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CANADIAN
ELECTRICAL NEWS
AND
STEAM ENGINEERING JOURNAL.

VOL. II. TORONTO AND MONTREAL, CANADA, SEPTEMBER, 1892. No. 9.

THE BELL TELEPHONE COMPANY'S NEW EXCHANGE, TORONTO.

THE Toronto offices of the Bell Telephone Co. have been removed to the Company's new building on Temperance St., but the removal of the operating room will not take place for some months, pending the completion of the new switchboard which is at present in course of manufacture at the Company's workshops in Montreal.

A recent inspection of the new building, which is nearing completion, shows it to be a most substantial structure, and designed in the best possible manner to meet the requirements. The building is stone and brick, three stories in height, and is said to be the only thoroughly fire proof structure in the city. The outer walls are 4 ft. thick at the base, and about 3 ft. thick above the foundations. The inner walls are of brick, and are supported by steel girders encased in hollow fire brick. The first and second floors are tiled, as also the lower portion of the walls of first and second story and of stairway. The only part which would be affected by fire would be the door and window frames as even the partitions dividing the various offices are of porus terra cotta. The wood work throughout is of cherry, and presents a rich appearance.

Half of the basement is occupied by the cables, which are brought in through a large manhole beneath the sidewalk; these cables will number about 125. Each of them will contain 100 wires, thus meeting the requirements of the exchange, which is designed to serve 5000 subscribers. These cables pass up through the floor above to terminals in the distributing room, from which the wires are carried beneath a false floor to the distributing rack, and from thence back beneath the floor and through a shaft to the switchboard. The remaining portion of the basement is occupied with the steam heating apparatus and for storage purposes.

Immediately to the left of the main entrance is a pleasant room which is to be fitted up as a reception room, and adjoining it will be the long distance telephone department; on the same floor are the store room, repair shop, testing room and lavatories.

The second floor is reached by an iron stairway having marble steps. The manager's office is located on this floor at the front of the building, immediately across the hallway being the public office and the offices of bookeepers, stenographers, etc. On this floor are the offices of the superintendent, a large battery room and a lunch and cloak room for the operators. The cloak room is provided with double lockers, each locker being divided for two operators.

On the third floor will be the operating room, around three sides of which will extend the switchboard, which will embrace every improvement which has been perfected up to the present time. The room is perfectly lighted by a large skylight. In the centre will be situated the chief operator's desks. There has been provided a second iron stairway, leading from near the centre of this room to the floor below, designed to afford an easy means of egress in cast of fire.

Everything is as yet in an incomplete condition, but it is safe to say that when all arrangements are perfected, the Bell Telephone Exchange in this city will be equalled by few and excelled by none on this continent. It is the Company's intention to erect shortly a storage warehouse, where all its supplies will be kept. The quantity of supplies required to be kept on hand for constantly extending the system and for repairs, is very large, as may be judged from the fact that the regular order for wire amounts to 150 miles per month. It is the intention also to erect, in the near future, branch exchanges in East Toronto and Parkdale. The Company give employment in this city to 250 persons.

The following extract from the last annual report of the City Engineer of Toronto, will serve to show the extent of the Company's operations in this city:

"From the manager of this branch, Mr. Dunstan, I have been furnished with the following statistics: As an essential feature of their reconstruction work in the central portion of the City, they have erected a new and central Telephone Exchange building on Temperance Street, at a cost in the neighborhood of $60,000, and it is in every way a thoroughly satisfactory, substantial and fire-proof Telephone Exchange. During the past five months the Company have moved their Yorkville branch to the south-east corner of Yonge and Bloor Streets, and have now at that place a thoroughly modern Exchange, equipped with a metallic multiple switch-board capable of serving 3,000 subscribers. The wires are all brought in under ground to this office to cable terminals which are supplied with the best lightning and electrical arresters. In order to carry out this underground service and comply with the terms of their agreement with the City, the Company have placed a number of poles on side streets and alley-ways, have strung over 300 miles of wire, 300,000 lineal feet of aerial cable, and have brought into use over 31,830 feet of under ground-cable. They have supplied "second" wires to about one-sixth of the total number of subscribers in Toronto, thus giving them the great advantage of quiet metallic circuits, free from noise caused by electric induction. While this work of moving the Telephone Exchange has been going on, the Company on an average have put in about 100 new connections a month, each one of which necessitates the erection of outside line and interior wiring. There are now laid in Toronto 16,183 lineal feet of this Company's under ground conduit, which contains 310,537 feet of duct, each duct being intended for one cable. This amount is made up as follows: 64,857 feet 2½ inch Macdonald duct; 55,312 feet 3 inch Macdonald duct; 190,368 feet 3 inch Wychoff duct, all of which is made of a specially prepared creosoted wood imported from the United States, and in such a manner as to exclude all moisture from the cables. Forty-seven man-holes, six feet square, have been constructed in connection with this conduit system, besides the large area in front of the Company's Central Exchange on Temperance Street, which affords access to this under-ground system. In order to move into their new building on Temperance Street, and work the new metallic system, and otherwise comply with the terms and conditions of their agreement with the City, the Company have to lay about 1,400 feet of conduit, equalling 162,500 feet of duct, and for this they purpose using cement-lined iron pipe, which, though considerably more expensive than creosoted wood, will, it is believed, be more durable and satisfactory. When this is done the Company will be able to remove 784 of their poles from the streets, which now carry 3,867 cross-arms and about 1,300 miles of wire. This new construction work will necessitate an expenditure for under ground metallic line of between $175,000 and $200,000; and besides this there will be the work of erecting new distributing routes on the side streets, and building "second" lines to the 3,000 subscribers not yet having a metallic service, and the re-wiring of the interior of each one of these 3,000 dwellings or offices. Besides all this there is the moving of the main Exchange and the setting up of a complicated switch board capable of accom

modating 5,000 subscribers. This switch board is now being manufactured at the Company's shops in Montreal, and will be of iron frame board of the most modern description, and will cost in the neighborhood of $50,000. The Company have also to duplicate the construction work done in Toronto during the past twelve years, and complete it inside of the next two years. The Company have now 3,843 subscribers in Toronto, and they are about combining the Toronto Junction service with that of the City, and they also purpose building another branch Exchange at the eastern end of the City. The Company also now have in use 3,406 miles of over-head wire, strung on 97 miles of poles."

ASSOCIATION OF EDISON ILLUMINATING COMPANIES.

THE thirteenth convention of the above association was held at the Rossin House, Toronto, on August 9th and 10th. Upwards of forty delegates were in attendance, among whom were Mr. Frederic Nicholls, manager Toronto Incandescent Electric Light Co., Mr. John Langton, Canadian Works Edison General Electric Co.; Mr. M. D. Barr, District Manager Edison General Electric Co., Toronto, W. S. Andrews, General Superintendent Canadian Works Edison General Electric Co.

The proceedings, as on former occasions, were conducted behind closed doors, so that it is not possible to furnish our readers with a report of the meetings.

In view of the presence of the President and legal counsel of the General Electric Co., it may be presumed that the relation of the Edison Illuminating Companies to the General Electric Co., was up for consideration.

The Toronto Incandescent Electric Light Co., exerted itself most successfully on behalf of the entertainment of the visitors, who were treated to a moonlight excursion and luncheon, a drive round the city, etc.

The following are the officers elect for the ensuing year:

President—John J. Beggs, New York.

Vice-president—Frederic Nicholls, Toronto.

Secretary—W. J. Jenks, New York.

Treasurer—Wilson S. Howell, Orange, N. J.

Executive Committee—C. P. Gilbert, Detroit; C. L. Eager, Boston; E. R. Weeks, Kansas City; W. D. Marks, Philadelphia, Pa.; Samuel Insull, Chicago.

The place of next meeting will be chosen by the Executive Committee.

THE STEAM PUMP.*

The idea entertained by many engineers that water is raised by suction is erroneous, as, properly speaking, there is no such principle as suction. Water or other liquids are raised through a tube or hose by the pressure of the atmosphere on their surface. When the atmosphere is removed from the tube there will be no resistance to prevent the water from rising, as the water outside the pipe, still having the pressure of the atmosphere upon its surface, forces water up into the pipe, supplying the place of the excluded air, while the water inside the pipe will rise above the level of that outside of it proportionately to the extent to which it is relieved of the pressure of the air. If the first stroke of a pump reduces the pressure of the air contained in the pipe from 15 pounds on the square inch to 14 pounds, the water will be forced up the pipe to the distance of about 2¼ feet, since a column of water an inch square and 2¼ feet high is equal in weight to about one pound. Now if the second stroke of the pump reduces the pressure of the atmosphere in the pipe to 13 pounds per inch, the water will rise another 2¼ feet. This rule is uniform and shows that the rise of the column of water within the pipe is equal in weight to the pressure of the air upon the surface of the water without.

The distance that a pump will draw or lift water, as it is termed, is about 33 feet, because a column of water of one inch area 33 feet high weighs 14.7 pounds, but pumps must be in good order to lift 33 feet, and all pumps must be air-tight. Pumps will give better satisfaction lifting from 22 to 25 feet.

There are many things to be considered in locating a steam pump, such as the source from which the water is obtained, the point of delivery, and the quantity required in a given time; whether the water is to be lifted or forced directly into the boiler, or raised into a tank 25, 20 or 100 feet above the pump.

When purchasing a steam pump to supply a steam boiler, one should be selected capable of delivering one cubic foot of water per horse-power per hour.

No pump, however good, will lift very hot water, because as soon as the air is expelled from the barrel of the pump the vapor occupies the space, destroys the vacuum, and interferes with the supply of water. As a result of all this the pump knocks. When it becomes necessary to pump hot water, the pump should be placed below the supply, so that the water may flow into the valve chamber.

The most necessary condition to the satisfactory working of the steam pump is a full and steady supply of water. The pipe connections should in no case be smaller than the openings in the pump. The suction lift and delivery pumps should be as straight and smooth on the inside as possible.

When the water contains chips, shavings or sawdust, a strainer should be placed on the lower end of the pipe.

When the lift is high, or the suction long, a foot valve should be placed on the end of the suction pipe, and the area of the foot valve should exceed the area of the pipe.

A suction air chamber is a great advantage to the pump when the lift is high.

The area of the steam and exhaust pipes should in all cases be fully as large as the nipples in the pump to which they are attached.

The cylinder of steam pumps should in all cases be oiled before starting in the morning or stopping at night.

Stuffing boxes on the piston and valve rods should in all cases be kept well filled with soft and moist packing, as, if the packing is allowed to become hard and dry, it will flute the rods, inducing leakage and necessitating repairs.

The air vessel on the delivery pipe of the steam pump should never be less than five times the area of the water cylinder.

When the pumps are standing still, idle or out of service, in cold weather, all the drain, drip and pet-cocks should be left open.

* From a paper read by President Crowley at the late meeting of the N. A. C. E., Jersey City.

THE SPEED REGULATION OF CENTRAL STATION ENGINES.

By W. H. Booth.

IN *Cassier's Magazine* for May, an article appears under the above heading from the pen of W. S. Aldrich. Mr. Aldrich considers the desirability of some form of governor for steam engines, the action of which shall not be due to speed of the engine, but shall be controlled by the work to be done. There may not, it is true, appear to be much difference in the distinction here drawn, but there is very much more than at first sight is evident. In all ordinary governors there is a position of the governor which corresponds with the normal engine speed. When, by reason of load reduction, the engine begins to run faster, the governor takes up another position, being said technically to rise. In thus rising, it is made to act upon the throttle valve or other means of reducing steam supply, and it thereby prevents an indefinite acceleration; but is clear that the reduced steam supply can only be maintained by the governor being at a supernormal height, and, of course, this implies that the engine also will be above its proper speed. If a 2 per cent. increase of speed caused the governor to have such a motion that it cut down the steam supply below that necessary to run even at normal speed, there would be no steadiness of action whatever, for as soon as the engine ran slow, say 2 per cent., the governor would then turn on an excess of steam, and the fluctuations would never cease. Such a case demands that the effect upon the valve be made less by a re-adjustment of the connecting gear between governor and throttle. In the Corliss gear the same fault is introduced, for the position of the tripping cam depends entirely upon the height of the governor, and an earlier cut-off can only be secured by an addition to speed. Many years ago a Lancashire firm introduced a method of absolute governing, which combined the instant partial action of the governor upon the throttle valve, with a further mechanism for varying the cut-off valve, which was so devised, that whenever the engine revolved above or below its normal speed, certain wheel gear came into action, and through a differential motion changed the cut-off valve until the engine came back to its normal speed, the governor also resuming its normal height, and thus there was never for long any departure from best

speed. As a corollary to this effort, the Corliss valve makers were compelled to modify their Corliss gear, so that the same result was attained, and this they did by adding a second or supplementary governor, the duty of which was simply to turn a right and left screw by which was varied the length of the connection between the governor and the trip gear. By means of a piece revolving between two detents, it is easy to arrange any governor to any degree of adjustment, so that any departure from normal speed shall cause revolution one way or another of the screw sleeve. In the Corliss gear the supplementary governor did this. Supposing a change of engine speed causes a pull of, say, ¼ inch in the trip rod; the supplementary governor puts into gear a winding train, which turns in the screw sleeve in this rod untill the ¼ inch of pull has been let out again. The tripping piece being thus still held at the position it was placed in by the governor, while the latter has been allowed to fall back to position of normal speed, this supplementary action will always bring the engine to its normal. In the old Boulton and Watt days a certain percentage of speed variation was allowed and a suitable fly-wheel added.

