandescent lamp in Ontario installed on the "flat rate" basis instead of on the meter basis? Has any one ever heard of a gas company contracting with consumers at so much per month per burner? The thing seems so perfectly obvious that one is disinclined to weaken the position by descending from generalities to particulars, but at the same time the methods of managing stations are so very crude that one is forced to conclude that no argument will have any weight unless it is copiously illustrated. "A" has ten lamps in his house, and he pays a certain definite sum per month for them, whether he burns them or not. There are any number of men who would burn them all so as to "get their money's worth." Anyway, since A does not benefit himself by turning out a lamp that he really does not require, the chances are that he will leave it burning, either from forgetfulness or from meanness. This means reduced profit to the supplier. Put a meter in A's house and watch. Do you think he will leave his bedroom without shutting off the lamp? Not much. In this case the unnecessary light touches his pocket, not the supplier, and he economizes. One advantage of the meter basis applies more particularly to electric lighting and will be referred to later. This important matter seems to receive no consideration at all, although it lies at the threshold of the "dividend" question.



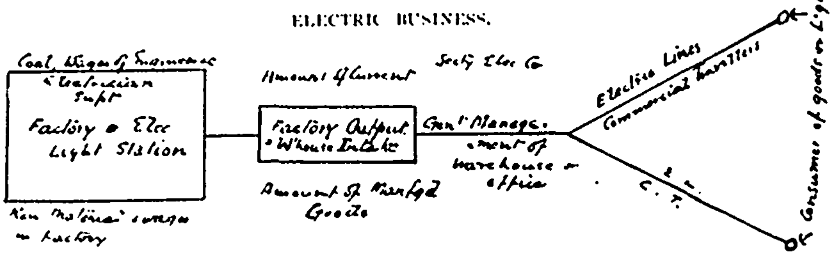
The Incandescent Light Co. of Toronto—Fig. 4.

Light is a manifestation of energy, and is accompanied by more or less heat, as the optical efficiency of the transformation of stored into radiant energy is less or more perfect. In proportion as the lengths of the waves set up in the ether are greater or less, so will the transformation of stored energy produce more heat or more light. Now, coal being the form of stored energy most frequently used, it is perfectly plain that whether more heat or more light is produced depends entirely on how the coal is burnt. In the furnace of a boiler, for instance, the design may be such that a great deal more heat goes up the chimney in the form of unconsumed gases than is utilized to raise steam; or, and more likely, the ignorance of fireman, engineer and superintendent as to the theory of combustion and its applications causes the same waste. No sooner, therefore, do we begin to study the economics of electric lighting than we find a fruitful source of unnecessary expenditure at the very first step. It might be supposed that the means taken to guard against the introduction of waste would be commensurate with the liability towards such waste. Therefore, where quantities of fuel are to be consumed to produce steam we might expect to find such consumption being watched by a person who, to a certain extent, knew what was going on, and was capable of detecting, at least, large wastes and of remedying them. At this important strategical point we generally find placed an ordinary laborer, who gets $1 or $1.25 per day, and who knows as much about combustion as combustion knows about him. If an engineer be employed he is rarely better than a fair mechanic who can make little repairs and do odd jobs. So that, actually, at the point where a very large waste can easily occur "false economy" places the very man who is least capable of checking it.

It is a commercial principle that a "business" is to be treated as an individual, with whom a debit and a *credit account is kept*, and the comparison of these accounts shows profit or loss. In a business involving the manufacture of a commodity the general accounts are divided into two main divisions: 1, the cost of production, and 2, the cost of distribution and sale. There will be one complete set of books kept by the factory, and a separate set kept by the warehouse. In the former set can be traced every stage in the manufacture, from purchase of raw material to delivery at warehouse door of finished product, and great importance will be attached to returns showing: a, the quantity of such product in comparison with the quantities of raw material used; b, the cost of the product for wages, materials, etc., at various points in its progress toward completion. In the latter will be set forth the cost of handling the material from its delivery by the factory authorities up to the moment it is finally disposed of to a consumer. The factory will be debited with the cost of the raw material, wages, cost of power, etc., and credited with the amount of its output at a price sufficient to wipe out the debit. The warehouse again will be debited the cost of the finished product it receives from the factory, salaries of clerks, general expenses of distribution and management, and it will be credited with the receipts on sale of goods. In this case there really are two separate businesses—a manufacturing and a distributing. It is just as necessary for the factory to know the amount of its output in manufactured goods as it is for the warehouse to know exactly what quantity of goods have been disposed of. If the warehouse does not know how many articles have been sold for a certain sum, it cannot tell whether they have been sold above or below cost price. If the factory does not know how many articles have been manufactured out of a certain quantity of raw material, and with a certain expenditure for wages, etc., it cannot tell how much those articles have cost each ; it cannot tell whether half the raw material has not been pilfered by operatives ; in fact it simply is not in a position to do business against competition in the open market, and a business conducted on such lines would very rapidly go to the wall. Moreover, the arrangement of the books would be such that returns might be made showing the most profitable line of goods ; the direction in which other lines might be pushed, that one particular goods should no longer be manufactured ; and that improvements in the material or design of another are necessary in order to hold the market. In fact the principles on which such a business is conducted are such that every detail can be examined and kept in order like the works of a watch, and every "tick" sent forth by the great commercial timepiece of the world's market is promptly echoed within its little case, and its little hands move "on time."

An electric light or power business differs in no respect from the above. Electric current is manufactured and sold for various purposes. Raw material—coal—is used, wages paid, current produced, distributed and disposed of. It really includes two businesses—the generation of current and its distribution and

ELECTRIC BUSINESS.



COMMERCIAL BUSINESS.

sale the former purely practical, the latter more or less commercial. A diagram will clearly set forth the analogy.

I am afraid, however, that this analogy is purely a paper one, judging from actual practice, for I should greatly like to hear of five stations in Ontario that can tell what their output is. I do not mean that take periodic readings of their ammeters and so construct a sort of curve which gives them a fairly approximate notion of it, but that can say that as a result of a month's running their output has been so many kilowatts and can prove it. The writer knows of a very nice little plant, the engineer of which makes a report every morning to the secretary, giving with great accuracy several details, among them being set down the highest and the lowest reading of the ammeter. This is the nearest approach he has seen to keeping any account of output, and he entirely fails to see the use of such report.

It must be evident, on the most cursory consideration, that a station operating in this way really cannot know what its output is. It is working purely in the dark and has no more chance of success than the ordinary commercial business that keeps no accounts of goods between the initial stage of raw material and the final stage of cash from customers. It simply knows that a certain sum has been paid out for coal, wages, etc., and that another sum has been received from customers for light. But for how much light? Is it any wonder at all that complaints are frequent that electric lighting does not pay? How can it pay under the extraordinary mismanagement it receives? And in proof of the statement that I have made that such stations do not know their output, I give here the actual results of a night's run, taking hourly readings of the ammeter, and compare them with the report furnished next day to the secretary. Averaging the hourly ammeter readings gives 22.57 amperes. The maximum reading was 39, the minimum was 11. Of course these latter figures are given in order to arrive at an average which in this case would be figured $\frac{39+11}{2}$ 25 A. These two approximations differ by very nearly 2½ amperes, or ten per cent. of the higher one. Reducing this to horse power hours, for a run of 14 hours at the initial voltage of 1040, shows that whatever amount of fuel has been consumed to generate power has generated 49-horse power hours less than as calculated from the reports, and that consequently the consumption of coal per h.p.h. has been greater than as calculated. Assuming that this difference of 49 h.p.h. is kept up through the year, which is after all fairly allowable, shows that the station has been credited with over 17,000 h.p.h. that it has not generated. What kind of management is this?

Another instance of how the perfect and comprehensive ignorance of principles, or blind disregard of their application, contributes to an actual considerable loss came under the writer's notice. A hotel man paid $45 a month for his lights on the "flat rate" basis, and considered he could save money by putting in a meter. Next month his charges by meter record were $63. Of course he objected, but the meter was right. In this case the station was losing 18 good dollars every month by supplying him on the flat rate. Had the management known really how much current was being consumed, by keeping any reliable record of station output, the change from flat to meter rate would have originated with them instead of with the customer.

Returning to our diagram, and confining ourselves to the factory at first, here system reigns, ensuring strict economy. A pound of raw material is followed through its various changes ; the various ingredients that go towards the finished product are well known their proportions, the cost of each, the necessary wastes that occur during the successive processes, are clearly recognized and very carefully kept down to their proper limits, and an exact biography can be written of a copper kettle, giving quantity and price of pig copper, waste in smelting, polishing, modeling, etc., and resultant cost price, cost price during its various stages, and suggestions as to effecting economies. Does this analogy hold in an electric station? Barring the few bright exceptions alluded to above, is there one station in Ontario that weighs every shovel of coal put into the furnace? Of course it is not necessary to weigh smaller amounts than wheelbarrow loads, but the idea is an accurate knowledge of the exact number of pounds burnt during a night's run? If he neither weighs his fuel nor knows his exact output, what station manager will be bold enough to say that his current costs him such and such a figure? It is pure guess-work and therefore quite unreliable.

(To be Continued.)

TRADE NOTES.

George White & Sons, of London, have fitted out the saw mills of Gow & McLean, Fergus, and George A. Patrick, Delaware, with new internal fired boilers, and "clipper" engines.

The announcement is made that the business heretofore carried on by the Dominion Electric Co., Ltd., and the Packard Lamp Co., Ltd., of Montreal, has been acquired by the Packard Electric Co., Ltd.

The Canadian General Electric Co. have closed a contract with the Kingston, Portsmouth and Cataraqui Ry. Co., for additional equipment, including a 200 Kilowatt generator and several G. E. 800 equipments, with forty foot car bodies.

The Ottawa Porcelain & Carbon Co., has been incorporated with a capital stock of $100,000, to manufacture carbon and porcelain goods for electrical purposes. Mr. J. W. Taylor, formerly manager of the Peterboro Carbon Co., is the manager of the new company.

The Montreal Electric Co., agents for the Fensom Elevator Co., of Toronto, report having changed over freight and passenger elevators in Nordheimer's Building, Montreal, from hydraulic to electric. The freight is a 6 k. w. motor and belted, while the passenger is a 7½ k. w. motor direct connected. The circuit is a 250 volt one.

In October last, the Kay Electric Works, of Hamilton, called a meeting of their creditors and compromised their liabilities at 33⅓ cents on the dollar. It was hoped that this compromise would enable them to discharge their liabilities, and place themselves in a position to carry on their business successfully. These expectations, however, have not been realized as the company have just made an assignment of their estate. The creditors have accepted the offer of Mr. J. L. Job for the purchase of the assets. The business will be continued under the same name.

CHARACTER SKETCH.

JAMES GUNN,

SUPERINTENDENT TORONTO STREET RAILWAY CO.

Whatever thy race or speech, thou art the same,
Before thy eyes Duty, a constant flame,
Shines always steadfast with unchanging light,
Through dark days and through bright. — The Ode of Life.

It has been said, that an honest man is the noblest work of God. In an age when indifference, to the smallest, as well as the largest, duties of life, is a crying evil, one may well wish to apply the term "honest" in one particular direction of life. The men who can be relied upon to do the work placed in their hands are none too many. As one has said, a man is already of consequence in the world when it is known that he can be relied upon; that when he says he knows a thing he does know it; that when he says he will do a thing, he can do, and does it.

In Mr. James Gunn, superintendent of the Toronto Street Railway Co., we have one, who, by faithfulness to duty, has attained to a high position in his chosen calling. When in 1869 he identified himself with the street railway of Toronto there was nothing very tempting, from a purely material point of view, in the position assumed. The street railway of that day with its few odd horse cars, and a somewhat imperfect route on Yonge and Queen streets, carrying a few hundred passengers daily, was a small affair, contrasted with the railway of to-day, so splendidly equipped as an electric system, and covering nearly all parts of the city. But, as secretary at that time, Mr. Gunn did his duty no less faithfully than when he became a leading official of the mammoth concern of to-day.

Mr James Gunn.

The subject of our sketch was, to a large extent, to the manner born, so far as his experience in dealing with men is concerned. His birthplace was Bannskirk, in the parish of Halkirk, near Spittle Hill, Scotland. He has not to this day lost the burr of his Scottish home, as a few minutes conversation with him, readily proves. His father was a road contractor in Scotland, and the son worked with him, keeping track of the men's time, and in other ways mixing up with them, and having to assist in the handling of large numbers of men. After a time he left his native parish and found his way to Edinburgh, where he engaged in mercantile life, holding a position for a considerable time with Christie & Son, large military tailors.

From the time he first entered the activities of life he had an ambition to settle in America. "Westward the course of empire takes its way" had no meaningless inspiration for him, and in 1867 he broke away from the ties of Scotia's land and took sail for America, coming direct to Canada, and locating almost immediately on his arrival in the city of London. There he was engaged for two years with Mr. Charles Dunnett, tanner and leather merchant. It did not seem to the young Scotchman, however, that there would be much chance for him to push ahead in the position obtained. He had formed an acquaintance with Mr. E. W. Hyman, a capitalist of the Forest City. Mr. Hyman had obtained an interest in the Toronto Street Railway, of that day, through having made certain advances to Mr. William T. Kiely, who was then part owner of the railway. Mr. Gunn came to Toronto at the suggestion of Mr. Hyman, partly, no doubt, to watch his interests in the company, and at the same time accepting the position of secretary.

Thus it was that Mr. Gunn's connection with the Toronto Street Railway, and which through its various changes, has remained unbroken, was commenced in May, 1869. He can look back from the present with a large share of interest at the operations of the road in those early days. Mr. W. T. Kiely was general manager of the road and Mr. Gunn was secretary, two important officers. But, as with the beginnings of every business, the men who were in at the start could not be too particular in choosing the work that came to them. Mr. Kiely and Mr. Gunn in those days had to take their turns in relieving the conductors of the road. They did not always please the public any better than the ordinary conductor. It was not an uncommon thing for Mr. Gunn to be sitting at his desk and have parties come into the office and lay complaints of some irregularity, and on enquiry to learn that the conductor who had blundered was the general manager, Mr. W. T. Kiely. It would then become the duty of Secretary Gunn to inform Conductor Kiely, that if this kind of thing occurred again he would get his walking ticket. At another time General Manager Kiely would be in charge of the office and a complaint would be made against Conductor Gunn, who, on reporting at the office, would be informed that his position was in jeopardy if, as a conductor, he could not meet the public wants in a more efficient manner. These were a few of the pleasantries of the business that in those early days came to the present superintendent of the Toronto Street Railway Co.

Historically it may be of interest to remark that prior to the days of Wm. T. and Geo. W. Kiely, who afterwards became so intimately associated in street railway matters in Toronto, the business of public propulsion in the city was in the hands of Mr. Alexander Easton, who, with others, operated the first street railway in Canada, in Toronto, in the year 1861. The construction of the Yonge street line was commenced on the 26th day of August of that year and it was opened to the public on the 11th day of September following. The Queen street line was commenced on the 16th day of October, 1861 and opened to the public on the 2nd day of December of the same year. The average number of passengers carried daily on Yonge street at that time was 1270 and on Queen st. 688. A few years later the street railway property fell into the hands of the Bowes' estate, and in 1869 it came into the possession of the Kiely Bros. In 1873 Frank Smith, now Sir Frank, senator, became a large shareholder in the concern, buying out Mr. Wm. T. Kiely for some $250,000, and the property, as is generally known, remained practically in the hands of Sir Frank Smith and Geo. W. Kiely up to the time that it was taken over by the city in March, 1891.

