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CANADIAN
ELECTRICAL NEWS
AND
STEAM ENGINEERING JOURNAL

OLD SERIES, VOL. XV.—No. 6.
NEW SERIES, VOL. VI.—No. 3.

MARCH, 1896

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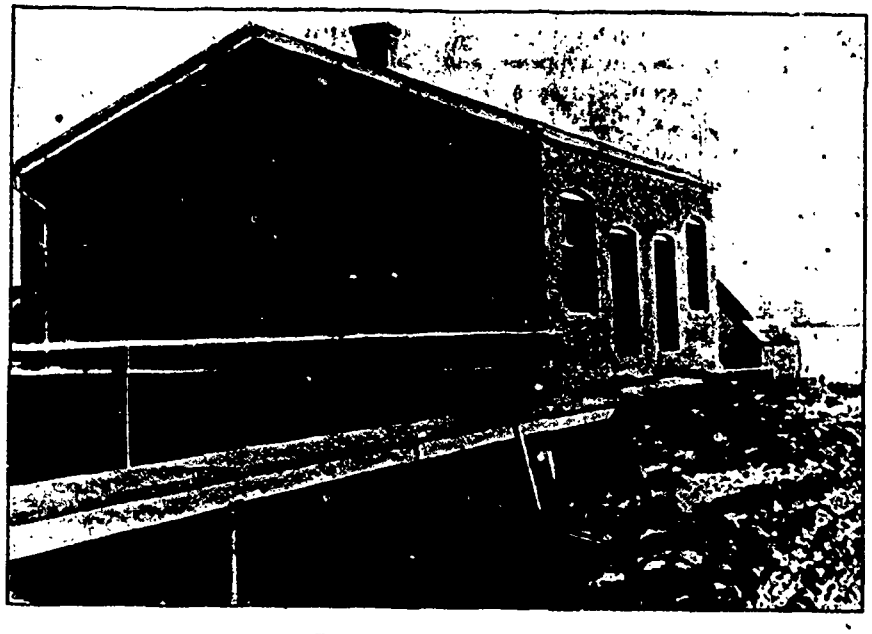
CANADIAN
ELECTRICAL NEWS
AND
STEAM ENGINEERING JOURNAL.

VOL. VI. MARCH, 1896 No. 3.

THE DUNNVILLE ELECTRIC LIGHT COMPANY'S NEW STATION.

A GRATIFYING feature of the development of electrical industries in Canada within the last three or four years has been the success of the incandescent lighting plants, especially in most of the smaller towns and villages. This success has been at once a source of benefit to the public, even in the smallest communities, in placing within their reach the most perfect of artificial illuminants at a cost but little, if any, in excess of that of coal oil, while at the same time it has yielded to the owners of the plants a substantial return for the money invested. Such a result has been due partly to the great improvements in standard apparatus, and the better engineering methods adopted within the last few years, and also to a considerable degree to the recognition on the part of business men generally of the essentially profitable nature of electric lighting as an investment when handled with the same push and ability which they have been accustomed to devote to their other interests.



THE DUNNVILLE ELECTRIC LIGHT COMPANY'S NEW STATION.

An excellent and recent example of a central station plant of this type is that recently installed by the Dunnville Electric Light Company, of Dunnville, Ont., a town of about 2,000 inhabitants. The company, which has been in business for some years, consists of two members, Messrs. W. F. Haskins and James Rolston, the former a private banker and the latter a hardware merchant in the town. Their plant, until recently, consisted of a Thomson-Houston arc dynamo operated by rented power. Having determined, however, to meet the growing demand for improved interior lighting, it was decided to add an incandescent machine to the plant, and at the same time to erect a new power house, and take advantage of an opportunity which presented itself of obtaining water power. To this end the company engaged the services of Mr. W. C. Johnson, Am. Soc. C. E., Chief Engineer of the Niagara Falls Hydraulic Power and Manufacturing Co., by whom plans and specifications were made for the entire hydraulic plant.

POWER PLANT.

Near the mouth of the Grand River, which flows into Lake Erie at Dunnville, a dam has been built by the Canadian Government for the purpose of supplying a feeder to the Welland Canal. This feeder, through the village of Dunnville, runs nearly parallel with the Lake Shore and some three hundred feet from it. The difference in level between the water in the feeder and the lake varies from time to time from six to thirteen feet.

The electric light company's plant is located between this feeder and the lake, at a point about a thousand feet from the river.

The floor of building is set as low as possible and to be sure of being above flood water of the river. The floor of the flume is fourteen feet below the floor of the station, and is about the same level as the bottom of the feeder, from which the supply of water is taken, and also about the same level as high water in the lake.

The principal difficulty in developing this water power arose from the fact of the low head available, combined with the very great fluctuations as compared with the head, the highest being more than double the lowest head. *It follows, therefore, that a water wheel would* be capable of developing more than double the power at some times than at others. On this account it was decided to put in two wheels in two independent flumes, so arranged that either or both of the two electric machines could be run by either or both water wheels. The water flows in one channel to the front of the building, passing through a rack, as shown in the engraving. At the front of the building a centre wall divides the channel into two parts, each provided with a head gate, by which the water can be shut off of either flume for repairs to the wheel.

Under ordinary circumstances one wheel is sufficient for driving the plant, and only one wheel will be used, the couplings being arranged with removable plates which can be taken out, cutting off either wheel from the line shaft, or by unshipping the coupling each machine is left attached to a single wheel. In low water both wheels will be used coupled together.

The wheels were specified to run at a uniform speed of sixty-six revolutions per minute under any and all heads from six to thirteen feet, and under all heads from six to nine and a half feet to develop not less than eighty horse-power; under all heads from nine and a half to thirteen feet to develop not less than one hundred and sixty horse-power, and to show an efficiency of not less than seventy per cent. of useful effect at seven-eights to full gate opening when running at a speed of sixty-six revolutions per minute.

While this is not a high efficiency when wheels are run at their best speed, it is a high efficiency under the unusual requirements as to speed. The wheel of the proper size to run at sixty-six revolutions per minute under a head of six feet, would give its best efficiency under a head of thirteen feet when running at about one hundred revolutions per minute.

The contract on the wheels was awarded to James Leffel & Company, of Springfield, Ohio, for two of their "Sampson" wheels, sixty-two inches in diameter, and they have been running for several months and are giving good satisfaction.

The wheels are provided with draft tubes, enabling the entire available head to be used when the level of the water in the lake is below the bottom of the wheels.

Since the wheels have been in operation a period of low water has occurred, when the lake level was but just above the end of the draft tubes and the head water but little more than covered the cases of the wheels. No trouble was experienced in operation.

The shafting, floor stands, pulleys, etc., were furnished by the Waterous Engine Co., of Brantford.

The flume walls were built of stone laid in hydraulic cement, upon a flooring of brick bedded in concrete. The walls above the foundations were built of brick without finish on the inside.

The roof consisted of sheeting of two inch plank laid on iron beams imbedded in the walls and covered with slate, making the whole building practically fire-proof.

A brick partition wall divides the gear room from the room containing the electric machinery, which serves to deaden the sound of the gears and affords a protection in case of fire.

At one side of the machine room two small rooms are partitioned off, one for an office and the other for a work room. A loft over the gear room serves as a store room.

ELECTRIC PLANT.

In the station are installed the Thomson-Houston arc machine, by which the street lighting is supplied, and a 75 kilowatt alternator of the Canadian General Electric Co.'s monocyclic type. The company, in selecting the monocyclic system, were guided by the fact that while their present requirements would be for current for incandescent lighting, and while this would continue to furnish the greater portion of their business, there would no doubt in time be developed a considerable field for the supply of power to stationary motors. It was therefore desirable to install a system in which the greatest possible simplicity should be maintained for the lighting circuits, and from which, at the same time, polyphase currents could be maintained, if desired, for the operation of induction motors. The distinctive feature of the monocyclic system is, of course, its special suitability for this class of service. The lighting being done on the single-phase system avoids the complication in wiring and difficulties in balancing attendant on the use of the various polyphase systems, while, for the supply of power to the motor at any given point, it is only necessary to carry to it the third or teaser wire from the dynamo, and make the proper transformer connection.

The alternator is in design of the well known iron-clad armature type, and is compound wound so as to compensate automatically for line losses, and thereby maintain an even potential at the centre of distribution throughout all changes on load. The armature coils are wound on forms and inserted in longitudinal grooves in the surface of the armature, and are easily and separately removable in case of damage to one or more coils. The station instruments are all of the latest type, and handsomely mounted on a switch-board of enamelled black slate.

A feature of special interest in this plant is the use throughout of the Edison three-wire system for secondary distribution, by which a considerable saving in transformer capacity and secondary wiring is claimed to be effected, while at the same time ensuring a higher efficiency and closer regulation for the entire secondary system. Through that portion of the town where lighting is to be supplied, three-wire secondary mains are run and fed at intervals of 1,000 to 1,500 feet by pairs of large transformers, connected with their secondaries in series to give 208 volts. This system of distribution being once erected, the wiring of additional buildings from time to time calls for no additional expenditure for material, beyond that required in running a service from the mains to the building wired.

Altogether the new plant of the Dunnville Electric Light Company is a credit at once to its enterprising owners, Messrs. Haskins & Rolston, and to Mr. W. C. Johnson, consulting engineer, and the contractors who furnished the apparatus and material used throughout.

An interesting use of magnetism is being made at the Sandycroft foundry in England. At these works electric cranes are operated from the electric power and lighting circuits, together with electro-magnets, which permit the ready lifting of pieces of iron or steel up to two tons. The magnets constructed for lifting purposes are attached to a crane. One magnet takes 5½ amperes at 110 volts to excite it, at which energy it will support a weight of two tons of iron or steel. A switch controls the supply of current delivered to the magnet.

Ampere, like other philosophers, was noted for his absent-mindedness, says the London Electrical Engineer. It is stated that on one occasion while walking along the street he mistook the back of a cab for a blackboard, and as a blackboard was just the thing he needed at the time to solve a problem which had been vexing his mind for some moments during his walk, he made use of it. Taking a piece of chalk out of his pocket he proceeded to trace out a number of algebraical formulæ on the cab's back, and followed the moving "board" for the space of a quarter of an hour without noticing the progress of the conveyance.

CORRESPONDENCE

THE PIONEER ELECTRIC RAILWAY OF CANADA.

TORONTO, Feb. 13, 1896.

Editor CANADIAN ELECTRICAL NEWS.

SIR, — A cynical writer has remarked that "without lies we should have no histories," and since reading a presumably historical account of the first electric railway in Canada, contained in Cassiers' Magazine for January, I begin to believe that the cynic's opinion was founded on fact, as the source of the supposed historical account must have either been densely ignorant of the facts or fully qualified for the presidency of an Annanias Club. An accurate account of the experiment of 1883 may be worthy of preservation; if such be your opinion, you are free to publish this account, which is accurate.

The electric railway experiment of 1883 was at the expense of the Ball Electric Light Co., of Canada, and was carried out by Frank B. Scovell, the Vice-Pres. and Electrical Engineer of that company, assisted by the writer, who was then assistant electrician of the Ball Electric Light Co., of New York—therefore, this account is neither a matter of rumor nor of imagination.

The track consisted of eight lengths of common railway T rails, spiked to common ties, laid on the surface of the ground, on the premises of the Industrial Exhibition in Toronto—about where the iron tower or police station are a present located. The car was an ordinary flat car.

The transmission was by overhead wires from Machinery Hall to the track. One line was coupled to both tracks and the other to a bare copper wire which lay on the ties between the rails. Contact with this wire was maintained by a carrier, which lifted the wire off the ties as it passed back and forth. As the track was perfectly straight, this was satisfactory, there being no tendency to pull the wire against the rails, as might have been the case with curves. The motor equipment was an old style Ball machine, built in London, Ont., and the power plant two similar machines. Each of these would at regular speed operate at 200 volts with 15 amperes, but being designed for arc lighting the armature reaction would rapidly run the voltage and torque down with increase of amperage. The motor was belted to a countershaft and that to one pair of axles, by common flat leather belting. The reduction in speed proved insufficient to enable the motor to move the car up the slight grade, though it was capable of doing so on the level and down the grade; up the grade it required a couple of men to assist, even with an unloaded car. The intention was to carry passengers as a novelty, but owing to the above fact this was not attempted as a matter of fact, as the Exhibition closed before the necessary changes could be effected. A very little more motive power or less attempt at speeding would have enabled us to have carried out the intention, and engineers of that time will remember that we had no guide but the result of our own experiments, and judge Mr. Scovell rather by the measure of success secured than by the want of full success, due solely to want of information that is so readily secured now by the tables and published results of experiments that are almost universally disseminated among engineers of the present day.

The company mentioned in Cassiers' did not come into existence until about ten years later than the date of this experiment, and I am informed that the head of this company was then engaged in button-making in Springfield, Mass. The view therein given as one of the road of 1883, and the information as to carrying passengers, I believe, is really applicable to the road built and operated by Mr. J. J. Wright, under the Van Depoele patents, I think in 1884 or 1885. The fact that Mr. Scovell has since departed this life may possibly explain the inaccurate account given in Cassiers', as so far as I know he and I were alone acquainted with the facts.

Yours respectfully,

JAMES W. EASTON,
Electrical Engineer.

ELECTRIC RAILWAY IMPROVEMENTS.

TORONTO, Feb. 21st, 1896.

Editor CANADIAN ELECTRICAL NEWS.

Dear Sir,—The writer of this has always heard Hamilton spoken of as being behind the times and an overgrown village, and other uncomplimentary remarks made about it—as being behind the age, yet a visit there a few days ago showed that, even if the town is a little behind the times, the people are not so bad. I had the pleasure of a trip over The Hamilton, Grimsby & Beamsville Railway in company with Mr. C. K. Green, Chief Electrician. You are aware, no doubt, that this railway runs from Hamilton to Grimsby—seventeen miles—through the Garden of Canada. On boarding the car at Hamilton Mr. Green promised me a surprise, and this I got, as I found that when the trolley was put on the wire the headlight shone out clear and bright—an arc lamp, which, on the run from Hamilton to Grimsby, illuminated the track as clear as daylight from six to eight pole-lengths in advance of the car, one-half of which was more than sufficient to stop the car in case of anything being on the track. The arc lamp is in series with the car heaters, gives a clear, bright and steady light, and is easily controlled by the motorman. The mechanism, and in fact the idea, seems to have originated with Mr. Green.