As Mr. Aldrich points out, there is a difficulty with large engines in regulating them for sudden and heavy variation of load. In an engine of high reciprocation, say, of ten working strokes a second, the load variation can be coped with in one-tenth of a second, but with large engines where, say, for a 1,000 horse-power, a suitable quantity of steam has been admitted to the cylinder to maintain such power, a sudden decrease of 500 horse-power cannot be coped with until next stroke. In such a case with steam at cut-off for 1,000 h.p. rate at work, there would be 500 h. p. going entirely to acceleration.

It follows that for such a case we must know, or assume, the maximum and minimum loading, and, having fixed upon the speed variation which can be allowed, we must so proportion our fly-wheel weight that the maximum load variation during that portion of the stroke uncontrolled by the governor shall not set free, or absorb so much energy as to accelerate the fly-wheel beyond the allowed limit, or add to the duty of the engine more load than can be taken out of the stored energy of the fly-wheel.

For central station work, Mr. Aldrich is in favor of some kind of electro-magnetic govenor which shall act quickly upon a variation of load, and it would appear that such a governor should act by curtailing the steam supply before it would be influenced by the centrifugal governor; but even the most rapid action cannot possibly take effect after the beginning of expansion, and the problem of regulating large engines is one of the most powerful objections to their use for central station work. The power to cope with an increased load is even more difficult than that of dealing with a suddenly reduced load; for in the latter case it is quite open to us, if we do not mind wasting some of our energy, to cause the electric governor to put in action a a powerful break, but this would have no counterpart in the reverse action of sudden load increase, unless it be in some device for re-admission of steam to the cylinder after cut-off has occurred.

In respect of governing, the steam engine does not compare favorably with the turbine, either hydraulic or steam, for the turbine can be very quickly regulated, being equivalent to a steam engine of infinite reciprocation. In any station the question of engine sizes must very largely depend upon the total power to be generated if great steadiness be required, and in a station with several engines, better results may be expected than from a single engine, which may be drawn upon for the whole of the load variation.

For sudden load variation it will always be difficult to so regulate an engine as to avoid considerable departure from even mean normal speed, but for gradual changes of load the problem was solved half a century ago, in the manner described, and as has been very commonly carried out in Corliss engines, and in the Knowles supplementary governor brought out a few years ago. With these appliances the engineers of the great textile factories preserve an almost absolutely even mean speed, as evidenced by a speed recorder, and any variation in speed during each revolution in controlled by the fly-wheel inertia, With the best of governing, there must always be placed considerable reliance upon fly-wheel action, and this the small, quickly reciprocating engines do, for their small fly wheels have very considerable inertia relative to the stroke duration. The so called slow running mill engines are not really slow running as regards piston speed, and many of them might with advantage be made of higher reciprocating speed and could be, were better attention given to bearing surfaces, which could be run much tighter than they are if more truly circular, for with correct valve setting, the change of direction of pressure need not be accompanied by shock, to get rid of which is one of the objects of the design of single-acting engines.—London *Electrical Review.*

CHANGES IN THE CANADIAN PATENT LAW.

IMPORTANT amendments have been lately made to the patent act of Canada by the Canadian Parliament. Some new features borrowed from the United States patent laws are noticeable, such as the employment of examiners in the Patent Office to make a thorough examination of the applicant's title to his invention. The other material changes made are noted below.

Models of inventions or specimens of compositions need now only be furnished if required by the Commissioner of Patents. The duration of a patent is to be 18 years, with a fee of $60, with the option, however, of paying partial fees of $20 and $40 for terms of 6 or 12 years.

The inventor's oath or affirmation may be made before a minister plenipotentiary, *charge d'affaires*, vice consul or consular agent, a Judge of any court, a notary public, a justice of the peace, or the mayor of any city, borough or town, or a commissioner for taking affidavits having authority or jurisdiction within the place where the oath may be administered.

Importation of the invention into Canada after 12 months from the time of granting a patent (or any extension of such period) by the patentee, his representatives or assignees for a whole or a part of his interest in the patent, renders the patent void only as to the interest of the party importing or causing to be imported.

A federal court, the Exchequer Court, is given jurisdiction not only of all questions involving the validity of a patent but also of all questions arising as to whether any intrest therein is null and void.

A citizen of Canada electing to obtain a foreign patent for an invention, before obtaining a Canadian patent, shall have the right to obtain a patent in Canada, if the same be applied for within one year of the date of issue of the first foreign patent, the inventor gives notice to the commissioner of his intention to apply for a patent in Canada, then no other person having commenced to manufacture the device in Canada during such period of one year shall be entitled to continue such manufacture after the inventor has obtained a patent in Canada, without the consent of the inventor.

SPARKS.

Mr. Hendrie, the owner, is negotiating for the sale of the St. Thomas street railway.

A brick addition is being built to the present power house of the North-West Electric Co., Winnipeg, and two additional steam boilers installed.

Mr. F. N. Gisborne, Superintendent of Government Telegraphs, and one of the most able electricians of the day, died at Ottawa on August 27th, aged seventy years.

Messrs. H. P. Dwight, the president, and G. D. Perry, the secretary of the Great Northwestern Telegraph Co.; F. H. Waycott, the manager of the Anglo-American Telegraph Co.; Wm. Wainwright and F. Roper have given notice to the Quebec Legislature of application for incorporation under the name of the Anglo-Provincial Telegraph Co., with a capital of $25,000. This company will carry on a general telegraph business in the province of Quebec, with headquarters at Montreal.

The Merchant's Telephone Co., of Montreal, has applied for incorporation with a capital of $100,000, to do a general telephone and electric business. In order to prevent the concern from being absorbed like its predecessors by the Bell company, each subscriber for a telephone must also subscribe for $100 of its stock and also agree to take his telephone for a period of five years. The rental of a telephone has been fixed at $25 per annum, and the stock of the company having been fully subscribed, will be increased largely.

Under the direction of Mr. A. B. Smith, Superintendent, the Great North Western Telegraph Co., have recently installed as part of their battery plant, a motor generator of new and novel design. The machine has been in practical use for some time past, replacing about one thousand cells of ordinary Calland battery. The officials of the company are so well pleased with the results and the great economy effected that it is the intention to discard the use of chemical batteries and adopt dynamo currents exclusively. This is the first time that telegraph companies in Canada have adopted dynamos for battery purposes, and the new departure cannot fail to be of interest to the fraternity.

FIELD MAGNETS.

THE field magnets of a dynamo electric machine, says the *Electrical Age*, constitute one of the two of its most essential parts. The other part is the armature.

The field magnets are constructed of several parts, namely, the magnet cores (of which there are usually two), the yoke piece, the pole pieces and the wire with which the magnets are wound.

The accompanying illustration shows these various parts and the manner of assembling them to make the field magnets complete.

There are many forms of dynamos in use, but the one illustrated in the diagram is in no essential respect different to all the others.

The function of the field magnets is to create and maintain a magnetic field in which the armature may revolve. As a rule, dynamos are so built that the field magnets are stationary while the armature revolves. Some machines are made, however, with stationary armature and revolving magnets. One part *must* move, this is manifest when we think for a moment that in order to create a difference of potential in the wire of the armature, or, in other words, generate a current, that wire must cut through the magnetic lines of force in the magnetic field. This implies motion.

The material used for the different parts of field magnets is the softest iron procurable, except in the case of the wire, which

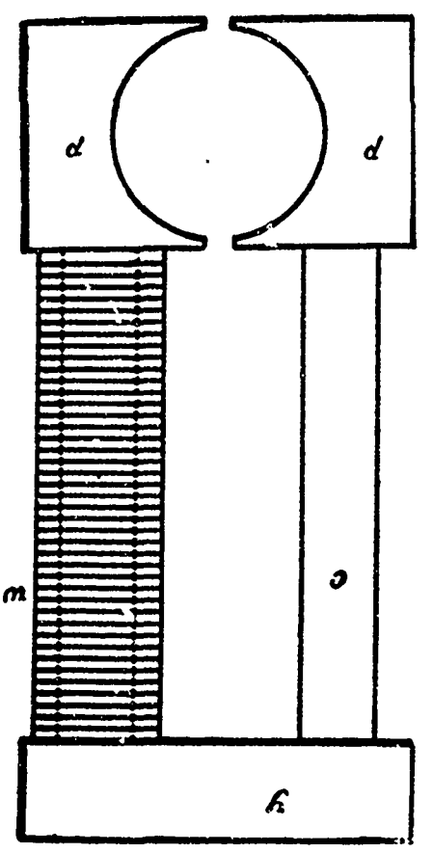

DIAGRAM OF FIELD MAGNETS
Y, Yoke. *C*, Magnet core. *W*, Magnet windings.
P, *P*, Pole pieces.

is of copper. Soft iron is used, because with it, it is possible to produce a much more powerful magnetic field than if any other quality were used. Iron is the essential metal to use always for magnets in all cases of electrical instruments on account of its high magnetic properties; that is to say, it is the best conductor of magnetism. Metals are divided into two classes with reference to their magnetic behavior, viz: magnetic and non-magnetic. Copper is classed as a non magnetic metal, while iron is the most magnetic, hence the importance of iron in the construction of magnets will be readily understood.

There are as many different forms of dynamos as there are makers—no two being alike. As the field magnets usually constitute the most prominent part of dynamos, the difference in form of machines relates wholly to the shape of the field magnets, although there are structural differences in different makes of armatures as well. These, however, are not readily noticeable to the observer.

The form of dynamo illustrated in our figure requires a yoke, the function of which is to effect continuity in the magnetic circuit. Without the yoke the magnetic field surrounding the armature would be infinitely weaker, and the machine would be practically valueless. All dynamos do not possess a yoke piece, indeed, some dynamo field magnets are constructed on the typical horseshoe form, and consequently require no yoke. The form shown in the figure is a modification of the horseshoe, instead of the curve it has corners.

The pole pieces are really enlargements of the core, so as to increase the surface of magnetic action, and are constructed with curves on their inner surfaces, so as to cover the surface of the armature as completely as possible, and yet have a break in the continuity of the magnetic circuit.

These pole pieces are really the "poles" of the electromagnet. We all know that a horseshoe (permanent) magnet is strongest at its poles; so in the case of a dynamo, the magnetism is strongest at the pole pieces, and as the lines flow from one pole to the other, according to the direction of the current flowing in the magnet wire, they must necessarily flow or act through the space between the pole pieces. As this place is filled with the magnetic lines of force, and as the wire on the armature must cut lines of force in order to effect a difference of potential, and consequently generate a current, the armature is placed in this space, or magnetic field, as it is usually called.

Concerning the magnetic field we will say more later on.

The core of the field magnets are generally made round. Some, however, are elliptical in shape. They are never made square or in any other form possessing points or corners, because such projections became "poles" themselves, and as it is essential to have all the magnetic influence concentrated at two points, namely, the pole pieces, the importance of adopting every means possible to convey the magnetic lines to these points is manifest; hence the round form is adopted for magnet cores. In the case of the yoke piece the magnetism is very weak, or practically *nil* at that part of the magnetic circuit, hence the existence of the corners makes no material difference in practical results.

The magnetism is strongest between the pole pieces and weakest at the yoke.

As to the winding of the magnets, of course, that involves many factors in its calculation, and as it is not within the scope of these articles to consider indefinite problems of this nature, we refer those of our readers who desire to go into the subject further to any one of the text-books which are now published, giving all such information. An excellent book of this class is "Principles of Dynamo-Electric Machines," by Carl Hering.

Copper wire, of course, is always used for magnet windings, It is covered with some insulating material in order to keep the windings from touching one another. The copper must be of the purest quality obtainable in order to keep the resistance down to a minimum. The size of the wire is determined by calculations based on the work that will be required of the machine.

Some dynamo field magnets are wound with two coils. Such machines are known as compound-wound dynamos.

It is important to have all joints between the parts of a field magnet very secure and reliable, so as to interpose no resistance in the magnetic circuit.

TRADE NOTES.

We have received from the Ball Electric Light Co., a tastefully printed book of testimonials from users of the Ball apparatus in Canada during the last ten years, certifying in flattering terms to its efficiency.

The Royal Electric Company, of Montreal, report the following sales during the month of July: Hamilton Electric Light and Power Company; Hamilton, Ont., one 50 light 2000 candle power arc dynamo and lamps, John Starr, Son & Co., Halifax, N. S., one 50 light 1200 candle power arc dynamo and lamps, W. S. Shaw, Huntsville, Ont., one 500 light alternating dynamo, The T. Eaton Company, Toronto, Ont., one 7½ horse power motor and 42 arc lamps. Hunt Bros., London, Ont., one 65 horse power generator and three tons of wire; The Wingham Electric Light Company, Wingham, Ont., one 500 light alternating dynamo with 300 lamps and fixtures; The Dominion Electric Company, Montreal, Que., one 7½ horse power motor, F. X. Charbonneau, Montreal, Que., one 1½ horse power motor, Messrs. Conlan & Levell, Montreal, Que., one 1½ horse power motor.