The history of negotiations at that time are so recent as to be clear to the memory of almost everyone. The amount paid to the owners, as per the award, was $1,453,788, an illustration of how valuable the franchise had become in those thirty years. From March until September 1891, when the present company took hold of the business, it remained in possession of the city. During the interim Mr. James Gunn was constituted general manager, with extraordinary powers of management and heavy responsibilities, a high tribute to his ability and sterling integrity. The heavy receipts of the road were all deposited in the name of James Gunn, and he personally, without any countersigning by any city officer, signed all cheques for disbursement.

With something like 80 miles of track to-day, and the whole of this, practically, worked by the electric system, the Toronto street railway will always have a very lively interest for electricians.

Mr. Gunn remains one of the chief officers under the new management. He is known as superintendent, being the man in charge of the practical operations of the entire system. His wide and intimate knowledge of the system from its commencement peculiarly fits him for this position, and it is needless to say that the work is being performed with that same high regard to duty that led to success in the several important positions he has previously held in connection with the company during the past eighteen years.

These years have been of too busy a character to permit Mr. Gunn to enter at all largely into the work that comes to citizens outside of their regular business. He has done well the work that was beside him, and this, after all, is the highest compliment that can be paid to any man. Mr. Gunn is a Presbyterian, and an active and efficient member of the board of management of the Westminster Presbyterian church. Personally he is possessed of the social characteristics of the Scottish people and has a host of warm friends in the city of his adoption.

QUESTIONS AND ANSWERS.

"A Subscriber" writes: I notice that when we are running our dynamo that the outside brush will sometimes get red hot. They are carbon brushes. I have done almost everything I can think of to try and remedy it, but she will do it. I notice our lamps burn out very quickly; the fuse never burns out, but the lamps go very quickly. Is it the fault of the lamp or the machine?

ANS. It is impossible, without examination, to assign the real cause for lamps burning out. They may be poor lamps; or more probably, the dynamo pressure is not maintained constant. The potential indicator may be out of adjustment, reading too low; or the transformer system may be such as to allow a very large variation in pressure between full and light load. Again it is very likely that the wiring system is so faultily designed, as to leave too high a pressure at the lamps. Try a change of lamp make; if that does not answer examine the potential indicator as to its correctness, and go over the wiring system. As to the brush trouble, examine the machine; tighten all connections; and especially see that the "outer" brush makes good connection with the brush holder, and that there is no poor contact anywhere. It is very unlikely that the trouble is caused by either machine or lamps; much more probably in the attention it receives.

J. J. C., Kemptville, Ont., writes: Would you kindly through your valuable ELECTRICAL NEWS describe the latest process of producing Calcic Carbide (T. L. Wilson process); also a description of the electrical furnace used in its production. I feel confident this would interest your readers as this discovery will affect electric lighting, should the right to manufacture same be covered with patents.

ANS.—There are various kinds of electrical furnaces. The main thing seems to be to place a mixture of lime and carbon—say anthracite coal—within the influence of a powerful electric arc. The exact nature of Mr. Wilson's process has not yet been made public. When it is, we shall be glad to lay it before our readers.

J. L. M., Orillia, Ont., writes: Some time ago I wrote you re making a bar magnet, and followed your directions, but when the steel bar was placed on end on the field magnet of a Ball system arc dynamo and left there for five hours it was no more magnetized than when it was put on. Can you explain this, or can you give me further instructions?

ANS. You have made a mistake somewhere. Take a file and place it in a similar position on the dynamo. If it is strongly magnetised your material or hardness is not right. If the file does not magnetize, the position on the dynamo or the dynamo itself is to blame. Five minutes will do as well as five hours.

W. R. K. writes: 1. What is the reason telephonic communication cannot be carried on through the Atlantic cable? 2. Where can I get a description of the duplex telegraph? 3. What is "cross section of the armature wire?" 4. Are there telephones which transmit and produce speech without losing its original loudness, in practical use? If not, why not?

ANS. 1. *Retardation of current* is too great owing to large static capacity of cable. 2. In any modern work in telegraphy. 3. Cross section of armature or any other wire is the area or surface of the end of the wire if cut across, usually measured in circular mils. 4. There are no telephones in practical use to produce loud speech. There is no particular demand for them. If there was, a louder speaking telephone than the ordinary instrument would doubtless be forthcoming.

E. V. B., Stayner, Ont., writes: Would you be so kind as to inform me where I can purchase the non-arcing metal used in a form of lightning arrester described in a recent number of the ELECTRICAL NEWS?

ANS. So called non-arcing metal is made by manufacturers of lightning arresters in their own apparatus, but so far we do not know of any such metal being placed on the market as such.

"Fireman" asks: Will you kindly give me a receipt for a boiler compound that will remove scale and not injure the boiler. We use Lake Ontario water which is very hard on a boiler. State what quantity of the compound to use.

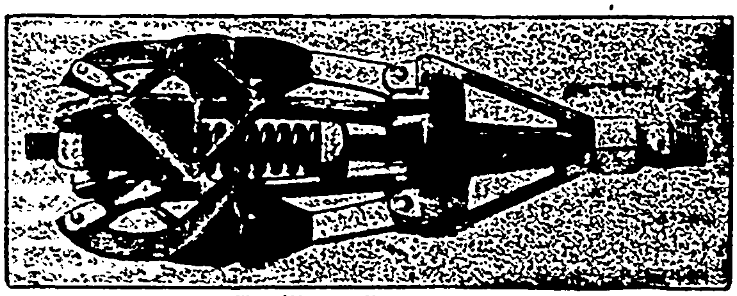
ANS. There are numberless substances used to prevent scale. One of the best is caustic soda, but too much should not be used, as it is liable to attack the brass seats of check valves and stop valves, and corrode them somewhat. Vegetable substances, as sumach and slippery elm bark, or any bark or wood, such as oak chips that contain tannic acid, are also very good and quite harmless.

LEGAL.

DIXON v. TORONTO. This was an action for $5,000 damages brought against the City of Toronto, the Toronto and Mimico Railway and Light Co., Ltd., and the Toronto Electric Light Co. by one Dixon for injuries alleged to have been sustained by coming in contact with an electric light pole while riding on the upper deck of an electric car on the Mimico Electric Railway. The case was heard before the Hon. Mr. Justice Robertson and a Jury in the Court of Assize at Toronto. Following are the terms of the judgment: This action against the corporation of the City of Toronto is dismissed so far as said corporation is affected by it—is dismissed without costs; and as against the Toronto Electric Light Co. this action is also dismissed with costs; and the jury find a verdict for the plaintiff against the defendants—the Toronto and Mimico Electric Railway and Light Co. Ltd., and assess the damages at $1000. I order judgment to be entered for the above sum of $1000 with full costs of the action to be entered against the Toronto and Mimico Electric Railway and Light Co., Ltd. on and after the 3rd day of the next sittings of the divisional court.

THE WESTON FLUE SCRAPER.

THE attention of the engineers of Canada is invited to the advertisement on another page and to the accompanying illustration of the Weston Flue Scraper. This scraper has been pronounced by some of the most competent American engineers to be, and is guaranteed to be capable of fulfilling all demands. Being made solely of malleable iron, the blades will always keep a good cutting edge, and the action of the coil spring keeps



THE WESTON FLUE SCRAPER.

them to their work, preventing them from riding over the scale and dirt.

Any tension required can be put on the spring by judicious adjustment of the set nuts, thus making it adaptable to the strength of the operator and the amount of scale and soot on the flue.

Attention is also requested to the "shearing cut," which is an exclusive feature of this scraper and which it is claimed makes it the easiest running in the market.

PERSONAL.

Mr. F. E. Lovell, of the Coaticook Electric Light Company, Coaticook, Que., was recently married in New York city to Miss Jean Norton, formerly of Coaticook, and recently of Jackson, Mich.

The sudden death is announced of Mr. Francis Northey, who for sixteen years past held the position of engineer at the Hamilton water works pumping station. Mr. Northey was a brother of Mr. Thos. Northey, of Toronto.

The town of Hespeler has given a five years contract for street lighting to James Fenwick, of Preston, at 17 cents per light per night for 300 nights per year.

The earnings of the Montreal Street Railway Company for the six months from September 30 to April 1 amounted to a total of $462,262.63, making a net increase over the same six months of the year previous of $92,714.46.

MUNICIPAL VERSUS PRIVATE OWNERSHIP OF ELECTRIC LIGHTING PLANTS.

Editor CANADIAN ELECTRICAL NEWS.

DEAR SIR,—I was much interested in the article on municipal ownership of electric lighting plants by Mr. G. White-Fraser, which appeared in the January number of the NEWS, as well as in the discussion which followed.

As Mr. Fraser in this article, as well as in a communication which appeared in the Toronto Mail over his signature some time since, criticises the paper which I presented at the Montreal convention of the Canadian Electrical Association, I beg leave to reply.

In that paper I argued and endeavored to show from returns given that in towns large enough to support a fair sized plant, the municipal lighting can be supplied cheaper and will be performed better by a private company than by the corporation itself. I also expressed the opinion that it is unjust for a municipality to establish a lighting plant in opposition to an existing company, provided the company are acting fairly, and that in small places, or where there is no other plant, a municipal plant may be justified on the ground of public necessity. I am pleased to see that my argument is supported by such eminent men who are able to pass an independent opinion, as Mr. Baillargé, of Quebec, as well as by a large number of engineers who have had experience with municipal stations. Mr. Fraser takes exception to my argument, though he expresses himself as in accord with my opinions otherwise.

In towns where the lighting plant can be operated in connection with some other branch of the public service, such as a water pumping station, it is quite evident that a saving can often be effected in the total original investment as well as in running expenses, although in cities where the machinery is running the full twenty-four hours each day—where the load is large enough that all the machinery can be operated at its maximum efficiency, and where all the men employed have their time fully occupied, I do not see that anything can be gained by combining these two departments. In the smaller towns there may be other considerations, too, which weigh in favor of a municipal plant. In such places, if they have a private plant, it is usually carried on in connection with some other business and does not receive the necessary attention to details to give a good service. If, at such places, the plant is owned by the town, the public take a considerable interest in it and the committee in charge pride themselves on having everything in good order; moreover, the chances for "boodle" are for various reasons very small. A number of such plants have been installed of late. In Bracebridge, for example, the town bought out a private plant which had been running for some time, overhauled it and enlarged it somewhat. It is now run in connection with the water pumping station, and is giving such good satisfaction that it has already been found necessary to further increase its capacity.

The combined pumping and lighting station at Orillia is a good one in point of construction, it is well arranged throughout, and it is quite probable that this plant can under the circumstances be operated very efficiently and economically. The figures which are given concerning it are very alluring, but I do not find it stated anywhere that they have been realized. No account is taken of insurance, depreciation, interest and taxes; moreover, some of the men employed seem to have very long working hours, and private lighting companies usually find it necessary to have a man patrol the street circuits during lighting hours.

In his communication to the Mail, Mr. Fraser claimed that a municipal plant is not required to pay rates and taxes. Arguing from the same premises, I suppose he would claim that when a man happens to own the house he lives in he is not required to pay anything in the way of rent.

When we come to consider the large towns and cities the question assumes a somewhat different aspect.

In the argument whether a corporation or a private company can operate a large plant more economically, I repeat what I stated in my Montreal paper, that the burden of proof lies with the advocates of municipal ownership and not with the side of private control, as Mr. Fraser would have us suppose, and it is therefore only necessary on the part of the latter to point out possible defects in the arguments put forward by the champions of municipal ownership. It must certainly be admitted that the possibility of aldermanic corruption, the possibility of political partisanship influencing appointments, and the possibility of the same undue influence being exerted to keep in office incompetent persons to the detriment of economical management, are not imaginary but are real difficulties in the way, examples of which are not far to seek.

I agree with Mr. Fraser that the whole argument seems to reduce itself to a weighing of facts on the one side and possibilities on the other. Considering the question only from the commercial point of view, it must be decided by the relative efficiency and economy of municipal plants and private plants. Now, of the facts on the one side, the principal one is that the municipal plants which have so far been established in this country and the United States have not yet demonstrated their ability to supply a better and cheaper light than is furnished by the private plants. The possibilities on the other side, as pointed out by Mr. Fraser himself, are those above stated. From the commercial standpoint this is really all there is to be said.

E. CARL BREITHAUPT.

Berlin, March 30, 1895.

CANADIAN ASSOCIATION OF STATIONARY ENGINEERS.

Note.—Secretaries of the various Associations are requested to forward to us matter for publication in this Department not later than the 20th of each month.

HAMILTON ASSOCIATION NO. 2.

Editor ELECTRICAL NEWS.

At the last two meetings of Hamilton No. 2, considerable business of importance was transacted, and some very interesting discussions indulged in. Among the most important was one in which the requirements of an engineer for different plants and the kind of men required for engineers was considered. A discussion took place upon the appointment of representatives to wait upon the Ontario Government in connection with the Engineers' license bill. The members were very much pleased with the report of the delegates upon their return home.

We intend holding our annual supper on the eve of Good Friday. As usual, it will take place at the Commercial Hotel, and it is not necessary for me to say that all attending will have a good time.

WM. NORRIS,
Cor.-Sec.

A deputation representing the Canadian Association of Stationary Engineers recently waited on the Ontario Government, and requested the aid of the Ministry in support of the bill to make compulsory the obtaining of license certificates by stationary engineers. In view of the opposition to the measure on the ground that the Association are seeking to become a close corporation, the deputation expressed their willingness to leave the licensing in the hands of the Government, and offered on behalf of the Association to furnish an examining board so as to render the operation of the act inexpensive. The deputation was composed as follows: Messrs. James Devlin, Kingston; J. T. Smart, Peterboro'; Arthur Ames, Brantford; Geo. Gilchrist, Guelph; Robert Mackie and Duncan Robertson, Hamilton; Fred. Donaldson, Ottawa; John Graham, Dresden; Wm. Vaughan, Berlin; A. E. Edkins, A. M. Wickens, M. V. Kuhlman and O. B. St. John, Toronto. They were introduced by Mr. Crawford. The spokesmen were Messrs. Edkins, Robertson, Devlin and St. John.

Mr. James Devlin, Secretary of the Kingston Association of the C. A. S. E., had the misfortune recently to break his leg while stepping off an electric car.

MONTREAL JUNIOR ELECTRIC CLUB.

February 25. Paper on "Treatment of Suffering by Accidental Shock," by R. H. Street.

March 4.—Paper on "New Electrical Discovery in Primary Battery," by E. W. Sayer.

March 11.—Paper on "Telephones," by W. T. Sutton.

