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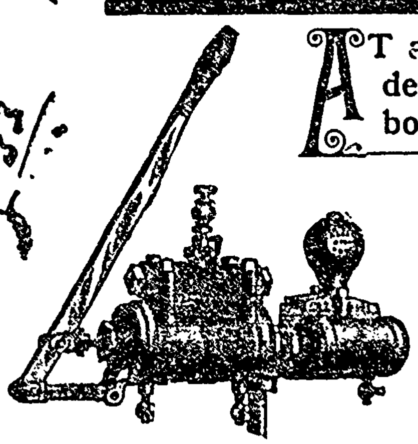

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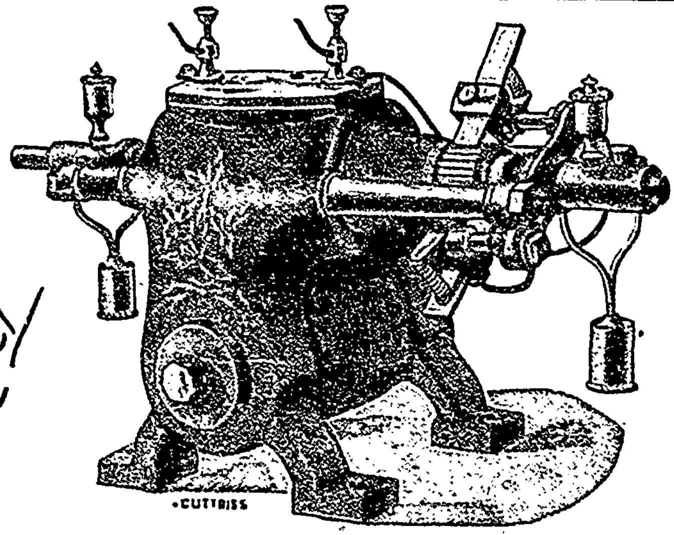

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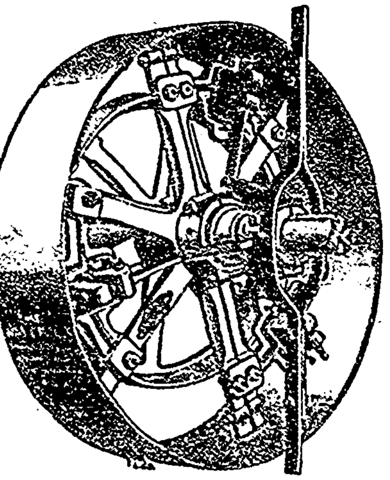

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CANADIAN

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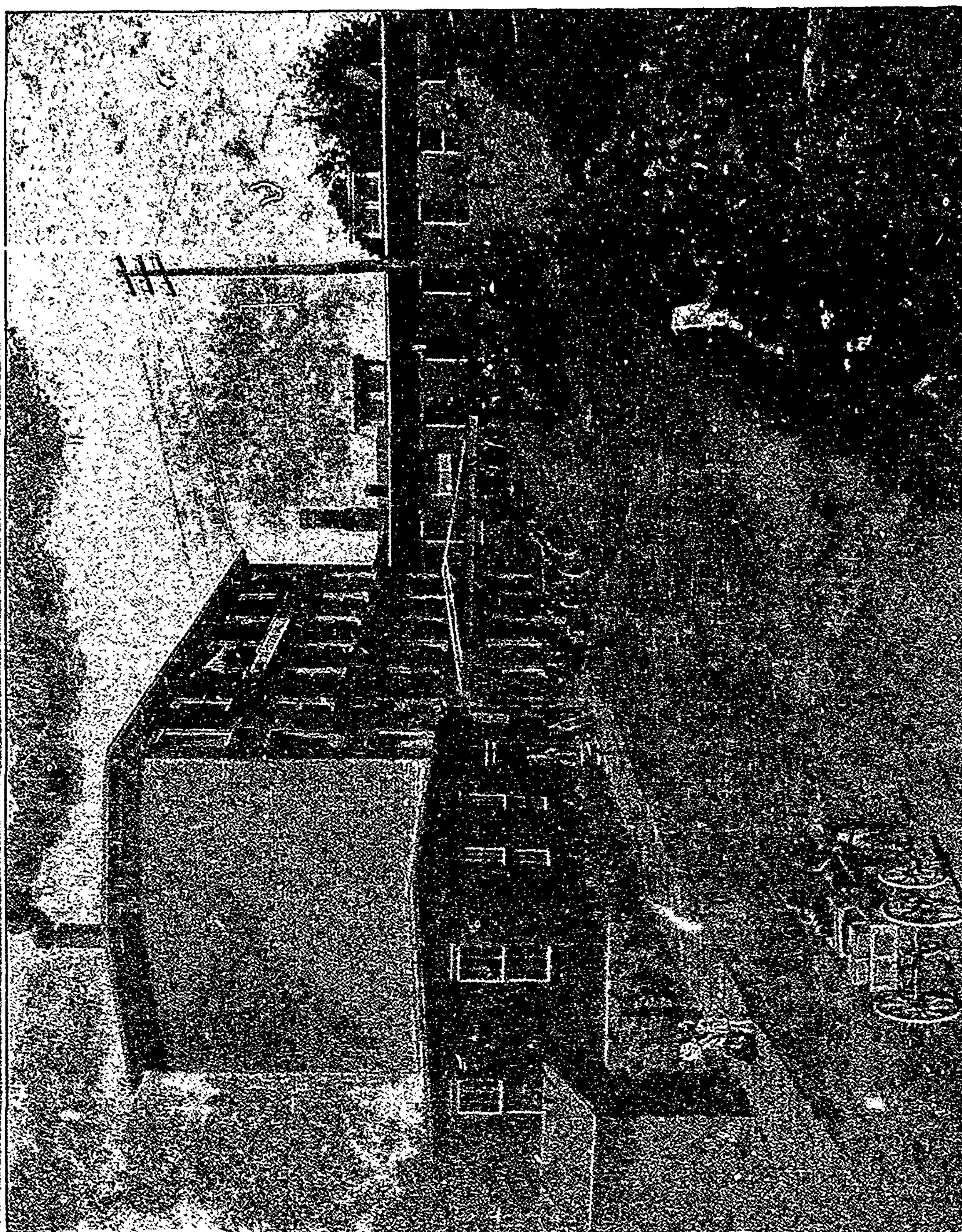


CANADIAN WORKS OF THE EDISON GENERAL ELECTRIC CO., SHERBROOKE, QUE.

EDISON GENERAL ELECTRIC CO.'S WORKS AT SHERBROOKE, QUE.

The Canadian works at Sherbrooke, though small in comparison with the Edison company's American establishments, present more points of interest than any one of these, for here are combined the industries embraced by the New York and Schenectady works. Indeed, we find here the manufacture of all machinery and appliances necessary for the equipment of all kinds of plants for the supply of light and power, except lamps. In the dynamo department there are always in course of construction machines of all sizes, from the small 250-watt," which supplies current for five sixteen-candle power lamps, to the "No. Thirty-two," designed to run 1,150 lamps of the same lighting power. The motor department turns out machines for all kinds of work and for a large range of capacity, from ¼ to 75 horse power. These are both for stationary and street car work.

The foundry is occupied with the production of castings of brass in every size and shape, ready to be passed on to the machine shop, where by means of lathes, drills, punch-presses and other suitable machinery they are fitted up for the purpose they have eventually to serve. In the carpenters' and pattern makers' shop patterns are made of parts of machines which the moulders will afterwards turn out in brass and iron. The cable department supplies all varieties of stranded conductors for conveying currents for different classes of work, amongst which the chief are telegraph, telephone, lighting and power. Here, amongst others, are made large lead covered telephone cables, some of which contain upwards of two hundred separately insulated wires, and composite conductors designed for every kind of overhead, underground and subaqueous purposes. On these the tube department are now working—the method of manufacture being as follows. Copper rods of thickness varying from ¼ inch to 4-5 inch have wound round them a spiral of rope saturated with a liquid insulation, after which three rods are bound together with a similar larger spiral. The bundle is then slipped into a length of pipe, the ends of the rods being allowed to protrude at each extremity. A viscid bituminous compound is now forced in under pressure, so as to completely fill all the interstices between the copper, rope and pipe, rendering the whole tube impervious to moisture and gases. The ends of the pipe are then closed with rubber plugs, through which the rods are allowed to appear, and the conductors are tested, after which they are ready for shipment. Contiguous rods are connected when laid underground, by flexible copper cable, which allows for expansion and contraction of the conductors caused by heat or cold. Two tubes may be joined together, either in a straight line or at any angle required. The connecting joints are covered by cast iron coupling boxes fastened to the ends of the tubes, which are filled with insulating compound. Another product of the Canadian works consists of insulated wire of all descriptions. From the wire department are produced magnet and armature wires, weatherproof line wire, rubber-covered wires for sundry purposes, office wires, annunciator wires, gas fixture wires, tinsel cords, resistance wires, non inflammable house wires, and silk and cotton braided flexible cords for hanging lights, and so forth. All sorts of metals are here worked on, from the gold cord in the tinsel and the German silver in the resistance wire to the usual copper conductor and the galvanized iron of telephone lines. The range of size runs from stout rods of copper, half an inch in diameter, to the filament gauging only fifteen ten-thousandths of an inch—half the thickness of the human hair, one pound being 32 miles in length. Insulation is effected by means of silk, cotton, rubber, worsted and other materials of a non-conducting nature. The growth of the whole works has been steady and rapid. Starting in the spring of 1889, only a small force was employed, but this has increased, until to-day there are over 220 hands on the rolls, and this number will soon be considerably added to. The necessities of the industry compel a constant addition to the list of departments, the latest amongst which is the result of a contract with the Thomson International Electric Welding Company, whereby the Edison works have agreed to build the necessary outfits for all welding plants, started in Canada under the Thomson Company's patents. Besides the articles already enumerated, these works produce ready for the market, all kinds of general electric appliances and supplies, such as meters, switches, pockets and receptacles for lamps, cut-outs, regulators, Amperemeters, volt-meters, resistance boxes, etc.

It is gratifying to learn that the company's Canadian business has grown to an extent that has rendered necessary the erection at Peterborough, Ont., of new workshops of greatly increased capacity, in which operations will be continued on an extended scale the coming spring.

WHAT SHALL AN ENGINEER STUDY?

By "AUTOMATIC CUT-OFF."

This is a very important question, and one that cannot be settled offhand. The term engineer is so widely used that every person who has anything to do with boilers, engines or steam, whether he be the veriest stocker who just knows a steam gauge from a glass water gauge, or a first-class man, even a graduate from a Technical College or a man capable of taking full charge of one of our ocean greyhounds—all come under the name of engineer.

No matter what position a man holds in the engineering world, he should have knowledge enough to manage safely the steam plant under his care, and if the employers insisted upon this being proved to their satisfaction, they would save themselves some anxiety and considerable money. I heard an employer say, "I don't want any book-learned engineer around my place, I pay my men to work." Well, he got what he wanted, and in a few days there was a shut-down in the middle of the afternoon—146 men standing still. Upon inquiry as to what was wrong, the engineer (?) said he had no water, and could not get the pump to work. After spending two hours on it, they sent to a neighboring machine shop for a man. In ten minutes the machinist found a piece of scale under check valve, and had there been water enough in the boiler, the machinery could have started at once, but as the case was the boiler had to be cooled off and then filled up by hand. The loss in this case is considerable – 146 men three hours, equals 438 hours, or 43 days for one man

Now if this engineer (?) had "book-learned" enough of the principles upon which a boiler feed pump works, he would not have been stuck so easily, and undoubtedly in that case would have saved his employer the cost of 43 days labor.

From the fact that at the present day steam engineering is running to faster speeds and higher pressures, as well as better compounded engines, it becomes necessary for the engineer himself to acquire more knowledge in order to work with the same degree of safety for himself, his fellow employees, and his neighbors. The opportunities for gaining knowledge have advanced as rapidly as the improvements in the machinery, so that there is no excuse to be made for the engineer who does not keep up with the procession. It is not to be expected that all men can attain the same degree of knowledge, even with the same advantages, neither is it necessary for men running engines to have a technical education, but all men in charge of steam plants should study natural philosophy and hrydrostatics. They should learn enough about chemistry to help them about combustion, that they may properly use their employer's coal. They should understand arithmetic, at least as far as square cube root. Any engineer who is master of common arithmetic that far, can always work the problems he may meet with in ordinary, everyday practice.