At the first annual meeting of the Ottawa Electric Street Railway a dividend of seven per cent. was declared.

CANADIAN ELECTRICAL ASSOCIATION.

A MEETING of the Executive Committee of the above association was held in Toronto, on the 8th of August. There were present, Messrs. J. J. Wright, (in the chair), K. J. Dunstan, John Yule, W. A. Johnston, D. Thomson, S. J. Parker, A. B. Smith and the Secretary. The accounts in connection with the holding of the Hamilton convention and the printing and distribution of the report of the same in pamphlet form, totalling about $200, were passed and ordered to be paid. The sum of $25 was also voted the Secretary-Treasurer to reimburse him for incidental expenses. The Treasurer reported that after paying all liabilities and the grant to himself, the balance to the credit of the Association would be $200. A discussion ensued as to the nature of the statistics to be collected by the Committee on Statistics appointed at the Hamilton convention. The opinion prevailed that data might be procured as to the cost of supplying electric light and power which would be valuable as a guide to those in the business. The matter was finally left to the discretion of the Committee, of which Mr. D. Thomson was appointed chairman. Reference was made to the fact that the Dominion Government has placed in the estimates an appropriation to cover preliminary expenses in connection with the establishment of a system of electric light inspection. The opinion was that there was nothing objectionable in the proposal, provided meters could be got to correctly record the results of the operation of the various kind of electric apparatus. The Committee discussed the question of a Canadian electrical exhibit at the World's Fair. It was deemed inadvisable to take action, principally for two reasons. First, no trade would be likely to accrue to Canadian manufacturers from such an exhibit. In the opinion of many, did any such possibility exist it would speedily be converted into an impossibility by an increase in the U. S. tariff. Secondly, the unfriendly spirit which the Government of the United States has of late exhibited towards Canada, has given rise to the feeling that the people of the Dominon, electrical and otherwise, should refrain from taking any part in the approaching World's Fair. So far as the electrical interests are concerned, it was thought to be more wise to make an effort to hold a creditable exhibit in connection with the Toronto Industrial Exhibition of 1893. The Secretary was instructed to have the constitution and by laws, as revised at the recent convention, reprinted and distributed to members. The names of several peusons were mentioned who will be asked to prepare papers for the meeting of the Association in January.

A SUGGESTION.

Editor ELECTRICAL NEWS.

SIR,—I have read with interest the report of the doings at the Canadian Electrical Association convention, and think it bids fair to be a splendid institution for those interested in the financial department of electrical business. There is one thing, however, that seems to be entirely omitted that is, the mechanical management of the business. I think there is no other business under the sun, in which the owners have to depend on their men so much as in electric lighting.

Do you not think that it would be profitable to both the proprietors and men who look after the plants, to form an association and meet in different places at stated periods. At such meetings, papers could be read, and discussed by the dynamo tenders and engineers. This, I am sure, would be of great benefit to all parties concerned. I was talking to a well-known dynamo man, a few days ago, about the matter. He said he had no interest in telephone business, and therefore would have nothing to do with the Canadian Electrical Association. The engineers have associations for the benefit of themselves, so should the dynamo men. Hoping that the matter will not drop,

I remain, yours respectfully,

A DYNAMO MAN.

[The writer of the above appears to be under a misconception regarding the character and objects of the Canadian Electrical Association. It is not designed to be an institution in the interest only of persons whose capital has been invested in electrical enterprises; nor is it designed especially to promote the telephone interest, or, in short any sectional interest. On the contrary it is intended to be an association for the benefit of all persons in any way connected with or interested in the application of electricity to commercial or scientific uses. We cannot agree with our correspondent's statement that the mechanical management of the business was entirely omitted from the proceedings of the recent convention at Hamilton, in proof of which we are able to point to Mr. Thomson's paper on "Central Stations," Mr. J. J. Wright's paper on "Steam and Electric Power," and Mr. Fisk's paper on "Carbon Manufacture," all of which contained information of value to persons charged with the care of electric lighting apparatus. The formation of more than one Association of persons representing electrical interests in Canada, is unnecessary. There is a field for the profitable operation of one such organization, but not for more than one. If the Canadian Electrical Association is lacking in its duty to any particular interest, those who have been placed in charge of its affairs will always be pleased to have their attention called to the fact, and will use their best endeavors to make good the deficiency. Meanwhile will our correspondent or some other "dynamo man," *volunteer to prepare a paper for the January* meeting of the Association, which would be instructive to others of their class? In a word, the way to make the Association of the greatest value to all is by becoming a member and then giving it the benefit of your personal ideas and effort. Editor E. NEWS.]

CORRECTION.

Editor ELECTRICAL NEWS.

SIR, I notice in an article on the C. A. S. E. picnic, published in your last issue, that Ryrie Bros. are said to have given the first-prize in the ladies' race. This is a mistake. Robin & Sadler, belt manufacturers, of Montreal, gave the very handsome card receiver which was given as first prize in the ladies' race; *it was given by the Toronto agency of the firm, to whom I think* a correction is due.

E. J. PHILLIPS,
Rec. Sec. C. A. S. E.

"THE FOREST CITY" LIGHTING STATION.

Editor ELECTRICAL NEWS.

DEAR SIR: While in London a short time ago, I visited the Forest City Electric Light plant, owned by Messrs. Hunt Bros. The plant is a frame building situated at the back of the flouring mill, of which Hunt Bros. are also the owners. The dynamo room is 30 x 40, the engine room is also 30 x 40, the boiler room 20 x 40, with a fine brick stack. There are seven dynamos of the T. & H. system, built by the Royal Electric Co., of Montreal, of the following dimensions. Four 40 lt. 2,000 c.p.; one 10 lt. 2,000 c.p.; and two 20 lt. 2,000 c.p.

These machines are wired to a Royal switch board, by the manipulation of which the load can be changed from one machine to another at a moment's notice. Their usual load is 180 2,000 c.p. arc lamps, 87 of which are private lights, the remaining 93 being city street lights. There is also in the dynamo room a nice screw cutting lathe, for making necessary repairs.

The motive power, in addition to water wheels, is supplied by a 150 h.p. and a 65 h.p. Leonard Ball high speed engines, supplied with steam from two large steel boilers. There is a good water power also, but not enough of it for both the mill and the lighting station.

Power is transmitted from the engines to a countershaft which is fitted with Waterous clutch pulleys, and in the centre of the shaft is a Waterous coupling, so as to allow one-half the plant to be run by steam and the other by water, whenever desirable.

The circuits consist of about 40 miles of No. 6 B. & S. wire. The firm are, at the present time, figuring on putting in a power generator for supplying customers all over the city. The lights are giving the best of satisfaction, notwithstanding the fact that no night inspectors are employed.

The electrical part is looked after by Mr. R. A. Lyons, while the steam engineering is under the supervision of Mr. R. Shapland and his assistant. Everything around this station, in both departments, is kept in good order, and reflects credit on the men in charge.

Yours truly,

TRAMP.

The machinery in the agricultural implement department of the Montreal industrial exhibition will be operated by electric motors.

The Consolidated Electric Co., of St. John, N. B., is constructing a new building to accommodate more engines and other machinery, and provide room for the balance of the machinery now at the old station of the New Brunswick company, and the new street railway generator

CANADIAN ELECTRICAL NEWS AND STEAM ENGINEERING JOURNAL

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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 may 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 must 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 coming legitimately within the scope of this journal.

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

CANADIAN ELECTRICAL ASSOCIATION.

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NOTICE OF REMOVAL.

On or about the 20th of September, the publication offices of the ELECTRICAL NEWS will be removed to the new Confederation Life Association Building, corner of Yonge and Richmond Streets, Toronto.

NEGOTIATIONS are understood to be in progress for the purchase of the Edison works at Peterborough, Ont., by the Toronto Construction and Electrical Supply Company. In the event of the bargain taking place, the intention is to largely increase the capital stock of the purchasing company.

THE new electric railway and the first industrial exhibition went into operation at Winnipeg almost simultaneously, and both proved to be remarkable successes. The railway carried thousands to the Fair grounds. The trip was made in fifteen minutes, or at the rate of seven miles an hour. With a Westinghouse car a trial trip was made at a speed of 27 miles an hour.

THE City of Brantford will try the experiment of owning and operating its own electric lighting plant and street railway system. The results will be watched with interest. The Chairman of the Fire and Light Committie of Toronto Junction, which has been doing its own lighting, could, it is said, "a tale unfold" which should cause other municipalities to hesitate about moving in this direction. The cost of electric lighting in Toronto Junction under municipal control is currently reported to be about three times what would be paid under contract with a private company. Since the above was put in type, the ratepayers of Brantford have refused to vote the money for purchase of plant.

THE manager of an electric light company which has found it necessary to increase its motive power, writes us for advice as to the best kind of engine to purchase. We have referred him to our advertisers who manufacture engines specially adapted for central station work. In view of the demand for engines for this purpose it is singular that more engine builders do not seek to make the acquaintance of our readers. We may be permitted to remark for the benefit of some who do not appear to be aware of the fact, that an electrical paper is the best place to advertise engines or anything else required by electrical people.

THERE is an old white horse connected with the Toronto Electric Light Company's station, whose eccentricities have been the subject of much amusement to everybody around the establishment. He has been employed for two or three years past in hauling the ashes away from the boiler house. This work he performs with the utmost willingness six days of every week, but no amount of persuasion will induce him to work on Sunday. From whence he imbibed his strict Sabbatarian views is unknown to his present owners, who cannot but admire, however, the consistency with which he adheres to his principles. Another of his peculiarities is his objection to do any work or go anywhere outside of the station yard. He manifests this objection by falling down in utter helplessness whenever he is put to do any outside work, notwithstanding when at his usual employment he has never been known to fall.

UNTIL a few weeks ago the Montreal street railway was one of the worst managed concerns of its kind on the continent. The cars were dirty and uncomfortable, and were run with the greatest irregularity. The company issued no tickets, and had no provision for transfers. All this has been changed as if by magic, by the company which has lately assumed charge of the road. The citizens are said to be delighted with the change, and are showing their appreciation by using the cars to a much greater extent than formerly. Indeed, we have been told that on the first day that tickets were issued, the receipts were more than double what they had previously been. The road being owned by the Everett-McKenzie syndicate which controls the Toronto street railway, is being operated on the same basis as the latter—viz., six tickets are sold for a quarter, and eight for a quarter good for use from five to eight o'clock a.m. and from five to 6:30 p.m. The Royal Electric Co. has been given the contract for the equipment of upwards of seventy electric cars for use on this road, which, simultaneously with the Toronto

system, is being converted to electricity as rapidly as it is possible for the work to be done. The order for the equipment of the Toronto system has been placed with the Edison Co. It is understood that in Montreal a new motor designed by Mr. Fred. Thomson, of the Royal Electric Co., is to be used.

ELECTRIC street cars have commenced running in Toronto, and the trolley system will soon be in general use in the city. Many people are much alarmed and fear that fatal accidents will be common. It would be well for all concerned to act upon the advice given by one of our American engineering papers on this subject, "Don't meddle with what is none of your business, if you do not understand the peculiarities of the device." The trolley cars are intended for the public to ride on, and nothing more. The public should be careful about getting on and off the cars, and do so only when the cars are stopped. Most of the accidents have occurred through neglect of this very simple rule. The electric cars are usually run much faster than the horse cars, and it takes time and experience before one can properly judge the speed at which it would be quite safe to get on or off a moving electric car, hence it is safer to wait till it has stopped.

BOURNE, in his treatise on the steam engine, introduces the subject of "Boilers," by saying: "A disquisition on the subject of boilers naturally begins with the subject of furnaces, for although furnaces may exist without a boiler, a boiler will be of little utility without a furnace." That was written over thirty years ago, and is still true, only some in our time advocate that the consideration of what is requisite for a steam boiler should begin not with a furnace, but with a man. Of what use, say they, will either boiler or furnace be, unless a proper man be placed in charge. The Canadian Stationary Engineers' Association is doing good work in this country, in the way of training men to take charge of boilers, furnaces and engines. Owners of steam machinery should aid the Association in its laudable efforts. They can do this, by insisting that the men employed by them to manage their steam plant, should hold certificates of competency from the Association. The Executive Council of the Association met in Hamilton on 30th August, for the election of officers for the ensuing year and for the discussion of matters affecting the interests of the Association. Papers were read on steam boilers, the qualifications of engineer, and kindred subjects.

THERE was a prospect at one time that Canada would be largely represented at the Columbian Exposition, but circumstances alter cases. The American government has passed an Act by which the President is authorized to impose burdens and annoyance upon the trade of this country, until such time as the Dominion shall be able to perfect her canal system and be independent of her neighbor. This attempt on the part of a great and powerful nation to check our development, has naturally chilled the friendly feelings with which heretofore we regarded the Republic. In consequence some of our largest manufacturers whose intention was to send large exhibits to Chicago next year, now declare that they have withdrawn altogether from the undertaking. Reference is made elsewhere to the fact that no action is likely to be taken by the Canadian Electrical Association toward securing an exhibit by Canadian electrical manufactures. In addition to the unfriendly attitude assumed by the United States toward the Dominion, there is the important consideration that the American tariff makes it impossible for any business to be done by our manufacturers across the line. An instance of this came to our notice the other day wherein the Brooks Manufacturing Co. of Peterborough received an order from the States for 20,000 carbons, but in the face of a 55 per cent. duty were unable to fill it.