March 18.—Paper on "Dynamos," part 1st, by I. Turner.

The following are the officers elect of the London Street Railway Company for the present year: President, H. A. Everett; vice-president, E. W. Moore; manager and treasurer, Chas. E. A. Carr; secretary, S. R. Break; assistant secretary, Chas. Curry; superintendent, I. H. Debarte.

CANADIAN ELECTRICAL NEWS AND STEAM ENGINEERING JOURNAL

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Advertising rates sent promptly on application. Orders for advertising should reach the office of publication not later than the 25th day of the month immediately preceding date of issue. Changes in advertisements will be made whenever desired, without cost to the advertiser, but to insure proper compliance with the instructions of the advertiser, requests for change should reach the office as early as the 22nd day of the month.

SUBSCRIPTIONS.

The ELECTRICAL NEWS will be mailed to subscribers in the Dominion, or the United States, post free, for $1.00 per annum, 50 cents for six months. The price of subscription should be remitted by currency, in registered letter, or by postal order payable to C. H. Mortimer. Please do not send cheques on local banks unless 25 cents is added for cost of discount. Money sent in unregistered letters will be at senders' risk. Subscriptions from foreign countries embraced in the General Postal Union, $1.50 per annum. Subscriptions are payable in advance. The paper will be discontinued at expiration of term paid for if so stipulated by the subscriber, but where no such understanding exists, will be continued until instructions to discontinue are received and all arrearages paid.

Subscribers may have the mailing address changed as often as desired. *When ordering change, always give the old as well as the new address.*

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

EDITOR'S ANNOUNCEMENTS.

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

THE CANADIAN ELECTRICAL NEWS HAS BEEN APPOINTED THE OFFICIAL PAPER OF THE CANADIAN ELECTRICAL ASSOCIATION.

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MONTREAL BRANCH NO. 1.—Meets 1st and 3rd Thursday each month, in Engineers' Hall, Craig street. President, Jos. Robertson; first vice-president, H. Nuttall; second vice-president, Jos. Badger; secretary, J. J. York, Board of Trade Building; treasurer, Thos. Ryan.

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.—Meets 2nd and 4th Tuesday, each month, corner Bank and Sparks streets; Frank Robert, President; F. Merrill, Secretary, 352 Wellington Street.

DRESDEN BRANCH NO. 8.—Meets every 2nd week in each month; Thos. Merrill, Secretary.

BERLIN BRANCH NO. 9.—Meets 2nd and 4th Saturday each month at 8 p.m. W. J. Rhodes, President; G. Steinmetz, Secretary, Berlin Ont.

KINGSTON BRANCH NO. 10.—Meets 1st and 3rd Tuesday in each month in Fraser Hall, King Street, at 8 p.m. J. Devlin, President; A. Strong, *Secretary.*

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BROCKVILLE BRANCH NO. 15.—W. F. Chapman, President; James Aitkens, Secretary.

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

THE Canadian Controller of Customs has decided that electricity brought into Canada from the United States is subject to a duty of 20 per cent. This matter came up for decision at Washington a year or two ago, and if we mistake not, electricity *was declared to be a manufactured product, and as such* subject to duty.

MUCH sympathy is being expressed with Mr. Nikola Tesla, the brilliant electrical inventor, in consequence of the destruction by fire on March 13th of all the apparatus which he was accustomed to employ in his experiments. Unfortunately there was no insurance on the property. Mr. Tesla lost no time in vain regrets, but immediately set to work to replace what had been destroyed.

THE Supreme Court has reserved its decision in the case of the appeal of the Toronto Railway Company to be granted a refund of $56,000 paid as duty on steel rails imported into Canada for use in the construction of their system. Item 173 of the Customs Act exempts from duty steel rails over 25 pounds in weight for use on railway tracks. The Exchequer Court has decided that this item does not apply to street railways. The present appeal is from this decision. The case appears to hinge on whether an electric road is a "tramway" or a "railway." The extent of mileage and nature of construction of the suburban electric roads built during the last two years should be sufficient evidence upon which to conclude that they are in the truest sense entitled to be classed as railways. A proof of this is to be found in the electric railway bill now before the Ontario Legislature, the author of which, in introducing it said that "it was intended that the bill should bear the same relation to the electric 'railways' that the general act does to the steam railways."

A SECOND meeting of the executive of the American Street Railway Association to complete arrangements for the Montreal Convention is announced to take place at the Auditorium building, Chicago, on the 10th inst. It has been decided that the convention shall extend over four days, viz., Oct. 15th, 16th, 17th and 18th. The meetings will be held in the hall of the Windsor hotel. The Victoria Rink, opposite the hotel, has been secured for the use of exhibitors of electrical appliances. Exhibits from the United States will not be required to pay duty, but a reasonable charge will be made for space in the Victoria Rink. Messrs. Granville C. Cunningham and E. Lusher, of the Montreal Street Railway Company, are devising means for the entertainment of the members of the Association during their stay in Montreal.

IT is said to be the intention of the Chicago City Railway to lay this spring thirty miles of track with cast welded joints. The testimony of the electrical engineer of the Cleveland Electric Railway on 1,000 feet of continuous track laid between two and three years ago with hot rivetted joints, is, that it is as good as when put down, and has required no repairs. Experiments with hot rivetted, driven bolt, and electrically welded joints in various parts of the United States and in New South Wales, seem to demonstrate that a track laid in this manner is not thrown out of alignment by contraction and expansion due to extreme changes of atmosphere. The statement of the engineer of the Cleveland Railway on this point is, that notwithstanding that during the past winter the thermometer frequently ranged at 10 below zero for days in succession, only six out of three thousand electrically welded joints gave way. The result of the adoption of this method on an extensive scale in Chicago will be looked for with much interest by street railway managers.

A BILL has been introduced in the Ontario Legislature by Mr. Bronson, and has received its second reading, designed to regulate the manner in which electric railways shall be constructed and operated. The bill debars directors of an electric railway company from any interest, direct or indirect, in any contract for construction. It provides that plant and material shall be paid for in cash, that the original issue of stock must be sold for cash, and subsequent issues by tender to the highest bidder, that all contracts for construction for leasing rolling stock or power, shall be subject to a two-thirds vote of the shareholders. Dividends are limited to 8 per cent. above a fair charge for working expenses. The limit of fare is placed at five cents for a distance of three miles and under, a provision which may interfere with present arrangements on the H. G. and B. and other suburban roads on which a system of graded fares has been put in operation. Sunday service is forbidden on roads extending more than one mile beyond the limits of any city, town, or incorporated village. Companies are to be allowed to purchase and improve pleasure parks, but such parks must not be opened on Sunday. These are a few of the more important features of the bill, which is a lengthy measure. It is to be hoped that before such a bill is placed on the statutes, its provisions will have undergone the most careful revision, and that an opportunity will be afforded representatives of the electric railway interests of the country to submit their views on the subject. The greatest care should be exercised to avoid hampering the development of electric railway enterprise.

WE are pleased to observe that the Bill recently introduced by Mr. German, the member for Welland, in the Ontario legislature, with the object of making electric light, telegraph and telephone wires and poles assessable as personal property, has been withdrawn. Evidently the author of the Bill did not foresee the injurious results which would follow the putting into operation of the measure; and it is creditable to him that when he became possessed of larger information on the subject, and was able to see what the effect of the measure would be, he decided upon its withdrawal. Immediately after the Bill was introduced the Canadian Electrical Association issued a circular calling the attention of electric lighting companies throughout the country to the Bill, and the injurious effects which must follow should it be placed on the Statute books of the province, and urging them to lay the facts before their representatives in the legislature so that the Bill might not become law. In this action the Association has shown itself to be alive to electrical interests. In addition to the influence thus exerted, a deputation of fruit growers from Mr. German's own constituency waited on the Committee of the House and urged that the Bill should be thrown out, pointing out the advantage which at present is derived from telephone communication throughout the country districts, and showing that if telephone poles and wires were taxed in the manner proposed it would be the means of doing away with the present convenient and valuable means of communication, and of again placing fruit and agricultural producers in the isolated conditions with which they were surrounded previous to the introduction of these modern facilities. The presentation of facts resulted in the withdrawal of the support of the Patron element from the Bill, and sufficed to show Mr. German that the measure was likely to result in serious injury to the very class whose interests he was especially seeking to serve. So far as electric light companies located in towns and villages are concerned, it is a well-known fact that very few of them are more than self-sustaining under present conditions, and there is required to be exercised the closest economy in order to make ends meet; consequently, they are not in a position to be burdened with additional taxation. It should be borne in mind that the property of an electric light, telephone or telegraph company differs from that of a stock of dry goods, for example; the latter can be sold and removed to another locality without suffering in value, but electric light poles and wires cannot be so removed after having once been erected in the streets of a municipality. The cost of removing poles would be as much as their value, and the same would apply to wires. The only proper method of assessing these companies is to base the assessment upon the earnings of the company, and in the event of legislation being again proposed, we trust this fact will be borne in mind.

THE class of man usually found operating electrical machinery is such as to cause a doubt as to the advisability of any further improving the efficiency of dynamos and lamps. It seems to be of very little use to raise the efficiency from 95 to 96 per cent. by alterations in design, improvements in material, and by the expenditure of valuable time and money when the person responsible for its subsequent operation is not competent to either appreciate the saving or to continually watch that the conditions of operation are such that the higher efficiency may affect results. For instance, 3 watt lamps are, broadly, more efficient than 4 watt lamps, but the condition of efficiency is a more perfect pressure regulation. A 3 watt lamp will, generally speaking, suffer more by a varying pressure than a 4 watt. Pressure varying directly as speed it would appear that it is very questionable economy to use 3 watt lamps and supply them from a dynamo run by an ordinary saw mill engine. The writer has seen this done, likewise been told that those lamps were "no good," although the agent claimed them as "more economical." There appears to be very little advantage in manufacturing dynamos or transformers with a very high percentage of efficiency when the actual economy effected by their use instead of low priced low efficiency machines, is not recognized. What is the actual advantage of high efficiency, and how may it be measured? The actual advantage is a direct saving of money, and it can be measured by the increase in dividends. The efficiency of a dynamo being the percentage of the mechanical power required at the pulley to turn the armature, given out in the form of electrical power by the armature, measured at the brushes, it follows that two or more machines can be directly compared. Take two, of efficiencies 94 and 95 per cent. This means that of 100-horse power delivered at each pulley one dynamo, will return 94 h.p. and the other 95 h.p. Neglecting losses in engine, belting and boiler, and assuming 5 lbs. coal per h.p.h., the machine with lower efficiency will require 5 lbs of coal per h.p.h. more to run it than the other. Taking 10 hours of operation every night for 365 nights, with coal at $3.75 the short ton, we find that the low efficiency machine costs $33.75 per horse power per year more to run it than the high efficiency. This is 10 per cent. on $337. The high efficiency machine therefore might cost $337 more per h.p. than the low and yet be actually no more expensive as an investment. The same remark applies to transformers, lamps, etc. The efficiency of a boiler is largely a matter of firing, and this depends entirely on the fireman. In a 50-h.p. plant, running 10 hours each night, 365 nights, coal as above, 5 lbs. per horse power hour, the consumption of a quarter of a pound per h.p.h. more than necessary, means $427 spent per annum which might be saved. What fireman at $1 a day knows enough to save this? What "superintendent and electrician" at $50 a month knows that this is being wasted? And yet, very few small plants, managed by inexperienced persons, can say that they are not wasting a good deal more?

THE statement was recently made to the writer by the owner of a medium sized arc plant, that "Arc plants do not pay. Communications received from owners of arc plants all over Canada show that not one of them is paying anything. I don't believe there's any money in electric lighting, anyway." Whether this be a fact or not, with regard to electric lighting generally, with regard to the particular plants communicating their sad experience it seems to indicate either ridiculously low prices for light or conspicuously poor management. If the former, then it shows a very considerable "margin of ignorance" in the consideration given to the preliminaries, especially commercial; if the latter, it points to the same ignorance of the principles of what now is almost a science—"station management"; and in either case it emphasizes the fact that electric lighting has emerged from the stage in which all that is necessary to be known about it can be learned from the pages of the daily press. As an illustration of this ignorance factor, the same gentleman whose opinion is given above stated that he was "operating at very high economy, the electrician's time, and therefore salary, was equally divided between a gas plant and the arc plant; and the only other employee was a trimmer, and he was burning coal at the rate of 4 lbs. per horse power hour." Under all these favorable conditions why doesn't that plant pay? Is it possible that these conditions are not so very favorable after all? Is it possible that a man, who is not even a scientific gas maker, may not be the very most competent person to become "electrician" of an arc plant? or that a gentleman whose business is hardware does not necessarily know "all about" the economical generation and utilization of the electric current? It seems quite impossible, but then it doesn't pay. The stated coal consumption of 4 lb. per horse power hour seems to indicate not only remarkable quite remarkable economy, but also very capable, skilled management, and as such is quite incompatible with ignorance or carelessness. In fact it is such a very remarkable figure as to call for some analysis. The plant is one of about 50 200 c.p. arcs, engine simple, non condensing, belted to dynamo, boiler being return tube type. The engine, therefore, must develop about 50 h.p. Such a small engine will certainly require nearly 40 lbs. steam per h.p.h. This will require for evaporation from 100° feed to 80 lbs. pressure 44280 h.u., supposing that everything is in first-class order and the fireman thoroughly skilled in his work. As 4 lbs of coal is stated to be the consumption, each pound of coal must have the calorific value of $\frac{44280}{4}$ h.u. = 11070 h.u., (which is the value of really very high-class, expensive coal supposing that every h.u. is rendered available for evaporating purposes. Assuming that such a very high percentage as 80% of the h.u. of the coal are made use of, we find that at least 55380 heat units will be required to raise the necessary amount of steam, and if we assume the calorific value of the coal used to be 9000 h.u. per pound (which seems reasonable) we get as the amount of coal required to raise steam for the 50 h.p. engine—assuming all machinery to be in good condition, no loose contacts on lamps, and everything as it would be in a first-class station 6.15 lbs. How the figure 4 lbs. was arrived at hardly appears, but it would be pretty safe to say that 7½ to 8 lbs. are used. Does all this ignorance, not only of theoretical possibilities, but of actual practice and results, not point to reasons why plants do not pay dividends? It seems almost superfluous to point out that it is because electric lighting is not generally recognized as a business possessing its special features and problems, each requiring special and careful study.

Negotiations are said to be in progress for the absorption of the St. John, N. B., Gas Light Company, by the St. John Street Railway Company. A two-thirds vote of the shareholders will be required to consummate the deal.

To make filaments of electric incandescent lamps more brilliant, says Invention, Messrs. Chancy and Depoux soak the fibre in a solution of the nitrates of magnesia, zirconia, and lathania, and the effect is said to be analogous to that of the Welsbach lamps.