One trouble the student meets right on the threshold is, that the mechanical books he studies from do not agree on many points. In some instances the rules given by two different writers result in different answers. This is confusing to the student, and should be corrected by some means. We should have standard rules, so that results would be alike in the whole mechanical world. If we had license and inspection laws it would tend greatly to remedy this trouble, as it would become a necessity to have a fixed standard by which to conduct the business.

There are many instances occurring wherein the engineer who studies has the advantage. One I call to mind where an engine had been doing very well for nearly a year from the time it was started. All at once the crank pin brasses began to give trouble. The connecting rod was of the English stubb end pattern; and the brasses were held in place by two bolts with jamb nuts on them bolting them to the stub end of rod. The engineer soon found that these bolts were stretching, and wrote the builders of the engine to that effect. They were positive the bolts were all right—had been making many just like them and all were satisfactory but this one—the engineer must be mistaken, etc., etc., in fact they repudiated the whole thing. In the meantime one of the bolts broke. It was renewed by the builders, but at once began to stretch. Our engineer by this time had got tired trying to get these brasses to run right. As he was a member of one of the engineering associations and had been gaining knowledge, he concluded to figure out the strength of the bolts, and the strain put on them when the steam was admitted to the cylinder. These figures proved plainly that the bolts were too small in sectional area to stand the strain put upon them. These figures were sent to the builder of the engine, and the result is that the engine is supplied with stronger bolts and the trouble for ever cured Now if that engineer could not have done this, there would have been many shut downs, and every body and every thing but the right one would have been blamed.

I may say here that when this engineer joined the society he could not figure up the strength of one of those bolts any more than he could fly. I could go on and cite instances enough to fill this paper, where the engineer has been of signal service to his employer by studying and practising a little "book larnin." I say, engineers, study to be equal to all your duties, and employers, get a man who can prove he knows how to manage a steam plant.

MR. ARTHUR AMES.

THE subject of the accompanying portrait is President of No. 4 Branch of the Canadian Association of Stationary Engineers at Brantford, Ont. He was born in the city of Toronto in 1857. A few years later he removed with his parents to Stratford, where he attended school until fourteen years of age. The next three years of his life were spent in a stationary and drug store.

Having a greater liking for mechanics' than for commercial pursuits, and being particularly attracted towards steam engineering, he set to work to study along the lines of desired knowledge. The information thus gained served but to intensify the natural liking.

After having gained some experience, Mr. Ames in 1877 entered the C. T. R. shops at Stratford. After remaining there for a year and a half he was transferred to the company's car shops at Brantford and given charge of engine and boilers. In this capacity he spent two years, at the end of which period he severed his connection with the company to accept a position with Wm. Paterson, Esq., M. P., wholesale manufacturer of biscuits and confectionery, in whose employ he has now been for ten years.

BRANTFORD BRANCH NO. 4, C. A. S. E.

Brantford Branch No. 4 of the Canadian Association of Stationary Engineers was organized in June, 1888, with eight charter members. Mr. A. M. Wickens, then President of Toronto Branch No. 1, was largely instrumental in bringing about the result.

MR. ARTHUR AMES.

This branch has at present 15 members in good standing, embracing it is believed all the reliable engineers of the city. Its future growth is limited by the comparatively small number of manufacturing industries. Any lack in numbers is fully compensated for by the enthusiastic interest in the success of the institution manifested by the present membership. The meetings are well attended and profitably conducted, and the finances in a healthy condition. The society has a nicely furnished hall, on the walls of which are hung handsome photographs of the productions of leading steam engine and pump manufacturers of Canada and the United States.

The Society holds its regular meetings on the second and fourth Friday in each month. The names of the officers for the present term are: A. Ames, President; Thos. Pilgrim, Vice-President; Joseph Ogle, Secretary, Lewis A. Fordham, Treasurer.

A WORD TO ENGINEERS.

EDITOR CANADIAN ELECTRICAL NEWS.

SIR,—I am in receipt of the first copy of the ELECTRICAL NEWS, and, in my humble opinion, it will supply a long-felt want among electrical and steam engineers in Canada.

At the present time there is, and will be, a still greater demand for engineers who are competent to successfully operate dynamo machinery in connection with their steam plants. This being the case, every intelligent engineer should make it his business, not only to get the necessary information to enable him to run a dynamo, but he should also become a subscriber for the above paper, and others treating on the same subjects, so that he may be enabled to keep up to the times in all matters appertaining to his calling, so that when he has the opportunity of securing a better position, he may be ready for it, and not be left behind by the other fellow who had sense enough to see the necessity of fitting himself with the necessary knowledge and "know how to get there."

There will be many openings for engineers during the next few years to take charge of electric light and power plants, and it will be their own fault if they are not prepared for the occasion.

Our Canadian Association of Stationary Engineers offers advantages to every engineer in Toronto in the educational line, which is its chief feature. We meet every second and fourth Friday, in Room D, Shaftesbury Hall. After the general routine of business, there is always some subject brought up for discussion, each one giving his views thereon, and I can assure you that it is productive of much good.

I know men who, when they joined the Association couldn't figure out the area of a 12" circle, who can now get up to the black-board and figure out almost anything.

The trouble is that many of the steam users and engineers do not sufficiently appreciate the objects of the Association.

I must apologize, Mr. Editor, for taking up so much of your valuable space, but this is my first offence. I wish the NEWS every success, and trust that its circulation may surpass your most sanguine expectations.

Yours truly,

ALBERT E. EDKINS,

Pres. Toronto, No. 1.

22 Agnes Street.

HEAT THE FEED WATER.

IT cannot be too often stated that the steam engine is a heat engine. Many young engineers, and even some who are no longer young, seem to think that somehow or other it is the *pressure* that is the main thing to be considered, forgetting that the heat is the source of the pressure. The engine that converts the most heat into power is the one that is most economical to use. Engine owners will admit this, and yet will use an engine that throws away exhaust steam into the air—proving a nuisance to all the neighbors and will at the same time pump cold water into the boiler, or put it in by means of pressure from the city mains, because that saves the expense of a pump.

In the winter time the temperature of water in the city mains in Toronto is as low as 37 Fah., and may at times be even below that. In an ordinary boiler with steam at 80 lbs. pressure on the gauge, the water in the boiler will be about 324° Fah., and the exhaust steam thrown out by a common high pressure engine may be as low as 213°, or as high as 220° or more. Suppose the steam to enter the engine cylinder at 324°, and the exhaust to leave it at 213°, there is a fall in temperature of 111°. If the feed to the boiler be from the city mains at 37°, the difference between that and the temperature of the exhaust is 176° more than 50% of a greater difference than between entering and leaving the cylinder. That is, more heat is thrown away than is expended in the cylinder. If even a portion of the heat of the exhaust were used to heat the feed water there would be a gain, and the question to be considered is, how much is that gain?

With steam at 80 lbs. pressure in the boiler, and the water in the boiler at 324°, the feed water of 37° has to be raised 287°, but to get it into steam over 1,176 heat units have to be added. The total temperature from zero is 1,213°.23, and 37° the temperature of the feed water subtracted, leaves 1176°.23 to be added. If by the exhaust steam the feed water be raised to 190°, then 1213°.23 less 190° = 1023°.23 to be added, or a difference of 153°. A saving of 153° on 1176°.23 amounts to 13%, or 260 lbs. on each ton of coal used.

In a mill using about 160 h. p. the exhaust steam leaves the engine at about 3 lbs. pressure, the feed water is heated to a temperature of 208°, the mill itself is heated in the winter time, and after that there is still enough left to heat the water used in a large dye house to 160° temperature. Wherever there is exhaust steam from an engine some use should be found for it, as the owner might just as well dump some of the coals into the lake every day as blow the steam off into the air.

The city electric committee of Vancouver B. C., have in preparation their report to the Board of Aldermen recommending the addition of new engines of 200 horse power or more to the city's electric light plant. The committee will also advise the purchase by the corporation of the plant and business of the gas works, and Electric Illuminating Co., and Tramway Co., and that when this shall have been accomplished lal the wires be placed underground.

ELECTRICAL INSTRUMENTS.*

CURRENT INDICATOR OR AMPERE METER.—This apparatus is to indicate the current strength at all times. It should be put up in each case where a constant current strength is required as in arc light circuits or in the series multiple system of incandes-

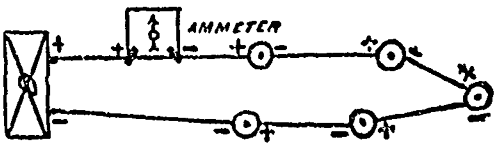


FIG. 1.

cent lighting. The instrument must be connected in series with the arc lamps or with the groups of incandescent lamps in the series multiple system. It is also used in the multiple arc or multiple series system and is always put in one outgoing wire of the dynamo, Fig. 1.

PRESSURE OR POTENTIAL INDICATOR, OR VOLTMETER.—This instrument is absolutely necessary on dynamos which must

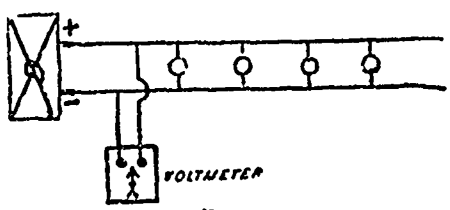


FIG. 2.

be kept at a constant e. m. f., as in the multiple arc or multiple series system of incandescent lighting. The instrument is connected in parallel with the lamps, as shown in Fig. 2.

CURRENT REGULATOR.—This instrument, also called rheostat or resistance box, consists of a box which contains wire or some other resistance and which can be switched in or out of the electric circuit by means of a crank. If this is to be done by hand, the instrument is called a hand regulator; if done automatically it is called an automatic regulator.

The regulator for series dynamos is connected anywhere in the circuit, the whole current generated by the dynamo passing through it. By putting more or less resistance in the circuit, the current flowing through the other parts of the circuit can be strengthened or weakened. In shunt dynamos the regulator is put in the shunt winding of the field. Putting in or taking out the resistance decreases or increases the strength of the field

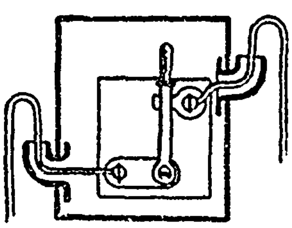


FIG. 3.

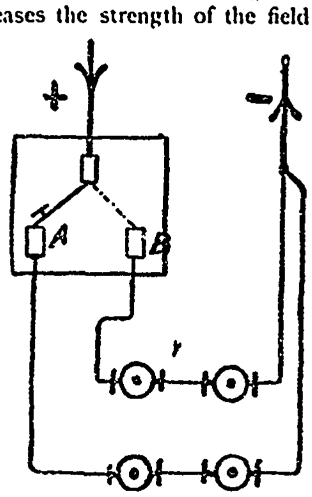


FIG. 4.

magnets and thus controls the current generated in the armature. In some arc light dynamos the regulation of the current is effected by putting more or less resistance in shunt with the field circuit, and in others by automatic devices for shifting the brushes. The movement of the latter towards the neutral point will decrease the current, while moving it toward the maximum point will increase the current strength.

SWITCHES.—A switch is an instrument to break or make circuit, or, in other words, to cut off the current in certain places for a number of lamps or cut them in again. The switches should be constructed so that they will open and close very quickly and not show very much sparking. [See Fig. 3.] This is accomplished by having the switch so arranged that the human hand will start it, while a powerful spring throws the switch open or closes it immediately. The contact should be sufficient to prevent any heating at these points.

Two-way switches are used in various ways; for instance, for two different sets of lamps. If one set of lamps is not required, the handle, as shown in Fig. 4, is moved from *A* to *B* and the lamps marked *X* will go out, while those marked *Y* will be started.