THE new electric street railway at Hamilton, like a fractious young horse under the process of being subdued to harness, seems determined to exercise the privilege of kicking up its heels occasionally before settling down to the sober work of life. As a consequence there have been two or three collisions with street vehicles, in which, as a rule, the latter came out second best. An exception to the rule, however, was one day met with in the driver of a watering cart, who, while leisurely crossing the street, smiled defiance at the threats of the motorneer to enforce the right of way. On one occasion the James St. car failed to take the switch at the corner of James and King streets, but kept straight on up James street. A short distance in front was seen the dummy engine and a train of cars belonging to the Dundas rail way crossing the streets. So frightened did the motorneer and conductor become, in view of the seemingly impending collision, that the former jerked the handle off the rheostat, while it never occurred to the latter to shut off the current by breaking contact between the trolley and the wire. The passengers, taking in the situation, jumped from the car, and drawing themselves up in line on either side of the street, watched with interest the termination of the episode. Fortunately the Dundas train cleared the crossing ahead of the arrival of the electric car, while the motorneer and conductor, having recovered their presence of mind, again secured the control.

THE proceedings of the convention of the Canadian Electrical Association at Hamilton have been printed in pamphlet form, and distributed to all persons known to be interested in electricity. If there are any such who have not received a copy, they may obtain one free of cost on application to the Secretary. It is the subject of regret that the report is not as full or as accurate as could be desired, for reasons which need not here be stated, but which were beyond the power of the officers to remedy. Care will be taken to secure verbatim reports of future conventions, which reports will probably be sent to members only. Speaking of future conventions, we are reminded that preparations must soon be commenced for the meeting to be held in Toronto in January. Some live papers are required, calculated to instruct the members engaged in the various departments of electrical work, and provoke valuable discussion. It would please the Executive Committee very much if some of the members, without waiting to be pressed into service, would volunteer to prepare papers for the occasion. The Committee would also welcome any suggestions calculated to impart to the Conventions of the Association the greatest possible interest, or add to the usefulness of the Association in any way. We will gladly place the columns of the ELECTRICAL NEWS at the disposal of members who may have suggestions of any kind to offer for the welfare of the Association. Suggestions are also invited touching desirable amendments to the constitution and by-laws, the revision of which was delegated to a committee by the Hamilton meeting. The first convention is admitted to have been a success, and if every member feels that there is individual responsibility resting upon him to help on the work of the organization, the conventions of the future should be occasions of ever increasing interest.

WE cannot too forcibly impress upon owners and managers of existing electric light companies, and particularly those who have municipal lighting contracts to fulfil, the importance of keeping their service up to a fixed standard at all times, thereby giving the interested parties such a degree of satisfaction that when the time comes for a new contract to be made, they will be the ones to secure it against other competitors, even though their figures should be a trifle higher. Good service will also tend to render unpopular the idea of municipalities attempting to operate their own lighting plants. It is infinitely better in every way for cities to have their lighting done by a company or individuals than attempt to do it themselves. It is a well recognized fact that where towns and cities have tried the experiment, it has always turned out a dismal failure, costing them in some instances fully 50 per cent. more than if they had let the contract to others. There has come under the writer's observation within a very short period, an instance in which a company was supplying so called 2000 candle power arc lights and with but a 7½ ampere current, and in which one or more lights went out after starting time, and could not be made to go again. There was no provision for changing such lights; they were allowed to remain unlighted until next day, when the lamp instead of being brought in and put in good order again, was in most cases patched up in its place on the pole, no attention apparently being paid to the fact that the company's contract with the city called for good and efficient service at all times. Then, as if to make the aldermen and citizens generally see how poorly the wires and lamps could be constructed, the center of the municipality seemed to have been the part selected for one of

the poorest jobs of line construction that we have chanced to see for a long time. It is not to be wondered at, that this municipality is considering the advisability of doing its own lighting. In face of the fact that the authorities must be reasonably sure that they cannot operate the light at as low a figure as the existing company tenders for them, they seem positively assured that they will be able to give decidedly better lighting than at present. True, the company promise to put in new apparatus and new lamps and fix things up generally, but public feeling seems to resemble that of the burnt child who dreads the fire. All this but emphazises the remark in the first part of this article that it is for the welfare of any company supplying electricity for commercial purposes to endeavor to give the best possible service to their customers, both as to quality of light and keeping their outside plant in good order, thereby preventing the dissatisfaction which is bound to prevail if these important points are neglected.

THERE seems to be contemplated some legislative action in the Dominion parliament to fix upon a method of inspecting and testing the supply of current of electric lighting, and also of making disinterested tests of meters. This has no doubt been brought about through the influence of the gas companies, who it is well known must submit their meters and gas to government inspection at stated intervals. While we see no objection the testing system, yet the circumstances, compared with gas, are so different, that there will be special requirements in making such tests to make inspection a benefit to the company supplying the light as well as to the consumer, which, of course, should be the purpose of the contemplated enactment. It is of as much interest to the supplier as to the supplied to know that payment is made for the exact amount of current consumed, and that a revenue is coming in for every ampere of current that is produced at the machine. The point of most importance will be to determine by what standard the present meters should be tested. Gas being supplied from a tank, the meter will not change in its registering should the pressure run up or down beyond a normal or fixed point. The reverse is the case with the electric meter. A gas meter being composed of a pair of bellows whose capacity is just so much, no matter whether the gas pressure be high or low, will just register each bellows full that passes through it. Electric meters on the contrary are built for a certain fixed pressure or voltage, and do not register properly if this voltage is increased or decreased, the ratio being far in excess of the slight drop or rise in the voltage. True this could all be arranged by the government insisting on a fixed or standard voltage, but the question would then arise, who is to pay for the alterations in converters and lamps needed to suit what in a great many cases would be a change from existing methods? With reference to the candle power of lamps it would probably be found difficult to fix upon a better ratio of current than that which was submitted at the first convention of the Canadian Electrical Association, a few months ago, and which was left over until the next convention for further consideration; viz., "That when the carbons in an arc lamp are the proper distance apart, to give their maximum amount of light without either flaming or frying, that the strength or current for a 2000 (nominal) candle power arc shall not be less than 9½ amperes; for a 1600 (nominal) c. p. arc not less than 8 amperes; for a 1200 (nominal) c.p. arc not less than 6 amperes, and for an 800 (nominal) c p arc not less than 4 amperes." It is, of course, possible to make a photometric test of an arc light, but we question whether such test is absolutely accurate, and think the most advisable course to pursue would be to fix a standard of current, and if the carbons are as they should be and the lamp well adjusted, such standard current will give the same amount of light in every case. It is entirely different with incandescent lights, in the case of which the photometer can be used to advantage, and will no doubt measure the light given out very accurately Even here, however, it would be well to establish a fixed number of watts per candle, and we would suggest that a suitable standard for incandescent lights would be 3½ watts per candle.

In return for an exclusive franchise the Bell Telephone Co. is said to have offered to pay the city of London $800 per year and keep free of charge for the use of the city fire alarm wire the top cross arm of every pole to be erected.

OIL AS FUEL FOR BOILERS.

SOME time ago a proposition was made to use oil as fuel under the steam boilers at the pumping station of the Toronto water works. The proposal was made, with the hope that the use of oil would prove a deliverance from the power of combination in the coal business. Up to the present time, we understand, nothing has been done in the matter.

If it were possible to have the furnaces arranged so that either coal or oil could be used, then fair competition might be obtained, and fuel secured at a reasonable price. Here is a problem well worthy of the attention of the skilled men who are engaged about steam boilers and furnaces.

Many attempts have been made to produce such a furnace, but as yet none have come into practical use, and there is a good opening for such a contrivance.

Oil is used as fuel for steam boilers in Russia, where petroleum is found in large quantities. It is used in locomotives on the railways, and in the Caspian sea the steamboats use it instead of coal.

The furnaces require to be of special construction, the main difficulty being in getting the oil broken up into small particles and mixed with a proper quantity of air, and at the same time having the temperature high enough to support combustion.

In some of the furnaces an arrangement of brickwork is made, something like a small oven, with openings through part of the walls for the escape of the heated gases or flame. Into this brick oven the oil is blown in the form of spray by means of a steam jet.

The Russian locomotives use this form of furnace, the brick oven taking the place of grate bars and the usual fire brick bridge wall. Air has to be admitted, and between the usual jet in the smoke pipe and the jet forcing in the oil, a very strong draught can be maintained.

In England experiments have been made in using oil as fuel for locomotives. One method tried with considerable success, is to retain the grate bars and burn a thin coal fire on the bars. Chalk is thrown over the fire, and oil injected in a spray by means of a steam jet.

In Chicago, and the west, oil is used in many places, but in all we have been able to get information about special furnaces and steam jets are required.

Oil can be used successfully, and it is only a question of the relative price of coal and oil as to which is the cheaper. One advantage that oil has is, that self-feeding apparatus can easily be applied, and as there are no ashes to remove, there is a saving in labour, and in some cases the number of men employed may be reduced.

QUESTIONS AND ANSWERS.

AN electric lighting company in Ontario write: "Kindly give estimated cost of steam power each arc light per night."

ANS.—We cannot give you price of steam power per light, having no data, and furthermore cannot obtain it. The number of lights is not alike, in most instances, two nights in succession. It altogether depends on the number of lights burning, as it is manifest that one engineer could attend to an engine running 200 as easily as one running 50 lights. Where consumption of fuel also includes day running for power and steam for heating, the different services overlap so that they cannot be separated. The price would vary under different conditions in any place, and no two are alike—for instance, cost of fuel, number of lights, amperes of current, hours of burning, variety of engine, whether high pressure or condensing.

PERSONAL.

Mr. Sylvester Potter has been placed in charge of the steam plant at the Hamilton Street Railway power house.

Messrs. John Carroll, Secretary-Treasurer of the Eugene Phillips Electrical Works, and Chas. W. Hagar, manager of the Royal Electric Co., Montreal, were present at the annual clam-bake given by Mr. Eugene Phillips at Providence, R. I., in July. Mr. Hagar is credited with having made an excellent speech.

Mr. W. E. Davis, formerly mechanical and electrical superintendent for the Toronto Incandescent Electric Light Co., has accepted the position of Superintendent of the Toronto Street Railway Co. He will have supervision of the employees of the company, and of the supplies and equipment in connection with the entire system.

ELECTRICAL LESSONS FOR MACHINISTS AND ENGINEERS.

Since our last issue, it has occurred to us that it would be better, before going further into the details of the construction of dynamos and motors as intended, to give a few of the most important points and facts relative to planning, running and manufacturing them.

There are many faults liable to arise which, although apparently trifling in themselves at first, may at any moment, if neglected, result seriously and perhaps in the complete destruction of the machine.

We will direct your attention to some of the most common faults, and explain how best to remove them, and how by ordinary case they may be avoided altogether.

The sparking at the brushes, a very common fault, may be due to any one of several causes, such as bad contact between brushes and commutator, by reason of the brushes pressing too heavily or too lightly or unevenly on the commutator, or through bad adjustment, or the parts being over-heated or worn away. The proper position and pressure of the brushes on the commutator can best be found by shifting them until the least sparking and best results are obtained. When the brushes become worn away unevenly they should be turned over, or the ends should be trimmed off evenly.

The commutator should be frequently oiled to prevent undue wear and friction, which means heating, and heating is a very objectionable fault. The oil, however, must be of good quality and very sparingly applied, as otherwise it will introduce resistance, sparking and, perhaps, open the circuit.

Bad adjustment of the brushes means loss of current on the outside circuit, and consequently a diminished light.

The slipping of the driving belt is a thing of too frequent occurrence in small electric plants ; it is due to one or the other of several causes. In some instances it may be remedied by using a long and broad belt, a little tighter than used for ordinary work.

The perfect insulation of all wires is one of the most important facts to be remembered. A very trifling leak from one wire to another may instantly terminate in the destruction of the machine, so far as wiring is concerned. For this reason too much care cannot be taken in insulating the wires from each other and from every other part of the machine.

The contact or short circuiting of the wires or a contact between wires and pole pieces may, by dividing the current, act in such a way as to cause the machine to give but a fractional part of the energy it otherwise would do. The careful insulation of the wires forming the circuit is a point to be carefully watched ; use no bare wires and avoid the use of metal staples in fastening against walls, etc., but use in place thereof fiber staples, or, better still, wood clamps or cleats.