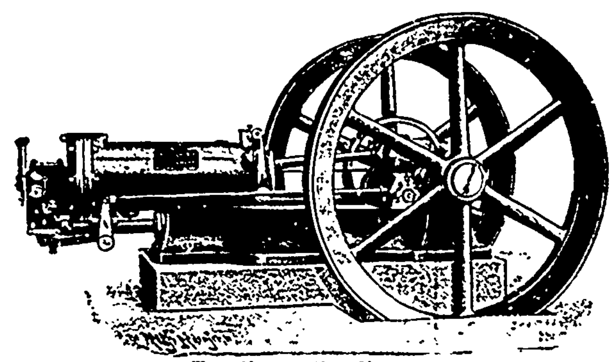
GAS ENGINES.

REFERRING to the article in our March number on the subject of gas engines, in this issue we call attention to those manufactured by The Fried Krupp Grusonwerk, of Magdeburg, Germany.

These engines, made of three different models B, C and D (the accompanying cut represents model B), are designed for electric lighting, industrial and other purposes. Those for electric lighting are provided with patent cut-off gear, and are so regulated that they are constantly supplied with the same quality of gas mixture, the quantity of which is automatically varied by the governor.

In some gas engines for electric lighting that are offered for sale only the quantity of gas is altered by the regulator according to the load and consequently the explosive mixture is not constant and therefore sometimes uneconomical.

In the Krupp cut-off gear engines, however, the air supply is also influenced by the governor, so that whatever may be the



THE KRUPP GAS ENGINE.

quantity of mixture in the motor there is always at the intake valve and before the igniting valve an easily inflammable and under all circumstances perfectly constant mixture.

In the cylinder itself the remaining gases in the compression chamber, which are always equal in quantity, have a more diluting action on the pure fresh combustion charge in the cylinder in the case of small charges than in the case of large, and therefore the mixture burns slower and consequently more unfavorably in the case of small charges. In order to obtain a more favorable combustion in the case of small charges their ignition is made earlier than in the case of large charges. The governor accomplishes this automatically, so that in all circumstances a proper combustion takes place in the engine, regularity and economy being thereby secured even when only half loaded.

The gas consumption is more favorable the larger the engine. With full load it reaches 0.45 cub. m., and for the smallest engines about 0.7 cub. m. per brake h.p. an hour. The cylinders are made of the best chilled cast iron and are slid into the cooling jacket. Crank shaft, connecting rod, etc. are made of steel; axle boxes and bushes are made of phosphor-bronze or are lined with special bearing material.

The engines with automatic cut-off gear are made in three models, viz. (1) one cylinder horizontal engines model C up to 12-h.p. (2) one cylinder horizontal engines model B from 10-h.p. upwards, and (3) two cylinder engines model D from 40-h.p. upwards.

The representatives in Canada for The Fried Krupp Grusonwerk are Messrs. Jas. W. Pyke & Co., Montreal, to whom all communications for particulars should be addressed. They have imported a small sample engine and made arrangements to have it erected for testing purposes at the establishment of Mr. Samuel Fisher, 57 St. Sulpice street, Montreal, who is also acting as local agent for Montreal and district. Those who have already examined this engine admit that it is a fine piece of workmanship and runs with remarkable smoothness. Mr. Fisher will be pleased to show the engine working, and give all information regarding it to interested parties.

The town of St. Louis Du Mile End, has entered into a contract with the Citizens Light & Power Co., to light the streets of the town, and has also entered action against the Montreal Street Railway Company for laying their tracks within the limits of the municipality. The company claim that they were obliged by the city by-laws to lay down the tracks, and will hold the city of Montreal responsible for any damages which may be incurred.

THREE-PHASE PLANT AT ST. HYACINTHE, P. Q.

THE town of St. Hyacinthe, at which place is located the first three phase plant installed in Canada, is on the Portland line of the Grand Trunk Railroad, about thirty five miles from Montreal. A branch line of the Canadian Pacific also reaches the town, and a new line of railway called the United Counties passes through it, connecting it with the town of Sorel on the west and Iberville on the south. The population is at present about 11,000, which is rapidly increasing. A fine water power on the Yamaska river is utilized to operate the granite mills owned by Feodore Boas & Co., manufacturers of woolen goods, and several other factories. There has been for some time, however, a demand for more power than was available in the town itself, and in the fall of 1893 the transmission of power from the Rapid Plat, 4½ miles below the city, was first discussed. In February, 1894, this power was acquired by Mr. A. M. Morin, and in April of that year a company called La Cie des Pouvoirs Hydrauliques de St. Hyacinthe was formed to improve and distribute it for motive purposes and lighting in the town. Work was commenced at once on the water power, and in July contract was closed with the Canadian General Electric Company for the necessary electrical apparatus for the plant. A thorough investigation was made of the different systems of electrical transmission, and the President of the company, Mr. Louis Cote, and their consulting engineer, Rev. Father Choquette, visited a number of power transmission plants before their decision was reached. The contract for the water wheels and shafting was awarded to the James Leffell Co., of Springfield, Ohio, who also furnished plants for the installation of the wheels.

THREE-PHASE PLANT AT ST. HYACINTHE, P. Q.

WATER POWER PLANT.

The power had formerly been utilized for the operation of a grist mill and woolen factory on one side of the river, and for a small grist mill on the opposite side. No change was necessary in the dam, although it will be possible by raising this to greatly increase the power available. The canal leading to the mill was almost entirely reconstructed and deepened, so that its capacity is nearly three times that of the old canal. In addition to this a long tail-race was excavated, greatly increasing the head, which is now about 17 feet. The water is led directly to the wheels, which are four in number, of the Leffell Co.'s Sampson type, 50 inches in diameter, and running at a speed of 100 revolutions per minute. These wheels are on vertical shafts and placed in wooden penstocks with separate gates. At the top of the vertical shaft is placed a crown wheel 6' 2" in diameter, having 78 iron wood teeth. This is geared to a pinion, 24 9-16 inches in diameter, having 26 teeth, and connected to a horizontal shaft by means of clutch coupling. The shaft is divided into two sections connected by a Hill cut-off clutch, two wheels being geared to each section. The main driving pulleys, which are four in number, and each provided with Hill clutches, are placed on an extension of this shaft under the dynamo room. Hand wheels controlling each of the four wheels and the four clutch pulleys are placed in a convenient position in the dynamo room, so that the entire operation of the plant can be absolutely controlled from the switchboard. Two electric governors, one for each pair of wheels, are connected to controlling mechanism, which is also placed in the dynamo room. It is intended to connect a tachometer to the shafting which will at all times indicate the speed.

ELECTRICAL PLANT.

The electrical equipment of the power house, installed throughout by the Canadian General Electric Co., Ltd., consists at present of three of their type A. T. 12-150-600 standard three-phase alternators, each having a capacity of 150 k. w. at 2,500 volts. They are compound wound in the same manner as that company's single-phase high periodicity alternators of the Thomson-Houston type, the commutator, however, being in three sections to accommodate the three-phase current. The separate exciting current is supplied by two 6 k. w. standard Edison dynamos, either one of which is capable of exciting the fields of all three machines.

The periodicity of these alternators is 60 cycles per second, this having been adopted in place of the old standard of 125 cycles, as it has been found from experience that motors operate very much more satisfactorily the lower the periodicity, and this number was decided upon as being more suitable for the combination of motors, arc lamps, and incandescent lamps, the steadiness of the latter being affected when the periodicity is much further reduced. The current from these machines is led to the centre panel of the switchboard, as shown in the accompanying cut, and is there connected to the main bus bars in multiple through three high potential triple pole switches. On this panel is also placed a current indicator and potential indicator for each machine, together with the phase indicator by which the machines are thrown together. The feeder panel is to the right and is equipped with three current indicators, one for each leg of the system, a ground detector, lightning arresters and feeder blocks. On the left are the three station transformers and the exciter current indicators and switches

LINE.

The distance between the power plant and the town, as stated above, is 4½ miles. The line consists of four number 00 B & S bare copper wires placed on double petticoat insulators. The poles are all of cedar, 30 feet in height above the ground, and a double set of cross arms, pins and insulators are placed on each pole. Only three of the wires normally are in use, the fourth being kept as a spare in case of accident. The line is of the most solid and substantial construction throughout, and has been built with the object of providing amply for any addition to the lines which may be required at any future time.

SECONDARY DISTRIBUTION.

The primary wires are brought to the centre of distribution in the town, and from this point primary mains extend over the district which is to be furnished with light and power. The greater portion of the lighting is from a four-wire system of secondary mains fed by banks of transformers at suitable points. This system combines the economy of both the three-wire and three-phase systems and insures a uniform potential at all points. All large motors will be connected to separate banks of transformers, only the smaller sizes being operated from the secondary mains.

THE COMPANY.

The directorate of the company includes the names of nearly all the prominent business men of the town. Mr. Louis Cote, the president, is well known as the inventor of several important labor saving machines for shoe manufacturing. Mr. Payan, vice-president, is a member of the firm of Duclos & Payan, tanners and manufacturers of leather. The construction work and wiring has been done under the supervision of Mr. R. Duperouzel, superintendent of the Hydraulique Company, to whom much credit is due for the manner in which he has carried out an installation having so many novel features.

RECENT CANADIAN PATENTS.

Canadian patents have recently been granted for the following electrical and steam engineering devices :—

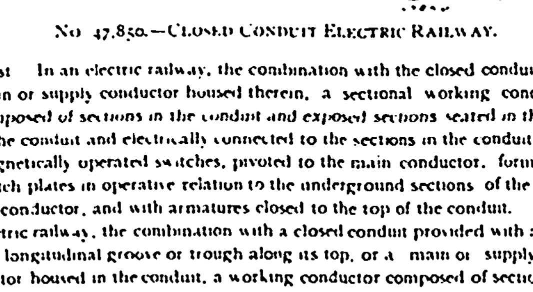
No. 47,796, for gas engine, to Frank S. Mead, Montreal.

No. 47,832, for automatic railway car protector, to Chas. Gletner, Cincinnati, Ohio.

No. 47,834, for feed water heater, to Stirling L. Bayley, Chicago, Ill., and John W. Dowd, Toronto, Ont.

No. 47,848, for car fender, to Wm. Hofmeister, and W. F. Madaus, New York City.

No. 47,850, for a closed conduit electric railway, to James Francis McLaughlin, Philadelphia, Pa. The inventor's claim for this device, which is herewith illustrated, is as follows :—



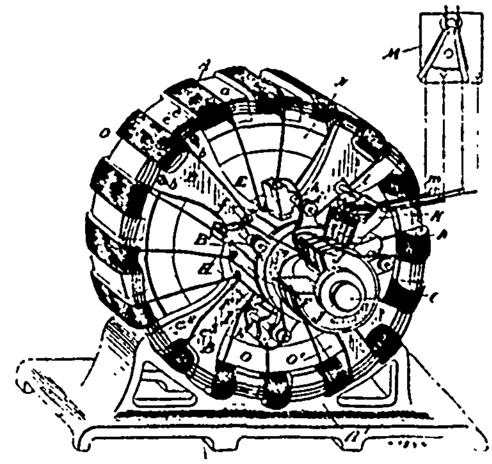
No. 47,850.—Closed Conduit Electric Railway.

1st In an electric railway, the combination with the closed conduit, of a main or supply conductor housed therein, a sectional working conductor composed of sections in the conduit and exposed sections seated in the top of the conduit and electrically connected to the sections in the conduit, and magnetically operated switches, pivoted to the main conductor, formed of switch plates in operative relation to the underground sections of the working conductor, and with armatures closed to the top of the conduit. In an electric railway, the combination with a closed conduit provided with a central longitudinal groove or trough along its top, or a main or supply conductor housed in the conduit, a working conductor composed of sections in the conduit and exposed sections seated in the trough and electrically connected to the sections in the conduit, and magnetically operated switches pivoted to the main conductor and formed with switch plates in operative relation to the underground sections of the working conductor and with armatures close to the top of the conduit between the trough and sides of the conduit.

No. 47,858, for electric switch or circuit breaker, Frank Stevens and Robert Roswell Kesteven, Philadelphia, Pa.

No. 47,859, for an electric motor, to Jas. H. K. McCollom, Edwin Knickmore, Thos. Ed. R. McCollom, Melville R. R. Gordon, John W. Sweetnam and Thos. W. Hector, Toronto, Ont. The following description of this motor, an illustration of which appears herewith, is abstracted from the statement of claim of the inventor:

The combination with a stationary armature comprised of a ring having a series of sections arranged equi-distant around it between the toothed projections, the sections having a plurality of coil layers arranged in multiple and suitably connected to the corresponding sections of the commutator, of an arc-shaped field magnet supported and magnetically insulated from the main shaft of the motor by a disc as shown and for the purpose specified. The combination with the ring-shaped stationary armature composed of a series of sections arranged as specified and having arms secured to the ring

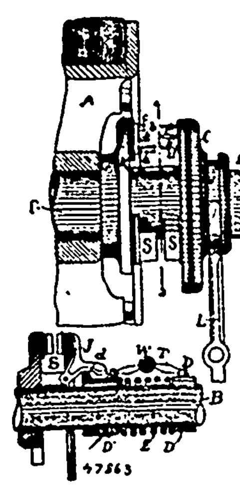


No. 47,859.—Electric Motor.

and extending inwardly and terminating in hubs, which form bearings for the main shaft of the motor, of a stationary commutator secured in one of the hubs, rotating brushes and arc-shaped field magnets supported upon and magnetically insulated from the shaft by a suitable disc and designed to rotate in unison with the commutator brushes, which are suitably supported and derive current from electrically insulated rings through the contact brushes resting on such rings and connected to the main circuit.

No. 47,861, for a trolley, to Carl Ast, Gorlitz, Prussia, Ger.

No. 47,863, for a multiphase motor, to the Canadian General Electric Co., Toronto, Ont., assignee of Louis Bell, Chicago, Ill. The accompanying illustration and statement of claim will serve to explain the invention :—



No. 47,863—Multiphase Motor.

In an electric motor having a closed-circuited armature-winding, the combination with resistance in circuit with said winding and carried therewith upon the armature shaft, said resistance being divided into sections, of automatic switching mechanism also mounted on said armature shaft and responsive to the speed thereof, whereby successive sections of the resistance are short-circuited as the speed increases.

No. 47,867, for car brake, to Geo. Hill Kinter, Geo. D. Teller and Geo. Tait, Buffalo, N. Y.

No. 47,892, for telephonic relay, to Geo. Gilmour, Douglas, Isle of Man.

No. 47,908, for telephone annunciator and call bell, to Fred. G. Warrell, Philadelphia, Pa.

No. 47,909, for telegraphic transmitter, to Frank F. Howe, Marietta, Iowa.

No. 47,935, for an electric railway, to the Thomson Houston National Electric Co., Portland, Maine.

No. 48,030, for a steam generator, to Chas. Wm. Vanderberg, Wellington, B. C.

It is understood that a satisfactory understanding has at last been reached between the London Street Railway Co. and the City Council, in accordance with which the railway system of the city will immediately be transformed to the trolley system. The company is said to have secured property adjoining that of the General Electric Company at the foot of Bathurst street, on which to erect a power station and car barns. The situation is a very desirable one, water for condensing purposes being obtainable from the river Thames.

DYNAMO DESIGN.*

BY E. B. MERRILL.