SAFETY DEVICES.—Strips of an alloy which fuses at a low temperature are used as safety devices, or plugs, in incandescent wiring. The cross-section of the plug must be of such size that it will melt before the wire it protects gets dangerously warm. Hence the diameter of the safety plug depends upon the cross-section of the wire to be protected and not upon the number of the lamps. The safety plug is not supposed to protect incandescent lamps from an excess of current, but to protect the building from fire by preventing any part of the electric light conductors from getting too hot. The marking of safety plugs with the number of lamps they can carry has misled many an employe of an electric light company to think that the plugs are put in for the protection of a certain number of lamps. The

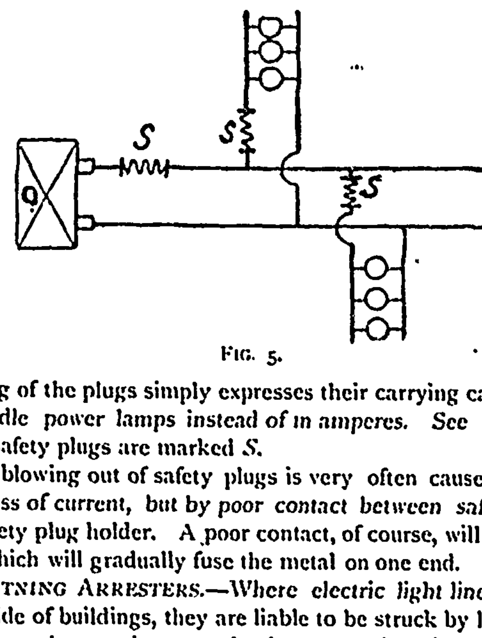


FIG. 5.

marking of the plugs simply expresses their carrying capacity in 16 candle power lamps instead of in amperes. See Fig. 5, in which safety plugs are marked *S*.

The blowing out of safety plugs is very often caused, not by an excess of current, but by poor contact between safety plug and safety plug holder. A poor contact, of course, will generate heat, which will gradually fuse the metal on one end.

LIGHTNING ARRESTERS.—Where electric light lines are put up outside of buildings, they are liable to be struck by lightning. To meet such a contingency, the dynamo and station apparatus are protected by a lightning arrester (*fig. 6*): *D* represents the dynamo; *A* and *B* are brass plates, through which the two outgoing wires pass, and *C* is a brass plate connecting to moist earth. The space between the toothed sides of *A* and *B* and the centre plate *C* is adjusted to the thickness of a piece of cardboard. If lightning should come in on one of the wires, it would leap over this narrow space and run into the ground without doing any serious mischief. Such an arrester will keep the lines discharged, and very often during a thunder storm the atmospheric electricity will continuously leap across these plates in the form of blue sparks. These discharges may sometimes cause the centre plate to fuse to one or even both toothed plates. In the latter case, the current of the dynamo may follow the arcs which are simultaneously set up between *A*, *C* and *B*, *C*. If the centre plate should be fused to both toothed plates the dynamo would be short-circuited through *A*, *C*, *B*, and the belt would be thrown off or the armature, and possibly some of the instruments in the circuit, might be burned.

In order to prevent such an accident, numerous devices have been designed to operate in connection with the lightning arrester. They may be classified as follows.

First, Safety fuses inserted between the dynamo and the strips *A* and *B*. They will fuse when the dynamo is short-circuited, break the current and thus save the armature.

Secondly, Electro-magnets which are energized when the dynamo is short-circuited and open the circuit.

Thirdly, Devices which will extinguish any electric arc that might be formed between *C* and *A* or *C* and *B*. Such devices are based on the principle that a magnet will attract the electric arc and pull it away from the plates *A* and *C* or *B* and *C*.

Whatever devices are used, one important point should not be overlooked. This is the absolute necessity of a good earth contact. The wire leading from *C* to earth should be at least a

* From "Dynamo Tenders' Hand-Book."

number 4 Brown & Sharpe copper wire. This wire should be solidly connected and soldered to a galvanized iron plate at least ⅜ inch thick and having an area of at least ten square feet on each side. If a pipe is used instead of a plate, the external area is not to be considered, but twenty square feet of external area is necessary. This earth plate should be sunk so deeply in the earth that even during a dry season it will always be in moist ground. A well or a stream of water is preferable. The earth wire should also be connected to water pipes or gas pipes if they are near by. Such a connection, however, is not a substitute for the earth plate, which is a necessity under any circumstances.

The conductor of the lightning rod of a building must not be connected with the earth wire of a lightning arrester.

All connections underground must be soldered and then painted with asphaltum to prevent corrosion and poor contacts. Poor connections with the earth are very often the cause of the unsatisfactory working of lightning arresters.

It should be borne in mind that no lightning arrester is an absolute safeguard against the freaks of lightning. Very long circuits, especially those not protected by tall buildings or trees, are very liable to be struck by lightning. In such cases extra devices at some points along the line must be put up as an additional protection.

The jaws of the lightning arrester should be kept clean and at a proper distance. It is advisable to run a cardboard between the plates every day to make sure that the jaws are at a proper distance from each other.

GROUND DETECTOR.—It is absolutely necessary to test electric light circuits frequently, and this means at least once a day, for grounds. In incandescent light installations which run

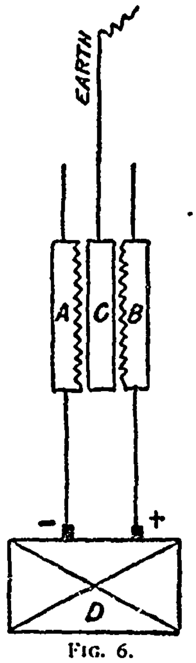


FIG. 6.

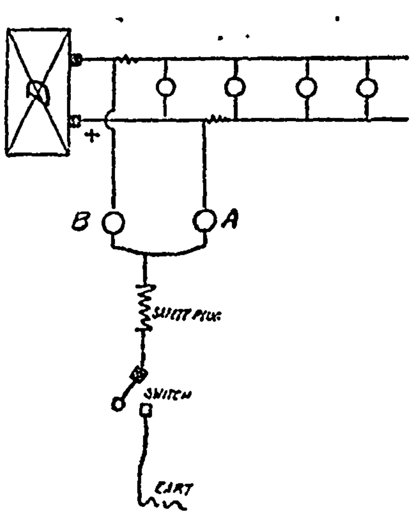


FIG. 7.

continuously, arrangements to indicate a ground while the dynamo is running should be made. A simple form of ground detector is shown in Fig. 7. Two lamps are connected in series between the mains near the dynamo. A wire leading to earth is connected between the two lamps or a safety plug and a switch are put into the earth wire. If there is no ground on the line the two lamps will burn very very dimly but at equal candle power. If a ground should occur anywhere in the circuit, say on the positive pole, the earth wire and the ground will form a shunt of low resistance to the lamp nearest the positive wire; the result will be that lamp *A* will dim down and lamp *B* will brighten up. Sometimes it may occur that both poles of a circuit are grounded and that the grounds are of about equal resistance. In such a case the two lamps will burn equally dimly. By switching out one lamp, however, it can be seen whether the lines are grounded or not. If the other lamp also goes out the lines are not grounded, but if the other lamp continues to burn the lines are grounded on both poles. To make this test one lamp should be provided with a socket with key.

Instead of two lamps a galvanometer with two coils connected in the same manner as the two lamps may be used. The needle will stand at zero when there is no ground on the line and deflect as soon as the wire gets grounded. Any grade of sensitiveness may be given such an instrument.

SWITCH-BOARD.—A switch-board is used in larger plants to connect any dynamo with any circuit. Of course only dynamos of the same kind can be made interchangeable. For arc lamp plants, plug switch-boards are generally employed. Short cables with a plug on each end can be inserted in the different

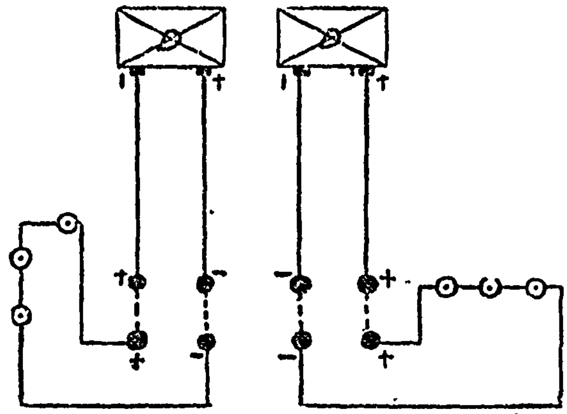


FIG. 8.

sockets. The latter are marked with + or −, and with *D* (dynamo), *C* (circuit). In addition, they are marked with a number. For instance, *D* 1 (meaning dynamo number 1) can be connected to *C* 2 (circuit number 2), and so on. Fig. 8 is a diagram showing the arrangement of a switch-board.

In incandescent plants large lever switches are generally used, as large enough plugs could not be conveniently made to carry the heavy currents of incandescent circuits.

CIRCUITS OR LEADS.*

OUTDOOR LEADS FOR ARC LIGHTING.—The wire used for outdoor circuits is mostly what is called underwriters' standard. It consists of a copper wire which is braided with cotton and painted with asbestos to make it uninflammable. This wire is fastened to glass insulators on poles or houses in a way similar to that in which telegraph wires are usually run. Insulated wire, and not bare wire, should be used for tie wire, as the common non-insulated tie wire will cut the insulation of the line wire and possibly cause leaks. The size of arc light conductors varies between numbers 6 and 4, Brown & Sharpe gauge, number 6 being the smallest wire which can be used, according to the rules of the National Board of Fire Underwriters. If the return wire is fastened on the same poles, the positive and negative wires should be kept sufficiently far apart so they cannot touch each other when swung by wind. It must be understood that the insulation called underwriters' standard is only an insulation when perfectly dry, and when wet is hardly any insulation at all. If, therefore, the positive and negative wires exposed to rain or moisture of any kind should come in contact with each other or with the ground, a short circuit would be caused. This may cut a number of lamps suddenly out and cause damage to the dynamo. Such an accident, for instance, may burn out the armature or throw off the belt. In very cold weather such occurrences are rare, as frost may make out of a circuit of the poorest insulation one of very high insulation, while on the other hand a thaw or rain may cause all kinds of disturbances. If these disturbances occur during a thunder storm accompanied by rain, lightning is often unjustly accused of having done the mischief, while in fact the poor insulation of the wires is the prime cause.

Accidents from poor insulation of lines are more frequent than damages caused by lightning, though the latter will always be a ready excuse for anything that may have happened. Recently weather and water-proof insulation have come in vogue, and they are much safer than underwriters' standard wire.

In conducting wires into houses, great care must be taken to prevent rain following the wires. The wire should be fastened to the insulator below the point where it is intended to be led through the wall or a window frame, so the rain would have to run up hill in order to follow the wire, Fig. 1.

Fig. 2 shows a wood pin and glass insulator, such as are used on cross-arms. The latter are fastened to poles by means of

* From "Dynamo Tenders' Hand-Book."

lag screws. Fig. 3 illustrates a wood bracket, which can be spiked to poles or houses and provided with a glass insulator. The glass insulators must always be fastened in a nearly vertical position, the closed end on top, so the space between the pin and glass insulator, Fig. 2, will remain perfectly dry in rainy weather and secure perfect insulation.

Fig 5 shows a rubber hook insulator. This should for the

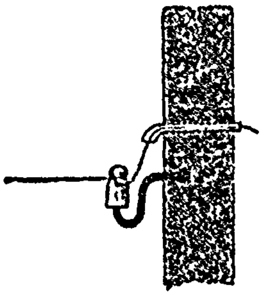


FIG. 1.

FIG. 2.

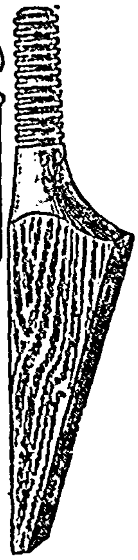


FIG. 3.

same reason be fastened with the hook downward. A hole can be bored with a ⅝ inch bit underneath a cross-arm and the rubber hook screwed in with a wrench.

An extra heavy insulating material, such as rubber hose or hard rubber or porcelain tube, Fig. 4, must be put over the wires where they pass through walls or partitions.