The most troublesome faults in any and every electric installation, whatever its application, is bad joints. Joints that are loose, unless well soldered, often times do not make metallic contact and at other times they do, yet so far as can be judged by the eye they may appear to make perfect contact. Therefore it is wise to make a practice of always soldering joints and to make sure that the solder flows freely. To show the necessity of practicing the utmost care in joining wires, we will digress a little to relate a troublesome fault which occurred on a telegraph wire while under the supervision of the writer. An intermittent fault showed itself on a wire which was bringing in from $200 to $300 per hour. The fault appeared for a few minutes a time only, but several a day and frequently about the same hours. The line was carefully tested and appeared perfect in every way, the only difference to be detected was a very slight one in the metallic resistance which was slightly higher than when the line was first erected. The wire was partly overhead and partly underground and passed through a railroad tunnel which was about one mile long. After a long and careful search, for the fault would not show itself when we were watching and thereby enable us to locate it, we discovered the fault in a joint where the wire was carried through the railroad tunnel. The vibration due to some of the trains passing the point was often sufficient to break the metallic contact at the joint and the vibrations from the next train would probably bring the wires together again, or they would come together through some other cause. Our readers can not begin to imagine the annoyance and trouble such a fault will cause on a telegraph circuit. On any electrical circuit such a fault will give endless trouble so long as it exists. As a precaution do not neglect to solder your joints well. Rubber tape is generally used to cover the joints after soldering to insulate them.

The wires used in the construction of dynamo and for connecting dynamos and lamps, etc., should be of the very best quality of copper and leads should be of a gauge large enough not to become heated or offer much resistance. A No. 14 B.W. G. will do for one or two lamps on a short line. A high resistance wire means loss of electric energy, as the electric is converted into heat energy in the wires. The heating of the wires indicates that they are not heavy enough to do the work they are taxed with. Wires should on no account be fastened against damp walls.

The dynamo should be set upon a solid and level foundation, preferably on an adjustable wood bed, so that the whole can be readily moved to tighten or adjust the belt as required. On both dynamos and motors always use sight-feed lubricators.

Do not start a dynamo until you have satisfied yourself that everything is in a perfect order and adjustment. The dynamo, if required for arc lighting, should be series wound, and if for incandescent lighting it should be shunt wound.

The wire for the arc light circuit should be in one continuous loop. Then to connect a lamp at any point it will simply be necessary to sever the wire and connect the ends to the terminal or binding post on the lamps.

The wire for the incandescent circuits should be severed in the centre of loop and the wires fixed parallel to each other, one or two inches apart. The lamps should be connected so as to bridge across from one wire to the other. *Scientific Machinist.*

STEAM AND EXHAUST PIPES.

THE question often arises in the mind of the engineer, says the Boston *Journal of Commerce*, as to whether his steam pipes and steam ports are large enough. It is pretty evident that there is a limit below which it is a great mistake to have the sizes of steam pipes come. An engine moving very fast must have very much larger pipes than one moving slower, and where the diameter of the cylinder is increased the size of the pipe to supply it should also be increased. A mistake is also made in allowing a six-inch pipe to answer for a seven-inch pipe, with the idea that it is only an inch larger and cannot make much difference. A six-inch pipe has an area of 28.27 square inches, and a seven-inch pipe an area of 38.48 square inches, a difference of nearly 40 per cent. which does make a difference, even though the diameters are only an inch apart. It pays to look into this matter, for a pipe too small is usually much too small.

The area of a steam port should be such that the steam will not be required to flow faster than at the rate of 100 feet per second. The method of finding this area is as follows. It is first necessary to find the volume that the steam must fill. This will, of course, be the area of the piston times the length of stroke. Thus a 20-inch cylinder, having an area of piston of 2.18 square feet, and a stroke of 5 feet, must give a volume to be filled by the steam at each stroke of $2.18 \times 5 = 10.90$ square feet. It makes no difference about the cut off, the cylinder must be filled at this rate, whether the cut off be long or short. Suppose the engine to be making 64 revolutions per minute, which is 128 strokes. This would be $128 \div 60 = 2.13$ strokes per second, hence the port must be large enough that in every second $10.9 \times 2.13 = 23.217$ cubic feet of steam can pass through it, and in passing through it not move at a greater speed than 100 feet a second. To find the proper size of port, then all there is to do is to resolve this 23.217 cubic feet into a block 100 feet long. Dividing, then, 23.217 by 100, we have .23217 square feet as the area of the port, or 33.43 square inches.

This is the explanation of the matter. The rule is as follows. Multiply together the area of the piston in square feet and the piston speed in feet per minute, and divide product by 6000. Quotient is proper area of port in square feet. Multiply by 144 to get square inches. Steam pipes are usually made slightly smaller in area than these where the piston speed is below 400 feet per minute, but above this should be of same size. Exhaust ports and pipes should be made at least 25 per cent. larger than the steam pipe, since they must discharge all the steam that enters the cylinder in the period of admission, in the very short time when the engine is turning the centre.

SAFETY VALVES—THEIR HISTORY, ANTECEDENTS, INVENTION AND CALCULATION.

By William Barnet le Van.

(Continued from August Number.)

Hugo Bilgram, mechanical engineer, of Philadelphia, makes the following explanation of the cause of that remarkable phenomenon: His investigation revealed the fact that the current *a b*, Fig. 63, instead of leaving the ball in the line *b c*, as might be expected, follows the curvature of the ball

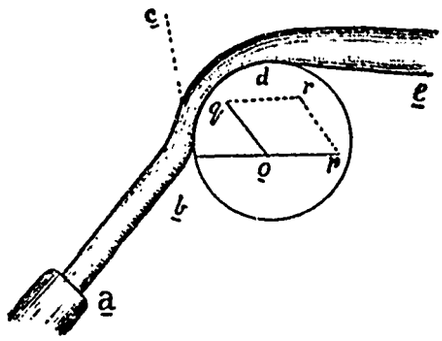

Fig. 63.

along the line *b d*, and at length leaves the ball in the line *d e*. A light ball when placed in the jet, is struck nearly centrally (see Fig. 64), the current envelops the whole ball and unites again, leaving the ball in the line *d e*, appearing as though the current was passing through the ball. It can however, easily be found that the upper branch of the current is stronger than the lower one.

By a series of subsequent experiments, it was found that any current of

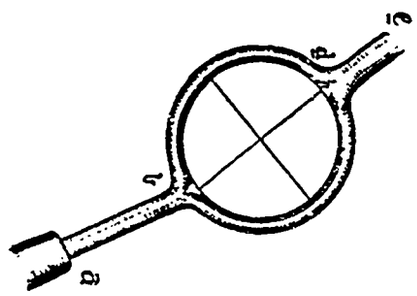

Fig. 64.

air striking a convex surface, has the tendency to follow that surface. One of these experiments is as follows. Attach to one end of a small tube, about ½ inch to ¾ inch diameter, and 4 to 6 inches long (which may be made by rolling up a piece of writing paper), a piece of thread or yarn about 4 to 5 inches long. Blow through the other end of this tube and direct the current against an object with a convex surface. The thread, following the current

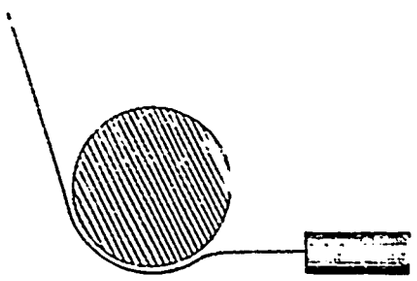

Fig. 65.

will indicate a deflection as shown in Fig. 65. After demonstrating this fact, the next step was to find its cause. It is well known that any current tends to carry along with it the surrounding particles of air; hence, the supposed currents *b c*, Fig. 63, being freely supplied with air from the left side only, will create a rarefaction of air in the angle *c b d*. It is thus exposed to a one-sided pressure, and will therefore, be deflected, as mentioned, and follow the curvature of the surface until it meets a counter-current sufficiently strong to prevent a further rarefaction. If this view can be substantiated, it is plain that two external forces are acting upon the ball. One, the impact of the air current at *b*, transmitted at right angles to the surface, acts radially, and can be represented by the line *o p*. The other force, *o q*, is occasioned by the surplus pressure of the atmosphere on the lower side of the ball, over that of the rarefied zone under the curved current, and, combined with *o p*, it forms the vertical resultant *o r*, by which the weight of the ball is sustained. The rarefaction of air under the deflection current can be proved by the following experiments: Cut a small hole, say ¼ inch square, in a piece of cardboard, fasten over this hole a cover of the same material, by means of a strip of thin paper and mucilage, to form a valve, and bend both the card and the valve into cylindrical form. If, now, a current of air is directed against the card, as shown in Fig. 66, the valve will open wide, showing the pressure under it to be greater than that above it. Or, take a strip of ordinary paper, about 1 to 2 inches wide, lay it over a cylindrical surface, and blow against it in a nearly tangential direction. The end of the strip will then rise as shown in Fig. 67.

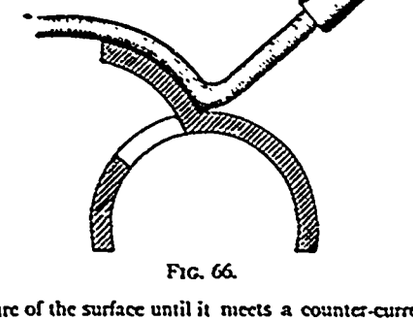

Fig. 66.

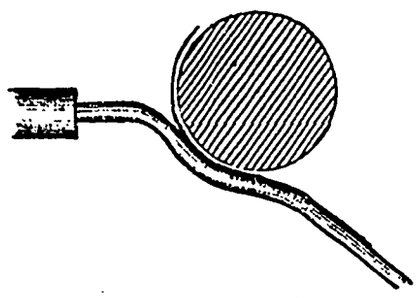

Fig. 67.

Quite a number of other experiments might be mentioned, proving the same facts. The rotation of the ball is produced by the friction of the air currents passing over the ball, and is, therefore, a secondary result.

The phenomenon of deflection of a current when striking a convex surface can be brought to bear on geographical and meteorological facts. The Gulf Stream follows the curved shore of the United States, for the identical reason that the aërial current follows the shape of a cylinder or a globe, and takes a course which otherwise it would not take. When a current of the higher strata of the atmosphere strikes the peak of a mountain, it will be deflected, follow the sides of the mountain, and will sweep the valley.

A TREACHEROUS SAFETY-VALVE.

Boilers are often operated without a steam gauge, depending on the safety valve only, to show the maximum steam pressure, a practice which should not be allowed under any circumstances. W. F. Durfee relates the following circumstances which came under his experience, which shows the dangerous practice of using boilers with *one* safety valve only, also the hidden danger which may exist in an apparently reliable safety valve.

Mr. Durfee says. About twenty years ago, during the progress of some constructions then under my supervision, I procured a second-hand portable boiler for temporary use. This boiler was provided with a safety valve whose lever was graduated to 120 pounds, and three gauge cocks, but had neither pressure guage nor glass water gauge, and, as the boiler was to be used but a short time, I did not think it necessary to furnish it with the two last-named fixtures.

The boiler was placed in the care of a steady going son of Erin, whom we will call John, with instructions to leave the safety valve weight on the 60-pound notch; to keep two gauges of water; to keep the steam as near 60 pounds as possible, and to report at once any trouble which occurred. John took a lively and attentive interest in his duties, and everything went well with him and the boiler for several weeks. But one day I was surprised by his sudden appearance, with every limb and feature indicative of extreme terror. As soon as he was able to speak, he exclaimed:

"The divil's got in the boiler, Mr. Durfee!"

"What do you mean, John?" said I.

"The divil's got in the boiler, I tell ye; fur the weight's on the ind av the liver, an' is up in the air as high's it can git; an' the divil a mite iv stame's comin' out!"

"Well," I replied, "We will go down and see if we can get the 'divil' out."