After admiring the beauties of the arc lamp, and the splendid way in which it lit up the track, Mr. Green gave us another surprise in the way of communicating by telephone with any station on their line from inside of the cars. In the corner, in one end of the car, a small open box is affixed to the wall; in this a very small telephone is enclosed, and attached to the telephone is a flexible cable of sufficient length to reach the telephone wires running on the poles of the railway company. These are hooked on by a bamboo pole, which is carried on the outside of the car. Communications can be established with any station from any point of the line in this manner. As a magneto the same as is used on the ordinary telephone would be too cumbersome to put in the car, Mr. Greene arranged a small metallic roller having a perforated disc, and this being moved from point to point would give a vibrating current, which would make a magneto on any point of the line ring. Altogether, the arrangement is about as complete as could be wished for.

The arc lamp, used in the way it is on this line, is the first practical application of it in Canada, and telephoning from the cars, while not being something absolutely new, yet speaks well for the enterprise of Mr. Green in meeting the conditions, which can only be found in a long suburban road.

A TRAVELLER.

MR. JOSEPH R. ROY.

MR. JOSEPH R. ROY.

THE chief engineer of the Montreal Park & Island Railway Company is Mr. Joseph R. Roy, whose portrait we have the pleasure of presenting herewith. He is a native of Montreal, and a graduate in engineering of McGill University He is also a member of the Canadian Society of Civil Engineers. Mr. Roy was for three years employed by the Department of Public Works, and at a later date was appointed resident engineer in charge of the construction of the Massini springs and Fort Covington railway. He then became chief engineer of the Montreal and Ottawa railway, which position he held until the year 1892, when the road was made a part of the Canadian Pacific railway.

THE ELECTRICAL PLANT AT NIAGARA FALLS.

THE following notes are the result of a visit by a Canadian electrician to this plant of world wide interest and observation which is now in successful operation. The Niagara Falls Power Co. owns about 1,500 acres which it expects to sell or lease to manufacturing companies using its power. The user of the power may put in his own water wheel, renting the use of the tunnel as a tail race, or he may take his power from the shaft of the Niagara Co., or use the electric power itself. So much power is being taken up by companies in the immediate vicinity, that long distance transmission is likely to be delayed for a year or two at least.

About 3,000 h. p. is now being utilized, distributed as follows: Pittsburgh Reduction Co., 1,500 to 2,000 h. p.; Carborundum Co., 1,000 h. p., and Street Railway Co., 500 h. p. This is handled by one of the two 5,000 h. p. generators now in place. The third, which completes the order placed with the Westinghouse Electric & Manufacturing Co., is expected in two weeks. As the power is rapidly being taken up, it is likely that bids for new generators will soon be called for.

One cannot but be impressed by the thoroughness and lasting qualities of all work done in and about the power house. Even the visitor is provided for, in the shape of a gallery, from which a fine view of the station can be had. All heavy apparatus is easily handled by a 50 ton crane running the length of the station. The armature, the heaviest part of the generator, weighs about 35 tons. The whole revolving part of the machinery, field shaft and turbines, weighs about 65 tons. But this great weight, revolving at 250 revolutions per minute, is almost entirely balanced by the water pressure, which acts upwards on the lower side of the turbines. So much is this the case, that the strain on the thrust bearings is estimated at not more than 2 tons when the machine is running. At some loads there is no pressure on the bearings whatever, the whole weight being supported by the column of water. The speed is regulated by ball governor mechanism shifting two gates which are balanced against each other and require extremely little power to move them.

The fields are excited from rotary transformers driven by the generators themselves and placed near the central vault supporting the switchboards. There is also a step-down transformer with each rotary transformer.

All wires are carried under the floor to a vault in the centre of the station. In this vault the switches, moved by compressed air are placed. The bus bars are suspended from the roof of the vault and connections made to the switches which stand on the floor. There are two switches to each generator, a distributing switch and a generator switch. The field rheostats are not placed in the vault, being too bulky, but the connections from them are all brought in here. All instruments and levers, for regulating the switches, etc., are placed on top of the vault. This is surrounded by a brass railing, and here the electrical engineer in charge has a view of the whole station and perfect control over the electrical apparatus. The instruments consist of the ammeters and two volt meters (one for each phase) and one watt meter for each machine. It may be mentioned here that the two legs of the two-phase circuit bear loads which differ considerably, due to single phase current being rented in some cases. The step-up transformers for long distance transmission are provided with a special building across the canal. Lightning arresters are provided for all circuits leaving the power house.

Street railway power is furnished from a 500 h. p. rotary converter, built by the Westinghouse Co.

Power is transmitted to the transformer house of the Pittsburgh Reduction Co., near by, where it is reduced to a pressure of 115 volts and transformed by rotary converters to direct current at 160 volts, ready for use in the reducing furnaces in the production of aluminum. There are four rotary converters of 500 h. p. each, built by the General Electric Co. They are of very large size, but were so made that they might be increased, when necessary, to 1,000 h. p. each, by changing the armatures. If necessary one of these machines can be started up in 3 minutes, and the whole station in 11 minutes. Such rapid starting up would be impossible in the case of a steam plant. Indeed one is greatly impressed here by the absence of anything in the shape of a tall chimney and smoke. The load is pretty steady and power is kept on day and night. About 6 tons of aluminum is turned out every 24 hours.

The Carborundum Co. also receives its power in a step down transformer whence it passes through a regulator of special construction moved by hand. The regulator is required on account of the variable pressure necessary during the heating process. It is a transformer in which the mutual induction is varied by turning the inner part of the apparatus and its windings, the outer part being fixed. 1000 h. p. is used, one furnace being in operation at a time. A heat lasts for 24 hours, a ton of carborundum being turned out at each heat. The ingredients consist of coke, salt, sand and sawdust. These are thoroughly ground up and mixed before being put into the furnace. The electric conductors are connected to plates at opposite ends of the furnace. From each of these plates 36 carbon cylinders project into the furnace. A sort of conductor of coke is lain through the middle of the furnace from one terminal to the other and the carborundum crystals are formed around this. These crystals are washed in sulphuric acid and then in water, from which latter bath the carborundum is obtained and sorted in sieves into different sizes ready for the factory. At present it is sent to the factory at Monongahela, Pa., where it is made into wheels and cones of all sizes for various grinding purposes. A factory is being built at Niagara, and when it is complete, the other will be shut down. The process is very much cheapened by the use of the Niagara power.

QUESTIONS AND ANSWERS.

F. & T., Walkerton, Ont., write: 1st. Why cannot alternating current be used instead of direct for street railway purposes? 2nd. What is the difficulty in using same? Our opinion is, that with double wiring twin trolleys, two commutators and rawhide gear, feed wire and transformers, with a few minor changes in the method now in use, it would be possible, and at a very reduced rate. Will som eone give us their opinion on the same?

ANSWER. The alternating current has not hitherto been used for street railway purposes, first on account of the unsuitability of the alternating motors for the conditions imposed on railway motors, their torques at other than full speed not having been satisfactory. This defect has been overcome in the induction motor, which is no doubt adapted for traction purposes, and probably will be so applied in the near future. By your mention of twin trolleys you no doubt mean to throw out the rails as return circuit, but in any case the single phase alternating current would not be at all suitable for traction, as single phase motors will not start from rest without introducing a complicated phase-splitting apparatus, so that you would either have to use a two phase current with four wires, four trolleys, etc., or a three phase with three wires, three trolleys, and so on. You mention two "commutators," but it does not appear what a commutator has to do with an alternating current. The alternating current is scientifically applicable for traction, but not commercially as yet.

The Secretary of Dresden Association C.A.S.E., propounds the following question:—"What is the indicated h.p. of an engine, 13 in. bore, 18 in. stroke, 170 revolutions per minute, boiler pressure, 70 lbs.?

ANSWER. The indicated horse-power of our engine is calculated from the formula

$$\text{H.P.} = \frac{\text{A.} \times \text{M.E.P.} \times 2\,\text{R.S.}}{33{,}000}$$

where A. = area of piston in square inches; M.E.P. = the mean effective steam pressure; R. = number of revolutions; S. = length of stroke in feet. In the case mentioned, the piston area in inches is 132·73; the mean effective pressure at one-quarter cut-off is (with 70 lbs. boiler pressure) 29·63 lbs., non-condensing; the stroke is practically 1·1 foot hence, substituting in the formula, we get

$$\text{H.P.} = \frac{(132{\cdot}73) \times (29{\cdot}63) \times (2 \times 170 \times 1{\cdot}1)}{33{,}000},$$

which is a little over 44 horse-power.

WALKERVILLE, ONT., Feb. 12, 1896.

Editor CANADIAN ELECTRICAL NEWS.

DEAR SIR, I notice in the "Questions and Answers" column of the NEWS a query from "Constant Reader," Whitby, Ont. He asks, "How is it, when lamps are connected in series, as in railway circuits, the highest voltage lamp always gives the brightest light?" With your permission I would like to state my theory contained in the following table and explanations:

16 C. P. LAMPS, 60 WATT EFFICIENCY.

Volts.	Amperes.	Hot Resistance in Ohms.	
50	1.2	41.66	Lamps of any efficiency can be taken provided all are alike.
70	.875	81.77	
100	.6	166.66	
104	.577	180.24	
110	.5454	201.68	

With a circuit of 500 volts, using five lamps in series, suppose four lamps of a series are 100 volts and one lamp 104 volts, then by adding the resistance of the five lamps, we obtain 846.9 ohms (166.66 × 4 = 666.66 + (1 × 180.24) = 846.9). Applying Ohm's law we get the current required,

$$\frac{500 \text{ volts}}{846.9 \text{ ohms}} = .59 \text{ ampere C.} = \frac{\text{E.}}{\text{R.}}$$

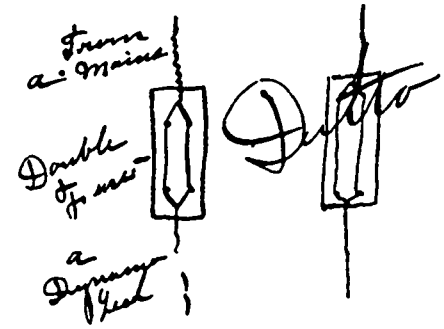
By comparing the result (.59 amp.) with the table, it will be seen that the current passing through the series is .013 amp. less than is required for the 100-volt lamps, and .01 amp. more than is required to bring the 104-volt lamp to 16 c.p. The practical result is that the 100-volt lamps will burn a little below and the 104-volt lamp a little above the normal, making a preceptible difference in the light. Lamps of the same voltage but of different efficiencies will give similar results. The higher efficiency lamps being of higher resistance and requiring less current, will give the brighter light, e. g., 55-watt and 60-watt lamps connected in series, the 55-watt lamps will be the brightest. Nothing but a test will show whether it is the efficiency or voltage that is at fault if some lights in a series burn bright or dim.

J. W. SCHELL.

"P. S. C.," Oshawa, Ont., writes: Please be so kind as to answer me the following questions in the March issue of the ELECTRICAL NEWS: (1.) "Suppose after two guages of water show in glass that pump was stopped; five minutes after that you notice water at the top of glass, what would you do, and what was the cause of difficulty, boiler not foaming? (2.) Suppose feed-pump working, but water level in boiler gradually falling. Name the different places you would look to find the difficulty? (3.) If the valve stem of the steam valve of a Corliss engine should break, what could be done to prevent a shut down? (4.) In triple engine, with second cylinder doing much more work than low pressure, how can cut-off be best adjusted in either cylinder to balance load between cylinders?"

ANSWER.—(1.) We should advise you to blow out the gauge glass to see if the level indicated was the right one, or whether in some way the gauge cocks had become clogged. If, as a matter of fact, the level of the water was above the glass (and the guage had become so clogged as not to indicate properly,) open the pet cocks of the cylinder, and the drain in the pipes, so as to carry off the water flowing into the pipes. If no further trouble occurred in the cylinders wait until water appears again in the guage glass, but if there is any reason to fear that the water level is so high as to flow over into the cylinder, then blow the boiler down a little. (2.) Either the pump is not working fast enough or water is leaking at joints or seams, or around the tubes, or at the blow-off. In fact, overhaul the boiler immediately? (3.) Splice the stem temporarily with anything—a piece of stiff wood—and wrap the stem and *splice with some stout cord or rope, drawing the valves* together, so as to keep the whole thing taut. (4.) You can do nothing unless the cylinders are individually controlled by a cut-off valve, in which case adjust as in a single cylinder.

"W. R. R.," Stayner, Ont., writes: "To protect our alternator from short circuit in the outside mains, there is, as is of course the practice, a fuse introduced between the dynamo leads and the main—but in our fuse cut-out there is, I think, something peculiar, if not out of place. Each wire has a separate cut-out. The following diagram shows the whole as it is:—



The reason given for the double fusing on each line is, "if one should be blown out, the other would still be there to prevent the interruption of the circuit." Is this in place?"

ANSWER.—The two fuses are intended to be duplicates, so that if one goes there may still be the other which can be switched or plugged in. There should be

some arrangement for switching one off and the other on; but of course both should not be in circuit together.

Mr. F. G. Proutt, of Malden, Mass., writes: I noticed in your paper of this month a communication from some one who signs himself "A Constant Reader." From the question he has asked, and which you took so much trouble to answer, I imagine that he is not a constant observer, but to help you complete the answer to his question, the reason a high voltage lamp becomes more incandescent than those of a lower voltage when connected with them in series, is this: The higher voltage the lamp the less current passes through it, or, rather, is required by it; for instance, about ½ ampere is required for a 100 volt lamp, while one ampere, or about that, is required for a 50 volt lamp. Now, if we connect 8 50 volt lamps and 1 100 volt lamp in series across a 500 volt circuit, we would have current passing in proportion to the resistance, and if the 50 volt lamps have each 50 ohms R, and the 100 volt lamps an R of 200 ohms, then

$$\frac{E}{R} = C \text{ or } \frac{500}{8 \times 50 + 200} = C = 5\text{-}6 \text{ amp.}$$

Now, 5-6 of an amp. is not quite enough current for the 50 volt lamp, but is very much too high for the 100 volt lamp. Hence, the high voltage lamp would burn very much brighter, and in every case where lamps of different voltages are run in series, the one made to be at the highest voltage will be the most incandescent.

CENTRAL STATION BOOK-KEEPING.

By George White-Fraser, E. E.

III.