Poles for lines should be set deep enough in the ground ; the

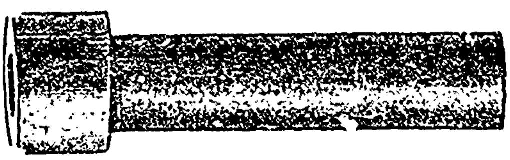


FIG. 4.

depth, of course, will depend upon the soil and the height of the pole. In sand, at least one-fifth of the length of the pole should be buried in the ground, while in rock one-tenth of the length is sufficient. In putting up wires, the season, or, in other words, the temperature, should be taken into consideration, allowing for contraction in cold weather. If, for instance, a wire should

FIG. 5.

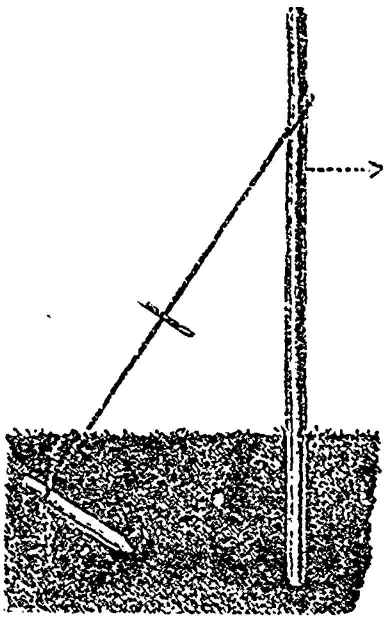


FIG. 6.

be put up very tight in July, it would cause a good deal of damage in breaking off glass insulators and pins as soon as the temperature fell to zero and caused the wire to contract. Corner poles must be braced or anchored to keep them in a nearly vertical position. See Fig. 6 and 7.

When a splice is necessary, it should be made after the fashion of the American telegraph splice, Fig. 8, and should be perfectly clean and solidly soldered and then well taped with insulating tape. In order to prevent the tape from peeling off, it is advisable to fasten the last turns of the tape to the wire with a few turns of bare copper wire, say about number 20. If this precaution is omitted the tape is sure to peel off in time. Most of our electric light lines will show places where the tape is hanging down a couple of feet. Besides, having no insulation

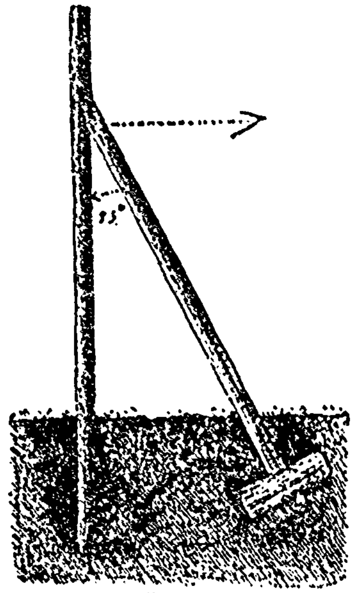


FIG. 7.

on the splice, this, of course, does not contribute to the beauty of overhead wires.

Brass line connectors, Fig 9, are only allowed for inside work where there is no strain on the wires. The set screws should be well tightened, and the connector be run full of solder and taped. Good soldering and taping of joints will save at least 50 per cent. of all the troubles that occur in an electric light plant. Joints should never be left unsoldered, even if persons who

FIG. 8.

claim to know all about it should think it unnecessary. The best apparatus for soldering joints on line wire out of doors is the gasoline blow-pipe, Fig. 10. Every trace of acid should be wiped off the wire with a moist or oily cloth before taping, to avoid corrosion.

OUTDOOR LEADS FOR INCANDESCENT LIGHTING.—The rules which were given for outdoor arc lines can be applied for incandescent light lines. As the wire used will very often be considerably larger than number 4 wire, the poles, cross-arms and other supports must necessarily be heavier to stand the greater strain, and poles should be set closer together. In a low tension incandescent system, very often bare wires are used,

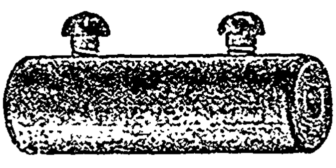


FIG. 9.

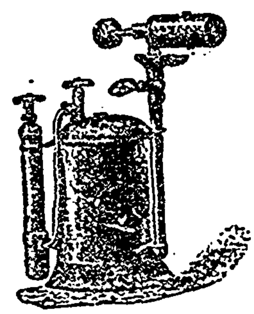


FIG. 10.

and still more care must be taken to prevent accidental contact of the positive and negative wires with each other or with the earth.

ARC CIRCUITS INSIDE OF HOUSES.—The wires for these circuits should be fastened to porcelain insulators, Fig. 11, and be exposed to view. Owing to the high tension which prevails in arc light circuits the concealing of these wires is not permitted by the underwriters. The directions given for splicing and insulating hold good also for inside wiring.

In rooms which are exposed to steam or moisture, as, for instance, in packing houses, wire with a better insulation than underwriters, standard must be used. The moisture which covers insulators and wire would cause considerable leakage, and, besides, would corrode the wire. The use of wood cleats or iron staples instead of porcelain insulators should not be permitted in any case, as they are liable to cause grounds and, in fact, have been the source of mischief in a good many cases in years gone by.

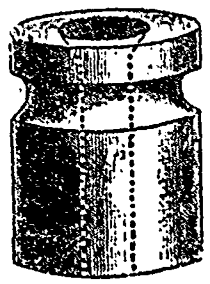


FIG. 11.

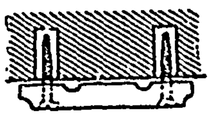


FIG. 12.

INCANDESCENT CIRCUITS INSIDE OF HOUSES.—In the low tension systems, wooden cleats or wooden molding are permitted for fastening the wires to the walls and ceilings if there is absolute safety from moisture. Underwriters' wire may be used also under the same conditions. If there is any possibility of moisture getting to the wires, the latter should be first-class water-proof insulation. If any "fishing" has to be done, where wires are to be concealed under floors, above ceilings, or between walls or laths, only water-proof wire can be used. Incandescent wiring inside of houses requires a good deal of skill and experience, and should only be entrusted to reliable and responsible concerns. Unfortunately, any man who ever fastened a piece of wire for a bell-pull, thinks himself an expert also for incandescent wiring; a good many even important jobs have been done by such men, with the result that, after a great expenditure of money by the owner of the house, the whole system had to be condemned, as not an inch of the wire had been put in properly and could be used.

The joints or connections in water-proof wire should be made water-proof also. This is done in the following way: After

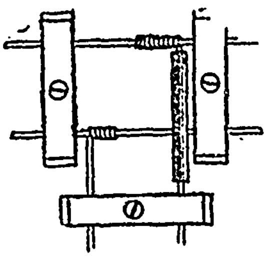


FIG. 13.

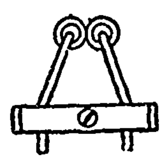
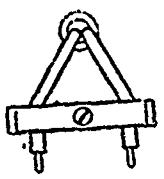


FIG. 14.

having spliced, soldered and cleaned the wires properly, cover the joint with hot Chatterton's compound by molding it between the fingers to almost the total thickness of the insulated wire. Then cover it with kerite tape and give it a second thin coating with hot compound, or hot asphaltum, and then give it a second coat of kerite tape. Hot liquid asphaltum should be used in lieu of compound where there is danger from sewer or illuminating gas that is prevalent in the soil and basements of houses in large cities.

Figs. 12, 13, 14, 15 and 16 show the use of cleats. Fig. 12 shows a familiar form of cleat. Where the positive wire crosses the negative, an extra protection of rubber tube is required to prevent any danger from short circuits, Fig. 13.



G. 15.

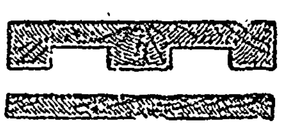


FIG. 16.

In passing through a wall, each wire should be inserted in a separate hole, lined with a hard rubber tube, Fig. 14, or each wire should be covered with soft rubber tubing and both may be drawn through one hole, Fig. 15, lined with a pipe of non-conducting water-proof material.

Fig. 16 is a cross-section of wood molding. The lower part is fastened to the wall or ceiling, the wires put in—positives in one groove and negatives in the other—and the cover screwed on. Care must be taken that nails or screws do not touch the wires.

The safety plugs are put in the circuit according to the rules of the fire underwriters. They must be of such size that they will fuse before the wire they have to protect can get dangerously warm.

SIZE OF WIRES FOR INCANDESCENT LAMP INSTALLATIONS.—The wire for each main or branch must be of such size that it can carry the current to the lamps which are connected to it, without getting very warm. The number of amperes a wire can thus safely carry is called its carrying capacity. The larger the wire the less the loss; the smaller the wire the higher the loss. In house wiring not more than 5 per cent. loss should be allowed from the dynamo to the lamp.

For those who want to give this matter more study the following formulas are given. Any one who understands arithmetic will be able to calculate the size of wire for any loss and for any lamp:

n = number of lamps.

d = distance = ½ length of circuit.

% = energy lost in the conductors, expressed in decimal fractions of 100 as 5% = .05.

r = resistance in ohms.

1. r of wire $= \frac{r \text{ of lamp hot} \times \%}{n}$

2. Length of wire : 1000 = r of wire : r per 1000 feet.

3. r per 1000 feet of wire $= \frac{r \text{ of lamp hot} \times \% \times 1000,}{n \times 2 \times d}$

4. r per 1000 feet of wire $= \frac{\text{constant,}}{n \times d}$

5. Constant = $500 \times \% \times r$ of lamp hot.

EXAMPLE: Find size of wire necessary to carry 40 sixteen candle power lamps (r = 167 ohms hot), 500 feet, 10 % loss.

Formula 5: Constant = $500 \times .10 \times 167 = 8350$.

Formula 4: r per 1000 feet $= \frac{8350,}{40 \times 500.} = .417$ ohms.

This is the resistance per 1000 feet of the wire necessary to use. If the resistance hot of the lamp should not be known it can be calculated from Ohm's law. $C = \frac{E}{R}$ or $R = \frac{E}{C}$. Supposing the e. m. f. = 100 volts and the current $= \frac{5}{10}$ amperes, R would equal $\frac{100 \times 10}{5}$, or R = 200.

TESTING.—The circuit should be tested every day for grounds by means of the detector galvanometer or a magneto bell. If a ground is indicated it should be speedily located by disconnecting the circuit in different places and taking each section separately, until the ground is located.

TRADE NOTES.

The contract for lighting the town of Lunenburg, N.S., has been awarded to the Edison General Electric Co. Plant to be installed is 750 incandescent lamps.

The contract for lighting D. W. Alexander's tannery has been awarded to the Edison General Electric Co. Plant to be installed consists of 180 incandescent lamps.

The contract for electric light plant at Merrickville, Ont., has been awarded to the Edison General Electric Co. Plant to be installed will consist of 500 incandescent lamps.

The contract for electric lighting at Niagara Falls, Ont., was awarded to the Edison Co. on Jan. 22nd. Eight different companies were competing. The contract was awarded to the Edison Company on its merits, as their price is said to have been nearly the highest of any of the tenders. The plant to be installed consists of 60 arc lights and 750 incandescent.

The Windsor Electric Light and Power Co., of Windsor, N. S., started up their Edison plant on Nov. 15th. 1,000 lights are installed and in operation, and giving such satisfaction that it has been found necessary to increase the plant, and an additional order for two Edison dynamos has been given to the Edison General Electric Co, which will give the plant a capacity of 1,600 sixteen c. p. incandescent lamps.

We had thought that the talented and versatile newspaper reporter had invented about all the possible causes of boiler explosions, but a *new one* comes from St. John, N. B., where a boiler exploded "with great violence" (as they nearly always do), killing six men and wrecking build-ings. The despatch says: "From what can be learned, the boilers were low, the water was turned on, and the person in charge neglected to turn it off, with the result that the boilers overflowed and exploded." From this it will be seen that it is very dangerous to allow boilers to overflow.—*American Machinist.*

CANADIAN ELECTRICAL NEWS AND STEAM ENGINEERING JOURNAL

PUBLISHED ON THE FIRST OF EVERY MONTH BY

CHAS. H. MORTIMER,

Office, 14 King Street West,

TORONTO, - - CANADA.