On reaching the boiler I was surprised to find the valve weight at the 120-pound notch, and that it *was* as high as it could "git" (Fig. 69), and, to my utter astonishment, there was but a suggestion of steam escaping. My first thought was that in all probability I was in the immediate vicinity of a boiler explosion; however, there was nothing to do but to ascertain the cause of the existing conditions, and therefore I immediately tried the gauge cocks, found two full guages of water, and, from the appearance of the steam which escaped on opening the upper cock, it did not seem possible that there was 120 pounds pressure upon the boiler. I then took a fire-hook, and without much effort, pulled the safety-valve lever down, but on releasing the hook it slowly returned to its former position, and at no point of its movement was there any increase of the very small and feeble volume of steam escaping. I repeated this experiment with the same result, and then began to think that John's diagnosis was correct; the boiler certainly seemed to be "possessed of the devil." Just how he got in, and how he produced the observed effects, I could not imagine; my previous practical experience with steam machinery, which I had been in the habit of regarding as embracing every species of "pure cussedness" that steam generators were heir to, did not furnish any clue to the mystery—for mystery it certainly appeared, and one which required prompt and decisive action for its solution. I therefore ordered John to draw the fire as quickly as possible, and and to report to me when the boiler was cold enough for men to dismount

the valve. In due time this was accomplished, and the state of facts disclosed is represented in the accompanying cuts (Figs. 68 and 69), which show the interior of the valve before and after it became "possessed of the devil" of deadly danger. The engravings so clearly exhibit the details of the valve and the relative position of its several parts that very little explanation is

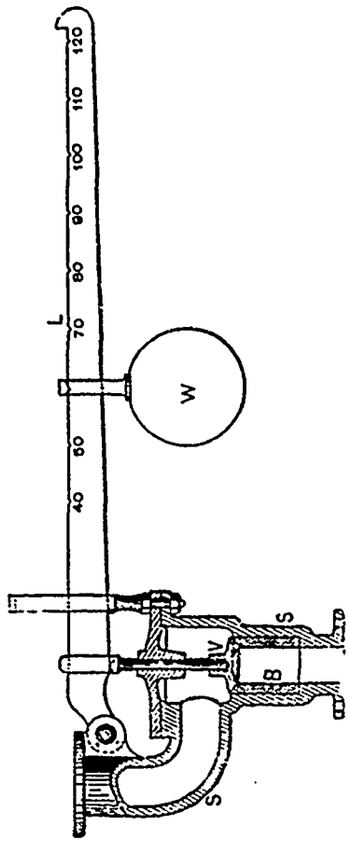

FIG. 68.—VALVE BEFORE THE DEVIL GOT INTO THE BOILER.

necessary, and it will suffice to say that the shell S of the valve was of cast iron, bored out to receive a cylindrical gun-metal bushing, B, which was forced into its place and held there simply by friction. On the upper end of this bushing and sit for the valve V was formed. As long as the bushing B remained immovable the steam pressure acted on a circular area of the lower surface of the valve V, having a diameter equal to that of the *interior* of the bushing B, but as soon as the repeated expansions and contractions

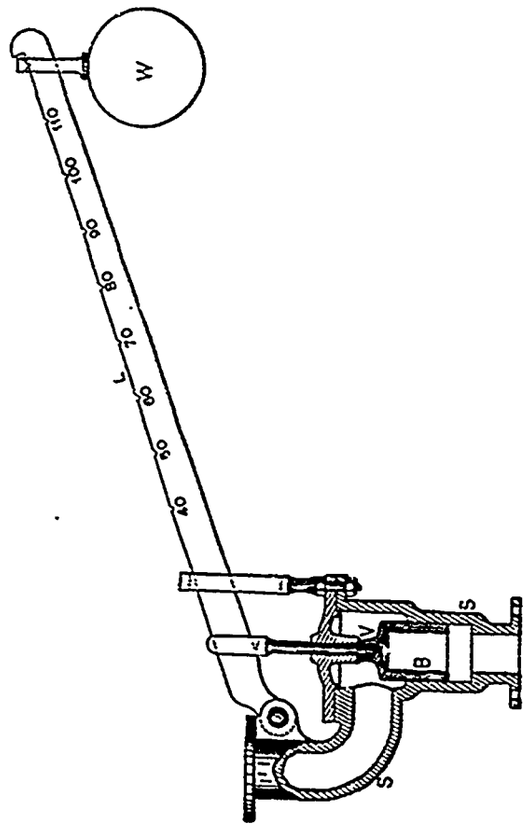

FIG. 69.—VALVE AFTER THE DEVIL GOT INTO THE BOILER.

incident to use and years had loosened the bushing B the circular area upon which the steam acted had a diameter equal to the *exterior* of the bushing B, which, with the valve V resting upon it, was then free to move upward (see Fig. 69) as far as the lever L would permit, acting simply as a piston valve or, rather, piston with no outlet for the steam save that due to the trifling leakage arising from its imperfect fit in the shell S. The area of the last named circle was a little more than *double* that of the first.

John's procedure before he reported the presence of the "divil" in the boiler, was as follows. Observing the lever L in the position indicated in Fig. 68, when the weight W was at the 60 pound notch, and desiring to ascertain what pressure there was on the boiler, he commenced moving the weight W outward, the pressure of his fear augmenting as he moved the weight from notch to notch until the end of the lever was reached, and then the dynamic valve of his terror was sufficient to send him flying to me as fast as his quaking legs could carry him. It is not uncommon for the coroner's jury, while attempting to ascertain the cause of some disastrous boiler explosion, to be told by the confident witness (he is always on hand *in strong force on such occasions) that "the safety valves were all right,* as they had been examined but an hour before the explosion occurred." Such evidence in the case of a safety valve like the one I have described would be of no value whatever, as the fact of its being in good order when examined would be no assurance that within the next five minutes it would not be worse than no safety valve at all. It is extremely probable that there are many such safety valves in use to-day, and also that valves of such construction have been the cause of many unexplained explosions.

HINTS TO ENGINEERS.

A person who is to take charge of a boiler should make himself familiar with all the needs or defects of it, says Edwin Woodward *in the Scientific Machinist.* In the first place its strength should be known, and this is best found by a force pump, warm water—cold water pressure is injurious—and a test gauge, or a steam gauge known to be correct, and the test made at least 20 per cent. greater than the maximum steam pressure to be used. Knowing the boiler to be strong enough, the next step is to examine the pump, which should be in perfect working order. Having absolute evidence that the pump can supply, the business of supplying is a mere matter of routine, but a pump that will sometimes work and sometimes will not, is eligible for the most rigid and instantaneous examination. It may fail when its work is most important. Granted motion to the piston or plunger, a pump fails because it leaks. There can be no other reason, and the leak should be found and repaired. Leaky valves are common and should be ground. Leaky pistons are not so common, but sometimes occur. Repairing is the remedy. Leaky plungers are common. They need returning. The rod must be straight as far as in contact with the packing. The packing around the plungers is sometimes neglected too long, gets filled with dirt and sediment, and hardens and scores an otherwise perfect rod, and so leaks.

The stuffing-box should have a generous allowance of hemp—not drawn tightly around the rod, but the box well filled, and the gland screwed down tight enough to prevent a leak. Too tight only ruins the elasticity of the packing, and causes undue friction. The suction pipe should be also looked to. It is usually the source of exasperating leaks. It is usually made up of poorly-fitted nipples, elbows, couplings, and to complete the train of evils, a globe valve without any gland, and poorly packed. Freezing weather often opens the weld at the top of the water, or, in some water-pocket not properly drained. Any of these causes will destroy the efficiency of a pump, and are so known to exist—effectiveness is wanting. A leak on thedelivery side of a pump is instantly visible, the water spurting at every stroke.

Leaks affect injectors the same as pumps, and in addition, the accumulation of lime and other mineral deposits in the jets stops the free flowing of the water. The heat of the steam is the usual cause of the deposits, and where this is excessive it would be well to discard the injector and feed with a pump. In many industries it is impracticable to use a feed-water heater and purifier, but when this is not so it will be found a great aid, for one of the most important cares of an engineer is to keep the boiler clean. No scale should be permitted to collect. Mud should be allowed no place in a boiler. The writer has seen the sheets in the water leg of a locomotive type of a boiler sprung half an inch between stay bolts six inches apart, from accumulation of scale lodging and burning fast there.

There are many compounds in the market that are recommended for dissolving scale. They should be used with care. Some are strong enough to "dissolve" the boiler.

Of the many other duties relative to the care of boilers, some further reference will be made in subsequent papers, the aim being to furnish the novice with the necessary information to prevent his too ready acquaintance with the Great Mystery.

EARLY EXPERIENCE OF JACK B.

At one of the re-unions of "Old Timers" held two or three years ago, Jack B. entertained the company with some of his early experience which we think ought to be read by those who were unfortunate enough not to be present, because so many new beginners have a similar experience, and they will be glad to know that there were other unlucky mortals besides themselves. His story was as follows:

My first experience was in a railroad office at a small town in Ohio. The privilege of practicing telegraphy was accorded me in consideration of my acting as "All Around Man" for the agent and operator.

After much humiliation and hard work, I was given a recommendation which stated that I could send twenty words a minute and read fairly well on a register. I wrote an application to the superintendent for employment, reading as follows:

"Will you please give me a berth as I need it very much? Enclosed find recommend."

In due time an answer was received as follows:

"Your application received and filed."

This was a cipher letter to me, but the agent translated it.

Two months later I was ordered to report at "F" office for duty, and when I stepped upon the train with a new crisp pass in my pocket, the happiest moment of my life was experienced.

Arriving at "F," I found the regular operator had absconded and left for parts unknown, but he had kindly left the telegraph instruments, although he might as well have taken them, for all the service they were to me. The register was dead, but the relay kept up an unintelligible rattle. Something had to be done, and I commenced upon the local battery and gave it a thorough cleaning, but still the register failed to show any signs of life. At last I discovered that one of the wires had been removed from the register binding post. A ray of sunlight fell upon my heart, but vanished again when the restored wire failed to produce the desired results. The heavy armature could be seen to quiver a little, but no impression was made upon the tape. In blank despair, I wrote to the superintendent, detailing my troubles, and asked what should be done. Two days later the lineman made his appearance and after a careful inspection decided that the "local" was of no account, and together we went to work upon it.

The porous cells were cleansed and scraped; the zincs were scraped until they looked like new. The coppers were similarly treated and the earthenware jars were filled up with warm rain water. To make success doubly sure, a handful of salt was added to each jar.

When making the connections the lineman remarked that if the battery did not work now, it never would, but the old marble based register stood like a tombstone, and only responded with a quiver.

The lineman left on the next train, and I would have given my last nickel to have gone home also, but the orders were to remain a few days and give the battery time to "get strong."

At the close of the first week I was sitting in my chair with one elbow on the table, my hand supporting my head and dreamily musing upon the miseries of this life, while with my left hand I picked aimlessly at the silk covered wire leading upon the register magnet to the marble base, when suddenly the old machine started up as if a demon had entered into it. I fell backward upon the floor, and my first impulse was to get out of the office, but recovering from the shock and fright, I undertook to discover what had caused the old register to become so active all of a sudden. This was an easy task.

The two wires leading from the magnets to the base had been bent over so as to touch the helix bar and the magnets were out of circuit. Picking at the wire had pulled it away from the bar and the magnets were thrown into circuit.

The office was now open for business, and everything passed off smoothly for two weeks when new troubles appeared. The old telegraph table had been bored full of holes, and the ink and dirt accumulation made it present a very untidy appearance. I conceived the idea of covering the top with oil cloth, as a cheap way to improve its appearance. The office was provided with two wires and two sets of instruments, a switch being arranged to transfer the register from one circuit to the other. One whole night was occupied in removing the instrument, tacking on the oilcloth and replacing the instruments.

Next morning the office presented a much neater appearance, and I was congratulating myself when "F" was called and asked to open No. 1 a moment, and "say when." The next message sent over the wire was to Jo Hicks, the lineman, and it read thus: "Nos. 1 and 2 'water crossed' between 'F' and 'N' offices," but as there had'nt been a drop of rain within four weeks, Jo concluded the water cross must be in some office, and he took the first train for "F." When he came into the office and saw the new oilcloth covering on the table he swore terribly, and said us kids would soon bankrupt the company if we kept on.

He then took his knife and started in on the oilcloth, and when he finished the largest part of it had disappeared. Two days later I received a letter from the superintendent, stating that oilcloth was a conductor of electricity and that I might as well have used a sheet iron covering and placed both keys upon it. I was threatened with immediate discharge if there was any more meddling with the wires or instruments at my office in violation of rule "23." Every operator likes to have the instruments and wires arranged according to his particular ideas, and the temptation to meddle with them is very great.

I had no ambition to further improve the appearance of the office for full two months, and then my desire to lower the switchboard so that I could reach it without getting out of my chair was absolutely uncontrollable. The main wires and the instrument wires all passed from the table up the wall to the board, and to lower the board it was only necessary to cut the wires off and make them a little shorter.

Certainly there could be no harm in this, and another night was spent in accomplishing it. Next morning I listened to every word that passed over the line to see if there was anything going to Jo Hicks about trouble on the wires. To my delight the wires both worked clear, and I felt that one job had been successfully accomplished. On my way from dinner I saw some nice new silver extension penholders in a jeweler's window, and resolved to possess one, but it would have been better for me had I purchased a rattle snake. I shall never live long enough to forget the grief it gave me.

The switchboard having been moved down where it could be reached conveniently, furnished a nice pen rack, and when the new silver extension pen was not in use, it was carefully laid up on the four binding posts located at the bottom of the board. Sometimes it would cut one set of instruments out and again the other set.

If it happened to rest on the two center posts it crossed the wires. The following morning I heard a message going to Jo Hicks, telling him to look for a swinging cross between "F" and "N" offices, and a cold chill passed down my spinal column. I examined every inch of the wire about my office and felt sure there was no swinging cross here. Jo came and took a survey of things, but luckily I had the penholder in my hand. He tested the wires and said there was no cross, and he guessed the testing operator at "J" must have had a fit. I expected every minute to hear him say something about the switchboard being moved, but he never discovered it and left on the first train going west. As soon as I reported the train I laid the pen on the binding posts, and in less than three minutes I heard another message going to Jo, saying the cross between "F" and "N" was now solid and to not waste so much time in getting it out.

He walked over the line next day but couldn't find the cross.

It happened on this morning that the pen cut out my instruments on the train wire, and I didn't hear a call on it until afternoon, when the pen was removed. The dispatcher told me on No. 2 wire that my office was bewitched, and that Jo Hicks had been ordered to go there and make a careful examination. He came, but when he entered the office I was using the fateful pen in recording the arrival and departure of the train. Jo gave it up and said he couldn't find any cross. The next morning, after No. 7 left, I walked into the office and reported it, and just as I laid the pen upon the binding posts some one entered the office and asked me if I was Jack B., and when I answered yes, he said he was superintendent of telegraph and had come to see what was the matter with the wires, but before finishing his remarks his eyes fell upon the pen and he said rather sharply, "Young man, did you put that pen on the switchboard?" "Yes," said I. "Is that where you usually keep it?" was the next query, to which I replied in the affirmative. He was too mad to explain what the trouble was, but made out to say I was discharged. I went home sad at heart, and loafed around for three months, when to my surprise I received a message requesting me to go to 'XY' office. The next train brought a pass and a letter stating that I would be given one more chance, and that if ever I violated rule 23 again, or interfered with the working of the wires, it would result in my final discharge. I resolved never to touch another wire or move another instrument, and I kept the resolution, but my troubles came just the same.