What has gone before will indicate the importance of keeping strict watch on the operating end of an electric plant. As soon as you begin to suspect the honesty and faithfulness of each piece of machinery in your power house, and lay traps to find out little lapses from rectitude, so soon will you begin to find your expenses going down, and your profits increasing.

When you look into things a little, you will be surprised to find what a great deal there is in "management" after all; and how even apparently unimportant apparatus and supplies may exercise a considerable influence on results. Lines are of course very simple, and once they are up will probably continue to be all right, if they are kept free from grounds, and generally kept in repair; but at the same time it is of considerable assistance to take observations from time to time, as to the insulation of the entire aerial structure, from the ground, and of the wires from each other. A leak in either way simply means wasted fuel, and presumably the business of a central station is to make, not to waste, money.

From the central station, the records will divide into those concerning arc services, incandescent service, and power service. As regards the arcs, there should of course be an account kept of the carbons used, and of the repairs necessary on each lamp. An account should be kept for each individual lamp, and the cost of any repairs to any one should be debited against it. If a coil burns out—or a carbon holder—you want to know of it, and which lamp it belonged to; and you can summarize the records at the end of the year, and probably have some instructive information as to the quality of your lamps as pieces of mechanism. Then, a few spare lamps should always be kept in stock in order to replace those on the lines brought in for inspection. Perhaps the idea of inspecting an arc lamp causes amusement; but when it is remembered that an arc lamp is merely a little machine for keeping carbons at a proper distance apart, and that it does so by virtue of being built and adjusted with that object, and that its proper working depends on some rather delicate devices, and that if it falls ever so little out of adjustment, it means wasted money for fuel—then it will be obvious, that to inspect it periodically, to see whether it actually is doing its work, is just as necessary as it is to indicate the engine.

What is an "arc light," and how is it produced? An arc light is simply the illumination produced by the intense incandescence of two "electrodes" separated by a space across which an electric current is being forced by an E. M. F. This incandescence is the result of the very high temperature caused in the electrodes by the interposition of the air space—it being a principle of mechanics as well as electrics that resistance dissipates energy in the form of heat. A greater amount of resistance will dissipate a greater amount of energy. A man will become hot and perspire when working hard, i.e., overcoming a great resistance, when he will not even feel warm over a light job; and as the principal work done by the current in passing through an arc lamp is right at the arc itself, it is plain that the longer the arc the more work done. Now, it is well known that a current of 9 amperes requires a voltage of 50 to force it across an air space of about 3-32 of an inch between the carbons, and the light produced is the nominal 2,000 candle-power. So that if you can arrange to have two 7-16 carbons continually held at 3-32 apart, and use a 9 ampere current, you will get nominal 2,000 c.p., and will require a pressure of 50 volts, or an expenditure of $50 \times 9 = 450$ watts of energy. If you vary the distance apart of the carbons, you will vary, in the same sense, the volts, wattage, and within limits, the candle-power. If you keep the carbons 4-32" apart you will get a somewhat larger candle-power, and you will require a higher voltage and expend a higher wattage. But as you are only getting paid for 2,000 c.p., you don't want to produce any more—hence the excess of wattage consequent upon higher c.p. is a pure waste of money. Every time your arc lamp pulls the carbons apart more than their rated arc length; every time the carbon rod sticks a little—generally, whenever your arc gets longer than it is intended to—you are wasting fuel, and consequently, money. With a 9 ampere current, an excessive voltage of so little as one-tenth of a volt, will require an expenditure of almost 3 h.p. hours per year—more than necessary—per lamp.

Try any lamp that has been on the line for some weeks, exposed to all the variable atmospheric conditions, and a few careful observations as to the fall of pressure across the terminals will be very instructive to anyone who is intelligent enough to apply the results. Assume 30 arc lamps, burning on a moon schedule of about 200 hours in the month, and assume that their adjustment is to become so inaccurate that they will draw out their arcs long enough before feeding to require an extra volt each. Assume that otherwise their working is reasonably good, and their feeding regular; then this plant will dissipate in excessive voltage alone, 432 h. p. hours every year, which might just as well be saved.

Every lamp should be tested for a whole night every two or three months. If its feeding is not regular it should be made so, by the proper adjustments, which can be done by any intelligent electrician; and the record of each lamp's performance should be kept. If any individual lamp is frequently found to be out of adjustment, it should be carefully overhauled. It may have some defect which renders it inefficient, and which can perhaps be remedied. If not, it is better to buy a new lamp than to run a bad one. By lighting the power house with the lamp to be tested, no extra expense will be involved.

It is quite important that tests should be made of the carbons. A carbon is by no means always a carbon. There are good, bad, and indifferent ones. The good will cost money to buy, it is true; but the poor one will cost money to run, it is equally true. There are hard and soft, long-lived and short-lived, cheap and expensive ones. Those who have not given any study to the carbon question generally believe that carbon is the best that lasts the longest, but that does not necessarily follow. Carbon is a material of comparatively high resistance, which can, however, be varied by varying its density and its ingredients. Cheap carbons are made of inferior materials, and not a great deal of attention is paid to the process of manufacture. The consequence is probably a very high resistance, and a want of homogeneity in the structure which causes it to burn unequally and break off in little chunks. It may have a long life, but the high resistance will cause the same extra expenditure over that required for a shorter lived, lower resistance carbon, as the undue lengthening of the arc described above. It may very easily happen that a short-lived carbon may be the most economical to use, because its smaller resistance will save more than enough energy to pay for the greater number of carbons used. Observation and experiment will enable the intelligent electrician to select actually the best carbon; and a certain number of each batch bought should be carefully tested as to their life, their resistance, and if possible, their candle-power. This latter point—candle-power—is of course very important, but to properly describe the tests and observations would require too long an article. Careful observations by experienced scientists have proved that carbons of the same apparent make, from different makers, sometimes vary as much as 50 per cent. in the candle-powers they give forth, for the same expenditure of energy; and they show that ultimately the best carbon is undoubtedly that one to the manufacture of which most scientific attention has been given, which is therefore necessarily high priced. But the test above mentioned should be made with a carefully regulated lamp, so that the arc shall be kept sensibly constant, and should record the exact length of life per inch and per carbon, and the average

resistance across the lamp terminals. These records will enable a fairly good comparison to be made between carbons of different makes and prices. If, by a proper system of lamp inspection and adjustment, and a careful selection of carbons, you can run each lamp at one volt less pressure, in the above assumed plant you will save over two tons of coal per year; or you will be able to put another lamp on the same circuit.

As regards the incandescent installation, about the most important feature is the lamps themselves; and this is the feature that seems to receive less attention and study from the average central station manager than any other. Lamps are of all kinds, sizes, makes and descriptions; and of course each manufacturer claims superiority for his own make. Price seems generally to be regarded as the most important factor governing the selection of a lamp, i.e., a lamp costing 22 cents is taken to be a more advantageous purchase than another costing 23 cents. As I have requently said before, it is a pretty fair principle to work on in these days of keen competition among manufacturers, that the highest priced article is generally the best one; and the question to ask is, not how little does such an article cost to buy, but how little does it cost to keep running in good order. An article that can be kept in repair and in good efficient condition for $1 a year, is worth, to buy, just twice as much as a similar article that costs $2 per year to maintain, other things being equal; and if the former article is sold at 50 per cent. advance on the price of the latter, then the higher priced article is actually and obviously far the cheaper of the two. This same principle applies to incandescent lamps. The factors that determine the comparative values of different lamps are: the candle-power, the life, the efficiency, the price—purposely putting price last. Lamps of all makes deteriorate as they are longer in use, some less than others, i.e., their candle-powers become, sometimes, considerably less the longer they are kept burning; and the lamp to be desired is, other things being equal, that one that keeps its candle-power longest up to its rated amount. Then again, lamps differ in point of efficiency. A lamp requires the expenditure of a certain amount of energy to make and keep it burning; so that other things being equal, that lamp that maintains its candle-power longest, for the least expenditure of energy, is the best. Having obtained by means of experiment or otherwise, a diagram showing the continuous candle-power curve of a lamp as a function of its life, and also of the watts of electrical energy expended during inch life, then an average can be struck which shows the average watts per candle power expended. And a comparison of several such averages will show the best lamp, other things being equal. The best is of course that lamp which requires the lowest average wattage per candle.

About the only other record that can be kept in places where lamps are rented on the flat rate system, is the dates when each lamp was put in. A little slip of paper with the date marked on it can be gummed onto the base, and so accurate track is kept of the life of each lamp, which can be returned to makers if burnt out before guarantee.

If the entire system is worked on the meter plan, which is *greatly to be preferred, then the monthly readings of the meters* added together should be compared with the month's total as registered on the station wattmeter. The comparison will enable any discrepancy to be traced and possibly lead to the detection of unsuspected leaks.

In a system where current is sold entirely by the meter it becomes of very special importance to study the incandescent lamp question, because the exigencies of this service introduce some very paradoxical conclusions. For instance, it is sometimes actually better and more profitable for the central station to break lamps long before they are worn out, and put in new ones at its own cost. Length of life, in this case, is about the least important advantage that can be claimed for a lamp. This, however, is a matter that cannot be discussed at proper length in this article. What is intended to be shown is, that just as there are engines and engines, dynamos and dynamos, so are there carbons and carbons, lamps and lamps, and that if judgment and caution are necessary in the purchase of a bicycle, or of a good horse—they are far more so in the purchase and operation of any electrical and steam apparatus.

There are certain general accounts that will be kept by every one—sand paper, oil, new brushes, fuse wire, and what not, which need not be particularly referred to. A central station that follows the line of the records indicated in the foregoing, will find itself in a good position to increase its profits. In electrical business it is not entirely what is made that pays dividends, but what s saved; and it cannot be said of even the most high class station yet known, that it has attained the highest possible point of efficiency, but the most successful are those that keep the most watchful eye over every individual machine or piece of apparatus, and who keep every detail in the highest and best order and this cannot be done without keeping the most comprehensive system of accurate records, and by the continual testing of everything.

ANNUAL MEETING OF THE BELL TELEPHONE COMPANY.

THE annual meeting of the Bell Telephone Company was held in Montreal on the 27th of February. Among those present were Messrs. C. F. Sise, president, Robert Mackay, vice-president, C. P. Sclater, secretary-treasurer, W. R. Driver, Robert Archer, C. R. Hosmer, R. McLea, F. X. St. Charles, J. McRae, J. Wilson, W. B. Miller, T. D. Hood, James Moore, A. Kingman, Reid Taylor, H. A. Budden, Hugh Watson, J. Williamson, D. Ross Ross, W. J. Withall, J. B. McNamee George H. Holt, Chas. Garth, John Crawford, Andrew Allen, Alex. Paterson, G. M. Kinghorn, Hector Mackenzie and others.

Mr. Sclater, the secretary-treasurer, read the annual report as follows:—

"The directors beg to submit their sixteenth annual report; 1,028 subscribers have been added during the year, the total number of the sets of instruments now earning rental being 28;809; 45 exchanges and 6 agencies have been constructed and added to the system. The company now owns and operates 345 exchanges and 268 agencies; 522 miles of poles, and 1,760 miles of wire have been added to the long distance system in 1895; of these 190 pole miles and 874 wire miles are in the Ontario department, and 332 pole miles and 913 wire miles are in the Eastern department.

The long distance lines, now owned and operated by the company, comprise 14,851 miles of wire on 5,884 miles of poles, which include a copper metallic circuit line from Montreal to Toronto, constructed during the past year.

Work on the new building in Montreal progressed favorably until it was deemed prudent to discontinue construction during the winter. It will be resumed as early as possible, and we trust that the building will be ready for occupancy before the next annual meeting. The growth of our Winnipeg exchange having rendered the present offices inadequate for the business, it became necessary to secure other quarters, and a lot was purchased on Thistle street, in a favorable location, where a building will be erected during the summer, which will be used solely for the purposes of the company.

The gross revenue for the year was $1,087,124.28, the expenses were $787,249.36, the net revenue was $299,874.92, the paid up capital is $3,168,000.

In addition to the net revenue of $299,874.92, the premium on bonds sold during the year, amounted to $10,750, making a total of $310,624.92, out of which $253,431.33 have been paid in dividends, and the balance of $57,193.59 together with $2,806.41, taken from revenue account, has been carried to the contingent account, which now amounts to $910,000.

In moving the adoption of the report, the chairman made a feeling reference to the loss the company had sustained through the death of the late vice-president, Mr. G. Ross. The report was adopted.

In reply to a question, the president stated that the net revenue of the company for the year had been 10 per cent. The revenue from long distance lines had been, in 1893, $140,000; 1894, $152,000; 1895, $178,213.

The directors were authorized to make a further issue of debentures for $600,000, in accordance with the authority given by the Dominion statute. These funds are required to meet current expenses entailed in improving the system. This sum will bring the total issue up to $1,200,000.

The balloting for officers resulted in the old board being re-elected as follows: C. F. Sise, president; Robert Mackay, vice-president; directors, W. H. Forbes, John E. Hudson, Robert Archer, Wm. R Driver, Hugh Paton and Charles Cassils.

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EDITOR'S ANNOUNCEMENTS.

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

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

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Modern Central Station Engineering.

THE tendency of modern central station engineering is towards greater science, higher economy, more comprehensive business methods. In the early history of electric lighting (about five or six years ago) we used to be satisfied—more, we were pleased—if on closing the switch we got light in the lamps, and our electricians used to be happy and read the paper while the plant ran itself. The fireman also piled in coal, and on cold nights opened the fire door to warm himself at; and if profits were not very large—well "Electricity did'nt pay anyway." But to-day our electrician has something else to do, and the superintendent can tell by comparing the reading of the station watt-meter with the last night's fuel consumption, how many times the furnace door was opened, and for how long, and if Mr. Fireman has not a satisfactory explanation to give he goes suddenly. In those days we knew how much coal was burnt and how much wages we paid, and if the income from the lamps was sufficiently large to have a little over, after paying expenses, we pocketed it with a thankful heart, and asked no questions. How very different is the method of running a central station now-a-days. In the first place, a comprehensive business policy governs the entire management, and furnishes a framework, into which are fitted such details as differential rental rates, lamp efficiencies, etc. The tabulation and classification of operating statistics will, in the hands of an experienced manager, be not only a sure record of the past, but also a guide to the future, and a careful and observant study of such dry statistics will often serve to so modify the

general policy as to effect considerable improvements in operating methods, or in profits. In the next place, each individual bit of machinery in the system, be it boiler, engine, belt, generator, or lamp socket, is continually under the watchful eye of the observant manager, who knows what it is capable of doing under favorable circumstances, and if at any time it falls somewhat below the mark, he knows it, and must know the reason why. If 500 lbs. of coal are burnt more to-night than last night, he is aware of it next morning, and far from saying it "can't be helped," he finds out why it was—whether there was a greater demand for current by consumers, or whether a belt slipped, or a valve got wrong. It can and must be helped, and is helped. The repair account is scrutinized narrowly every year, and any bit of apparatus that seemed to require frequent attention is examined with the object of making it more durable, and so reducing the expenses. There is a ceaseless effort to so raise the efficiency of the whole system, that the same amount of current may be generated at a less expense; or shall do a greater amount of work and so gain more; and the means to this end are enquiry into every stage in the process of converting coal into current, and ceaseless energy and investigation.