PRELIMINARY.

BEFORE proceeding with the design of a dynamo, it is necessary to ascertain as definitely as possible what is required of it. It is to be built for a given purpose. It is a generator, perhaps, to do lighting or electro-plating, or to supply a power circuit, or it may be a motor to run a fan, a lathe, or a workshop, an elevator or a street car; a generator for a constant pressure or a constant current circuit; or a motor for fixed, or for variable speeds, to be used on parallel or series circuits. We must obtain information on these points:

(1) What circuit is it to supply or be supplied from?

(2) What power is required of it?

(3) What are the general conitions of use—such as the position that it is to stand or be suspended in, the limit of floor space, the necessity for protection from dust, water, iron filings, and other sources of injury, the mode of driving, etc.

From the answer to the first question we determine one of the factors of the power. It will decide the pressure to be obtained between the terminals if for parallel working, as for incandescent lighting, and for motors on constant pressure circuits, or the current to provide for in series circuits; it will help us in settling the question of open or closed coil armatures, and of series, shunt, or compound fields. The degree of constancy necessary in the pressure of generators and in the speed of motors will determine whether they are to be shunt or compound wound. We shall know also whether special design and regulation will be necessary to effect alterations of electromotive force in generators, or of speed in motors.

From the answer to the second, we determine the other factor of the power, for, as we know electrical power is the product of current and electromotive force, and we have only to divide the required power—reduced to Watts—by the one given to obtain the other; usually we are given the pressure and require to determine the maximum current needed. As power is lost in the various windings of a dynamo, this also should be considered. Any such heat losses may be calculated just as they would be if the energy were being used in the external circuit, armature and series field coils as in series circuits, and shunt fields as in parallel circuits. If C is the total armature current and E the generated electromotive-force, driving the current in the generator or resisting the current in the motor,

$$E\ C = P\ (\textit{watts})$$

gives the total transformation of energy, mechanical to electrical in the generator or electrical to mechanical in the motor. The power given to or received from the external circuit is

$$E\ C \mp C^2 r \mp c_1^2 r_1 = E_1 C_1 = P_1$$

the negative signs applying to the generator and the positive ones to the motor.

r = resistance of armature or armature and series field winding.

r_1 = resistance of shunt field winding.

c_1 = current in shunt field winding.

$E_1 = E \mp Cr$, the pressure between the terminals.

C_1 = current given to or received from external circuit.

The answer to the third question will affect the general design, particularly the selection of the type.

There is an almost endless variety of different types of continuous current machines; they may all, however, be classed as bipolar and multipolar. The bipolar machines may be divided into those having single or multiple magnetic circuits, and these, again, as having one or more exciting coils. Multipolar machines, in practice, never have more than one magnetic circuit per pair of poles, and often this is abridged; that is, two or more pairs of poles may have parts of their circuits in common. Multipolar machines may, therefore, be classed as having one exciting coil—half as many coils as poles, or as many coils as poles, etc.

As to the effect of the power of a machine on the type, one may say, generally, that, for small powers, bipolar machines are preferable on account of their simplicity and economy in construction, while, for large powers, multipolar machines are most economical.

The common types of armature are the drum and ring (Gramme). In bipolar machines for small armature diameters, the drum winding is the more economical in length (*i. e.*, resistance) of conductor, and the core more simple in construction; while, for large diameters and shorter cores, the ring type gives more economy in winding, and offers much better opportunity for ventilation. Ring winding is done in distinct sections, so that it is much easier to insulate it and to replace portions of it than in the case of drum winding, in which the sections all over lap. In ring winding there is one active conductor in each loop; in drum winding there are two.

In multipolar machines, both rings and hollow drums are used; and for these we have the ring, and lap and wave windings, with as many parallel circuits as poles, excepting for wave winding, for which there are always two. The cores of armatures may be smooth or slotted. The advantage, on the whole, lies with the smooth surface. The teeth in the slotted core form good driving horns, and somewhat decrease the magnetic reluctance of the circuit; they also allow the heat to escape more rapidly from the core; but their additional cost of construction, the heating of the pole pieces, due to the unequal distribution of magnetism, and the trouble they cause in sparking, tell heavily against them.

Let us now, to fix our ideas, suppose that we are to design a dynamo for constant pressure. In the first place we know that the terminal pressure for a generator is less, and for a motor is greater, than the generated electromotive force by a product Cr; so that if Cr is small, as it must be for economy, the same machine generates nearly the same electromotive-force as a generator or as a motor with terminal pressures the same, and, therefore, as other conditions are unaffected, the speed must be nearly the same also, so that a generator and a motor to be used in the same circuit may be considered very nearly as the same machine.

THE ARMATURE.

As the electromotive-force of a dynamo is generated in the armature, and the whole current used must flow through it (excepting for the shunt field of a motor), so that both factors of the power affect it directly: and as the field provided by the magnetic circuit is only for the use of the armature, and must, therefore, be designed to suit it, the consideration of the armature is evidently the first and most important part of the design of a dynamo; so that, after deciding the number of poles to be used, we should proceed to determine what is required of the armature, and select the type.

We know approximately the electromotive-force that it must generate ($E = E_1 + Cr$, of which E_1 is known, and Cr is small, and need not be considered at this stage), and the maximum current that must flow through it, allowing a percentage for the shunt circuit (see at end of paper). The total armature current is divided between two parallel paths in bipolar, and between two, four, or more parallel paths in multipolar dynamos, so that the current that the armature conductor has to carry is fixed, *i. e.*, one-half, one-fourth, etc., of the total current, and from this, knowing the safe carrying capacities of conductors, we can fix the cross-section necessary. From 400 to 800 circular mils per ampere for copper gives the common range of practice, the lower values when the machine is run intermittently, or when there is good ventilation, and the higher values for continuous running, or when the ventilation is poor.

The armature of the common types of dynamos consists of the arrangement of a number of conductors (usually copper wire) on a core which is a good magnetic conductor, which is attached to a shaft, and revolves in a magnetic field, so that the conductors cut through the lines of that field as they pass from the poles of the dynamo across the gap, composed of clearance and space occupied by the conductors and their insulation to the core. Now, the cutting by a conductor of 10^8 lines per second produces in it an electromotive-force of one volt, so that the total electromotive-force produced in an armature is given by the equation

$$E = \frac{c\ v\ l\ \mathfrak{B}_a}{10^8}$$

where $\mathfrak{B}_a$ = the average number of lines per square inch in the field.

l = length of field in inches being cut by the conductors, *i. e.*, about the length of the conductor on the face of the armature or the length of the armature core.

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* Part of a paper read before the Engineering Society of the School of Practical Science, Toronto, March 20, 1895.

v = velocity of the conductors cutting through the field in inches per second, *i. e.*, the peripheral velocity of the armature. The electromotive-force produced in each conductor is therefore $\frac{v\,l\,\mathfrak{B}_a}{10^8}$

c = number of effective conductors in series, *i. e.*, the number of those in series which are cutting the field of strength $\mathfrak{B}_a$, and which are therefore within the polar arcs.

The cross section of the magnetic field is approximately the same as the area of the pole face, and the distribution $\mathfrak{B}_a$ is fairly uniform in a good design. As a means of decreasing the exciting power necessary for a given total magnetic flux, the intensity of magnetization, $\mathfrak{B}_a$ of the gap spaces is taken quite low, especially for smaller machines, as compared with the limits of saturation of the poles and armature core. The value in practice increases with the capacity of the machine, and is about 50 per cent. higher for wrought iron or steel than for cast-iron pole pieces. For bipolar machines, with cast-iron pole pieces, $\mathfrak{B}_a$ ranges from 15,000 for 1 kwt. capacity to 30,000 for 300 kwt.*

v as an easily-produced factor of the electromotive-force should be as high as possible. It is limited, however, by mechanical and electrical considerations, such as strain in the moving parts, vibration due to irregularities of balance, friction in the bearings and air friction in the clearance space, eddy currents and hysteresis losses which increase with the speed. The hysteresis losses depend on the number of reversals per second and the intensity of magnetization of the core. In practice, the peripheral velocities of drum armatures range from 25 to 50 feet per second, increasing with the capacities; and those for ring armatures—on account of their better ventilation and the better hold of the conductors—reach double that amount.

We must now select values for _ and v. We then have c and l to determine, having the relation $cl = \frac{10^8 E}{v\,\mathfrak{B}_a}$ between them.

As a question of internal resistance, c and l may nearly balance each other, and it becomes a question then as to whether altering l increases or decreases the idle wire necessary in the particular winding used. But there are other conditions which limit the fixing of c, a consideration of which will help us in making the adjustment. c is the number of conductors in series—in one of the two or more parallel armature circuits—which are actually cutting the magnetic field at a given instant, at any of its two or more pole faces; its ratio to the total number of conductors on the cutting surface is approximately that of the polar arcs to the periphery of the armature space. The length of the polar arc, we find in practice, ranges between 50 and 100 per cent. of the total circumference, and usually, lies between 70 and 80 per cent.; questions of magnetic leakage, sparking, etc., affect its length. Fixing this ratio now also fixes the relation between c, the *effective*, and the total number of *active* armature conductors.

Again, the number of conductors around the circumference, and the number of layers, with a knowledge of the space required for insulation (between conductors and core, between layers, between sections, and between individual conductors), and that needed for driving horns, will fix the circumference required for the armature and the depth of winding.

The radiating power of the armature fixes the limit of depth of conductors. The greatest current density allowed in practice, that is, the ampere turns per inch circumference, is fixed at about 800 or about 2,500 per inch diameter. The average would be about 600 or 1,900 per inch diameter, which corresponds to a rise of 125 to 140 F. The depth of winding varies, in practice, with the diameter of the armature ranging with drum armatures from .25 to .8 inch for diameters of from 2 to 30 inches.

Another question affecting c is the number of sections that there are to be in the armature and in the commutator. Many sections increase the difficulty of winding and insulating, and increase the size and cost of construction of the commutator, while few sections give greater losses in the coils short-circuited under the brushes, causing sparking, and give greater variations in the total electromotive-force generated. Thirty-six divisions cause only a variation of one-fifth of one per cent., so that this would be plenty for steadiness; but, besides this, the self-induction in the short-circuited coils require that the number of loops per section should be kept down, which would both tend to decrease the total number of conductors and to increase the number of sections. From 40 to 60 sections is good practice for pressures up to 300 volts on bipolar machines.

For high pressures, the effect of self-induction in the coils comes still more into play in increasing the number of sections, as also the necessity of keeping the pressure between adjacent segments low enough not to maintain an arc across the insulation between them.

Let us, then, decide upon a number of sections for the commutator. Each commutator bar will begin one coil and end another, so that the number of armature and commutator sections will be the same.

We may now select a value for l, obtained from a similar type of machine in practice, and obtain c and the total number of conductors; then select the nearest number to this which will give the chosen number of sections, and correct the assumed value of l. Knowing now the number of conductors per section, we can decide, from considerations above given, and from convenience in winding and insulating, the form that the sections will take and how they will be placed and wound. The circumference of the armature is readily deduced from this, and, therefore, the diameter. We may now see if the length chosen and the diameter deduced bear reasonable proportions to each other; if not, a new value of l may be selected.

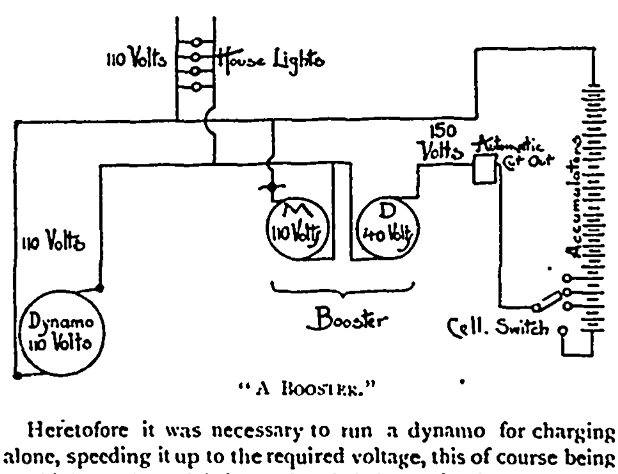
The selection of the type of armature need not be finally made until after a preliminary calculation of the dimensions, though, as we have seen, a higher v is allowed for ring than for drum armatures, which should be considered.

(To be Continued.)

* We are indebted for these figures, as well as for others that follow, to the valuable articles by A. E. Wiener, entitled "Practical Notes on Dynamo Calculation," which have been running for some time in the Electrical World.

"A BOOSTER."

AT the request of the Canadian representatives for Crompton & Co., London, Eng., the Montreal Electric Co. have lately installed at the Royal Victoria Hospital, Montreal, a "booster" in connection with their storage battery plant. The "booster" allows them to light the house circuits at the same time as they are charging the battery. The accompanying diagram shows the principle:



"A BOOSTER."

Heretofore it was necessary to run a dynamo for charging alone, speeding it up to the required voltage, this of course being too high to allow of their running their lamp circuits at the same time.

The "booster" is arranged so that it can also be switched in on their three wire bus-bars; it then supplies the boosted current from one circuit when the motor is fed from the other. The batteries can also be discharged either on their two wire or three wire bus-bars. The amount of current furnished to the batteries is 50 amperes normal.

The Common Pleas Divisional Court recently dismissed an action brought by a workman against the Hamilton Street Railway Co., for injuries received by coming in contact with an electric car while engaged in lining in rails for the new track. The court decided that there was no statutory duty on the part of the motor-man to sound the gong at the place where the accident happened, and that unless the presence of danger was apparent to him in time to prevent the collision, he was not to blame.

TRANSMISSION OF POWER BY BELTS.*

By Geo. Fowler.

I venture to say that there are few appliances so much abused and neglected as the one under consideration, namely, the old and tried friend of all shops and factories, the belt. We find it stretched out of all resemblance to its former self. We see it laced in a slipshod manner with perhaps half the lace holes torn out, giving opportunity for the belt to catch against the fingers of the shifter and finally tear out and come down on somebody's head. When we go into a shop or factory and see the belts in the condition described, we are pretty sure to find a shop where the time of attending to the shafting, hot bearings and attendant ills would make a big item in the accounts if it was counted on the list of running expenses. But this kind of a shop never keeps much account anyway, and guesses at the charges to be made for work, with the result of losing money.

It is not idle capital to have belts running slack and doing less work than they might possibly be made to do, for it is much better to have the capital invested in this way than to have delays, cut boxes, and the annoyance that follows in the wake of all unsatisfactory machinery and parts in the whole establishment. It is a pleasure to see a nicely running belt, to go into an engine room and see the great driving belt that is running the whole of a great plant and doing it without apparent effort, the belt running so loose as to give a sag to the upper half, and the lower half running straight as a line. This is a sure sign that the journals are running cool and everything is going along nicely.

I do not wish it understood that everything in this paper is original with me; on the contrary, some of it is borrowed from the best engineering practice in the country. I have been very generously assisted by the several belt manufacturing companies, who gave me good hints on the use of belting. I have also studied such works as Morin's, Cooper's, Nicholson's, Thurston's, and out of these I have taken and adopted several valuable rules and formula.