I hadn't been at "XY" quite a month when I heard the pay car was coming over the road. Of course, there was nothing due me, but I went out on the platform to see the train come in. The first person to alight was the superintendent of telegraph. Remembering that I had been oiling my revolver and left it lying on the operating table, I rushed back into the office, grabbed up the revolver and stuck it behind the switchboard, as that was the most available place in such an emergency. The superintendent came in, took a chair and asked me how I was getting along. Before I could reply the testing operator called me and said, "Open No. 2," and "say when."

In another moment he said the wires were crossed between my office and the next one west, and then he rattled off a message at a great rate to Jo Hicks, telling him to go to XY and see what was the matter, that wires were crossed again. This, of course, the superintendent heard, and he turned to me and said. "You seem to be particularly unfortunate in crossing the wires at your office." I said, "Yes, but it was certainly not intentional. I wanted to do right but the fates seemed to be against me. He then commenced looking around the switchboard and in another moment pulled out the revolver, saying, Here is the fellow that caused the cross. The barrel had touched the brass nuts connected with the straps of the two wires. I was advised to enter some other profession, that there was no hope for me as an operator. I had but little to say, but closed up my accounts, made out a monthly report to date, and sent it with the receipts of the office to the superintendent's address. I was too late that day to send by express according to rule, and as I was ready to go home I just sent it by baggage mail and took the train baggage master's receipt for it. On reaching home my appetite was gone, hopes for the future all blasted, and by the following day a high fever had set in and I was delirious. For two months my friends had no hope of my recovery. During my delirious moments they say I was constantly pleading with Jo Hicks, telling him the cross was not in my office.

I finally recovered, but there wasn't money enough on the pay car to induce me to accept another railroad office, and I decided to try my fortunes with a commercial company, and at a large office, where there would be chief operators to watch me and tell me what not to do.

It was not long before I secured the desired position, but as a parting

shot, the railroad telegraph superintendent notified me that the last remittance I made by baggage mail had been lost or stolen, and as I had violated rule "27" by not sending the money by express, I must make it good. The baggage master's receipt was of no service to me. I had violated the rules and must suffer for it.

There was just enough due me for four weeks service to pay the loss, and thus the accounts balanced and my railroad career ended forever. Thirty years have passed since that last fateful day and I am in the telegraphic service yet, but the witch forsook me when I was divorced from the railroad. —*Journal of the Telegraph.*

BALANCING RECIPROCATING PARTS OF A STEAM ENGINE.

The piston, piston rod, crosshead and connecting rod are the reciprocating parts of a direct acting steam engine, largely influencing the action of the steam pressure on the crank pin. While the crank, fly wheel and other rotating parts have a nearly uniform motion, these reciprocating parts (excepting the connecting rod) are at complete rest twice during each revolution, and between these two instants of rest there is a period during which they acquire a velocity even greater than that of the crank itself. It follows, from the foregoing, that these reciprocating parts must be accelerated during the first part of the stroke, the acceleration decreasing as the maximum velocity is attained, becoming zero at that point, and after passing the position of maximum velocity, the parts are retarded, this retardation increasing to the end of the stroke.

The first law of motion is that "Every body continues in a state of rest or uniform motion in a straight line unless compelled by impressed forces to change that state." We learn from this that any increase in the velocity of a mass is accomplished only by the expenditure upon it of energy; but energy exerted in increasing velocity of the mass, purely, may be entirely regained during the retardation of the mass. This process is spoken of as the *storing* and *restoring* of energy. The fly-wheel stores up energy during that part of the stroke in which the effort exerted on the piston is in excess of the resistance, and restores an equal quantity of energy during the period in which the resistance is in excess. The fly wheel is accelerated during the first period, and retarded during the second causing a fluctuation of speed in every stroke; but the mass and diameter of the fly wheel are made great enough to keep this fluctuation within limits.

It will now be evident that during the first portion of the stroke, part of the force of the steam is being used simply to increase the motion of the piston, crosshead, etc., the exact proportion so used, at any instant, depending upon the weight of these parts and their acceleration; and the energy so stored is given out during the latter part of the stroke.

The mathematical reasoning involved in treating his subject cannot properly be entered into at this time; but directions for determining and showing the effect of inertia in the reciprocating parts can be given.

It has been already said, that during the first part of the stroke a portion of the pressure of the steam is expended in accelerating the reciprocating parts; and to find the effort, still available for useful work, this force must be subtracted from the effective steam pressure. In the latter part of the stroke, of course, the pressure on the crank pin due to the reciprocating mass, is to be *added* to that of the steam. We can calculate the accelerating (or retarding) forces at various piston positions, and add (or subtract) them from the corresponding steam pressures.

The work of acceleration can be represented by a diagram; just as the work of the steam in the cylinder is represented by an indicator diagram, by letting horizontal distances represent piston travel and vertical distances represent accelerating forces.

Such a diagram is shown by the shaded area in Fig. 1, which is placed upon an ideal indicator diagram. The length of the vertical line from

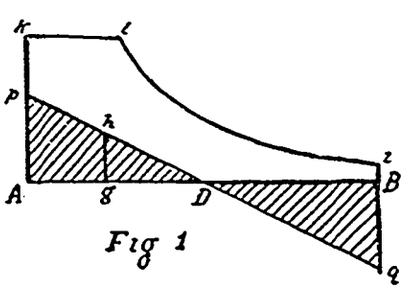

Fig 1

any point, *g*, in the left hand part of the horizontal base line, to the top line of the shaded part, gives the force exerted on the reciprocating parts in accelerating them at the corresponding piston position; and any similar line measured downward, in the latter part of the stroke, gives the effort exerted by these parts in being retarded.

The acceleration diagram would be bounded by a straight inclined line as *p q* in Fig. 1, if it were not for the angularity of the connecting rod. Neglecting this angularity, for the present, we can then draw the diagram, if we but determine the forces exerted on the reciprocating parts at any two points, as at the beginning and end of the stroke. In the case now under consideration these two forces are equal but opposite, and one would be represented by a vertical line above the base line, the other being of equal length but lying below the base, as *a p* and *b q*, in Fig. 1. These lines should, of course, represent the two forces to the same scale as that employed in the indicator diagram, when the two are to be compared. Having drawn the straight line *p q*, through the points *p* and *q*, the force exerted at any other piston position can be read off by measuring the height of the diagram at that position, exactly as is done in measuring steam pressure on an indicator diagram.

The forces exerted *upon* and *by* the reciprocating parts at the two ends of the stroke, when not considering the action of the connecting rod, are found by the following rule. *Multiply together the weight of the reciprocating parts, the square of the number of revolutions per minute, the radius of the crank (in feet), and the number .00034*, the product equals the force required. To reduce this force to equivalent pressure per square inch of piston (which of course must be done to compare it with indicated steam pressure) divide it by the area of the piston in inches. The quantities thus determined are the ones represented in the diagram, Fig. 1, by the lines *p a*, *h g*, *b q*, etc.

It will appear from the foregoing that the piston has its maximum velocity at the middle of the stroke, when the acceleration becomes zero. This is indicated by the acceleration line crossing the base line. But when the angularity of the connecting rod is taken into account, we must treat the case somewhat differently. It is well known that the effect of the ordinary connecting rod is to cause the piston to make the first half stroke, from the head end of the cylinder, in less time than it makes the second half, and the reverse of this occurs in moving from the crank end. Thus in Fig. 2, *A D* is passed over in less time, and consequently at a higher velocity than *D B*. The connecting rod also causes the piston position for maximum velocity to occur nearer to *A*. This position, *E*, is always that at which the crank and connecting rod form a right angle with each other at *C*, and it may be located as follows. draw *G H*, Fig. 2, to represent the stroke (most

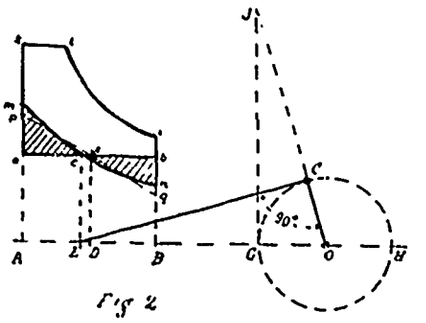

Fig 2

conveniently taken of same length as the indicator card). A circle on this line, with center at *O*, will represent the crank circle. Then draw the vertical line *G J*, of a length equal to that of the connecting rod, to the same scale as the rest of the figure, and connect *J* and *O*. Where *J O* cuts the circle, at *C*, will be the crank position for maximum piston speed. Prolong *G H* to the left, and then with a radius equal to the connecting rod, and a center at *C*, cut this center-line at *E*; this locates the piston position for maximum velocity. With the same radius and centers at *G* and *H*, cut the line of centers in *A* and *B*, thus locating the dead points.

As *E* is the position for maximum piston speed, it must be the point where acceleration ceases and retardation begins: then if the indicator card be shown above *A B*, the crossheads path, by the diagram *a k l i p a*, the point *e*, corresponding to *E*, will be the intersection of the acceleration diagram and the base line, *a b*.

Calculate the forces exerted on and by the reciprocating parts, by the rule already given the lay off *a p*, and *b q* equal to them, respectively. Now as the force is greater than the amount thus calculated for the left hand end, and less for the other end, owing to the velocity of the piston being greater in the first half stroke than in the second, we see that, considering the effect of the connecting rod, *a p* is too small and *b q* too large. The amount, *m p*, (=*n q*), to be added to the former, and to be subtracted from the latter, is found by multiplying *a p* (equal to *b q*) by the length of the crank, and dividing it by the length of the connecting rod.

Having made these corrections, we have three points, in the curve *m*, *e*, *n*, and a circular arc passed through these three points is a close enough approximation to the true acceleration curve for all practical purposes.

It will be seen from this discussion that there are two means of adjusting the action of the reciprocating parts of the variation of steam pressure; first by changing the weight of these parts; second, by changing the speed of the engine; for by the rule given for finding the effort, we multiply by this weight and also by the square of the number of revolutions.

This principle was first developed and put into practice by Mr. Charles T. Porter, on the Porter-Allen engine. Previous to this application the parts were made as light as was consistent with strength.—*Northwestern Mechanic.*

The boiler which is said to be the largest in the world was tested in July, 1890, at one of the electric light stations in New York. It is encased in a vertical shell, which is three fourths of an inch in thickness. It contains 600 tubes, each of which is three inches in diameter. The length of the tubes, if stretched out in a straight line, would extend to 7,200 feet, or very nearly a mile and a half. The whole boiler contains 6,000 square feet of heating surface, and is of 1,000 horse power. The shell of what is termed the Lancashire boiler is 28 feet long and seven feet in diameter. The barrel of a locomotive boiler is 10 feet long, and a little more than four feet in diameter. The marine boiler has a shell 12½ feet in diameter, and 16½ feet long. The boiler tubes serve to diffuse the heat through the mass of water in locomotive and other boilers.—*Fire and Water.*

ARMATURE BURNOUTS.

It is not always the case that the burning out of armature coils is due to overload. Such accidents are liable to occur from various causes which are avoidable, and it often happens that burnouts which are ascribed to overload are really due to something else.

A prominent case of this character is described on another page in an article by Mr. E. E. Stark, an electrician of this city. Last Fall there was a remarkably large number of burnouts in alternating-current dynamos in this city for a short period. It was during a cold, dry spell, and among the machines under Mr. Stark's charge the trouble occurred with a frequency that was serious and which led to the suspicion that it was not due to overloading at all, but something entirely different. It seems that the true cause of the trouble at this particular time was discovered by an accident. One of the workmen about one of the dynamos received a Leyden jar shock while touching some parts of the machine which at once opened the way to a determination of the cause of the trouble. It seems that the static electricity generated by the rapidly-moving belt accumulated on the iron framework of the machine, and when it attained a sufficient potential it broke down the insulation of the armature-coils, thus burning them out. The remedy for this trouble was found in grounding the base of the dynamo, but as this expedient was inadvisable on account of the possibility of developing other trouble through the use of a ground connection, experiments were made which resulted in a complete solution of the problem without the necessity of maintaining a direct-ground connection.

A small Geissler tube, constructed to discharge at a potential lower than that capable of piercing the insulation of the armature-coils, was connected between the base of the dynamo and the ground, and the battle was won. These Geissler tubes are now doing good service in this direction, and no doubt their general adoption would save a great many armatures.—*Electrical Age.*

THE PACKARD LAMP COMPANY.