Guarantees.

INVESTORS in electrical and steam machinery have an idea that if they base their selection of machinery on the guarantees given by the makers, they cannot go far wrong. When making a choice between several competing proposals, they do not very often take proper means to arrive at which is really the best for their particular case; but place their orders with the maker who gives the best guarantees. Before doing this they should consider first, what are the conditions under which the guarantee is given; and second, what means they have of proving it. Now-a-days that prices are cut so very low owing to the intense competition between all manufacturing companies, it is impossible in many cases for agents to cut still lower in order to obtain business, so their resource is to claim higher value for their goods, and if by guaranteeing a slightly greater efficiency or longer life, etc., they can effect a sale it is a little too much to expect of human nature that an agent will not guarantee a little more than he knows he can perform, when he has very good reason to believe that his machinery will not be put to any test, but that his bare word will suffice. It is perfectly evident that to buy machinery on the unsupported guarantee of an agent, and then not to test it to ensure its meeting such guarantee, is not only very foolish from the purchaser's own standpoint, but it is distinctly unfair to the whole manufacturing interest. It amounts in plain terms to placing a premium on dishonesty, and the purchaser frequently gets as badly let in as he thoroughly deserves to. A thoroughly reputable and honorable business man will make sure of what his goods are worth and will guarantee them for that and no more, relying on such policy to build up a business. A less responsible person will push the sale of his goods by claiming for them a value they may not possess, and take his chances that he may not be found out. Now whether he is found out or not, the purchaser does not see his money's worth, and has actually assisted in rewarding fraud. In the few instances where electrical and steam machinery have been purchased in the open market by competing tenders, any specifications that have been got out require such and such guarantees to be given of efficiency, etc., and the contracts have frequently been given to those guaranteeing the highest and most. But in how many cases have actual tests been made by competent persons, as to whether these efficiencies, etc., are really as guaranteed? And is it not plain that this system of purchasing on a basis of "competing guarantees" is a very foolish one unless there be some intention of testing their fulfilment?

Guarantees, even the best, may be very misleading unless some understanding be arrived at as to the conditions under which they are given, and a very little consideration will show that persons not specially trained may be completely hoodwinked when they think they are very wide awake. Take the guarantee that is so frequently given with a boiler, that "it will evaporate so many lbs. of water per lb. of coal." This appears very simple no doubt to compare boilers by this guarantee is as easy as falling off a log. But a boiler does not evaporate water itself; it must be set "just so," and have a certain number of feet of grate surface with a certain amount of draft. And again, "so many lbs. water evaporated per lb. of coal." What kind of coal? All coal is not the same. We have hard coal and soft coal; we have coal containing 13,000 heat units per lb., and we have coal containing only 7,000. Again we ask, what coal? Best Yonghisberry? Any boiler will do that with such superior coal; but it takes a good one to do it with lignite. Briefly, what is such a guarantee worth? Nothing. The person who gives it is in most cases a designing quack, and the purchaser who accepts it is an innocent simpleton. The guarantor gives it because he knows it never will be tested, and if it ever is tested he can say the conditions were not complied with. If persons require guarantees to be given with machinery, they should be satisfied with reasonable ones; they should establish the necessary conditions, and they should insist on tests being made to prove them. In this way, in a very short time, all but the reputable manufacturers will be crowded out of business.

Electrical Engineering as a Profession.

THE question is frequently asked, "In what field of effort may a young man hope to meet with the greatest amount of success in the present day?" Every department appears to be overcrowded, and the problem of the choice of a career is becoming more and more difficult of solution. The rapid development of the past few years in the applications of electricity has turned the attention of parents and young men in this direction, and there appears to be a widespread belief that this is the most promising field of effort for the future. With the view of determining to what extent this belief is well founded, Mr. Henry Floy, in an article in the Engineering Magazine for January, entitled "Are we Educating too many Electricians?" gives the result of an extended enquiry among graduates of engineering schools, as to the extent to which students of electricity graduating from these schools have been successful in obtaining employment at remunerative salaries. Referring to the tabulated results of these enquiries, Mr. Floy sums up the subject in the following words. "Considering the table of total results, which may be taken as a fair indication of the condition of the recent graduates in electrical engineering, it will be found that, while a greater

per cent. of the graduates in electrical engineering secure employment, as compared with other graduates, yet the fewest, relatively, secure employment in the line of work for which they had studied, that is, in order to get employment, they had to take positions in which their electrical knowledge did not count. It will furthermore be noticed that almost twice as many men secure employment in electrical engineering through the influence of their relatives as in mechanical or civil engineering, while about half as many obtain positions through their friends as in the other two professions."

Useless Fenders.

THE fenders on some of the Toronto Railway Company's cars are elevated too far above the track to allow of an obstruction of reasonable size being scooped up by them. An individual who should be so unfortunate as to fall in front of one of these cars would almost certainly pass *under the fender* and be crushed to death. Fenders attached to cars in this manner are a mockery.

Questions and Answers.

BY reference to our Question and Answer Department, it will be seen that some of our subscribers appear to have suddenly made the discovery of their privilege to ask questions and receive information through the pages of THE ELECTRICAL NEWS on any problems in electricity or steam engineering with which they may find themselves confronted. This should be gratifying to every reader, as well as to the publisher. The more questions are asked and answered, the more helpful the journal must become to its subscribers, and the greater evidence to the publisher that it is being widely and carefully read—a matter in which advertisers should also feel an interest. We have daily evidence that the NEWS is becoming more widely known and appreciated by the classes in whose interest it is published. There is no occasion for the expressed hesitancy and apologies with which some of the questions received are propounded. Questions honestly propounded, and of a character to draw forth information of a practically useful character, are cordially invited. If we except the man who "knows it all," we are all in the position of the pupil who is daily adding to his stock of knowledge, therefore, we need feel no hesitation about admitting our lack of knowledge on certain subjects, with which, perhaps, we have not had the opportunity to become acquainted. Those who know the most are invariably ready to admit what they don't know, and to ask to be enlightened. There is little hope of improvement for the man who either thinks he knows it all or is ashamed to ask for the information he requires lest he should be thought ignorant. So far as the readers of this journal are concerned, it is only necessary that they should ask in order to receive any information which it is in our power to give.

The Montreal street Railway Co. have ordered a 55 kilowatt direct connected motor-generator set from the Canadian General Electric Co.

Mr. F. O. Blackwell, of New York, engineer of the General Electric Power Co. was recently in Quebec in connection with the proposed electric street railway. Mr. Blackwell inspected the works and machinery of the Montmorency Electric Light Company. The construction of the railway in accordance with the present agreement, includes the taking over of this plant. It is said to be the intention of the promoters to commence work about the first of April.

CANADIAN ASSOCIATION OF STATIONARY ENGINEERS.

TORONTO NO 1.

THE above Association no whold their meetings in the new hall on Victoria street on the 1st and 3rd Wednesday in each month. The business transacted at their last meeting was largely in connection with the taking over of their new quarters. Arrangements have been made for starting the new library; some donations have already been received, while a number of manufacturing firms have promised books and models which will make the collection very valuable to the members of the Association. A letter containing the following has been sent to probable contributors to the library:

"Toronto No. 1. is now entering upon its tenth year, and having procured a new and suitable hall, propose commemorating the event by starting a mechanical library, and fitting the meeting room up with models and drawings. Should you feel disposed to assist, in any way, this very laudable object, an intimation to any member of the committee to that effect will be thankfully received, and promptly attended to."

An engineers' manual or pocket book is being prepared by the Association, which will consist of valuable tables and calculations relating to steam engineering. It will be compiled from the works of the best authorities, and is intended to supply engineers with easily accessible and correct calculations upon which to work.

A committee has been appointed to act in conjunction with a similar committee from the Ontario Association with a view to secure a compulsory law from the government, for engineers operating steam plants. It is not probable that any action will be taken by the government this session, owing to its close being near at hand. It is hoped that at the next session a bill will be brought in by the government which will ensure its success. The bill, as proposed, will exempt all steam engines under 15 horse power, and all persons running plants at the time will be given a permit, thus retaining their positions. The certificates of the Marine Engineers' Association, and the Ontario Association would also be accepted.

BRANTFORD NO. 4.

Mr. Jos. Ogle, secretary of Brantford No. 4 writes: "We are in a very healthy condition; our meetings are well attended and some very good questions brought forward and practically answered. The debate for our last regular meeting was, "Cylinder Condensation—Illustrations of Indicator Cards," which occupied our time fully to a late hour, having a various number of select cards illustrated on the blackboard."

LONDON NO 5.

London No. 5 has not been meeting with much success since the opening of the new year. From lack of attendance meetings have not been held, and the members have shown some indifference towards the Association. It is the hope of the officers that a revival in interest will be shown henceforth, in order that the association may not be allowed to become extinct.

GUELPH NO. 6.

The above Association held meetings on the first and third Wednesdays of February. There was a good attendance at each meeting, and one candidate initiated at the first meeting. On the 20th inst. Messrs. Ryan and Gerry read papers on the care of boilers and the keeping of the engine room.

CARLETON PLACE, NO. 16.

J. D. Armstrong, Secretary, writes: "Branch No. 16 has not been in a very prosperous state for the past year but has been reorganized, and is now in a far better shape than ever. Although our numbers are small, we are enthusiastic and look forward at an early date to forming the nuclues of a library, also to invest in some models. We have rooms over our President's place of business, and we may say that for the first time in our existence we are now on the way to becoming a successful society. We meet during March and April every Saturday night, and questions are given the members who purpose trying for certificates, to be answered the following week, so that if they get a certificate they will have to work for it.

A MOTOR-CYCLE CONTEST IN CANADA.

THE letter published in our February number from the pen of Mr. A. W. White, of London, Ont., relative to a contest of motor-cycles in Canada, has been the means of creating considerable interest in the matter. No action has as yet been taken by the Industrial Exhibition Association, but it is learned from the manager that it is quite probable that a contest will be arranged to take place during the coming exhibition. The test would take place on the public highway, a part of the agreement being that the contestants should exhibit their vehicles in the ring on certain days.

As to the conditions under which the contest should be conducted, we have received the following suggestions:

Mr. G. H. Hewitt, President Duryea Motor Wagon Company, Springfield, Mass.: The "Cosmopolitan" offers prizes for a competition in which the awards are made upon points, such as speed, simplicity, durability of construction, cost, safety, etc. To my mind it would be manifestly absurd to award the first prize to the carriage which should come in last, even if it stood all

THE DURYEA MOTOR CARRIAGE.

the other tests. Either you must go into an exhaustive examination of each carriage or you must cut off all examination and let speed over a certain number of miles of ordinary road determine the merit. I am inclined to take up the idea of three trials and taking an average as the result. As to the amount of prize money, of course the more it is the more of an inducement it will be for people who are working on new designs to compete. A chance of getting a big prize will cause a man to hurry up his ideas, and enlist capital on his account. I presume you can get a good showing for $3,000 in prizes, say: First prize $1,500; second prize $1,000; third prize $500. We should be happy to enter, if the rules are satisfactory.

Morris & Salom, Philadelphia, Pa.: The only suggestions that we have to make in regard to the conditions governing the race is that the trial should be based on a service similar to that performed by horses at the present time. There is nothing to be gained by a run of 100 miles or more, which is merely a tour de force. Some tests should be selected under the conditions governing the use of horses at the present time, and they should be continued from day to day so that a comparison can be made with such service. The ordinary service of a horse does not amount to more than 25 miles per day, and as motor vehicles are intended to replace horses this point should be carefully kept in view in making comparative tests.

H. Mueller Mfg. Co., Decatur, Ill.: We think it advisable to make a maximum speed, say twelve miles per hour, those making a faster average speed being considered the same. This would be quite fast enough, as what we want is a practical carriage--one for general use, not for racing, one that will go at a good speed, have a strong pull at that speed, and be able to continue the same speed throughout, taking into consideration the kind of roads. Then economy of operation is the next factor to consider, because the better the economy the more practical the motor, and, besides, it would be a very easy matter to construct a powerful motor when the economy of fuel was left out of consideration. Simplicity and compactness should be considered together, as the motor might be compact, but be so intricate that in order to repair a certain part it would necessitate much unnecessary work to arrive at the fractured part, which might be the same with adjustment. Then, again, a motor might be simple in all of its parts, but not compact. It would occupy too much consideration to mention in detail all concerning the different subjects to consider, but those mentioned we consider first, besides there being vibration, odor, ease of guiding, controlling of speed, variation, quick stopping, etc. Why not make awards on the following principle: Say you call speed 40 points, economy 20 points, etc., making the total number of points that each motor vehicle can receive 100 points. Now, say Mr. A. comes in first, you give him 40 points in speed, you award him second in economy, which we will call 15 points, and then 5 points in simplicity and compactness, 2 points in elegance of design, 2 points in guiding, 2 points in controlling of speed, and perhaps nothing in remaining features. Now, Mr. B. comes in second, and you give him 35 points in speed, economy 20, simplicity 10, elegance of design 5, guiding 5, quick stop and start 4, vibration 3, odor 3, the total of which is 85 points, whereas Mr. A.'s total was 66 points, which would allow Mr. B. first prize for the most practical carriage.

TRADE NOTES.

Messrs. Rhodes, Curry & Co. have completed fourteen closed cars for the Halifax street railway.

J. G. Field, of Tavistock, Ont., has purchased an alternating plant from the Canadian General Electric Co.

The Acadia Sugar Refining Co., Ltd., has ordered two 60 horse power Robb-Armstrong engines, for the Woodside and Nova Scotia Refineries.