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

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EDITOR'S ANNOUNCEMENTS.

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

ANNOUNCEMENT.

WE desire to announce that the subscription price of the ELECTRICAL NEWS has been reduced from $1.50 to $1.00 per year. This has been done in order to make it possible for every person interested in electricity or steam engineering to become a subscriber.

The first number, notwithstanding its many imperfections, met with a flattering reception. Many kind things have been said of it in the press and elsewhere, for which we are grateful.

Subscriptions have been coming in during the month from all parts of Canada, and there is no reason to doubt that as the result of the personal canvass now being made the names of subscribers will soon mount up into the thousands. Those who have paid the rate of $1.50 have been credited with an additional half year. We desire to acknowledge the valuable assistance already received from the officers of the Canadian Association of Stationary Engineers.

Our advertising patronage shows satisfactory growth, and altogether, the outlook fully justifies our expectations concerning the future of this new enterprise. In view of such encouragement, no effort will be lacking to make the paper fulfil a useful purpose in the interest of every reader and advertiser. Let each reader who feels friendly towards the paper resolve that he will make some individual effort, however small, to advance its interests, and the results of such a combination of effort will not be long in manifesting themselves.

THE inconsistencies of public opinion have never been so strongly brought out as in the relative cases of accidental death by electricity and by the fumes of gas. If a careless and reckless lineman working amongst "live" wires and disregarding even the dictates of ordinary prudence, unfortunately meets with an accident which terminates fatally, the circumstance is proclaimed through the length and breadth of the land—the newspapers chronicle it with startling and sensational headlines, and call for summary vengeance on the person and property of the electric light people. But when a respected citizen in the peaceful pursuit of his everyday business, leaves his home and family never to return, having succumbed to the effects of the deadly gas served out at a dollar twelve and a half per thousand feet, these are the words found at the close of a six line paragraph in the local news of a city paper. "Coroner Johnson concluded that an inquest was unnecessary." Further comment is needless.

INQUISITIVENESS is a good thing if exercised within proper limits. Unfortunately it has in some degree come to be regarded as a characteristic worthy only of reprobation, because of its abnormal development in certain individuals. Few indeed there are so thoroughly posted as not to be in need of information on some subject appertaining to the profession or calling in in which they are engaged. Asking questions is one of the speediest methods of obtaining knowledge on any subject. We should be pleased therefore to receive and publish questions from our readers relating to subjects coming legitimately within the scope of this journal. Without laying claim to the possession of any extraordinary degree of knowledge, we nevertheless promise to exhaust all the sources of information at command in an endeavor to satisfy any demands for information which may be made upon us as the result of extending this invitation. The reward for any efforts put forth with this object would come to us in the interest and value to our readers which would attach to the publication of questions and answers of this character. Now bring on your questions!

THE incandescent light supplied from a well-equipped central station and by means of an exclusively underground system of mains and service pipes, may be looked upon as one of the most artistic and beautiful developments of the industry. Especially is this the case in the more modern edifices where the interior wiring is entirely concealed and the architectural and decorative details are made to conform and adapt themselves to the perfect illuminant. The glow-lamp lends itself in a peculiarly successful manner to the production of novel and charming effects. Whether in brilliant combination with reflecting mirrors and cut glass, or modestly peeping forth from the heart of a cluster of flowers, natural or artificial, there is a charm in the softness and steadiness of the light that is all its own. While for a time perhaps the cheapness of its smoky and noxious competitor may be detrimental to its general introduction, it is a fact not to be disputed that the cultured and æsthetic taste of modern society is creating a demand for it that is more than keeping pace with the supply. The advantages of the low-tension system of distribution in connection with underground mains are many and obvious. The difficulties are, that in a large city the demand comes from so many quarters that they cannot be reached as quickly as desirable, and would-be good paying customers are for a time left out in the cold; but this is only a temporary evil. The multiplication of central sources of supply will remove the difficulty, and the admirers of the modern illuminant will have the satisfaction of a perfect service when their district is reached as a compensation and reward for the exercise of the needful Christian grace of patience. Those who are not in a position by reason of distance to avail themselves of the coveted light, have the satisfaction of knowing that when it does come along they will have the advantage of all recent improvements and modern ideas. There are some fixtures for drawing room use that are a perfect dream of beauty, and every day adds to the number and variety. The low-tension system, while not so far reaching in its earliest inception as some others, still has advantages by reason of the means at command for keeping a supply of electricity in the mains at all times and seasons, irrespective of the difficulties that are inseparable from central station operations, even with the most perfect and approved facilities.

WE are glad to find that there is an increasing interest being taken amongst electric light men in our proposition anent the formation of an Electric Light Association in Canada. It is true that there is a similar association in the United States, but what is required is something distinctively Canadian. Electric light men as a rule are busy men, with scarcely leisure enough to keep track of the many improvements and developments being constantly made in their art. The meetings of the American Association being held anywhere from Maine to New Orleans, or San Francisco, are altogether too inaccessible to the modest and busy Canadian. The adoption, also, by our friends of the screaming eagle, of a higher and thicker wall of demarcation between the two countries, would seem to make it desirable that we should depend upon ourselves in a greater measure than formerly, and should seek as much as possible a community of interests that would render an entire commercial separation or suspension of intercourse a matter of less injury to electric lighting interests. We are still dependent upon our neighbors to a certain extent, and it behooves us to look ahead a little and determine what can be done to best forward the interests of our industry. We are in receipt of communications from central station owners strongly advocating the formation of an association for purposes of mutual benefit, and shall be glad to hear further from any others on this point. It has been suggested that Toronto, being a central location, might be made the place of meeting for the inception of such an institution. Some time about or during the coming Industrial Exhibition might be mentioned as a suitable time. There is some talk of building a new Machinery Hall by the Association, in which, no doubt, there would be ample facilities and space for a first-class exhibition of electrical apparatus. Electricity has made rapid strides during the last year or two, and if it were made generally known that during the time mentioned electricians and electric light men would meet in conclave, special efforts would be made to centralize and exhibit all that is newest and best in electrical methods and appliances. The exhibition authorities would no doubt earnestly co-operate to make this branch of the Industrial a complete success. An association of this kind should consist of those engaged in the business of manufacturing and selling electricity from central stations. The annual fee might at first be made nominal—simply sufficient to cover ordinary working expenses, until such time as it would naturally extend and place itself upon a firmer basis. Let those who are willing to take a hand in the formation of such an organization and to become charter members, as it were, speak out, and that with no uncertain sound, and on our part we will do our utmost to give publicity to any correspondence or suggestions bearing upon the subject.

FOR a number of years the idea of providing the city of Toronto with water from Lake Simcoe has from time to time been brought before the public. At present the idea seems to be popular, and on the face of it, there seems much to commend it. The lake is a large one, and stands so high above the city that it is supposed the water would freely flow down and supply even the highest parts of the city with an ample supply at sufficient pressure for every purpose. No pumping would be required, and consequently there would be no expensive engines to buy, and to repair when they broke down, and no large coal bills to pay, in order to keep the pumps going. Such may be said to be the popular view of the gravitation scheme. The distance of Lake Simcoe from the city, about 40 miles, need not be considered as an insuperable difficulty. Water is now being brought to Manchester, Eng., by a conduit 96 miles long. Liverpool has one 67 miles long. Glasgow brings its water from Loch Katrine, a distance of 34 miles, and in that distance there are 70 tunnels, one of which is 600 feet below the surface of the ground. The supply to New York by the Croton Aqueduct is brought over 40 miles, and has a capacity of 115,000,000 gallons in 24 hours. With such examples there is apparently nothing unreasonable in suggesting that Toronto's water supply could be brought from Lake Simcoe. There are, however, other things to be taken into account. Lake Simcoe is the highest part of the fresh water supply filling the great lakes. It is higher than Lake Superior, consequently the supply to it is limited to the rain fall over a comparatively small section of country. Its natural outlet is to the north by means of river and lakes with a slow current, and the quality and quantity of water available for city supply are still unknown quantities. Between Toronto and Lake Simcoe the height of land passes, forming a high ridge running east and west. The ridge is so high that the water cannot run over it, and must be brought under it or through it. We do not know the exact figures, and until an exact survey is made possibly no one knows, but it has been stated that to get through the height of land involves a cutting over 11 miles long and from 200 to 300 feet deep, or making a tunnel. Then there are hollows to be crossed, which can be done by inverted syphons, but which increase the cost. The probabilities are that by the time a conduit has been built, it will be found that the interest on the outlay will amount to a much larger sum than the cost of pumping an equal amount of water from Lake Ontario. After all, probably the strongest reason why Toronto should not go to Lake Simcoe for a water supply is the fact that Lake Ontario is so near and contains an unlimited supply of water of the best quality, and which can be had for the pumping. If Glasgow, Liverpool, Manchester and New York could have obtained such water as we have in Lake Ontario on the same terms, the long conduits would never have been built.

WE publish elsewhere an epistle from the exponents of a storage battery who apparently take exception to our remarks on storage batteries in general. We should have been better satisfied if, instead of claiming superiority for their battery, they had shown or made an attempt to show in what respect it is superior to others in experimental use to-day. Wherein does the construction differ? Does the material used differ from others, and if so, what is the advantage of the difference? If the battery is covered by patent, there should be no hesitation in courting the fullest publicity on these points. The refusal of an offer of car, track, and motor to demonstrate its efficiency, is to say the least of it, curious. When it is well known, and has been so expressed by us that a successful storage battery is the El-Dorado of street railway men, that it is the crying need of the electrical world to-day, we should have thought that the proprietors of this bonanza would have jumped at the chance to show their goods without cost to themselves. This journal has no antagonism to any individual or industry. We aim to chronicle the progress of electrical science as it actually presents itself, and while of course we court the advertising patronage of our electrical friends, our highest aim is to make the ELECTRICAL NEWS of value to all engaged in electrical and engineering pursuits. To do this we intend to express our opinions of men and things without fear or favor, to chronicle events and discoveries as they actually present themselves, and to condemn the sharks who make use of a little smattering of electrical knowledge to make a raid upon the pocket books of the unwary in the name of science. By adopting a straightforward course and issuing a journal that can be depended upon, we shall increase our circulation to an extent that will make it necessary for any progressive concern to make use of its columns to reach the public. If we express opinions that to our readers may seem to be open to criticism, we shall be most happy to hear from them, and if we make a statement that appears not to be borne out by facts, and such is demonstrated to us, we will make full, public and complete recantation. We are proud to say, however, that during our publication of the ELECTRICAL, MECHANICAL AND MILLING NEWS from its inception till it gave place to the present paper, we have had no occasion for anything of the sort, but on the contrary, "coming events" have so plainly "cast their shadows before," that in every case changes and developments which are so rapidly taking place in this progressive science have been accurately and completely foreshadowed by us. We make no exception in this matter of the storage battery. We have expressed our opinions of it, knowing what we talk about. We have said that no imitations of those "not dead" perhaps, but simply "gone before," will ever solve the problem, and that success must be looked for on new lines. We are, however, more anxious that our increasing *clientele* should have the fullest information on what is doing and actual facts connected therewith, than we are for our own glorification, therefore we make this offer to the storage battery people in question: Produce fifty of your cells, place them in charge of an expert appointed by us and one by you for a thorough and exhaustive test, and the results shall be made public without fear or favor. You have the floor.