There are few engineers who have not been frequently in want of information or readily applicable formulæ, upon which they could place reliance, giving the power which, under given conditions and velocity, is transmitted by belts without unusual strain or wear, therefore I believe it is well to study the experiments which are given in the works of the different authors, and acknowledge and adopt formula therefrom, and apply it to daily use. But in doing so we must be careful, because, notwithstanding the existence of this mathematical and experimental information, the numerous tables that have been given by mechanical engineers appear to have had only that kind of a basis which has come from guessing that an engine, or a machine, either the driving or the driven, with a belt of given width, was producing or requiring some quantity of power which might be expressed in foot-pounds generally without any stated arc of pulley contact. For instance, one writer says that a single leather belt one inch wide, running 1000 feet per minute, will transmit .76 horse power; another asserts .93 horse power; another claims one horse power; another makes out 1.33, and still another figures it out to be 1¾, and so on, thus producing conflicting testimony.

The rule which I have acknowledged and adopted may be thus expressed: An ordinary single leather belt one inch wide, with a velocity of 600 feet per minute, will transmit one horse power. After an examination of different text books, I find that General Morin's data gives us the clue to the truth of this rule, and also that it is supported by other good authority. Morin says: "Belts which are designed for continuous service may be made to bear a tension of .551 lbs. per .00155 square inches of section, which enables us to determine the breadth according to the thickness." This is equal to 355 lbs. per square inch of belt leather, and is also equal to about one tenth of the breaking strength of the same as given by Mr. Rankine and other good authorities. Cooper in his works says if we substitute 330 lbs. for 355 lbs. per square inch, we strike the component part of a horse-power and deduce the following: one square inch of belt leather at a velocity of 100 feet per minute will transmit one horse power with safety, and from these data get the rule: The denomination of the fraction which expresses the thickness of the belt in inches, gives the velocity in hundreds of feet per minute at which each inch of width will transmit one horse-power; and as the ordinary thickness of a single leather belt is generally about 1/6 of an inch, we simply multiply the denominator of this fraction by 100 and get the 600 feet at which a single strap one inch wide should run to transmit one horse power.

No rules can be given that will apply to all cases—circumstances and conditions must and will modify them. Belts, for instance, for machines which are frequently stopped and started, and shifting belts, must be wider to stand the wear and tear and to overcome the starting friction, than belts which run steadily and continuously. The breaking strength per inch width of belts when made from good ox hide, well tanned, has been determined as follows:

In the solid leather	675 lbs.
At the rivet holes of splices	362 "
At the lace holes	210 "

*Paper read before Toronto No. 1, C. A. S. E., February 8th, 1895.

Engineers are often required by their employers to put up new shafting, pulleys and belts for the purpose of doing an additional amount of work which may be stated in horse power, and the matter of proper dimension of same, such as size of shaft, diameter and speed of pulley, width of belt, etc., are left to the judgment of the engineer. I have no doubt that a majority of the members of this association are perfectly competent to oversee such work, but to those whose practice along this line has not been very extended, and who may be called upon at any time to take such matters in hand, I offer the following information, which is taken from standard works and may be relied on for everyday use:

The safe working tension is assumed to be 55 lbs. per inch of width, which is equal to a velocity of about 50 square feet per minute per horse power, which is safe practice.

Now let C = circumference in inches of pulley,
D = diameter in inches of pulley,
R = revolutions per minute,
W = width of belt in inches,
H = horse power that can be transmitted by the belt.

Then, to find the horse power that a single belt can transmit, the size and speed of pulley and width being given, the formula would be:

$$\frac{C \times R \times W}{144 \times 50} = H, \text{ or } \frac{C \times R \times W}{7200} = H,$$

or we may still further simplify the process by substituting D for C and divide the constant 7200 by 3.1416, which is the proportion of circumference to diameter. The formula would then be $\frac{D \times R \times W}{2300} = H$.

The transmitting efficiency of double belts of average thickness is to that of single belts as 10 is to 7, therefore for double belts the formula would be $\frac{D \times R \times W}{1575} = H$.

The horse power to be transmitted, and the size and speed of the pulley being given, to find the width of belt required:

For single belts $\frac{H \times 2300}{D \times R} = W$. For double belts $\frac{H \times 1575}{D \times R} = W$.

The horse power, speed of pulley, and width of belt being given, to find the diameter of pulley required:

For single belts—$\frac{H \times 2300}{R \times W} = D$. For double belts—$\frac{H \times 1575}{R \times W} = D$.

The horse power, diameter of pulley, and width of belt being given, to find the number of revolutions required:

For single belts—$\frac{H \times 2300}{D \times W} = R$. For double belts—$\frac{H \times 1575}{D \times W} = R$.

In the rules I have assumed that the belts are open, the pulleys of equal diameters, and the arc of contact is the semi-circumference. If, however, the pulleys are of different diameters and the arc of contact is less than the semi-circumference, the rules must be modified accordingly. The width of a belt required for any work depends on three conditions: 1st, the tension of the belt; 2nd, the size of the smaller pulley and the proportion of the surface touched by the belt; 3rd, the speed of the belt. The average strain under which leather will break has been found by many experiments to be 33,200 lbs. per square inch of cross section. In use on pulleys, belts should not be subjected to a greater strain than one tenth their tensile strength, or about 330 lbs. to the square inch of cross section. This will be 55 lbs. average strain for every inch in width of single belt 1/6 of an inch thick. The strain allowed for all widths of belting (single or double) is in direct proportion to the thickness of the belt. This is the safe limit, for if a greater strain is attempted the belt is likely to be overworked, in which case the result will be an undue amount of stretching, tearing out at the lace holes, and damage to the joints.

The working adhesion of a belt to the pulley will be in proportion both to the number of square inches of belt contact with the surface of the smaller pulley, and also to the arc of the circumference of the pulley touched by the belt. This adhesion forms the basis of all right calculation in ascertaining the width of belt necessary to transmit a given horse power. A single belt 1/6 of an inch thick, subjected to the strain which I have given as a safe rule (55 lbs. per inch in width) when touching ½ of the circumference of the pulley, will adhere ½ lb. per square inch of the surface contact; or if the belt touches ¼ the circumference of the pulley, the adhesion will be ¼ lb. per square inch of contact, and so on.

Mr. Evan Leigh, C.E., of Manchester, Eng., gives the following rule for finding the horse power that any given width of double belt is capable of driving: Multiply the number of square inches of belt contact on the smaller pulley by one-half the velocity of the belt in feet per minute and divide the product by 33,000, and the quotient will be the horse power. Mr. Leigh also gives a rule for finding the proper width of double belt for any given horse power. Multiply 33,000 by the horse power required and divide the product, first by the length of contact in inches on the smaller pulley, and again by one-half the speed of the belt, the quotient will be proper width of belt.

Now, if these rules (which the author devised some 20 years ago) can be compared with the single straps as at present used in mills, it will be found that they considerably overshoot the mark; yet single belts, being so much weaker and more liable to stretch than double ones, ought to have less strain upon them. The secret of wide double driving belts running so mysteriously long without attention will at once be seen, when it is considered that single belts are generally made to do two or three times more than they ought to do for their width and speed.

For existing establishments where it is not convenient to alter the speed of shafting or size of drums, in driving machines with single straps, the following rule will come nearer to actual practice: Multiply 33,000 by the horse power required and divide the product, *first by* the length in inches covered by the belt on the smaller pulley, and again divide by the speed of the belt in feet per minute; the last quotient will be the proper width for a single belt.

This, and more than this, is what *single* belts are made to do when driving machinery. Comparatively, then, the strong double belts, working as per first rule, have exceedingly light work, which can be done with great ease while running in a slack state. Hence their durability, and the *nearer* a user of belts can approach the rule given for *double* belts, *the longer* his straps will last.

To determine the strength and size of a belt, find first the amount of labor to be performed by it. This labor is its tension with velocity. If a belt passes over a 3 foot pulley which makes 100 revolutions per minute, its velocity will be: $100 \times 3 \times 3.1416 = 942.48$ revolutions per minute. Now, if this belt is to transmit 2 horse power, its tension on the pulling side will be: $\frac{2 \times 33,000}{942.48} = 70$ lbs. In this case it is assumed that one side of the belt is slack; if this is not the case (which in the average of practical instances may be depended on), the tension on the following side of the belt is subtracted from the above. We here see of how much more service the *horizontal belt* is than *the vertical one, for* it increases the tension by its own weight and also by the arc of contact. In most of these cases we may neglect the width of the pulley in the calculations of friction; for the strength of the belt, if sufficient to stand the tension, makes the belt wide enough for adhesion. In all cases it is advisable to make the belt sufficiently wide. No other loss arises from too wide a belt than that of first cost. If a belt is too narrow or the arc of contact too short, the tension must be increased in order to afford *sufficient* adhesion to the pulleys.

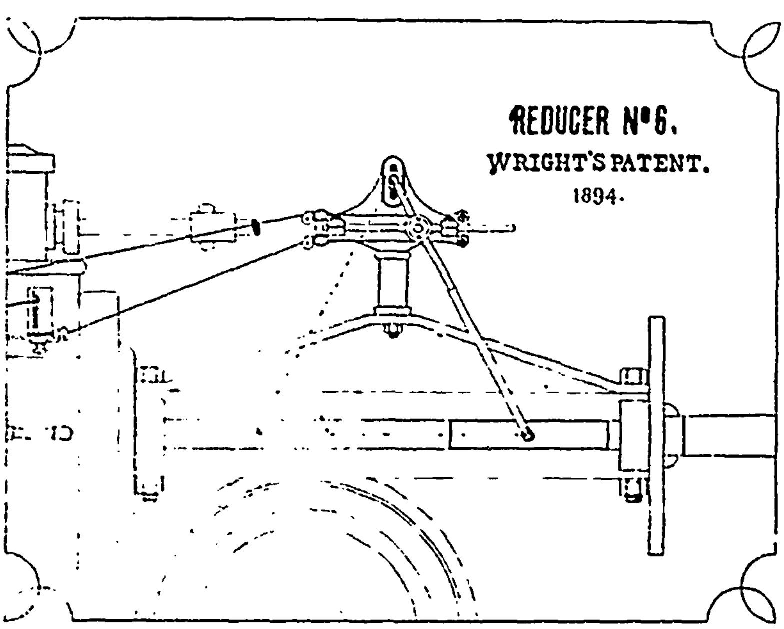
Short belts are very disadvantageous and so are vertical ones; they always require more tension than either long or horizontal ones. Those which are too narrow will stretch, in consequence of which tension and adhesion are diminished.

The adhesion of leather upon smooth surfaces is greater than upon rough surfaces, and for this reason pulleys ought to be made perfectly sound and smooth. Frequently we see the surface of pulleys convex in order to prevent the running off of the belt, but this convexity must be very small, or it will diminish the adhesion.

It is of great importance that a belt should be of such a length that it will adhere to the pulley enough to prevent it from slipping without the necessity of putting on the belt so tight as to wear the bearings. Every belt, to run easy and well, should be so slack when running that the slack side should run with a wavy, undulating motion, without any tension except on the working side; and when belts will so run without slipping on the pulleys, they wear for a great length of time, for although a belt may be heavily loaded, yet if at *every revolution* it can have an opportunity for relief from its tension so as to contract back to its natural texture, it will prevent it from breaking by the stress upon it. But if it be kept constantly strained to its greatest extent on both sides of the pulleys it will wear but a *short time* and will soon be destroyed.

A NEW REDUCING GEAR FOR INDICATOR USE.

THE readers of mechanical publications will have observed that in late years much attention has been paid to the details connected with the use of the steam engine indicator. All of the usual forms of reducing gear have been condemned, some from error in principle and some from error developed in use. Many engineers have contented themselves with a pine lever swinging on a wood screw, and some apparently thought that any backward and forward movement was good enough to communicate the motion of a piston to the paper barrel of an indicator.

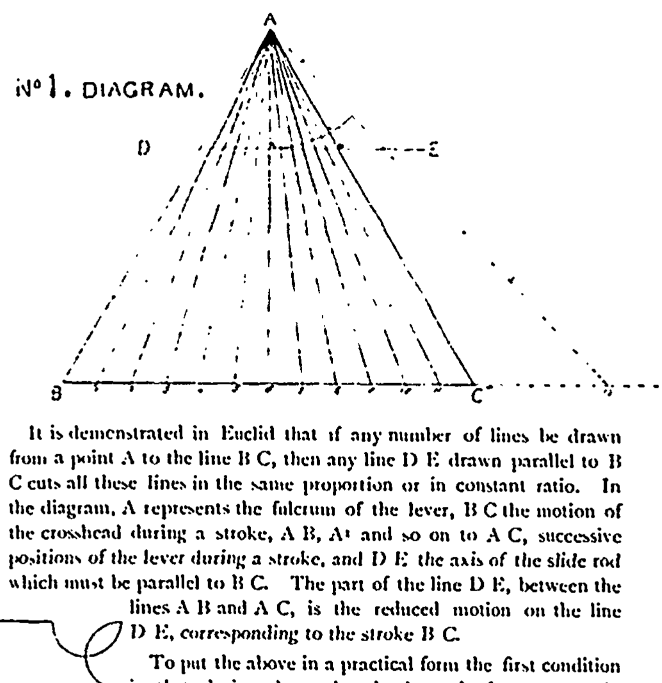


The development of the compound engine was probably the first event which directed the close attention of engineers to this subject. A certain amount of *possible error may be tolerated in engines of small size*, but in the case of engines of such size and power that a difference of one pound in the mean effective pressure made a difference of 75 or 100-*horse power in the work done*, it became evident that accuracy in every detail was essential in order to arrive at reliable conclusions.

Following the application of the steam engine for generating electric currents, the electrical engineer in establishing the relations between the first mover and electric energy, required a precision and durability which at first was considered impossible of attainment. It must be acknowledged that the makers of indicators have kept abreast of the demands, while the reducing gear remains a poor complement.

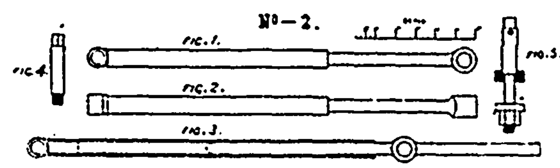
The pantograph and lazy-tongs were in favor for a long time, but now it would be a rare thing to hear an observant engineer say a word in *their favor.* As a geometrical question they are correct in principle but short lived in use, losing truth from the effects of wear in the numerous joints, and in best condition they are unfit for high speed in revolutions.

In the *improved device, herewith illustrated, the reduced reciprocating* motion for operating the paper barrel of an indicator is obtained from a sliding rod, which is actuated by a lever swinging on a fulcrum, *the other end following the motion of the cross-head* or other suitable point. The conditions under which a swinging lever must act on a sliding rod in effecting a true reduction of the motion of a piston is best illustrated by the diagram.