The Berlin and Waterloo Street Railway Company have placed an order for additional G. E. 800 motors with the Canadian General Electric Co.

The Petrolia Light, Heat and Power Co. have recently put in a complete condensing plant, including a Goldie & McCulloch 125 h. p. boiler and a Northey condenser.

The Halifax Illuminating Co. are now installing the first of their 150 kilowatt monocycle alternators recently ordered from the Canadian General Electric Co.

The Standard Shirt Co., of Montreal, have purchased a 100 h. p. Wheelock engine with which to operate electric motors in the several departments of their factory.

The Royal Electric Co. have rented the vacant store on the south of their premises on York street, Toronto, and by removing the partition wall, have doubled their office and show-room accommodation, besides adding greatly to the attractiveness of their establishment.

The Penberthy Injector Co., of Detroit, Mich., and Windsor, Ont., have lately issued an attractive catalogue relating to their celebrated injectors and other steam users' supplies. This catalogue contains much valuable information in the way of tables of capacities and results, directions for determining size of injector required, etc.

The Goldie & McCulloch Co., of Galt, Ont., have recently secured the right to manufacture for Canada the Ideal Automatic Self-oiling high speed engine. This engine is especially adapted to direct connected work, such as the operation of electric machinery. We hope to be able to publish further details of this engine at an early day.

THE STEAM ENGINE INDICATOR AND ITS USES.

By Wm. Thompson, Chief Engineer Montreal West Water and Light Station.

(Continued from January Number)

It will be found an exceedingly interesting and useful study to compare and test the expansion curve drawn by the indicator with the theoretical curve that would be drawn if the steam was a perfect gas and expanding in accordance with Marriontte's laws for the expansion and contraction of perfect gases, i.e., that the pressure of steam expanded will be inversely proportional to the space it occupies. Thus, if one cubic foot of steam at 80 lbs. pressure is expanded to 2 cubic feet, or twice the space, then the pressure will face to 40 lbs., or exactly half its original pressure, owing to the space it occupied at 80 lbs. pressure having been doubled. The pressure will thus fall proportionately to meet all other degrees of expansion.

The engineer must, however, bear in mind that these pressures must be dealt with as total or absolute pressures, that is, reckoned from a perfect vacuum, and also that the clearance space must be carefully noted, and a line drawn on diagram representing an amount of space on diagram equal to same per cent. of space that total area of clearance space bears to piston displacement. This is made evident by the fact that when cut-off takes place piston will only have moved a given distance or part of stroke, and that, supposing cut-off to occur at ¼ stroke, then to get correct space occupied by steam at any pressure at any point of stroke, clearance space at end of stroke, together with area of steam passages must be taken into consideration, as all steam confined and bearing on piston must have an effect on expansion curve, and when piston reaches ¼ stroke, space occupied by steam would not be fairly represented by supposing space to have been doubled while area through which piston has moved would be exactly doubled. Clearance line on diagram will vary as to position with different makes of engines, and can only be correctly ascertained by measuring engine on which test is being made. While steam confined in clearance space does no actual work during live steam period, just as soon as cut-off takes place it has an effect on expansion curve and raises terminal pressure as compared with steam expanded from the admission line only.

The engineer will note that any irregularity or bad arrangement of valves can be readily detected by the position of the various lines, while defects, such as leaky valves or piston, can only be

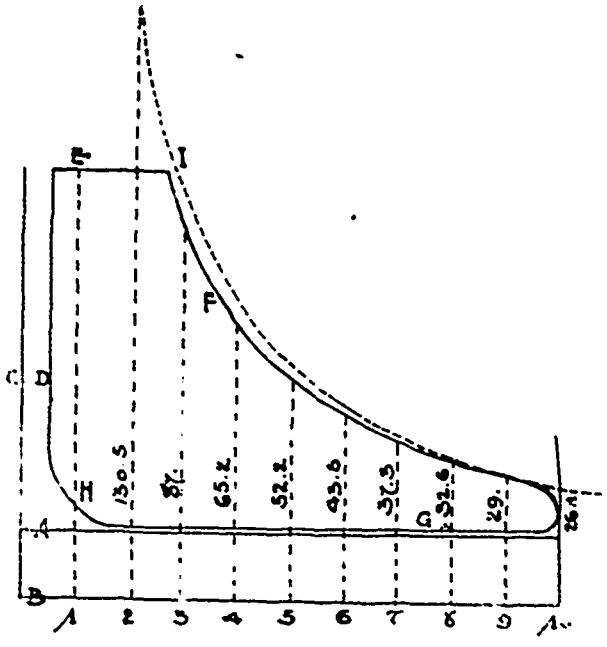


Fig. 1.

A, Atmospheric Line, B, Vacuum Line, C, Clearance Line, D, Admission Line, E, Steam Line; F, Expantion Curve; G, Exhaust Line; H, Compression Curve; I, Isothermal Curve (test.)

detected by testing and comparing expansion curve, particularly if leak is a small one.

A theoretical expansion curve to conform with above theory may be constructed by several geometrical methods, but probably the following will be the most easily understood by the average engineer:—

The diagram as drawn by the indicator will have the atmospheric line upon it as already described, and from this as a basis draw in the line of no pressure or line of perfect vacuum. To do this, draw beneath the atmospheric line a line as far beneath it as will represent the vacuum line on the same scale as the spring used in the indicator to draw the diagram. The clearance line must then be drawn in accordance with rules already given. Divide the length of the diagram into any number of equal parts by vertical lines at right angles to the atmospheric line and commencing at the clearance line as shown in Fig. 1.

Number the vertical lines as shown—10 being used in this instance simply because it is a convenient number, but any number would do; the more lines used the greater the degree of accuracy obtained.

Decide which part of the diagram its expansion curve shall coincide with, and touch the test curve; in example I have decided it shall be line No. 9. Now find what pressure line 9 represents on the scale of the indicator spring—which in this case is 29 lbs.—the line measuring 29/40 of an inch and a 40 lb. spring having been used to draw the diagram. Next multiply the pressure thus obtained by the number of the line (9) and divide the product by the number of each of the other lines in succession, and quotient will in each case be the pressures to be represented by the lines.

For example, to find the pressure requiring to be shown on line

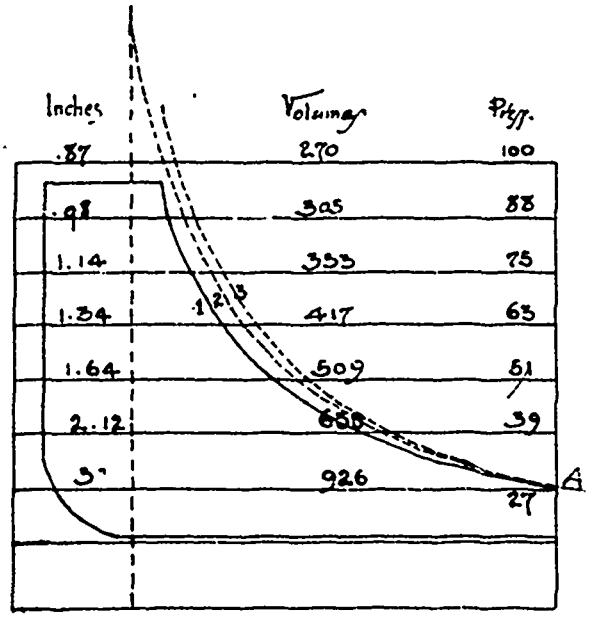


Fig. 2.

8, we have that, (261,) divided by number of line (8) gives 32.6—hence line 8 requires to be drawn high enough to represent a pressure of 32.6 lbs. above a perfect vacuum, or in this case 32.6/40 of an inch. Having carried this out for all the lines from 10—2, draw in the test curve, which will touch the tops of all these lines.

This curve, however, does not quite correctly represent the expansion of steam, although generally used. It would do so if the steam remained or was maintained at a uniform temperature during the whole period of expansion. It is therefore called the isothermal curve or curve of equal temperature. But, in fact, steam and all other elastic fluids fall in temperature during expansion and rise during compression, this change of temperature slightly changing and affecting the pressure.

A curve in which the combined effects of volume and resulting temperatures is represented is called the adiabatic curve or curve of no transmission since no heat is transmitted to or from the fluid during the change of volume, its sensible temperature will change according to a fixed ratio which will be the same for the same fluid in all cases.

A fairly close approximation to the adiabatic curve, to enable the engineer to form an idea of the difference between the two may be produced by the following process.

Take a diagram similar to the one used in Fig. 1 and illustrated as Fig. 2. Fix on a point for the coincidence of the two lines as before as at A, where the total pressure is shown to be 27 lbs. As in the former instance this point is chosen in order that the curves will coincide. Any other point might have been chosen for the point of contact; but a point in that vicinity should gener-

ally be chosen so that the result will show the amount of power that should be obtained from existing terminals.

The point chosen in Fig. 2 is 3 inches from the clearance line, and the volume of 27 lbs. is 926—that is, steam of that pressure has 926 times the bulk of water from which it was evaporated.

If we divide the distance of A from the clearance line by 926 and multiply the quotient by each of the volumes of the other pressures indicated by similar lines, the products will be the respective lengths of the lines measured from the clearance line—the desired curve passing and touching their extreme ends. Thus, the quotient of the first or 27 lbs. pressure line, divided by its volume (926) is .00323. This, multiplied by 655, the volume of the next pressure line (39,) gives 2.12 inches, the length of the line to be drawn from the clearance line, and so on for all the rest throughout the illustration.

The application of either of the above curves will show that some diagrams are much more accurate than others. As a general rule those from large sized engines will be more correct than from small ones, and those from high more correct than from low speeds, and with efficiently covered steam pipes and jacketed cylinders to prevent condensation, a great improvement can be effected.

The character of the imperfections in the expansion curve in the illustration (Fig. 1) shown by the application of the test curve is too high a terminal pressure for the point of cut-off—the first part of the curve being fairly correct, nearly the whole of the inaccuracy occurring during the last half. The usual and most accepted explanation of this is, that the steam admitted during the live steam period condenses somewhat, owing to its having to impart a certain amount of heat to the walls of the cylinder to raise it from the temperature retained from the exhaust steam, and that this water of condensation re-evaporates during the latter part of the stroke, when this water of condensation is at a higher temperature than the expanded steam, and thus increases the pressure. A leaky admission valve or wet steam may, however, generally be looked for if the expansion curve rises much during the latter part of stroke.

In seeking the causes that may produce a defective diagram, the following should be remembered: The indicator must be kept in perfect order, thoroughly clean and well lubricated, so that its parts will move freely. The motion of the paper drum should record an exact copy on a reduced scale of the piston, and should coincide with it at every point of the stroke.

The pipes from the indicator to the cylinder must be large enough to give a free and full admission and pressure of steam, and care must be taken that the water of condensation does not obstruct or enter the indicator.

The metallic point or pencil should be held to the card with just sufficient force to make a fine clear line.

The diagram should be the exact length of the atmospheric line; any difference in this respect shows poor adjustment in some part or unequal tension of cord.

A fall in the steam line could arise from too small a steam pipe. This can be tested by taking a diagram from the steam chest. The same fault could also occur from too small a steam port or an obstructed passage, such as partial closing of admission valve, also by steam leaking past piston and passing to atmosphere unutilized.

An expansion curve that is higher than it should be could arise from a leaky valve on the steam side letting steam in from the steam chest after cut-off had taken place; in this case the leak will naturally become larger as the steam expands and pressure on piston side of valve reduces, consequently terminal pressure will be more or less out of proportion.

An expansion curve that is lower than it should be may be caused by a leaky piston, by a valve that leaks on the exhaust side, but not on the steam side; or if the exhaust valve is separate from the admission valve, it may leak while the steam valve is tight, thus lowering the terminal pressure. It may also be caused by the cylinder becoming unduly cooled, as from water being allowed to accumulate in a steam jacket; this will particularly affect the curve during the earliest stages of expansion or even during admission.

As already explained there are many defects in the adjustment of the valve gear that will be clearly shown by the indicator diagram. But, it should be borne in mind that there are possible defects which the indicator will not show. For instance, a steam valve and the engine piston may both leak to an equal amount; as a result the expansion curve may not show the leak, while, as a matter of fact, loss is occurring from this source.

Insufficient valve lead, or in other words the admission valve opening too slow or late, would be shown by the piston moving a certain portion of the stroke before the steam line attained its greatest height. In this case the admission line, instead of rising vertically as shown in illustrations, would be at an angle to the right showing that the piston and consequently the indicator drum had moved a certain distance of the stroke before the valve was wide open and full pressure of steam admitted.

Exclusive lead is shown in Fig. 3 by the loop at A, where the compression curve extends up to the steam line and the lead carries the admission line above it owing to the engine piston moving against the incoming steam.

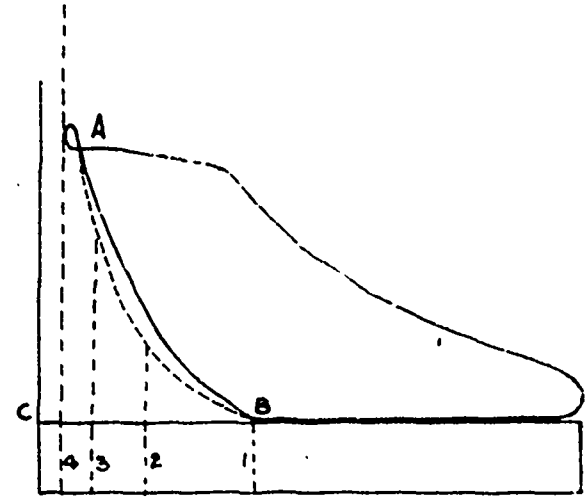


Fig. 3

To mark in the theoretical compression curve, that is the curve that would be formed by the compression of the steam remaining in the cylinder after the exhaust valve had closed and previous to the opening of the admission valve, the vacuum line and clearance line must be drawn in as before. In Fig. 3 compression commences at B, and at that time the space filled with steam is represented by the distance from B to the clearance line C. The pressure above vacuum of the steam remaining in the cylinder when compression began is shown by dotted line. Suppose the piston to have moved from point B to line 2, which is half the distance from the clearance line, of line 1, and as the compressed steam now occupies only one-half its former space, therefore the steam pressure will be doubled and line 2 requires to be drawn twice the length of line 1.