IT is announced that the Hon. John Costigan intends to introduce a measure during the next session of the Dominion Parliament, having for its object the appointment of a Government inspector of electric light. That is all right; there should be more inspectors. This country is not half enough governed. We need a few more officials to relieve the over-burdened producer of some of the superfluous shekels he has accummulated despite the harrassments and uncertainties of governmental interference. There is not enough risk in electrical investments at present even to make things interesting, so by all means let us have an electric light inspector; also let him have an assistant. Let there be a deputy assistant inspector and likewise a board of electric light inspection, with a chairman and secretary; also a vice-chairman and a few clerks, and charge up the expense in the usual way to the victims, and if this does not knock out what life there is left in electrical enterprises, let the suffering country be divided into districts, after the manner of inspectors in general, and duplicate these barnacles on the ships of state until the precious craft gets waterlogged. There is also a crying need for an inspector of tallow dips and tin lanterns, for was it not one of these "in combination," as a patent lawyer would say, with Mistress O'Grady's cow that burnt down Chicago. Perish the thought that such a sultry fate should overtake any body or any place in our young and glorious Dominion. Let us have inspectors appointed forthwith—inspectors of cows and deputy inspectors of tin lanterns. In plain words, this inspection business is overdone, even to the extent of trenching pretty severely on the liberty of the subject, and of becoming an hindrance to business and a means of driving it out of existence It is but too frequently an excuse for foisting upon the public purse a superannuated political hack so as to save him from arrest and imprisonment for having no visible means of support, and certainly results in increasing to the consumer the cost of the commodity "inspected." For instance, a notable specimen of municipal genius in Toronto is proposing to introduce a by-law to compel every load of coal sold in the city to be weighed on the public scales. He is gunning for popularity by imagining that he is after the scalps of the bloated monopolists of the coal ring, but his brilliant intellect must have flown off the handle this time. The cost of hauling to the scale and going back after delivery to weigh the empty cart say fifty cents per load—must of necessity come out of the pockets of the purchaser, with the ultimate result of a tax on the community to pay for more civic pensioners to engineer a further supply of city scales. In the case of the electric light we do not see how it is possible for any standard to be maintained. In every town in the province of any size, there is an electric light plant, frequently two. The current standard of each is different, and unless the machinery is thrown away and new substituted, must remain so. The owner offers to a store keeper or a business man his electric light and asks for it a price commensurate to its size or the hours used—so much per night or per month as the case may be. Nobody is compelled to take it, and if it does not suit they are not long in throwing it out. There are inspectors of gas simply because there are different *qualities* of gas, some bad, some worse, and some villianous, but the Government says nothing about the *quantity*; that is left as a *casus belli* between the consumer and the gas company. There is only one *quality* of electricity, that has yet been brought to our notice, and it is an invariable and unchanging unit, why, therefore, is it necessary to appoint an inspector to determine the quantity? That should be left as a matter of bargain and sale between the producer and consumer. If the intention of the Government is to establish a standard in candle power of certain currents and voltages by which arc lamps may be technically known to the trade, well and good, but the light under similar conditions of current and electromotive force may vary so much from the carbons employed, the state of the atmosphere and unavoidable momentary alterations of conditions in the central station apparatus and the delicate mechanism of the lamp, that an absolute and unvarying standard would become an impossibility. To meet the temporary disability caused by a slipping belt, an over-heated armature or a defective lamp, the customer usually makes a point of claiming a rebate for the shortage in quantity, and owing to the absence of ability to store electricity or keep a quantity in hand as it were for emergencies, this item of rebates is considerable with most stations, and is usually provided for in the contracts. All the inspection in the world will not prevent the broken belt, the temporary disarrangement in the mechanism of the steam engine or the crossing of some vagrant bell wire with the aerial circuit outside. If a Government official can produce an infallible panacea for these evils, electric light companies would hail his advent with pæans of thanksgiving, but being only mortal, and probably a poor specimen at that, his office would simply become an elegant sinecure at the expense of his more industrious and practical fellow-men.

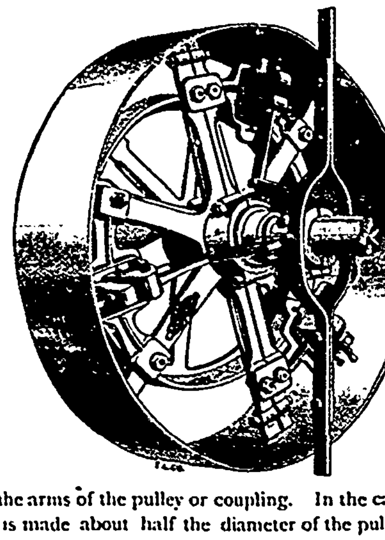
THE attention of engineers is directed to the particulars of a competition printed in another part of this paper. The publisher of the NEWS with the object of stimulating research on the part of engineers in charge of steam plants throughout Canada, offers prizes in cash for the solution of certain problems in steam engineering. It will be noticed that this competition has been limited to those actually engaged as operative engineers, and the questions are such as every competent engineer should be capable of answering. Should satisfactory interest be manifested in this competition, others designed to serve a like object will be announced from time to time in the future.

FRICTION CLUTCH PULLEYS.

FRICTION clutch pulleys are designed to supersede tight and loose pulleys, drop tightners, etc., and to avoid the unnecessary work and consequent wear imposed by them upon belts while the machinery is idle. They are extensively used in electric lighting and are very desirable when frequent or abrupt stoppage of machinery is necessary. They are being very expensively adopted in mills and factories of every description, and are especially suitable for high speed service and heavy work. The friction rim only is keyed to the shaft, the pulley and grip mechanism is free or loose thereon. Therefore, when not "in grip," the driving pulley remains motionless, while the shaft revolves freely in the babbitted pulley sleeve. Immediately upon being gripped the power is transmitted to the pulley through the grip and ring. When the grip is attached to the driven pulley (located on machine or counter shaft) the pulley revolves freely upon the shaft until the clutch engages with it and causes it to drive the shaft.

The accompanying cut shows a friction clutch pulley made by the Waterous Engine Works Company, of Brantford, Ont. It is claimed to be simple, compact and durable, engages and disengages gradually, thereby preventing any possible injury. The operation of this friction grip pulley and friction grip cut off coupling will be understood from the following description.

The grip ring or rim, instead of being cast to the arms of the pulley, as in ordinary clutch pulleys, is a pulley by itself, securely keyed or fastened with set screws to the shaft transmitting the power, or in the case of a driven pulley, to which the power is transmitted. The grip mechanism is



fastened to the arms of the pulley or coupling. In the case of a pulley, the friction rim is made about half the diameter of the pulley. In operating the pulley or coupling, this grip mechanism stands motionless when the pulley is not driving or when the connected shaft is cut off. To bring it into work, the sliding sleeve on the shaft "D" is forced with a lever toward the friction pulley rim, and readily passes beyond the diametrical centre or grip arms, which causes two, four or six sets of friction grips to grasp the rim with an irresistible, vise-like grip.

From the peculiar mechanism of the grips it will be readily seen that the pressure of the inside and outside jaws upon the friction rim is always exactly equal. When desired, the power may be applied by degrees and the pulley started gradually, or the sliding sleeve can be thrust in instantly by a quick movement of the shifter, when the pulley or coupling immediately starts at full speed. The friction grips are adjustable The end of lever is of cast steel, tempered, and engages a small block of cast steel, tempered, let into the under side of top grip arm. This steel block is adjustable, being hung from the inner end and adjusted by a set screw working from the upper side of grip arm. By this means, any strain desired can be put on the frictions to take up the wear of the friction shoes. The friction shoes are shod with thoroughly seasoned maple, set end on to their work, and will wear many years. The maple is easily renewable, and requires no oiling. When the sliding sleeve is withdrawn, the point of lever engaging the steel block in grip arm at once works into a recess formed in the steel block to receive it, and permits top grip arm to leave pulley, releasing immediately the grip from the friction rim. All parts subject to wear are renewable at a very slight expense, and without trouble or loss of time, it being unnecessary to remove the pulley from the shaft in order to renew or adjust any worn parts. There is absolutely no contact or frictional surfaces when not in grip. Owing to the short travel of the sliding sleeve, and the fact that it passes the diametrical centre of grip arms, the operation of gripping and releasing is so easy that it can be readily accomplished, and when once the sleeve is thrown into position there is no strain upon it what ever, nor can it possibly get out of grip without being forced by the lever. When desired, these friction grip pulleys and cut-off coupling can be promptly brought to a standstill, even when running at a high rate of speed. This in case of accident may prevent much damage or perhaps loss of life For furthers particulars address the manufacturers.

ENGINEERS' COMPETITION.

THE publisher of the ELECTRICAL NEWS invites engineers throughout Canada to compete for the solution of the following problems:

1 What is a horse power as applied to a boiler?

2 How much is gained if feed water can be had at 120° temperature instead of 40°?

3. With water at 40° fed into the boilers, and steam taken off at 90 lbs. pressure, how much coal should be required for each thousand gallons of water used?

4. What would be the safe working pressure for a horizontal tubular boiler, 64 in. diam., 14 feet long, with 90 tubes, 3 in. diam., shell made of 60,000 lbs. steel plates ⅜ in. thick, and double rivetted in longitudinal seams?

5. Give size of furnace for soft coal for such a boiler, and size of smoke pipe, and area and height of chimney for a range of six boilers of same dimension?

6. An engine has cylinder 18 in. diam. and 18 in. stroke, and makes 240 revolutions per minute. Steam is supplied at 90 lbs. pressure in boilers, 30 feet away. What size should steam pipe be?

7 With steam cut off in above engine at ⅝ in. of the stroke, and discharged into a heater open to the atmosphere, what horse power can be got?

8. If a condenser be added, maintaining a vacuum of 26 in. on the gauge at the condenser, what *additional* power could be got from engine?

9. What difference to the amount of fuel per horse power per hour should there be between above engine using a heater giving water at 190° and using a condensor, maintaining a vacuum of 26 in., and supplying feed water at 100°?

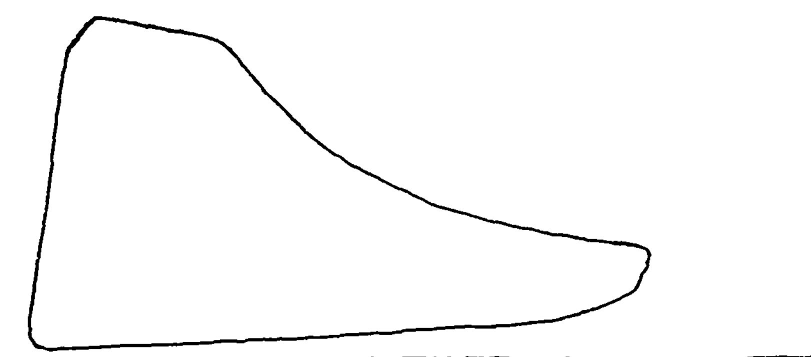
10. If engine speed varied while the pressure of steam and load were constant, what should be done to remedy the defect?

11. In a high speed automatic cut-off engine, what is the effect of the weight of the reciprocating parts on the steadiness of motion?

12. The duty of the governor is said to be to regulate the speed; upon what conditions does its power to regulate depend?

13. What are the advantages of "compression" in the steam cylinder?

14. Describe the defects in the annexed diagram, and state what should be done to remedy them.



Cash prizes of $15 and $10 respectively will be paid to the competitors whose answers to the above questions shall be found by the judges to be deserving of the highest number of marks, and who shall have complied with the under-mentioned conditions.

CONDITIONS OF COMPETITION.

1st. Competition is open only to subscribers to this journal actually engaged in the charge of steam boilers or engines within the Dominion of Canada.

2nd. Answers must be received at the office of the ELECTRICAL NEWS, not later than April 15th, marked "Engineers' Competition."

3rd. The answers will be judged and marked by points, in accordance with the merits of each.

4. Allowance will be made for neatness of writing, etc., as well as for correctness of answers.

5th. As a guarantee that answers are from the men intended, each competitor must send with his paper the name and address of his employer.

Messrs. Geo. C. Robb, Chief Engineer of the Boiler Inspection and Insurance Co., Toronto, and Mr. A. M. Wickens, ex-President Toronto Branch No. 1, Canadian Association of Stationary Engineers, have kindly consented to act as judges in this competition, and their decision will be final.

PUBLICATIONS.

The first number of a new trade paper entitled *The Canadian Dry Goods Review*, published monthly at Toronto by the Dry Goods Review Co., is received. It is very creditable to the publishers. We wish the new comer a long and prosperous career.

We have received the initial number of the *Canadian Miller*, published monthly by Mr. A. G. Mortimer, Canada Life Buildings, Toronto, price $1 per year. *The Miller* consists of 22 pages of matter well calculated to interest and instruct those engaged in the milling, grain and flour trades.