The Packard Lamp Company, Ltd., of Montreal, has fitted up a complete and commodious incandescent lamp factory at 96 to 100 King St., and is now manufacturing lamps to supply consumers and the trade in Canada. The lamps manufactured are the latest type of "Packard High Grade," in all respects similar to those made by the New York and Ohio Company at

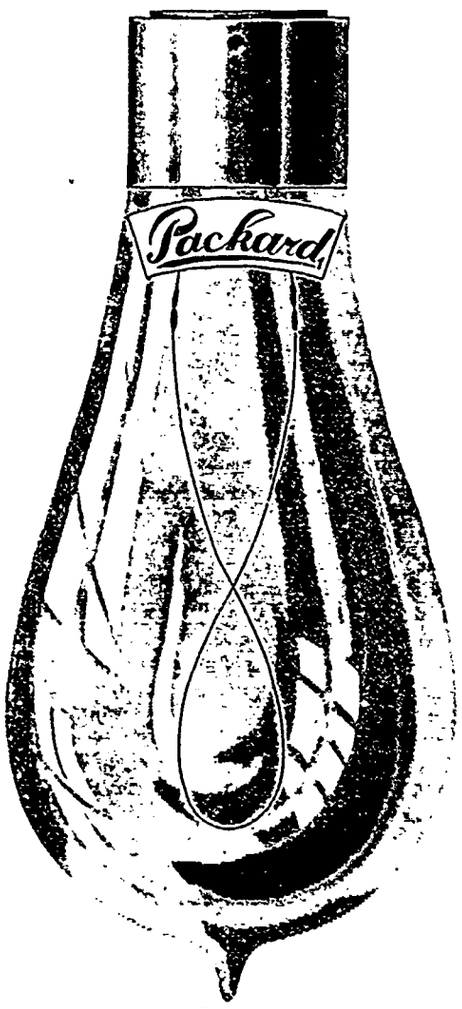

Fig. 1.

Warren, Ohio, the factory being under the personal management of the Messrs. Packard, with Mr. F. E. Cavanaugh as Superintendent.

The Packard lamp has, in the States, attained a reputation second to none, and its brilliant record has been continuous. In a recent disinterested and impartial test of all the various makes of incandescent lamps, the "Packard" is said to have proved to be distinctly ahead of all others in brilliancy and maintenance of candle power.

The new firm, having the only independent lamp factory in the Dominion, making a lamp of an established reputation, and being very advantageously situated as regards the employment of labour and the supply of materials, should be able to command an extensive trade. The complete lamps in all their details, and adapted to any base, voltage and candle-power, are manufactured in the King Street factory, none of the parts, as is sometimes the case, being imported, but all are made from the raw materials on the premises. The equipment of the factory,

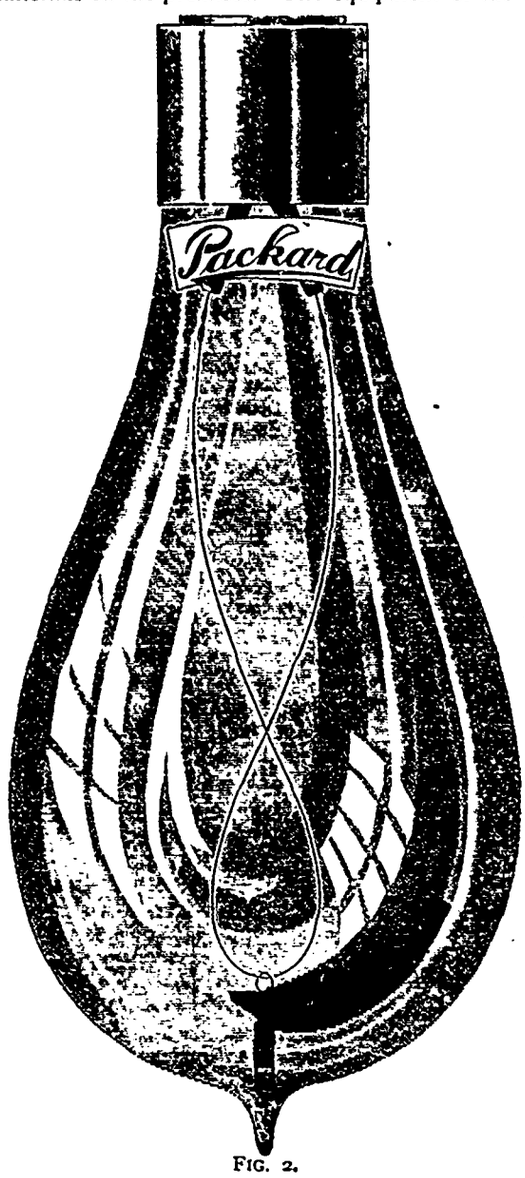

Fig. 2.

in instruments, pumps and all apparatus, is of the most complete and perfected type.

In the accompanying cuts, Fig. 1 represents the regular 16 candle-power low volt lamp, such as is employed on the alternating circuits generally used for commercial lighting.

Fig. 2 shows the special street railway lamp in which the carbon is supported at the top by means of a platinum hook, effectually preventing any damage which might result from the excessive vibration to which lamps so used are subjected.

The company start out with several very large orders booked, and are prepared to increase their output as the demand for their product arises.

PUBLICATIONS.

The third instalment of the argument in behalf of Lord Bacon as the author of the Shakespeare plays, is presented in the September number of the *Arena*. The discussion grows in interest as it proceeds. The September *Arena* also contains brilliant papers by Ibn Ishak, Rev. M. J. Savage, James A. Herne, Hamlin Garland, Congressman John Davis, Prof. Willis Boughton and other representative essayists, together with a powerful symposium on Woman's Dress Reform, prepared under the auspices of the National Council of Women of the United States.

CALCULATING CHIMNEY DRAFT.

To find the draft of a chimney, says the *Northwestern Mechanic*, the best way is to attach a bit of rubber hose terminating in a water-line glass bent into the shape of the letter U. This is filled with water and the hose attached to one end, the other end of the hose being connected to the base of chimney. Twice the difference in level between the water in the legs of the U glass, will be the draft of chimney in inches of water.

Another method of obtaining the result in fractions of a pound, is to subtract weight of cubic foot of air in the chimney, from the weight of the same quantity of air outside, and multiply the product by the height of chimney or stack in feet. The result will be the value of the draft. The following table of the weight of a cubic foot of air at different temperatures will be necessary for obtaining the weight of air from the outside and inside of chimney. The temperature being known by the use of a pyrometer and a thermometer, this may readily be ascertained.

TEMPERATURE AND PRESSURE OF AIR.

Temperature	Weight of one Cubic Ft.	Temperature	Weight of one Cubic Ft.
0	.086331	360	.048476
32	.080728	380	.047323
40	.079439	400	.046223
50	.077884	425	.04492
62	.076094	450	.043686
70	.07494	475	.04252
80	.073565	500	.041414
90	.07223	525	.040364
100	.070942	550	.039365
120	.0685	575	.038415
140	.066221	600	.03751
160	.064088	650	.035822
180	.06309	700	.03428
200	.06021	750	.032865
210	.059313	800	.031561
212	.059135	850	.030358
220	.058442	900	.029242
240	.056774	950	.028206
260	.0553	1000	.027241
280	.05371	1500	.020295
300	.052297	2000	.016172
320	.050959	2500	.013441
340	.049686	3000	.011499

THE MOTOR-MAN.

I would like to sing in a pleasing strain,
Yet, I fear I'll end in a sad refrain,
For the subtle forces of nature now
Are employing many a thoughtful brow,
In the field of progress, day and night,
To gather them in and hold them tight,
'Till steam shall yield to the lightning plan,
And the engineer to the motor-man.

Let the sceptics scoff on every hand
Let them doubt when they cannot understand;
But the mighty forces of steam must yield
To a mightier force, now scarce concealed
From the public view, but the gauzy veil
May be soon pulled off, and upon the rail
There will come a change in time's briefest span,
When we all must bow to the motor-man.

When Galileo preached his creed,
But few of his listners did him heed;
When Watts saw the lift on the kettle's lid,
He knew underneath there were forces hid;
When Fulton first launched his tiny boat,
Who'd dream of the palaces now afloat?
And when Morse his wires o'er the house-tops ran,
Who'd think of the coming motor-man.

Alas, alas! for the engineers,
How their bones will bleach in a few more years
In the boneyards over the country wide,
Where we'll all be thrown, bereft of pride.
We may then sit down, and our cuds can chew,
Telling stories of days when we filled the view
Of the public eye, when we lead the van,
Ere we heard a word of the motor-man.

What a mass of song in our simple way
I have chorused up for many a day!
How I tickled the ribs of the engineers,
And won pleasing smiles from their comely dears.
As I sung the joys of their railway life,
And I pictured pains of our daily strife,
As we forward marched in the labor van,
But I cannot sing for the motor-man.

I am now too old to begin anew,
I shall end my days with the engine's crew;
For the dynamos and the Leyden jars
I no more could catch than the distant stars.
In the cabs we reigned with a swing supreme
In the glorious days of the age of steam;
We must march in a ghostly caravan
When we're crowded out by the motor-man.

—*Locomotive Engineering Journal.*

SPARKS.

Authority is being sought to operate an electric street railway at Belleville, Ont.

The Dominion Telegraph Co. have just paid a quarterly dividend of 1½ per cent.

A Belleville firm is said to have commenced the manufacture of electric street cars.

The Bell Telephone Co. and Montreal Telegraph Co. have each granted a quarterly dividend of two per cent.

Mr. Granville C. Cunningham, late City Engineer of Toronto, has been appointed electrical engineer of the Montreal City Passenger Railway Co.

Hang a wet towel in front of your electric fan and you will find that your room or office will be much cooler. Moist air is better than dry air for cooling purposes.—*New York Electrical Review.*

Mr. J. J. Wright and the members of his family, accompanied by Mr. A. B. Smith and family, recently spent a very pleasant week on board the yacht "Electric," cruising on Lake Ontario between Toronto and Kingston.

The importance of using good varnish in electrical apparatus cannot be over-estimated, says the New York *Electrical Review.* A good method of testing is to cover a sheet of paper with several coats of varnish, and attempt to pass a 3,000 volts alternating discharge through it. If the varnished paper resists the discharge, it is suitable for electrical use.

In an electric arc the positive pole is hotter than the negative, the positive showing a temperature of about 4,000 degrees C., the negative showing a temperature of 3,000 degrees to 3,500 degrees C. This difference of temperature produces a counter electromotive force which acts like ohmic resistance. The cause of the positive pole wearing away twice as fast as the negative is due to this difference in temperature.—*Scientific American.*

SITUATION WANTED

By practical Electrician; over 9 years' experience as generator or motor builder, repairs, etc. Charge of central station, or inspecting, running and laying out plants. Highest references; open for engagement 19th September.

"PRACTICAL,"
CANADIAN ELECTRICAL NEWS, Toronto.

SPARKS.

The contract for cars for the new electric street railway at Brantford has been given to Patterson & Corbin, St. Catharines.

The incorporation at Montreal of the Packard Lamp Co., with a capital of of $6,000, is announced. The company will manufacture electric lamps and machinery.

The Light, Heat and Power Company, Newmarket, Ont., has been incorporated with a capital stock of $40,000 to make and supply electric, steam and water power.

The limited Sunday car service which obtained in Hamilton under the old *regime*, will it is said be discontinued, for the reason that it would not pay the company to get up steam for the purpose.

The Canadian General Electric Company, with headquarters at Montreal, has been incorporated with a capital stock of $1,000,000 to manufacture machinery, apparatus and supplies of every kind connected with the use of electricity.

The electric railway between Mimico and Parkdale is being pushed rapidly. The iron bridge across the Humber is nearly completed, and the tracks and wires are up as far as the Mimico Creek. It will be ready for running before long.

Mr. L. M. Pinolet, of Montreal, visited Toronto on the occasion of the Edison Convention in the interest of the *Electrical Engineer*, of New York. The other representatives of the foreign press were Mr. Sullivan of the *Street Railway Gazette*, Chicago, and Mr. Price of the New York *Electrical Review*.

The Beacon Electrical Co., have in view the establishing of a factory in Canada for the manufacture of incandescent electric lamps, which is expected to give employment to thirty or forty hands. Mr. H. S. Kaliske, business manager of the company was in Canada recently prospecting for a suitable location.

The building known as Pierce's saw mill at the Chaudiere bridge, Ottawa, has been fitted up as the power house of the Ottawa Street Railway, and is about to go into operation. The upper flat is to be used for the storage of wire, on the main floor are the dynamos. Three water wheels, each 500 h.p., one at the front and two at the rear of the building, will supply the motive power. It is the intention of the company to supply heat as well as light and power. The power house itself will be heated by the apparatus devised by Mr. Ahearn.

The following companies are announced as incorporated: The Citizens' Telephone and Electric Company, Rat Portage, capital $40,000; the Manitoulin & North Shore Telephone and Telegraph Company, capital $20,000.

Messrs. C. F. Stacey & Co., of Bathurst, N. B., have recently installed an electric plant, consisting of one of the Consolidated Electric Company's dynamos, two 1,200-c. p. arc lights, ten 24-c. p. and twenty-four 16-c. p. incandescent lights.

A delegation recently waited on the govenment at Ottawa, and asked that the rails used in electric railways which weighed over 30 pounds be admitted free of duty under the same classification as rails used for locomotives. The government in reply stated that electric railways are classified as tramways, and the rails used for electric railways are dutiable, irrespective of weight.