Line 2 is now the starting point for getting the next ordinate and 3 must be marked midway between 2 and the clearance line and twice as high as line 2, as it is obvious that at line 3 the steam will occupy only half the space it did at 2 and one-quarter of the space at 1, hence pressure is increased proportionately. Line 4 is drawn midway between 3 and the clearance line as before. Through the tops of these lines draw the theoretical compression curve as shown by the dotted line.

To find amount of steam actually saved by compression, consider the compression curve only beginning at the point of the diagram where compression actually began, and ending where the compression curve joins the admission line, the horizontal distance between these two representing the length of the cylinder bore actually filled by compressed steam.

It is stated that in a few weeks the Edison Electric Illuminating Company of New York will have in operation at one of their stations two 300 h.p. De Laval steam turbines with attached dynamos. These turbines were built by the Maison Breguet, Paris, and are now on their way to America. They were ordered under guarantee to comply with the following specifications: each 300 h.p. turbine is to drive two Desroziers dynamos, each of 133 h.p. capacity. The turbine shaft is to run at 13,000 revolutions, driving at a speed of 1,300 revolutions by means of helical gearing, two dynamo shafts situated on either side of the turbine shaft. Each dynamo is to be capable of generating continuously without undue heating 770 amperes at 130 volts or 625 amperes at 160 volts.

ELECTRICAL DEVELOPMENTS AT MONTREAL.

THE electric light situation in Montreal, as well as in Toronto, is at present at an interesting stage. The company formed some time ago, for the purpose of utilizing the water power of the Lachine Rapids, have been energetically pushing forward their enterprise, and maturing plans for the disposal of the electrical energy which will be generated from the works now in process of construction at Lachine.

It is understood that the company have bought up the lighting privileges of Westmount and several of the other suburban municipalities of Montreal, as well as the franchise of the Standard Electric Lighting Co., which is said to carry with it the right to do electric lighting within the city of Montreal. Under this latter franchise, the company propose to compete for the lighting and power business of the city of Montreal. They have already constructed poles and wires to a point about a mile within the city limits, but here their operations have had to be suspended for a time at least, owing to legal action brought against them by the Royal Electric Co.

The Royal Company, it is understood, will endeavor to prove that the franchise under which the company are preceding, does not give them the right to do business inside the city, and the courts are now considering an application for an injunction to restrain the new company from proceeding further with their enterprise so far as city business is concerned.

It is claimed that the Lachine Power Co. will be in a position to supply current at a greatly reduced rate as compared with the prices that are now being charged for lighting and power in the city of Montreal.

It will be remembered that several years ago the Royal Electric Co. purchased the water power at Chambly, across the river from Montreal, and about six miles distant from the city. The intention of the company seemed then to be to utilize as quickly as possible this water power. It is therefore somewhat surprising that nothing has been done in this direction, while a competitor has in the meantime secured the control of a greater water power, and one which is more conveniently situated. No doubt the fact that the Royal Company would have been obliged to bring the current across the St. Lawrence, through a sub-marine cable, which would be subject to the destroying action of frost and ice, at a point where an ice jam is a yearly occurrence, had something to do with the fact that no attempt has been made to utilize the power from this source. On the other hand the company are understood to be remodelling from top to bottom their electric lighting station, thus putting themselves in a position to meet any competition which may arise.

The following particulars of the works now in course of construction at the Lachine Rapids, under the direction of Mr. W. McLea Walbank, C. E., and R. E. T. Pringle, M. E., by Messrs. Davis & Sons, contractors, of Ottawa, with the aid of 300 workmen, will show the magnitude of the undertaking:—

Along the north shore of the river within 1,000 feet of it, 2,500 soundings have been made, which have shown that to overcome the freezing of the shallow water 250,000 cubic yards of shale rock will have to be taken out to deepen the water. When this is done an artificial canal will be made by building a wall 4,500 feet long and 20 feet wide, 800 feet from shore. 3,000 feet of this wall is to be built of crib work, filled with masonry and concrete, the rest of the wall, 1,500 feet, at the head of the head race, is to be submerged, coming within a foot of the surface of the water and built of cut stone to act as an ice breaker. Across the canal is being built a dam to raise the water 9½ feet above the tail race, the canal wall being at its highest to keep floating objects from the wheels.

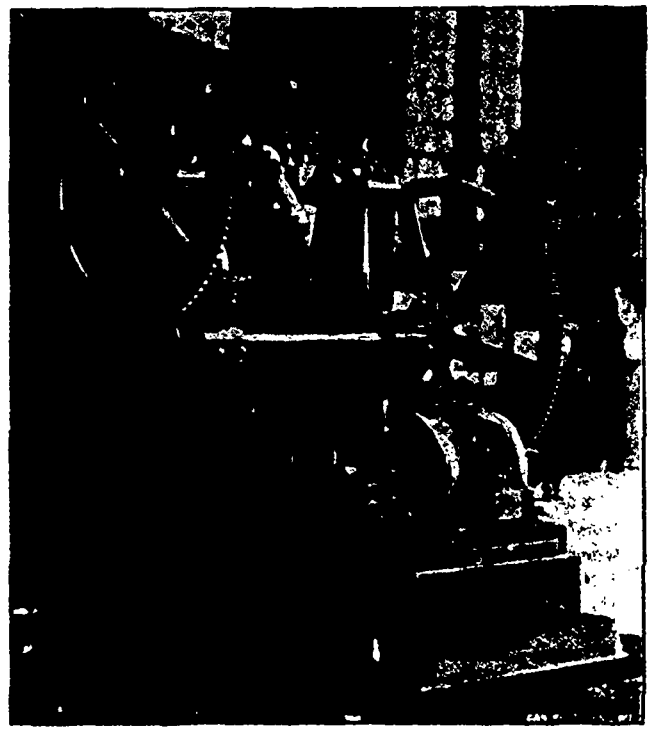
In this dam are to be placed 66 upright cylindrical gate turbine wheels to give 125 h. p. under 8 feet head, to realize 80% useful effect. Each wheel is placed between two stone piers. On this dam will be built three power houses, connected by galvanized iron sheds, the sheds covering the wheels. Each generator will be of the capacity of 750 h. p., having connected to it six wheels. Each power house will contain four such generators. All the generators will be connected to one switch-board, and the power will be carried under high voltage to Montreal, where by rotary transformers it will be reduced to the required voltage for power by day and power and light at night. The plant is to be completed and in full running order before the close of the present year.

The provisional board of directors of the company are as follows: G. B. Burland, Montreal and Ottawa; W. McLea Walbank, C. E., Montreal; Thos. Pringle, M. E., Montreal; Alderman Peter Lyall, contractor, Montreal, Samuel Carsley, merchant, Montreal; E. Kirk Green, merchant, Montreal; Hugh Graham, of the "Star," Montreal.

The capital of the company has been placed at $1,000,000, $500,000 of which is for sale. Debentures will be issued at 4½%.

DIRECT CONNECTED PUMPING SET.

AN interesting example of the prompt application for the alternating motor in directions which have not up to the present afforded much field for electric power service is presented by the pumping set illustrated herewith, which has recently been installed by the Mattawa Electric Light & Power Company, at Mattawa, Ont. This unit which presents the double advantage for the service of being particularly compact and so simple in operation as to require no attendance whatever, consists of a 5 horse power Canadian General Electric induction



DIRECT CONNECTED PUMPING SET.

motor geared to a Gould triplex pump, current for the motor being obtained from the Mattawa Company's monocyclic circuit. The work to be done is the filling of the C. P. R. water tank, capacity 50,000 gallons, formerly supplied by a steam pumping outfit, the length of the pipe (4") being 2,129 feet, and the lift from the water to top of tank being 96 feet. The motor pumping set has now been in operation for several weeks and has given the most perfect satisfaction. The only attention required at present is to start and stop the motor, but it is intended to do away with the necessity for even this small amount of attendance by having the motor started and stopped by the operation of a float in the tank.

The enterprise of the Mattawa Electric Light and Power Company in opening up what we believe to be an entirely new field for electric power, will, no doubt, be followed by other and older stations.

THE APPLICATION OF OHM'S LAW.*

By W. Norris.

It has become necessary for engineers to have a knowledge of electricity and the application of the same. I am therefore prompted to take a step towards making that subject to have a more prominent place in the engineers' lodge room. It is with much pleasure that I will try to illustrate a few important points that will be of much use to beginners.

Whenever we require to make any calculations upon the current that will flow from any kind of electrical supply through an ordinary conductor, we must have some law by which to be guided. Professor Ohm has laid down a law which is known as Ohm's Law, and reads as follows:

$$\text{Current in Amperes} = \frac{\text{Electrical motive force in volts.}}{\text{Resistance in ohms.}}$$

For instance, one volt will force one ampere through a resistance of one ohm.

100 feet of No. 10 B. & S. copper wire, which will conduct about 98 per cent. of the current, has a resistance of one ohm. So if the current in amperes is equal to the electromotive force divided by the resistance in ohms, then the resistance in ohms will be equal to the electromotive force divided by the current in amperes, and the electromotive force will be equal to the current in amperes multiplied by the resistance in ohms, and is represented in the following manner:

$$C=\frac{E}{R}. \quad R=\frac{E}{C}. \quad E=C\times R.$$

It can be plainly seen that if any two of the above elements are known, it is an easy matter to find the remaining one.

The figures 2, 8, and 4 always stand for C, E, and R, respectively. In order to illustrate the use of Ohm's Law more plainly, we will suppose we have a simple primary cell of battery with an E. M. F. of 2 volts, leaving a resistance within itself of ½ ohm; then, according to the formula $C=\frac{E}{R}$, we have 2 volts divided by ½ an ohm, equals 4 amperes, thus:

5 ohms) 2.0 v (4 a.
2 0

If we had found that we had 4 amperes of current and 2 volts pressure, we would have had 2 volts divided by 4 amperes, equals ½ ohm resistance

4) 2.0 (.5 or $R=\frac{E}{C}$
2 0

Let us now form a number of these cells together, thus forming a battery. Say we use 5 cells and connect them in series as shown in Fig. 1. By this means we get the effect of all the cells

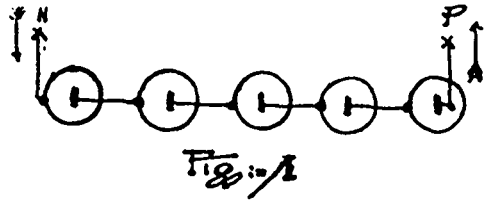


Fig. 1.

together, for the voltage will build up according to the number of cells that there are cells in series, although the amperage remains the same as in one cell, because each cell has a definite and determined resistance which increases as there are cells in series, and will only permit the same amount of current to pass through it as it will deliver itself. But each adjoining cell helps to build up voltage; therefore we have a pressure of 10 volts and 4 amperes from this battery.

One ampere flowing under a pressure of one volt is equal to one watt, which is the mechanical work performed and is the unit of a horse power; for 1,000 Watts constantly delivered to an electric motor will make it deliver one horse power, and as we have 10 volts, then the 10 volts multiplied by 4 amperes equals 40 watts, indicating the amount of work this battery will perform.

Let us now connect these 5 cells in another manner, as shown in Fig. 2. With all the positive poles connected together and all

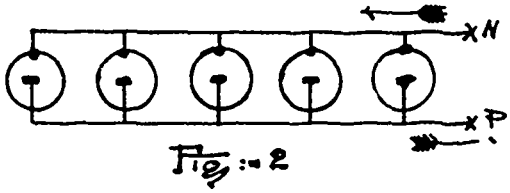


Fig. 2.

the negative poles connected together, this is known as the multiple connection, which causes the battery to deliver the current just the opposite to the series connection. For, instead of the voltage increasing it remains the same as in one cell, while the amperage builds up in proportion to the number of cells in multiple. We have these 5 cells each delivering 4 amperes, and the voltage on the mains is but 2; then 4 amperes multiplied by the 5 cells equals 20 amperes, and 20 amperes multiplied by 2 volts equals 40 watts; so it will be plainly seen that the work performed by these two batteries, Nos. 1 and 2, is just the same, although the current is different.

We will now take the same two batteries and connect them both together, making a compound connection as shown in Fig. 3, which is known as the multiple series; for each pair of cells is connected in series, with their positive poles of each pair connected to one wire, and all the negative poles likewise, so that from each pair of cells in series we have 4 amperes and 4 volts, and as there are 5 pairs of cells in the battery, we have 4 amperes multiplied by 5 pairs of cells, which gives us 20 amperes, which,

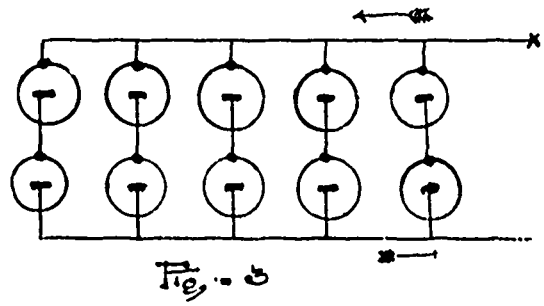


Fig. 3.

multiplied by 4 volts equals 80 watts, showing that the mechanical work that this battery will perform is equal to both the first batteries.

We will take still another form of battery, known as the series multiple, as shown in Fig. 4, using the same number of cells as in

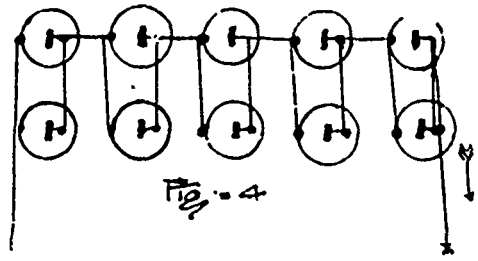


Fig. 4.

the last battery, each pair of cells being in multiple, thus acting as one large cell, so we would have the same as 5 large cells in the battery placed in series to each other. In this case we would have the same number of volts from each pair as from one small cell, but twice the number of amperes, which would be 8; and as each pair of cells are in series, we would have two volts multiplied by 5, equals 10 volts, because when each pair of cells are in series with each other, the voltage increases, but the amperage remains the same as if there was only one cell. Then by multiplying the 10 volts by the 8 amperes we have $10\times 8=80$ watts, showing that the mechanical work which this battery is able to perform is the same as with the last form of battery, the series multiple, although the voltage and amperage were both different.