The February *Arena* in addition to a brilliant array of American authors, presents two papers of great interest by foreign essayists. Camille Flammarion, probably the most eminent European astronomer, writes at length on "New Discoveries on Mars." His paper is accompanied with a full-page geographical map of this wonderful star, as prepared by Flammarion and other leading astronomers. It also contains two small maps illustrating strange changes that have recently taken place on one portion of Mars. The distinguished Frenchman's paper in the short compass of sixteen pages gives the busy reader the important astronomical discoveries of recent years in a nutshell.

RECENT CANADIAN PATENTS.

No. 35554 A Davis, Elevated electric cable
No. 35561. J. E. Wilson, Steam boiler
No. 35572. C. J. Van De Poele, Electric conductors.
No. 35575. S. Thring, Water gauge.
No. 35584. C. J. Van De Poele, Reciprocating elec. eng.
No. 35585. " " " " "
No. 35586. " " Railway train system.
No. 35587 " " Conduit for electric conductors.
No. 35594. W Kinsley Belt fastener.
No. 35599. N H Edgerton, Steam engine
No. 35618. C. D. Howard, Draft regulator.
No. 35630-19. G. A. Sanders, Electric gas lighters.
No. 35640. H. Gilmore, Tube cleaner.
No. 35647. J. G. Gamgee, Steam boiler.
No. 35672. G. W. Dryden, Pulley.

NOTES.

Messrs. Connell Bros., of Woodstock, N. B., are about to engage in the manufacture of steam engines.

It is proposed to incorporate as a limited liability concern, with a capital stock of $700,000, the well known manufacturing firm of Goldie & McCulloch, of Galt, Ont.

On the 28th inst. the Manager of the Edison Company at Toronto received the following telegram from Winnipeg "First Edison Canadian electric car has started. We send congratulations. A grand success." The despatch was signed by Mr. A. W. Austen, Manager Winnipeg Street Railway Co.

Letters of incorporation have been granted the John Doty Engine Co., of Toronto, (Ltd.), with a capital stock of $250,000. The members of the Company are: John Doty Franklin Henry Doty, Frederick William Doty, Daniel Hunter and John Franklin Walshe, all of Toronto.

The engines of the Steamers Spartan and Corcian, of the Richlieu & Ontario Navigation Line, are to be compounded and new boilers are to take the place of those heretofore in use.

A cement for leaky boilers (steam or hot water) consists of two parts of powdered litharge, two parts of fine sand, and one part of slaked lime. Mix with boiled linseed oil and apply quickly.

A cheap and efficient lagging for steam pipes can be made out of some of the waste products of paper manufacture. The waste products in question are chiefly those coming from the different cleaning and sorting machines which are of a fibrous nature. When dry they are mixed with potter's earth in the proportion of four to one, enough water being added to make a plastic compound. This is spread by hand over the surface to be protected in thin successive layers. When dry the coating is said to adhere firmly, and it has additional recommendation of entailing no greater cost than that of mixing and applying it.

A deputation representing the Coal Importing Association and the Board of Trade, Montreal, waited on the Minister of Marine and Fisheries a few days ago and asked for the abolition of the existing system of boiler inspection on vessels carrying coal from Nova Scotia to Montreal, on the ground that the delay of 48 hours necessary for inspection causes great loss, and that British competition is thereby shut out, as the English vessels hold that Lloyd's inspection should be sufficient and refuse to submit to the Canadian regulations.

CHIGNECTO MARINE TRANSPORT RAILWAY.

THE Canadian Locomotive and Engine Co., of Kingston, Ont., have kindly furnished us with the following particulars regarding the tank locomotive with eight coupled wheels, no truck, at present in course of construction at their works for the above railway:

Two of these locomotives abreast are to haul vessel on cradle 17 miles on a level and straight track at a speed of (10) ten miles an hour Weight of cradle and vessel 2,500 tons (of 2,240 lbs). Cradle carried on 120 four wheels trucks. Steel rails, 110 lbs. per yard; cylinders, 22" diam., 26" stroke; driving wheels, 47" diam., outside tyre; boiler working pressure, 175 lbs. per sq. inch; boiler, straight top, 59" diam.; tubes, 2" diam. Heating surface, 256 tubes, 1,741 sq. ft., firebox, 137 sq. ft.; total, 1,878 sq. ft. Grate area, 29 sq. ft. Total weight (all on drivers), 180,000 lbs., in working order. Capacity of tanks, 3,000 imp. gals.=3,636 U. S. gals.

A TOKEN OF APPRECIATION.

TORONTO, Jan. 19th, 1891.

Editor ELECTRICAL NEWS.

DEAR SIR,—I have pleasure in advising you that at the last regular meeting of Toronto Branch No. 1 of the Canadian Association of Stationary Engineers, the following resolution was unanimously adopted :

"That the members of this Association do hereby tender you a hearty vote of thanks for your kind liberality in advertising our Association in the late ELECTRICAL, MECHANICAL AND MILLING NEWS and also in the ELECTRICAL NEWS AND STEAM ENGINEERING JOURNAL. The Association recommends the journal to all engineers and mechanics, believing it to be a good medium through which to obtain information."

Wishing you every success, I am, dear sir,

Yours truly,

W. G. BLACKGROVE,

Secretary.

STEAM BOILER TESTS AS A MEANS OF DETERMINING THE CALORIFIC VALUE OF FUELS.*

BY D. W. ROBB, AMHERST, N. S.

IT will be recognized by those who use large quantities of fuel, especially of bituminous coals, that they differ very greatly in value, even coals which are taken from adjoining areas give very different results, so that it is sometimes very puzzling to the consumer and difficult to decide upon the merits and proportionate values of the fuel within his reach. It is likewise difficult to determine when the greater practicable amount of work is being obtained from the fuel, and consumers are frequently subjected to great loss from the want of this knowledge. There are three recognized methods of determining the calorific value of fuels, viz.: by chemical analysis, by the use of calorimeter, and by actual measurement of the water evaporated by a definite amount of fuel in a steam generator. By the first method, it is possible to ascertain the constituents of the fuel in their various proportions, and to determine the theroetical heat value when combined with a definite proportion of pure oxygen, and approximately to compute the amount of heat which would be converted into work when combined with ordinary air, and consumed under usual conditions. But this becomes a complicated problem, as will be seen when it is considered that the heat absorbed and wasted in heating the non-combustible constituents of both the air and the fuel must be taken into account, and that these wastes vary with the amount of superfluous air admitted through the grate, and with the proportion of non-combustible matter in the fuel; therefore, any estimate of the practical value of a fuel deduced from chemical analysis can only be approximate. In testing fuels by a calorimeter, a sample of the fuel mixed with chlorate of potassium is placed in an open mouthed copper vessel, which is submerged open mouth downward, like a diving bell, in a vessel containing a measured quantity of water. Combustion of the fuel takes place and the heat produced is absorbed by the water, the the total quantity of heat being determined by the rise in temperature of the water. This method has some advantages over an analysis and, if care is exercised in the selection of samples to be tested—or a large number of samples tested—is perhaps the best means of establishing a theoretical standard calorific value of a fuel, but the quantity tested is necessarily small and may not fairly represent the fuel ; it also leaves out the heat absorbed by the non-combustible portions of the air and fuel, which is an important factor in the combustion of fuel, under ordinary conditions. The method by which the fuel is consumed under actual conditions and in large quantities in evaporating water in a steam boiler, is generally regarded as a test of the efficiency of the generator, rather than as a test of the value of the fuel, but somewhat extended observation of the performance of various steam generators using similar grades of coal has convinced the writer that the steam boiler test, when properly conducted, is quite as valuable as a means of determining the calorific value of fuel, and of comparing various fuels as for finding the efficiency of the generator ; in fact, the latter is the more uncertain of the two, because, unless a boiler is tested with a fuel of a known calorific value, it is impossible to arrive at its actual efficiency or to compare it fairly with any other form of generator. In testing the heat value of fuel in an ordinary steam boiler two elements of uncertainty are introduced, viz., loss through imperfect combustion of the fuel, and the escape of gases at a higher temperature than the atmosphere, but as these losses, as well as the heat absorbed by the non-combustible portions, the air and fuel, are unavoidable in the present state of science, they should be taken into account in making a practical test of fuel, and strict accuracy only requires that the loss be uniform and minimum in result. Practical experience teaches that almost perfect combustion may be attained in any of the common forms of steam generator by careful and regular stoking with a proper air supply ; and, that the skill necessary to produce this result is possessed by many ordinary stokers, who have no knowledge of the laws which govern the combustion of fuels, will doubtless be admitted by many persons who have observed locomotive firemen or others, who are compelled to get a high rate of steam production. It is of course impossible to transfer all the heat produced in combustion to the water in a generator, because the gases cannot be reduced below the temperature of the water or steam within the generator, and a certain temperature above the atmosphere is necessary to produce draught in the chimney, but it is quite possible to so proportion the grate surface to the heating surface of the boiler that the gases will be reduced to a certain minimum temperature, and maintained at that temperature during a test. The temperature may be indicated by a pyrometer or high registering thermometer at the base of the chimney, and the rate of flow of the gases may be ascertained by the use of a draught gauge.

Frequently an attempt is made to analyse waste gases, this gives an uncertain result on account of the difficulty of getting representative samples of the gases, but from observation and examination of many tests the writer believes it unimportant, if the stoking and air regulation receive proper attention. The surface of the grate should be so proportioned to the heating, or heat absorbing surface of the generator that the gases will, when they reach the uptake, be reduced to say 400° Fahr.; the skillful firing and air regulation will produce practically perfect combustion and uniform temperature. It is not of so much consequence either, as some people imagine, what kind of generator is used. The brick furnace is supposed to possess an advantage in maintaining the temperature necessary to perfect combustion, while contact with the cooler surface of a water lined furnace is supposed to prevent ignition of the volatile hydro-carbons coming from some fuels, producing carbonic oxide; but the writer is convinced that, by a proper regulation of the fire, so that the air will pass through and the gases will pass over a bed of hot coals, or incandescent carbon, with frequent and even distribution of the fuel, as perfect combustion may be, and is obtained in a water lined furnace as in a brick one. The water lined furnace avoids the radiation of heat and admission of air, both of which are an uncertain but certainly wasteful feature of the brick furnace.

Steam boiler tests, although attended with some difficulty, are quite within the reach of ordinary consumers, and deserve to be better understood and used more than they are. In addition to their value as a method of determining the heating properties of fuel, they furnish the best possible means of ascertaining the condition and efficiency of the generator, and of checking, and if necessary correcting waste on the part of the stoker. It is desirable that such tests should be made frequently, because steam boilers are very liable to deteriorate and become wasteful, especially when set in brick, through the cracking of the brick walls, as well as by the coating of heating surface with scale or other deposits on the inner, and soot or ashes on the outer surfaces. It is quite practicable for steam users to have tests made by their engineers and ordinary assistants, but it is preferable to have an occasional test made by a professional engineer who has had experience in making such tests, as he will have gained special knowledge which will enable him to detect and locate imperfections in the generator more readily than those unaccustomed to such work. The writer would suggest to steam users the following practice : That one or more tests be made by an expert to determine the efficiency of the generator, and that he may direct any necessary repairs or corrections in the generator. After this has been done, and a standard of efficiency established, a good water meter should be inserted in the water supply pipe, so that a record of the water used may be continuously kept, and the stoker or engineer should keep a log and make daily reports of the coal consumed and the water

*A paper read on Dec. 8th, 1890, before the Nova Scotia Institute of Science, Halifax, N.S.

evaporated. The meter readings will need correction, if absolute accuracy is desired, but for practical purposes this may not be necessary. It may seem like unnecessary labor and expense to weigh all the coal used, but a short trial will undoubtedly prove its value, as it will not only indicate, constantly, the condition of the generator, but to a certain extent, be a check upon the working of the engine and the amount of power used by the establishment, and it will furnish a constant incentive to the engineer, stoker, and those in charge of the steam machinery, to improve its working and reduce the amount of fuel consumption to its lowest limits. A general practice of this kind throughout the country would induce a rivalry in the saving of fuel, parallel to that found in marine practice, where it is claimed a horse power is produced by from one and a half to two pounds of fuel per hour, instead of four to ten pounds—the last named quantity being not uncommon in ordinary steam plant, and would in the course of a few years cause an enormous saving to the country, as well as to individual consumers. Rules governing the standard system of boiler trade, adopted by the American Society of Mechanical Engineers may be found in the transactions of that Society, vol. vi, 1884. The following simple instructions will enable any steam user to conduct a test of his boilers for the purpose of comparing the values of fuels, etc., after the efficiency of the generator has been established by a complete test by an expert, (observations of the quality of steam, strength of chimney draught and analysis of gases are omitted, as they require special instruments and skilled manipulation).