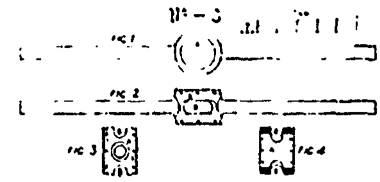
It is demonstrated in Euclid that if any number of lines be drawn from a point A to the line B C, then any line D E drawn parallel to B C cuts all these lines in the same proportion or in constant ratio. In the diagram, A represents the fulcrum of the lever, B C the motion of the crosshead during a stroke, A B, A[1] and so on to A C, successive positions of the lever *during* a stroke, and D E the axis of the slide rod which must be parallel to B C. The part of the line D E, between the lines A B and A C, is the reduced motion on the line D E, *corresponding to the stroke* B C.

To put the above in a practical form the first condition is, that during the stroke the lever is free to alter in length, as required by the varying distance between the fulcrum and the driving point on the crosshead. This is accomplished by a rod sliding in a tube, the common telescopic connection.

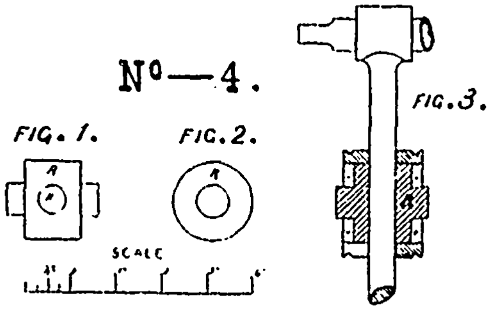


Figures 1 and 2 are front and side view of the lever. The pin (Fig 4) connects the tube end of lever with the crosshead, the fulcrum pin (Fig. 5) passing through the eye on end of rod. *In Fig. 3 the fulcrum* is intermediate.

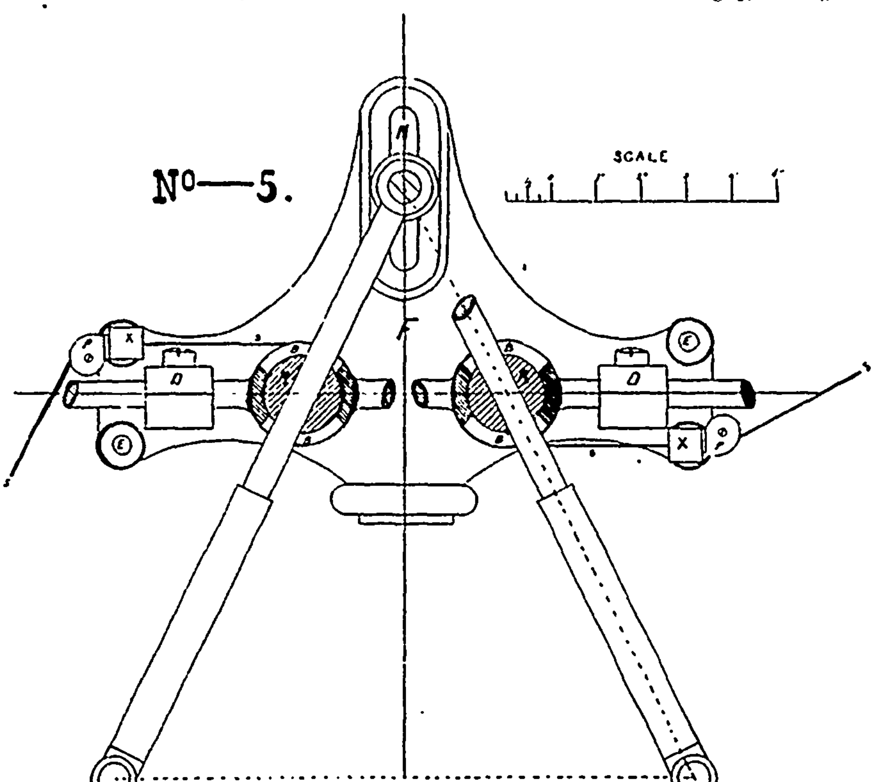
The second condition is that to maintain a constant ratio in all positions *between the length of the lever* and the distance between the fulcrum and the axis of the slide rod, the point on the lever which actuates the slide rod must shift its position during a stroke and always be on the line D C or some line parallel to it. This is effected by a sliding contact of the lever, with a cylindrical piece called the rocking slide carried in a case on the slide rod.



Cut No. 3 is the slide rod; Fig 1, a front view, showing the circular case A; Fig. 2, a plan; Fig. 3, an end view; and Fig. 4, a section of the case.



Cut No. 4 is the rocking slide R. Fig. 1 is a side and Fig. 2 an end view. Fig. 3 is a section of the case and rocking slide, with the fulcrum end of the lever in position.



Cut No. 5 is the frame F, carrying all the moving and stationery parts in position, with the lever in two positions and case and rocking slide in section. As seen in cut 5, the slide rod is held in position by the slides D D as shown in cuts 4, 5 and 6, the rod of lever passes diametrically through the hole H in the rocking slide, and the slots B B in the case. The lever is free to slide in the rocking slide; the slots permit the required angularity of the lever during a stroke, and the consequent roll of the rocking slide in the case.

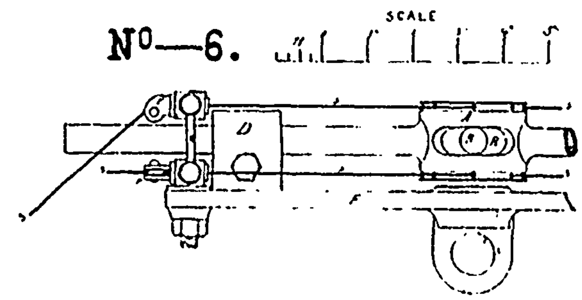
Referring to diagram, cut 1, all points on the rod of lever when working describe arcs with A as a centre. The point K on the lever coincided with the line D E when the lever stood in position A6. In the position A C the point K is at L, the rod having slid the distance L M through the rocking slide and case, and the point on the lever actuating the slide rod has been transferred on the lever from L to M, and in all positions is found on the line D E with the axis of the rocking slide intersecting the same point.

In this manner the geometrical conditions to communicate a true reduction of the motion of a piston during a stroke to a sliding rod is complied with, and the velocity ratio between crosshead and slide rod is constant and invariable. On diagrams taken by this motion the points of admission, cut-off, exhaust and compression are accurately laid down, the form of the expansion curve is not distorted and can with confidence in the results be compared with a hyperbolic, a saturation, or an adiabatic steam curve.

The fulcrum is adjustable in the slot N, cut 5. By this means long or short diagrams can be made as desired.

It is preferable, but not necessary, that the lever at mid-stroke be at a right angle to the piston rod. In diagram, cut 1, the line A12 is cut by D E in the same ratio as the others.

In conjunction with the adjustment of the fulcrum in the slot N the lever may be of any convenient length, but in its position of least length should not be less than ⅞ of the stroke. In cases where extreme variations in the length of stroke are to be met the tube of lever is made in two or more pieces, buckled together in the ordinary manner.



Cut No. 6 is a detail of the string operation. Strings S S may be led from the ends of the slide rod, but preferably from the case. Referring to Fig. 3, in cut 4, it will be seen that the case is wider than the contained rocking slide, and that from circumferential grooves cut on *the exterior string holes* are drilled to the interior where it is not covered by the rocking slide. The strings are held by knots in the interior of the case, and may if required be led in the groove to a point where it leaves the case, at a tangent *parallel to the* slide rod. This parallelism is constantly maintained on the frame F by pulleys P turning on a stem that is held in standards X set in the holes H in the frame, the axis of the stem and the groove of sheave coinciding *with the line of* the string. When properly set, the strings after passing the sheaves go direct to the indicator at any angle. In this manner four or more indicators can be operated at the same time from one reducing gear. *In the case of* engines which should not be stopped reserve strings may be reeved in empty holes and used if a working string breaks. In cases where the strings would be objectionably long, and errors or irregularities be introduced by its deflection or unsteadiness, the slide rod is lengthened to the extent required with a piece of cold drawn tube buckled to the end of the slide rod.

It will be observed that the device between the operating strings and the crosshead is a combination of three rocking and four sliding contacts, and contains in a straight line the principle of the pantograph, with true action limited to parallel lines.

It worked steady, and diagrams were of uniform length at slightly over 400 revolutions per minute, the highest it has been applied to. It is in use in the largest steam using establishments in this country, and is peculiarly adapted for lighting and power stations and locomotives.

There are four permanently erected on engines in *the lighting and* power stations of the Royal Electric Co., Montreal, where they have worked day and night as required for the last five months.

The elevation of design No. 6 shows it erected on a locomotive with a four bar slide. Manufactured at the Reliance Works, Darling Bros., Montreal.

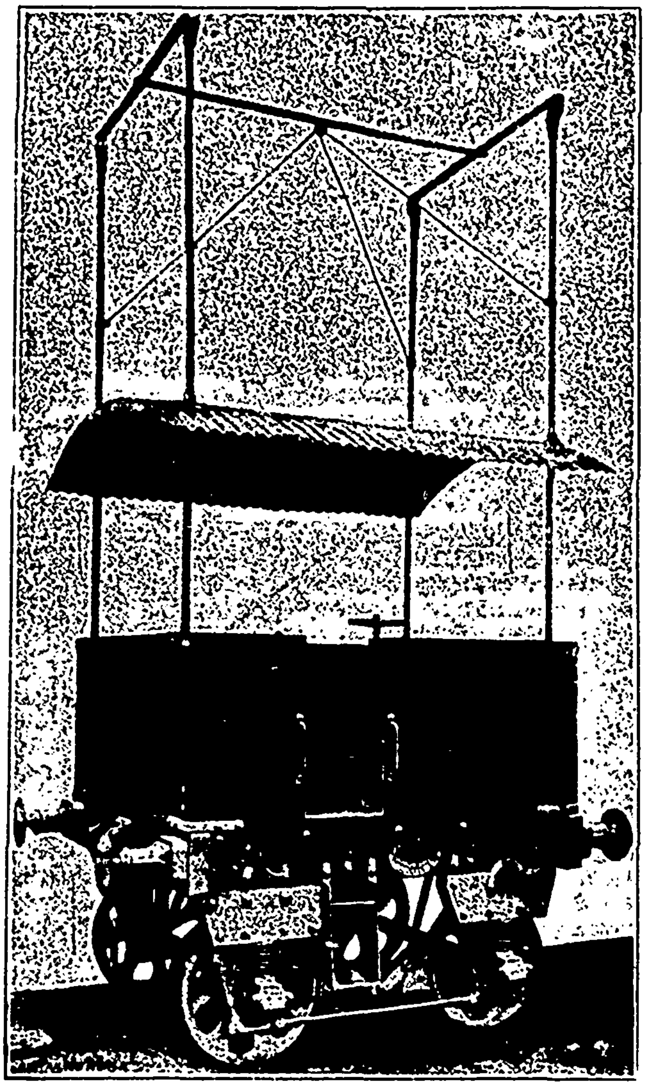
The Dunnville Electric Light Co., Limited, have decided to erect a power station, and to install an incandescent lighting plant of 1,000 lamps capacity. The last annual statement of the company shows a surplus of $7,117, equal to 13 per cent on the capital.

The municipality of St. Laurent, has granted a thirty years exclusive lighting and railway franchise to the Montreal Park & Island Railway Co. The company guarantee to have an electric road in operation by the end of the present year. St. Laurent is one of the largest municipalities on the island of Montreal, embracing an area of over 54 square miles

ELECTRIC RAILWAY DEPARTMENT.

AN ELECTRIC SHUNTING LOCOMOTIVE.

Whatever opinion may be held of the applicability of electricity to heavy railway work at the present time, there can be no question that it is eminently suitable for light service. We have on several occasions emphasized its advantages for light shunting work or for conveying goods cars to the main lines from manufactories or other points of supply situated at some distance therefrom; and in the issue of this journal for September, 1893, we described two electric locomotives constructed for such service in America. At that time there was, we believe, no similar service performed in this country; but we are now able to give some particulars regarding a plant that for some months has been constantly employed at the textile machinery works of Messrs. Tweedales and Smalley, Castleton, from whom we learn that the entire installation has worked admirably. Although the service is very light, it is hardly necessary to point out that, were it required, a locomotive of much greater power could be provided; and wherever locomotive power is needed at private works possessing a stationary power plant, there is probably no method of obtaining motive power more conveniently and economically than by the addition of an electric generator and the construction of an overhead wire system. The interest of the arrangements now to be described arises chiefly from the hint which they convey of possibilities, for the locomotive is designed to draw a loaded wagon not exceeding twenty tons weight at a speed of about two miles an hour. It is used for shunting wagons on a siding connecting the boiler house and delivery stores of the textile machinery works with the main line. The electric generator, which is of the patent Manchester type, is designed for an output of 100 volts, 54 amperes, at 1,100 revolutions per minute, and is driven off the main shafting in the works. It is fitted with fast and loose pulleys, so that it can be stopped when not required. The current is conveyed from the generator along the top of the engine-house to the overhead wires, and returns through the rails, which are bonded with copper strips and rivets.



ELECTRIC SHUNTING LOCOMOTIVE.

The locomotive, which has been designed and constructed by Messrs. Mather and Platt, Limited, of the Salford Iron Works, somewhat resembles an ordinary goods wagon. It is fitted with coil spring buffers of the standard height and centres, axles boxes, and guides, and hand screw breaks with wooden break blocks bearing on the car wheels, which are 28 inches in diameter. The locomotive is roofed in with galvanized corrugated iron carried on wrought iron pillars. These continue through the roof and carry the collector bars.

The driving motor is also of the Manchester type, and is mounted on a cast iron bed-plate which slides on cast iron brackets bolted to the framing of the car. The motor is fitted with a vulcanized fibre pinion with steel end plates of 21 teeth, which gears with a cut cast iron wheel of 72 teeth on the gudgeon shaft, on which is keyed a chain pinion of seven teeth, driving a chain wheel of 22 teeth. The latter is split into two halves, and is fitted to one axle of the locomotive. A sand box is provided, and the car is fitted with a controlling switch, resistance box for starting and regulating the speed, and a reversing switch. The weight of the locomotive is 3 tons, 0 cwt., 9 qrs.

The system of collectors on the locomotive lends itself particularly well to the requirements of this line, as there are many points, curves, and crossings. The system consists of two wrought iron bars placed about 6 ft. apart, one of which is always rubbing on the under surface of the overhead wire. This system is controlled by Messrs. Mather and Platt's patents, and has lately been used on an extended scale on the Douglas and Laxey Electric Tramway, of which a description was given in a recent issue of this journal.

As the locomotive is only required for two or three hours each day at odd times, it will be at once seen that a very great saving is effected by using an electric locomotive in place of steam, as the generator is simply started whenever it is required. As an ordinary labourer looks after the entire plant, including an overhead electric travelling crane, supplied by Messrs. Mather and Platt, to lift three tons, and worked from the same generator dynamo as the locomotive, the cost for attendance is also small.—Railway World.

SPARKS.

Several extensions will be made to the lines of the Ottawa Street Railway Co., during the present year.

A movement is said to be on foot to extend the Peterborough Electric Street Railway to Lakefield, a distance of nine miles, using the G. T. R. Co.'s track.