Quite a number of other connections can be made to suit the work the battery is required to perform. For instance, we have 5 cells each delivering 2 amperes and 2 volts, and when connected in series would be equal to 10 volts and two amperes, and as the resistance in ohms is equal to the E. M. F. ÷ by current in amperes, or $R=\frac{E}{C}$, then $10\div 2=5$ ohms which would be the resistance of the battery itself and the resistance in the line wire and bell, etc., should be about the same. So in this case the current in amperes would be equal to the electromotive force divided by the resistance of the battery and line wire, etc., added together, or $C=\frac{E}{R+R}$, thus $10\div 10=1$ ampere.

Now, the watt is the unit of a horse power of the work performed, and the current in amperes multiplied by the electromotive force equals the number of watts; then $C\times E=W$, $R=\frac{W}{C}$ and $C=\frac{W}{E}$. Supposing we have a 16 candle power lamp taking 3.1 watts per c.p., with 100 volts, how would we find the amperage as well as the resistance of the lamp? The lamp is 16 c.p., watts 3.1 per c.p., then $16\times 3.1=49.6$, or say 50 watts and the current in amperes is equal to the watts divided by the electromotive force, or $C=\frac{W}{E}$. It would therefore be 50 watts divided by 100 volts = ½ as the amperage of the lamp, and the resistance being equal to the electromotive force divided by the current in amperes, it would be 100 volts divided by ½ ampere = 200 ohms as the resistance of the lamps, thus:

.5) 100 (200 ohms.
10
00

So the $C=\frac{E}{R}$ because 100 ÷ by 200 = ½ ampere, and $C\times E=W$ because ½ ampere × by 100 volts equals 50 watts.

Nature states that an ingenious system of purifying atmosphere and regulating temperature is in operation for the switchboard room of the Chicago Telephone Company, where dust formerly interfered seriously with the connections on the switchboard. The air for the room is forced through a chamber, where it is thoroughly sprayed, then passed through rapidly rotating spiral coils, which strip it of superfluous moisture, and afterwards through a chamber kept at nearly uniform temperature by the use of ice or heating apparatus, as may be required. Access to the switchboard room is through an ante-chamber, and the temperature of the room itself shows a variation of not more than two degrees in a month.

*Paper read at regular meeting of Hamilton No. 2, C. A S. E.

ELECTRIC RAILWAY DEPARTMENT.

THE BERLIN AND WATERLOO ELECTRIC RAILWAY.

This road, which last year was electrically equipped, has recently undergone a change of ownership. The controlling interest has passed from the hands of Mrs. Burt, of New York, to Messrs. W. H. and E. C. Breithaupt, of Berlin. Mr. T. M. Burt and Mr. T. E. McLellan will be retained in their present positions in the management, though Mr. E. Carl Breithaupt is the President of the Company with general oversight. The following are the directors:—T. M. Burt, T. E. McLellan, A. Millar, G. Bruce and E. C. Breithaupt.

The charter of the Grand Valley Railway, of which E. C. Breithaupt is President, is virtually held by the same parties who now own the Berlin and Waterloo road. They therefore have a strong interest in bringing that scheme into life.

Mr. E. C. Breithaupt, the new President of the Berlin and Waterloo road, is recognized as being one of the most thoroughly educated electricians in Canada. This fact, together with his financial interest in the enterprise, is a guarantee that the road will be equipped and operated in the most approved manner.

SPARKS.

Seventeen open motor cars are now in course of construction for the Toronto Street Railway Company.

Contracts are now being let for the construction of an additional mile of the Guelph Electric railway, which will be completed by the 24th of May.

A Campbellford capitalist is investigating the prospects for the successful operation of an electric railway from Campbellford to Norwood, Ont.

The Ottawa Electric Railway will this summer be extended to Britannia. The route has been surveyed, and the line will be in operation by the 1st of July.

The town council of Perth, Ontario, will be asked to grant a bonus of $5,000 towards the proposed electric railway between Perth and Lanark.

The plant and charter of the Victoria Electric Railway and Light Co., Victoria, B.C., will be offered for sale by public auction in that city on the 11th of April.

The Railway Committee of the Dominion Government have passed a bill to incorporate the Huron & Ontario Railway Company, which proposes to build an electric railway.

The management of the Hamilton and Dundas Railway Company will shortly submit a proposition to the city council of Hamilton for the conversion of the road into an electric line.

The Port Dalhousie, St. Catharines and Thorold Electric Railway Co. has decided to build eight miles of overhead construction and two miles of track as soon as the weather will permit in the spring.

The Cornwall Street Railway Company, Cornwall, Ont., are applying for incorporation, with a capital stock of $150,000, to operate an electric street railway in that town and to distribute electricity.

The construction of an electric railway between Parry Sound and Ahmic Harbor, Ont., is one of the probabilities of the near future. The distance is thirty miles and the cost of construction is placed at $150,000.

Mr. W. S. Adams proposes to build an electric railway from Derwin, on the C.P.R., to Winnipeg river, a distance of twelve miles. The water power on the river will be utilized for supplying electricity for the line.

At the annual meeting of the Hamilton Street Railway Company the following directors were elected: B. E. Charlton (president), Geo. E. Tuckett, E. Martin, Q.C., W. Gibson, M.P., J. B. Griffith, William Harris and F. W. Fearman.

The town council of Lachine, Que., has adopted a by-law granting the Montreal Park & Island Railway running privileges in the town, with exemption from taxation, for thirty years. It is contemplated to build this line this spring, and to extend the Outremont line to St. Laurent.

By the agreement entered between the town of Brockville and the electric street railway company, the company is to have a twenty years' franchise, and is authorized to construct a single track iron street railway. Construction must be commenced before October 7 next, and one mile completed within a year from that date.

The new Board of Directors of the Hamilton Radial Railway Co. is as follows: Rev. Dr. Burns, president; A. McKay, M.P., vice-president; J. D. Andrews, secretary; W. G. Lumsden, treasurer. James Masson, M.P., Owen Sound; F. A. Carpenter, A. H. McKeown, E. P. Powell, London, Ont.; J. F. Smith, Thos. Ramsay and R. McKay.

A report has been current that the Hamilton Street Railway Company will make application to have the percentage of gross earnings of the system which is paid to the city remitted, owing to a large reduction in dividends. The increase in business anticipated as a result of the conversion of the line into an electric road has only partially materialized.

The city council of New Westminster, B.C., has received a communication from Mr. J. Buntzen, secretary of the Consolidated Railway and Light Co., offering to build an electric railway from Westminster to Steveston, with a branch to Sapperton, and to locate the central offices and repair shops in New Westminster. A bonus of $50,000 is asked from the city.

Albert Phenis, of New York; Lucius S. Oille, M. D., George E. Patterson, J. S. Campbell, of St. Catharines, and Henry A. King, Toronto, have petitioned for a bill to incorporate the Lincoln Radial Electric Railway Company, with power to take over the powers of the Lincoln Street Railway and Traction Company, and to extend the line to Toronto.

Mr. T. W. Lester, president of the Hamilton, Grimsby and Beamsville Railway, states that, notwithstanding the opposition of the Grimsby Council to granting right of way to Beamsville on reasonable terms, the electric road will be extended to Grimsby Park by a new route, independent of the Grimsby Council, and cars will probably be running by 1st July next.

The electric street railway was started in the city of Halifax about the middle of February. The initial trip proved quite successful, and was taken charge of by Mr. Norman Ross, E.E., representing the Canadian General Electric Co. The cars are equipped with C.G.E. 800 motors and parallel controllers. The Train company is installing two large C.G.E. dynamos of monocyclic type, having a combined capacity of 6,000 lights. The generators are operated by a 300 h.p. Robb-Armstrong compound engine.

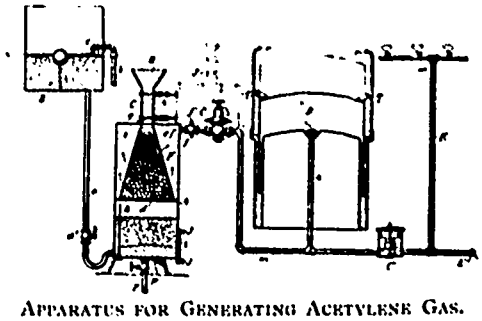
The bill to incorporate the Canadian Electric Railway and Power Company, which proposes to build an electric line from Windsor to Montreal, with branches of not more than 25 miles radius, came before the Railway Committee of the Dominion Parliament on the 26th of February. The promoters are Messrs. Castle Smith, London, Eng.; J. K. Osborne, T. M. Jones, C. W. Beardmore, W. H. Cawthra and Edmund Bristol, of Toronto, and E. F. Fauquier, of Ottawa. The application was opposed by the Grand Trunk and C.P.R. authorities. The measure was allowed to stand over for further consideration.

The supper recently tendered to the employees of the London Street Railway by the efficient manager, Mr. C. E. A. Carr, was one which will be remembered with pleasure by those present. The gathering numbered about 85, and included the office staff, motormen, conductors, power house employees and superintendents. The manager sat at the head of the table, accompanied by Mrs. Carr. The spread was an excellent one, and after full justice had been done, a toast list was introduced, Mr. Currie, secretary, and Mr. De Harte, superintendent, responding to the toast of the "London Street Railway Company," and Mr. Carr to that of the "Manager of the Company." The toasts of the various departments were heartily received, and the pleasure of the occasion was greatly added to by songs by Mrs. Carr, Mr. Currie and Mr. Birmingham.

Mr. C. A. C. Pew, of St. Catharines, is promoting an extensive electric railway enterprise across the north-western portion of Ontario, from Port Perry to Lake Huron. It passes through the counties of Ontario, York, Simcoe, Cardwell, Grey and Bruce, and will touch at the towns of Newmarket, Bradford, Beeton, Shelburne, Priceville, Durham, Hanover, Walkerton, Meaford, Owen Sound, Southampton, Kincardine, Teeswater, Wingham and Goderich. All these places are now served by parallel lines of steam railways, radiating mostly from Toronto, and which necessitates, on the part of travellers, the making of long round-about journeys to go from any of the points named to another. The proposed electric road is therefore intended to promote a great public convenience, and is in consequence meeting with a very enthusiastic support all along its route. It crosses the G.T.R. and C.P.R. at several points, and will in a measure serve as a feeder for both roads. The part of the country it passes through is fertile and prosperous, and much in need of railway accommodation in the direction proposed. Large meetings in favor of the project have been held at all the towns named, at which money for preliminary expenses was freely subscribed. Parliament will be asked at its present session for a charter, which, when obtained, will be passed over to a New York company, which proposes to build and equip the road without asking either the government or municipalities for a bonus. The road is sure of an extensive traffic, and can scarcely fail to return large earnings to its owners. An abundance of water power exists along the route.

RECENT CANADIAN PATENTS.

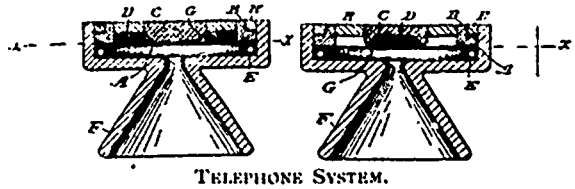
Patents have recently been granted in Canada for the following electrical and steam engineering devices:



APPARATUS FOR GENERATING ACETYLENE GAS.

Patentee: T. L. Willson, New York, N. Y., patented 5th November, 1895; 6 years.

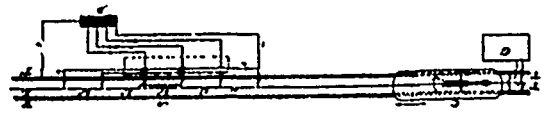
Claim.—The combination to form a gas-generating apparatus of a gas generator consisting of a chamber having a receptable for carbide, a gas outlet from the upper part of the generator, a water inlet to the lower part thereof, and a source of water connected with said inlet under pressure sufficient to raise it above the level of the carbide, the whole adapted for automatic operation controlled by the relative pressures of the water and the generated gas, so that the water, after reaching the carbide is forced out of contact therewith whenever the gas is generated enough faster than it is consumed to raise its pressure above that of the water.



TELEPHONE SYSTEM.

Patentee: A. C. Brown, Lewisham, Eng., patented 2nd November, 1895; 6 years.

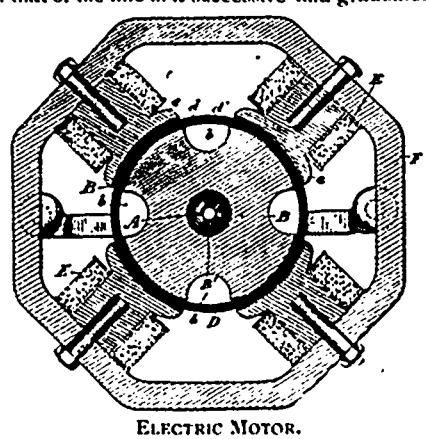
Claim.—In a telephone receiver the arrangement and combination of a central or cylindrical casing or ring seating with ear piece and with two diaphragms both adapted to be simultaneously vibrated in opposite directions to or from each other, and polarized by magnets. In a telephone receiver having two diaphragms clamped onto a cylindrical seating, the use for polarizing such diaphragms or cores of a split steel tube such as S, encircling the coils as above described, or for the same purpose of magnets arranged or adapted to operate substantially as above described and illustrated.



ELECTRIC RAILWAY SYSTEM.

Patentee: Canadian General Electric Co., Toronto, Ont., patented 18th November, 1895; 6 years.

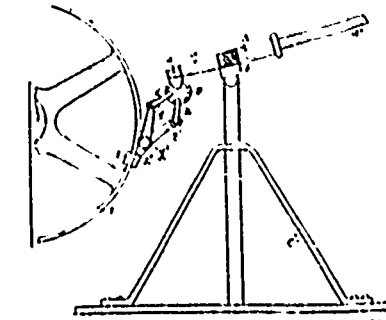
Claim.—In an electric railway system, the combination with a vehicle electrically propelled, of means for stopping and starting said vehicle at definite points, consisting of a series of conductor sections located near such points and making connection with the vehicle, and a storage battery, having connections from points of different effective potential to the various sections, the potential decreasing from each end section toward the middle. In an electric railway system, the line or supply motor, a series of section conductors connected to said line through resistant or equivalent devices for lowering the effective electro-motive force of said sections from that of the line in a successive and graduated manner.



ELECTRIC MOTOR.

Patentee: Charles Riordan, of Toronto, Ont., patented 18th November, 1895; 6 years.

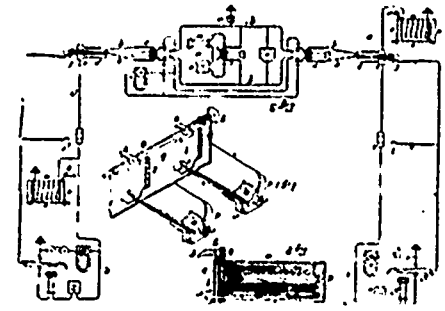
Claim.—In an electric motor the combination with the exterior field magnets, of a hollow cylindrical armature comprised of wire loops suitably supported and secured to the main shaft of the motor and a solid core located within the armature magnetically insulated from and loose on the shaft and provided with recesses in its periphery between the ends of the cores of the field magnets whereby the lines of force maintain such core from rotating on the shaft, the armature supported on discs and comprised of a series of loops substantially rectangular, arranged in sets abutting each other, the sides of the loops of each set being arc-shaped, and each side being arranged to fit beneath the side of the adjacent loop of the set, so as to form a complete cylinder of double layer arc-shaped wire sides, the ends of the wire of each loop being connected to corresponding sections in the commutator.



LEVER FOR TURNING STEAM ENGINES OFF THEIR DEAD CENTRES.

Patentee: John Donnelly, St. Henri, Que; patented 2nd December, 1895; 6 years.

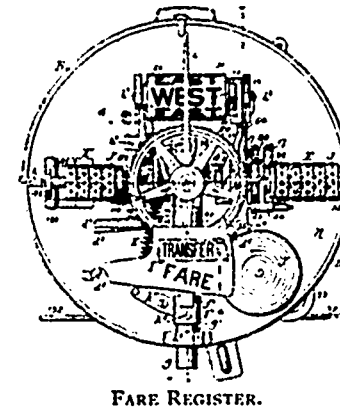
Claim.—On a lever for turning steam engines off their dead centres the combination of a lever A, having cross pieces b and a^1, two pieces a^2 and a^3, provided with the rings D and D^1, holding the ones E, to which is secured the levers g and g^1, of the grapples G, with a suitable stand C^1, and socket bar a^4.



MULTIPLE SWITCH BOARD FOR TELEPHONE EXCHANGES.

Patentee: The Bell Telephone Company of Canada, Montreal, assignee of C. E. Scribner; patented 5th December, 1895; 6 years.

Claim.—The combination with an annunciator having an electro-magnet, a pivoted armature therefor, an indicator and mechanism is connected with said armature and indicator adapted to actuate the indicator when the armature is vibrated between its extreme positions, of a circuit containing a source of pulsating currents, a source of continuous current and means for connecting said source of continuous current with the circuit, whereby the actuation of the indicator by pulsating currents may be prevented by connecting the source of continuous current with the said circuit. In an annunciator in a ground branch having an electro-magnet, a pivoted armature therefor, an indicator and a catch-arm carried by said armature having alternate teeth adapted to engage with and retain said indicator when the armature is in either of its extreme positions, but to release the same when the armature is vibrated, a connecting plug for insertion into any spring jack, having contact-pieces arranged to register with the corresponding contact-pieces of a spring jack, a conducting circuit joining the different contact-pieces of a plug, including a clearing-out annunciator, a source of current adapted to actuate said clearing-out annunciator.

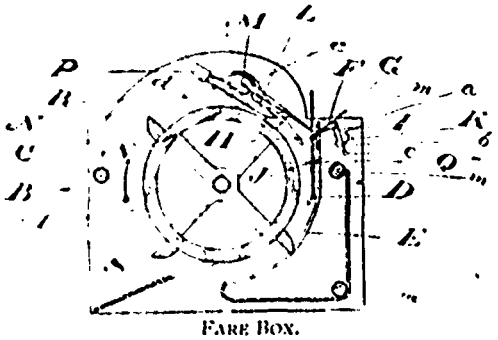


FARE REGISTER.

Patentee: The St. Louis Register Co., St. Louis, U. S. A.; patented 9th December, 1895; 6 years.

Claim.—The combination with the trip register, the permanent

register and means for releasing the trip-register, and for locking the permanent register against movement while the trip-register is released, of a motor for returning the trip-register to zero and means for actuating registers step by step and for unlocking the permanent register against movement while the trip-register is released. The combination with the registers and the fare indicating signal I of an arm for moving it in one direction, a longitudinally yielding pin for holding it in such position, and an oscillating pawl for depressing the pin to release the signal.



FARE BOX.

Patentee: J. H. Coleman, Tottenham, Ont.; patented 10th December, 1895; 6 years.

Claim.—In a fare box, one or more needles arranged to permit of the insertion of fares into the box and automatically arranged to resist their withdrawal when the box is in a normal position. In a fare box, a concave and a rotatable toothed drum between which the fares pass, with needles having weighted tails to retain the points of the needles in the path of fares passing between the concave and the drum.

SPARKS.

The Bear River, N. S., Electric Co. have decided to extend their lighting system to Digby.

A franchise has been given to the Belleville Electric Company to construct an electric railway between Belleville and outlying villages.

D. Knechtel, of Hanover, has started up his first 10 h. p. induction motor operating from the monocyclic circuit. The operation of the motor is so satisfactory that Mr. Knechtel looks for a considerable power business in Hanover.

Mr. James Milne, lecturer in Electricity at the Toronto Technical School, held a preliminary examination for the class on the 27th of February. Although only a small number of students were present, the results were very satisfactory.

In the city of Montreal many ex-telegraph operators hold positions of trust and responsibility. Among those may be mentioned: Sir William Van Horne, president Canadian Pacific Railway; Mr. Charles W. Hays, general manager, and Mr. Geo. B. Reeves, general traffic manager Grand Trunk Railway; Mr. J. Stephenson, general superintendent Grand Trunk Railway; Mr. J. Bryce, superintendent Canadian Express Co., and Mr. Wm. MacKenzie, stock broker.

A bonus of $10,000 for an electric railway between Perth and Lanark has been granted by the last named town.

Joseph Barrett desires to secure a franchise from the city of Toronto to distribute light, heat and power.

Messrs. James Oglivy & Sons, Montreal, are installing a 55 kilowatt and a 12 kilowatt C. G. E. multipolar machine for isolated lighting.

Mr. T. L. Wilson, of Calcium Carbide fame, is reported to have purchased power sites at St. Catherines, Ont., with the intention of locating his Canadian works there.

Mr. W. L. Gilchrist recently delivered a lecture at Victoria, B.C., on "Magnetism and Electricity."

The capital stock of the Toronto Electric Light Company, Limited, has been increased from $700,000 to $2,000,000.

The offices of the Kingston Light, Heat and Power Co. have been enlarged and equipped with modern appliances.

The Montmorency Electric Power Company, Quebec, are negotiating with the town of Levis to furnish 50 horse power for pumping apparatus and electricity sufficient for 80 arc and 2,000 incandescent lamps.

At the annual meeting of the Portage la Prairie Electric Light Company, Messrs. T. B. Millar, Judge Ryan, Hon. R. Watson, Smith Curtis and Mr. Blake were elected directors. The report presented showed a satisfactory year's business.

The Citizens' Light & Power Company, of Montreal, held its annual meeting early in February. Mayor Wilson-Smith was elected president, Mr. W. McLea Walbank, vice-president and managing director, and Mr. R. B. Hutcheson, secretary. The report showed that in the last month the company had obtained 25 new customers at meter rate, and 15 customers at flat rate. The directors elected for the ensuing year were: Major G. H. Burland, W. McLea Walbank, P. Lyall, M. P. Davis, L. H. Hêneault, Mayor of Ste. Cunegonde, and ex-Mayor Dagenias, of St. Henri.

The Citizens Light Co., of Montreal, have installed 600 lamps for lighting the Academy of Music.

The plant of the electric light station, New Westminster, B.C., consists of 4 boilers, 80 h.p. each; 1 Corliss engine, 180 h.p.; 1 Doty high-speed engine, 150 h.p.; 1 Ideal high-speed engine, 150 h.p.; 2 arc dynamos, 50x2,000 c.p. each; 2 incandescent dynamos, 1,500x16 c. p. (nominal) each; 1 incandescent dynamo, 650x16 c.p.; 2 extra armatures and other appliances, complete.

CANADIAN GENERAL ELECTRIC CO.

(LIMITED)

The following Letters speak for themselves:

PORT HOPE, Feb'y 27th, 1896.

MESSRS. CANADIAN GENERAL ELECTRIC CO.,
Toronto.

DEAR SIRS:—The 75 Kilowatt Monocyclic Alternator purchased from you was started up on Sept. 2nd, 1895, and has since been giving us an uninterrupted service of 160 hours each week, starting at four o'clock on Sunday afternoon and running till eight o'clock the following Sunday morning, without a hitch of any kind whatever. We expect a large increase to our business from motor service, and appreciate the excellent features of the Monocyclic system of this combined light and power service. There is, of course, no unbalancing, as the lighting is single phase, and the operation of the motors does not disturb in any way the evenness of the lighting. After an experience of six months we feel warranted in saying that we consider the Monocyclic as superior to any of the polyphase systems which we are acquainted with, and intend in the near future to duplicate this machine.

Yours truly,
R. A. CORBETT,
Pres. & Mgr. Port Hope Elec. Light & Power Co.

PARRY SOUND, Feb. 27th, 1896.

THE CANADIAN GENERAL ELECTRIC CO., Toronto.

DEAR SIRS:—Having now made a thorough trial of the Monocyclic system of Electrical distribution as supplied by you, I have much pleasure in informing you that it is giving entire satisfaction.

The machine, a 75 K.W., is a beautiful specimen of dynamo building, being strong and compact. Ventilation of the armature is excellent, and the general design of that very important part of the machine is good. Electrically and mechanically, I consider your machine to be superior to any I have seen.

We have not had occasion, as yet, to test the machine on the operation of motors, but speaking from the lighting point of view, I can fully endorse what you claim for the system.

We have 700 lights now wired and expect to increase to 1,200 before 1897.

Yours truly,
W. B. ARMSTRONG,
Manager Parry Sound Electric Light & Power Co., Ltd.

HANOVER, Feb. 21, 1896.

CANADIAN GENERAL ELECTRIC CO., Toronto.

DEAR SIRS:—In answer to your enquiry as regards the operation of our Electric System, I beg to say that we have now been running one of your 75 Kilowatt Monocyclic Dynamos for the past two months, and it is giving entire satisfaction in every respect. We have not had the slightest trouble with it in any way, and although it is being operated about 15 hours a day, it runs exceedingly cool, and requires practically no attention whatever.

The machine itself I regard as a model of simplicity, in fact to show my confidence in the apparatus I have placed the plant in full charge of my brother, who, previous to the starting up of this machine, had no experience whatever with electrical apparatus of any kind.

The perfect regulation of the Dynamos, and the simplicity of the wiring are also strong points which should recommend the use of this style of apparatus to anyone contemplating the installation of an electric plant.

In conclusion, I might say that after having decided upon adopting the Monocyclic system, my opinion became somewhat prejudiced against its adoption by representations made by other manufacturers, but I now fail to see wherein I could have secured anything better to that installed by your company.

Yours very truly,
D. KNECHTEL.

DUNNVILLE, February, 1896.

MESSRS. CANADIAN GENERAL ELECTRIC CO.,
Toronto, Ont.

DEAR SIRS:—We are pleased to be able to express ourselves as entirely satisfied with the Monocyclic system installed by you last fall. We are now in a position, having covered a considerable portion of the town with our lighting mains, to appreciate the value of the three-wire system for secondary distribution from the transformers, and the great advantage gained in simplicity by the Monocyclic from its being a single-phase system for the lighting distribution.

The workmanship and finish of the dynamo itself certainly does credit to your factories, and in operation it has proved itself to be exceedingly simple and satisfactory.

The commutator and brushes run without any sparking whatever, and do not give us a particle of trouble. We feel fully justified in saying that the Monocyclic system in operation has shown itself to possess all the points of excellence claimed for it by you at the time when we made the selection for our new plant.

DUNNVILLE ELECTRIC LIGHT CO.

MATTAWA, Feb. 27th, 1896.

MESSRS. CANADIAN GENERAL ELECTRIC CO., Toronto.

DEAR SIRS:—We are pleased to be able to express complete satisfaction with our Monocyclic plant, which has now been running since 27th Sept. We are especially pleased with the ease with which our former single-phase system has been changed into one suitable for the distribution of both light and power. The only change made in our case was the installing of the Monocyclic machine in place of our former single-phase alternator, and the running of a third wire to the points where power is to be supplied. Altogether the system is admirable, both as to simplicity in the wiring, and distribution and perfect freedom in operation from any trouble or complication. We are quite sure that the Monocyclic system will prove a means of increasing largely the revenues of alternating lighting stations by the sale of power without adding any complications to their operation. You will be pleased to know that the 5 h.p. induction motor geared to a triplex pump is now in successful operation pumping water for the C.P.R. water tank. It is certainly a very simple and substantial piece of machinery.

Yours truly,
MATTAWA ELECTRIC LIGHT & POWER CO., LTD.
A. F. HURDMAN, Sec'y-Treas.

SPARKS.

The Arnprior Electric Light Co. are said to have greatly reduced the price for lighting.

It is announced that a horseless carriage exhibition and race is being arranged for, to take place at the Hamilton Jockey Club track in the spring.

Mr. C. W. Bowman, of Walkerton, who was elected reeve at the municipal elections, has been obliged to resign his seat on account of having an electric light contract with the town.

The second annual ball and supper of the employees of the Ottawa Porcelain and Carbon Co., was held early in February. The event was much enjoyed by the large number present, including the general manager, Mr. J. W. Taylor.

An authority, speaking of the cost of producing carbide for the manufacture of acetylene gas states that it will cost at least $23.70 a ton, and that the new illuminant cannot be delivered for less than $12.50 for every 700 lbs. But it is claimed that only one-fifth as much acetylene gas is burned as of ordinary gas.

The annual meeting of the Guelph Light and Power Co. was held on the 17th of February. The twenty-fifth annual report showed a slight falling off in revenue during the past year, but considering the prevailing depression, was considered satisfactory. A vote of thanks was tendered to the directors for their services. The old board, consisting of Messrs. D. Guthrie, Q. C., Geo. D. Forbes, Geo. A. Oxnard, W. M. Foster, Richard Mitchell, E. Harvey, and James Innes, M.P., were re-elected. At a subsequent meeting of the directors, Mr. Guthrie was elected President, and Mr. Mitchell Vice-President for 1896. Mr. John Yule retains the management.