Mr. Fowler, of Carleton Place, who is the chief promoter of the Perth & Lanark Electric Railway scheme, states that the enterprise will shortly assume practical shape.

The Metropolitan Railway Co., of North Toronto are seeking power from the Legislature to operate their system on Sunday, for the alleged purpose of carrying milk to the city. It is said to be the intention of the company to extend their line during the present year, and to actively engage in the handling of freight for the Toronto market.

As forshadowed in our last number, a company to be called the Halifax Electric Tramway Co., Limited, has been incorporated to acquire the ownership of the Halifax Street Railway system. The promoters of the company are H. M. Whitney, of the Dominion Coal Co., G. B. M. Harvey, Boston, James Ross, Montreal, M. Dwyer, David McKeen, J. Y Payzant, Allan Haley, Thos. Lynch, A. Burns and W. C. Ross, Q. C., Nova Scotia.

The New Westminster & Bying Inlet Telephone Co. of Vancouver, B. C., of which Mr. H. W. Kent is manager, have secured control of the telephone system at Rossland, B. C. It is the intention to extend the system to all the leading mines in the neighborhood, and there is a possibility that a line will be built in the near future to Northport. A new building is under construction, and is about ready for occupation. The local management will be in the hands of Mr. G. A. Smith.

ENGINEERING NOTES.

It is of course necessary to have a set of heavy fire tools in every boiler room for the purpose of handling heavy fires, but there should also be a set of light tools there, for in many places the latter may be used to advantage during a large portion of the time, thus saving much labor on the part of the fireman. Do not compel him to use a hoe that weighs 75 pounds, more or less, to draw the ashes out of the ash pits, when a much lighter one will answer every purpose.

When buying gaskets with which to pack man-hole or hand-hole covers on steam boilers, be careful to select those that are soft and tough, and not too thin, for the inside of the heads where these are to be used, and also the covers themselves are frequently anything but smooth and true, and the gaskets must "fill the gaps" as it were.

It is a good idea to have extra man-hole cover guards on hand, so that if one is broken on Sunday or some holiday when it may be difficult to procure another, no loss of time will be necessary. Especially should this be attended to in plants that are located at a distance from foundries and machine shops.

In case of accident to the feed pump, or any part of the boiler which makes it necessary to reduce the temperature at once, it is much better to cover the fire with damp ashes or fresh coal, rather than to attempt to draw it, for when a fire is disturbed it gives out an intense heat for a few minutes.

It is a good idea to be as economical as possible in the use of oil, but it does not pay to attempt to run an engine with an insufficient quantity of cylinder oil, for not only will the cylinder be ruined, but you will use extra oil enough to much more than pay for all the cylinder oil needed.

Always have a sight feed oiler located where it will drop oil on the piston rod as it travels back and forth, for it lessens friction, saves wear on the rod, and makes the packing last much longer. This applies to both fibrous and metallic piston rod packing.

In laying out the holes in a belt for the lacing, do not get them too near together, for while this practice makes the finished lacing stronger, it makes the belt weaker on account of the large amount of material cut away in making the holes.

After cleaning boilers do not screw up the nuts on the man hole and hand-hole covers any tighter than is necessary, for you may break the guards or dogs that hold the covers in place, and cause yourself much trouble.

When wiping up the engine be constantly on the watch for loose set-screws, keys, nuts and pins, for by attending to this simple matter, many an expensive shut down has been avoided.

When fitting grate bars to a furnace do not make them too tight a fit, for expansion by heat must be provided for, or else the bars or furnace will be ruined.

When setting a boiler, pieces of common steam pipe, say about one inch in diameter, should be built into the outside walls in such a way that they will allow the air in the space between the two walls to escape when the heat expands it, and also allows it to enter this space when the boiler cools off.

Try gauge cocks often and keep them in perfect order, for you cannot tell how soon the gauge glass will leave you in the lurch, unless you have them to fall back on.

Asbestos packing for valve stems and similar purposes is much improved for use by oiling it well with cylinder oil before putting it into place.—Power and Transmission.

PUBLICATIONS.

The March "Arena" is a good representative number of this alive and progressive magazine, which, whatever may be said of contemporary literature in general, is certainly showing no decline in vitality and virility with the progress o the New Year.

Students of telegraphy will be interested in knowing that a useful work on their behalf has lately been published at 29 Ludgate Hill, London, E. C., entitled "The Telegraph Guide to the New Examinations in Technical Telegraphy," by James Bell, A. I. E. E. The questions therein will be found useful by the student in testing his knowledge. The price of the book is 1 s. 6d.

"The Engineers' Annual" is the title of a hand-book for Canadian marine engineers, issued by the Canadian Marine Engineers' Association. The name of Mr. O. P. St. John appears on the title page as having been the compiler of the book, which we regard in itself as a guarantee of the accuracy and value of the contents. The book is meeting with a ready sale at $1.00 per copy.

MOONLIGHT SCHEDULE FOR APRIL.

Day of Month.	Light.	Extinguish.	No. of Hours.
	H.M.	H.M.	H.M.
1......	P. M. 11.20	....	5.20
2......	....	A. M. 4.40	
3	A. M. 1.20	" 4.40	3.20
4......	" 2.00	" 4.40	2.40
5......	" 2.40	" 4.40	2.00
6......	" 3.00	" 4.40	1.40
7......	No light.	No light.	
8	No light.	No light.	....
9......	No light.	No light.	...
10......	P. M. 7.00	P. M. 9.20	2.20
11......	" 7.00	" 10.30	3.30
12......	" 7.00	" 11.40	4.40
13......	" 7.00	A. M. 1.00	6.00
14......	" 7.10	" 1.40	6.30
15......	" 7.10	" 2.30	7.20
16......	" 7.10	" 3.00	7.50
17......	" 7.10	" 3.30	8.20
18	" 7.10	" 4.00	8.50
19......	" 7.10	" 4.20	10.10
20	" 7.10	" 4.20	10.10
21......	" 7.10	" 4.10	10.00
22....	" 7.20	" 4.10	9.50
23	" 7.20	" 4.10	9.50
24.....	" 7.20	" 4.10	9.50
25.....	" 7.20	" 4.10	9.50
26.....	" 8.00	" 4.00	8.00
27......	" 9.10	" 4.00	6.50
28......	" 10.20	" 4.00	5.40
29......	" 11.00	" 4.00	5.00
30......	" 11.20	" 4.00	4.40
		Total.	170.10

Where the valve stems of Corliss or other engines are fitted with stuffing boxes for fibrous packing, it should be renewed at intervals and not be allowed to remain in place until it becomes so hard that it will no longer do the work for which it was intended.

CANADIAN GENERAL ELECTRIC CO.

(LIMITED)

Authorized Capital, $2,000,000.00.
Paid up Capital, $1,500,000.00.

HEAD OFFICE:

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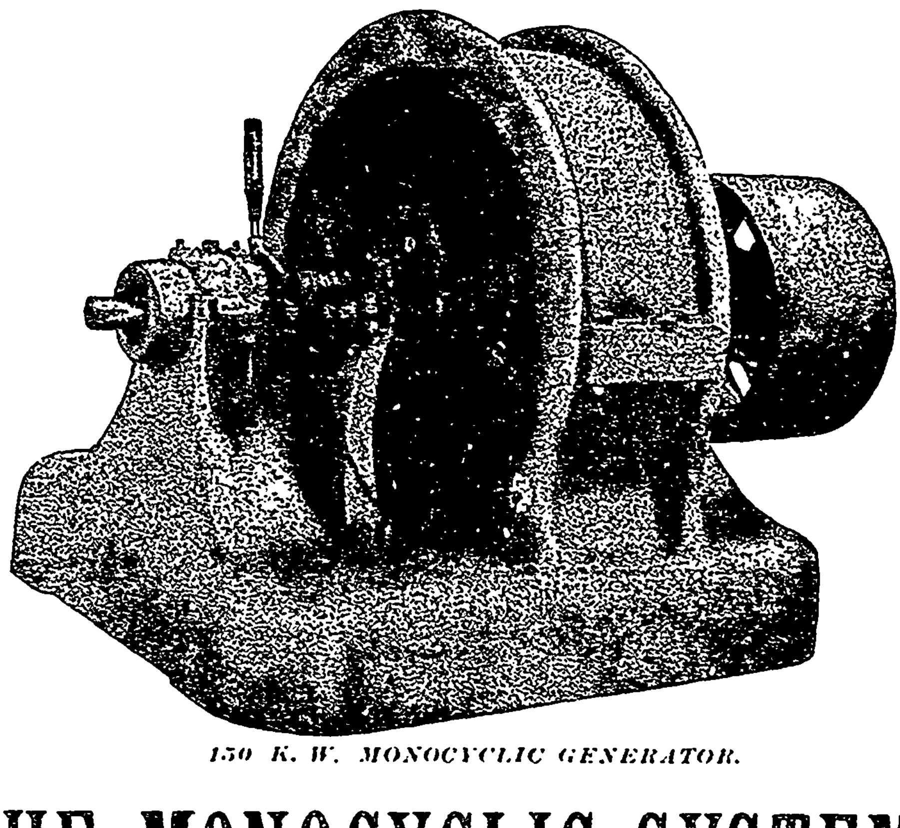

150 K. W. MONOCYCLIC GENERATOR.

THE MONOCYCLIC SYSTEM

FOR LIGHT AND POWER.

A Complete Central Station in one Machine.

THE incandescent and arc lighting circuits are operated on the ordinary single-phase system, thus avoiding the complications and difficulties in maintaining a balance attendant on the use of a polyphase distribution. Our induction motors operate as successfully on the Monocyclic as on the three phase system, but with the advantage that the third, or power, wire need only be taken to those points at which power is to be supplied.

SPARKS.

Work is proceeding on the construction of a telephone line from Moncton to Hopewell Cape, N. B.

A company is said to be in progress of formation, to supply electric light to the Parish of St. Rommand, Que.

The Mattawa Electric Light & Power Co., Limited, has been empowered to increase its capital stock from $10,000 to $30,000.

It is said to be the intention of the Kingston Light, Heat & Power Co., to make considerable additions to their steam and electric plant.

The town council of Magog, Que., are negotiating with the Dominion Cotton Mills Company, to supply electric light for the streets of that place.

An offer of $175,000 for the St. Catharines & Niagara Central Railway, is said to have been made recently on behalf of the Hamilton Radial Railway Co.

The Water & Light Committee of the city council of Vancouver, B. C., have resolved to call for tenders for both incandescent and arc lighting, for terms of five, seven or ten years.

It is said to be the intention of the Welland Electric Light & Power Co., to remove their plant to the American side of the river, for the purpose of obtaining cheap power from the hydraulic canal.

Mr. J. H. Eckert, formerly local manager of the Bell Telephone Co., at Brantford, has been transferred to Windsor, and Mr. D. Roberts, of St. Catharines, has been appointed local manager at Brantford.

Incorporation is being sought for by the Sault Ste. Marie Pulp & Paper Co. Amongst other things, the company ask for power to construct and operate an electric railway or railways. The capital stock is placed at two million dollars.

It is reported that the necessary equipment is being purchased for the construction of a new metallic telephone circuit between Montreal and Toronto, which will be in every way the equal of the famous long distance line between New York and Chicago.

The Niagara Falls, Ont., Electric Light Co., is said to be asking for a ten years franchise, in consideration of which they will agree to furnish arc lights at $28.50 per annum, instead of $35.00 as at present. The company's present contract with the municipality has yet three years to run.

Mr. J. C. Mullin was presented with a purse of gold by his friends in Ottawa, previous to his departure for Valparaiso, Chili, where he proposes to engage in the electrical business. Mr. Mullin was foreman of the Ottawa Car Works.

Incorporation has been granted to the Victoria, Vancouver & Westminster Railway Co., for the purpose of constructing a line from near Garry Point on the Fraser river, through Richmond South, Vancouver and Burnaby to Westminster.

A charter of incorporation has been granted by the Ontario Legislature to the London Radial Electric Railway Co. which proposes to build lines to Woodstock, St. Thomas, Port Stanley, Aylmer, Strathroy, Deleware, Lucan, St. Mary's and other places.

The Canadian Locomotive & Engine Co., of Kingston, are understood to be negotiating with one of the largest electrical supply companies in Chicago, for the establishment of a Canadian branch at Kingston. The company have also secured the right from a German firm to manufacture gas engines.

The annual report of the Niagara Falls Park & River Railway Co., for the year 1894, shows the receipts to have been $62,481, as compared with $58,064 the previous year. The operating expenses, (including $10,000 for advertising), were $42,994, as compared with $34,136 in 1893. The number of passengers carried during the year was 479,710.

The Berlin and Waterloo Street Railway is to be immediately converted to the electric system. Mr. E. Carl Breithaupt, of Berlin, has been appointed consulting engineer for the work, and is at present preparing the necessary plans and specifications. A contract has been made with the Berlin Gas and Electric Company to supply the power for the operation of the road.

Robert Conroy and John C. Nelson, Aylmer, Que., Wm. Jackson, Dennis, of Ottawa, will apply for incorporation under the name of "The Deschene Electric Company," for the purpose of constructing and operating works for the production of electricity for light, heat and power, and to distribute and sell the same in the town of Aylmer, and in other places in the county of Ottawa, and in the township of Nepean and the city of Ottawa, in the province of Ontario. The headquarters of the company is to be at Aylmer, and the capital stock to consist of $60,000, divided into 600 shares of $100 each.

The promoters of the Hamilton Valley City & Waterloo Railway are said to have had much of the necessary surveying for the line done, and arrangements made to commence construction immediately should the charter for which application has been made to the Legislature be granted the company.

Application has been made to the Ontario Legislature for the incorporation of the Niagara Falls Electric Street Railway Co., with a capital stock of $250,000 to construct a street railway and to supply electricity, for light, heat and power in the municipalities of the town of Niagara, the village of Niagara and the town of Stamford, Ont.

The corporation of Bracebridge have recently exchanged the 1,000 light alternator installed by the Canadian General Electric Co. last fall for a 2,000 lighter of the same type. This increase was necessitated by the phenomenal increase of their private lighting, the number of incandescents now installed in the town with a population of about 2,000, being something over 1,800.

The Mattawa Electric Light and Power Co. have decided to establish an alternating power service, and for this purpose have purchased from the Canadian General Electric Co., a one hundred horse power generator of their new monocyclic type. The power will be transmitted from the company's power station at McCool's Mill, a site to the town of Mattawa, a distance of some three and one half miles.

Mr. C. H. Stickles has presented to the City Council, of Victoria, B. C., a lengthy report on the present condition of the new electric lighting plant. The report goes to show the the lighting system has in many respects been poorly constructed and loosely managed, and that owing to the fact that the council expended $7,000 above the estimate on a site for the power station, the capacity of the station has been reduced by 65 lights, and it has been necessary to retain two systems of lighting the Ball and Wood instead of one. The report says no system has been hitherto followed in handling supplies, which has resulted in unnecessary waste and destruction of property, and suggestions are made to remedy this defect.