INSTRUCTIONS FOR CONSUMERS' TEST.

A test to be of any value should be continued for not less than ten hours, and will require the constant attention of not less than four persons besides the regular attendants, appointed as follows: One or two men to weigh the coal, and one or two to attend to and weigh the water; one clerk to keep the log of the coal and water weighed, and one clerk to record the pressure of steam, temperature of feed water, temperature of chimney gases, and to keep a gross account of the coal and water as a check to the regular log. These should be careful men, well posted as to their duties. Three good platform scales will be required, and two tanks, or clean tight casks, to weigh water in. Preparation should be made so that the water can all be delivered into the two tanks, which are placed upon two platform scales, and the water pumped alternately from the tanks to the boiler. A piece of hose attached to the suction pipe of the pump or injector will be convenient to transfer from one tank to the other. It will be advisable to procure from reliable instrument makers one or two accurate thermometers for the purpose of taking the temperature of the feed water and chimney gases. The temperature of the feed water should be taken by inserting a brass or copper cup in the feed pipe near its connection with the boiler. This cup may be filled with oil and the thermometer set in the oil. The temperature of the cold water before it enters the injector or feed water heater should also be taken. Great care should be exercised that all scales, steam gauges, etc., are correct, and that there are no leaks about the pumps, pipes or boiler, by which any water may escape without being evaporated. Steam leaks are not material except as misrepresenting the consumption of the engine. The temperature of escaping gases may be taken by inserting a brass or copper pipe, with closed end in the smoke connection where it leaves the boiler. This cup, which should reach the centre of the escaping gases, may be filled with oil and a high registering thermometer placed in it. Previous to the hour for starting, say 6.30 o'clock, steam should be up to the working pressure and the tubes and all surfaces and flues should be swept clean. The ash pit should be cleaned and the first charge of kindling and coal, or the fuel to be used, should be weighed, every man should be at his post, those who are to note the various readings provided with ruled forms for recording the gross, tare and net weights of fuel and water, and others for the pressure of steam, temperatures of feed-water and escaping gases, which should be noted every quarter hour. At the hour for starting the height of the water in the boiler should be marked on the gauge glass, so that it may be brought to the same place at the close of the test, and the fire should be drawn quickly and replaced with the weighed kindlings and fuel, (wood kindlings are generally taken at 4-10 the value of coal by weight). The working of the boiler may be conducted as usual in every way, the stoking should be done carefully, so that no waste may occur through dead spots or holes in the fire, or uneven distribution of fuel. If the fire is too thick, some of the gas will pass off unconsumed for want of sufficient air, and if the fire be too thin, too much air will be admitted. The draught or air supply should be regulated by the ash pit doors or registers, and an even fire and steady pressure of steam maintained throughout the test. If work is to be suspended at mid day, or any time during the test, the drafts may be closed, the fire banked, and an attendent left in charge who will regulate the fire if necessary, so as to keep the pressure constant. At the close of the test the water should be brought to the same level in the boiler as at the beginning and the fire withdrawn and deadened quickly with water. The remaining coal should be weighed and deducted from the quantity charged to the boiler, and the ashes may also be weighed. The net weights of coal and water may then be summed up and the result of the test ascertained and recorded in the following manner:—

Test of boiler at
day of 18
Kind of boiler
Dimensions
No. tubes
Size of fire-box
Grate surface sq. ft.
Heating surface do
Height of chimney
Size of chimney
Duration of test hours
Kind of fuel
Boiler pressure (by guage) lbs.
Temperature of feed-water entering boiler degrees Fahr.
Temperature of feed-water entering pump or injector degrees Fahr.
Temperature of escaping gases degrees Fahr.
Total fuel consumed lbs.
Percentage of moisture in fuel per cent.
Equivalent dry fuel lbs.
Total weight of ash lbs.
Equivalent combustible lbs.
Total water evaporated lbs.
Water evaporated per hour lbs.
Water evaporated per pound of dry fuel lbs.
Water evaporated per pound of dry fuel from and at 212° lbs.
Water evaporated per pound of combustible from and at 212° lbs.
Horse power developed.

The above particulars are determined in the following manner. The pressure of steam and temperature of feed-water and gases are taken from the average readings of the same.

The total quantities of fuel, ash and water are taken from the net summing of log, great care being taken that no error is made. The percentage of moisture in fuel is determined by drying a sample of the fuel for 24 hours and getting the difference between the wet and dry weights, which difference is multiplied by 100 and divided by the weight of sample before drying.

The equivalent dry fuel is found by multiplying the total quantity of fuel by the percentage of moisture and dividing by 100, which is deducted from the total quantity of fuel.

The equivalent combustible is found by deducting the total amount of ash from the total quantity of fuel.

The water evaporated per hour is the total quantity of water divided by the number of hours duration of test.

The water evaporated per pound of dry fuel is the total quantity of water divided by the total quantity of dry fuel.

The water evaporated per pound of fuel from and at 212° is found by multiplying the water evaporated per pound by the total heat, or heat units, on one pound of steam at the average pressure, less the total heat of one pound of feed water at the average temperature of feed water before entering the pump or injector, and dividing the product by 966, which is the total heat in units, of one pound of steam at 212°.

The horse power is determined by deducting the total heat units of one pound of feed water at the average temperature before entering pump or injector, from the total heat units of one pound of steam at the average pressure, and multiplying the product by the quantity of water evaporated per hour and dividing by 110.343 (which are the heat units required to raise one pound of water from 100° and evaporate it at 70 lbs. pressure), the quotient should be divided by 30, which will give the horse power according to the American standard. The following is an example of this method of finding the horse power:

Total quantity of water evaporated = 2,000 lbs.
Steam pressure (by gauge) 60 lbs.
Temperature of feed water before entering pump, 40°
Total heat of 1 lb. of steam at 60 lbs. pressure = 1175,710 B.T.U.
Total heat of 1 lb. of feed water at 40° = 8 B.T.U.
1174.710—8 × 2,000 ÷ 1110.343 = 210.33 ÷ 30 = 70 H. P.

Example of finding the equivalent evaporation from and at 212°.
Water evaporated per lb. of fuel, 10 lbs.
Average pressure by gauge 60 lbs.
" temperature of feed water, 40°
Total heat of one lb. of steam at 60 lbs. pressure, 1175.710 heat units.
Total heat of one lb. of feed water at 40°, 8. heat units.
Example. 10. × 1175.710—8. ÷ 966 = 12.08 lbs.

In comparing fuels as well as in comparing the efficiency of boilers, the quantity of water evaporated per pound of fuel from and at 212° should always be used. The actual quantity of water evaporated per pound of fuel will differ with variations of temperature of the feed water entering the boiler, and also with the steam pressure or temperature at which the steam leaves the boiler, but the quantity evaporated per pound of fuel from and at 212 allows for these variations and gives a true comparison of the value of fuel if the efficiency of the generator is constant, or of the efficiency of the generator if the calorific value of the fuel is known. The temperature of saturated or dry steam always corresponds with the pressure, but if from any cause the steam be not dry, it will carry away less heat in proportion to weight, or, if the steam be superheated by contact of the products of combustion with the steam surface of the boiler, it will carry away more heat. In either case the result of the test will be vitiated unless the quality of the steam be ascertained and accounted for. This is usually done by means of a calorimeter, one of the best of which, known as the "Barrus Calorimeter," was designed by Mr. Geo. H. Barrus, of Boston. No attempt has been made to ascertain or account for the quality of steam in the simple test given, because it would complicate the work; it is intended that a professional test of the boiler should include this important item, and, if the boiler is found to be abnormal in this respect, the expert should either give directions for the removal of the cause, or provide a formula for the correction of the error due to wet or superheated steam in future tests.

The following table will be found useful in ascertaining the equivalent rates of evaporation, horse power, etc.:—

STEAM TABLE.

Pressure of steam by gauge	Temperature	Total heat of evaporation above 30° in heat units
40	286.9	1169.460
45	292.5	1171.176
50	297.8	1172.779
55	302.7	1174.286
60	307.4	1175.710
65	311.8	1177.060
70	316.	1178.343
75	320.	1179.569
80	323.9	1180.741
85	327.6	1181.866
90	331.1	1182.945
95	334.5	1183.986
100	337.8	1184.992
105	341.	1185.961
110	344.1	1186.899
115	347.1	1187.809
120	350.	1188.695
125	352.8	1189.555

FEED WATER.

Temperature of feed water	Total heat above 32° in heat units
32	0
40	8.06
50	18.1
60	28.1
70	38.1
80	48.1
90	58
100	68
110	78
120	88.1
130	98.1
140	108.2
150	118.3
160	128.4
170	138.5
180	148.5
190	158.6
200	168.7

MERITS OF THE STORAGE BATTERY.

TORONTO, Jan. 23, 1891.

Editor ELECTRICAL NEWS.

MY attention having been called to an article in your January number, and believing that the writer would readily avail himself of the opportunity of being set right in reference to the all important and interesting question of the possible use of the storage battery system, for solving the question of rapid and comfortable transit, and eliminating all ideas of intentional misconception and allowing the error of judgment manifested in the article to be excusable, I nevertheless desire to set the matter before your already numerous readers in its proper aspect.

I notice the article in question refers to the storage battery as "a forlorn hope," and yet hopes against hope that the problem will be solved by an economically successful storage battery. Why, only on Thursday last in the Toronto Courts of Arbitration, Mr. Rice, the eminent City Engineer of Cleveland, on the witness stand said, in answer to counsel, that the storage battery question had been solved for street car work, and further answered in reply to questions put to him as to where the question of the commercial value of the accumulator had been solved: "Right here in your own city you have the best storage battery system on this continent, and the best for street cars or any other work I have ever seen." In reply to further questions, he said he referred to the Roberts storage battery system, of Toronto. Truly a prophet is never without honor save in his own country.

I have four distinct engagements in four different cities of the States to put my system in operation. With scarcely any effort, but simply on representations of experts, a company was formed in the States a few days ago, with a capital of $1,500,000.

Prof. Pike, a name known and relied upon all over the Dominion, after examining every known system on the continent, returned and gave an order for the School of Practical Science.

Statements regarding new storage batteries are practically worthless. In a masterly article in the *Electrical World*, the statement was made that the man who could point to a positive plate that had stood six months rough and careless work had solved the problem. Last week we forwarded to C. O. Mailloux, of New York, a positive plate that had been in constant service and subjected to continual travel for very nearly two years. Mr. Mailloux in reply expressed an opinion that established a record, and one we had need to be proud of. We are now engaged upon a plant for car work and forming a company for that distinct purpose; that is, of utilizing the battery for car purposes.

Now, in what are the distinctive features necessary to insure a perfect battery for car work? Why exactly the features required in every purpose to which a storage battery is applied: 1st, Freedom from buckling; 2nd, Disintregation of the paste; 3rd, Capability of standing heavy charging and discharging. These are or have been the common difficulties to be met with in the solution of this problem. We have overcome every one of them. We have not been deterred by the "forlorn hope" ideas of anybody—no true plodder in the pathway of scientific research was ever deterred by that idea. In proof of that we give a three years guarantee.

What we have done can or may be improved upon by others, but this much is certain, that before many weeks pass a storage battery system will be in operation in or near enough to this city that will for ever settle the problem. We have quietly replaced and are replacing all the leading makes, and such is our confidence in our system that we have applied for patents in every country in the world where it is possible to obtain them.

The question has been solved in England. The Central Tramway Company, of Birmingham, are putting an extensive system into operation there; the North Metropolitan Company are also using storage batteries. They will have to be used in all crowded cities, and certainly no where, in my opinion, would the practical solution of the question be hailed more gladly than in Toronto and Montreal. Hamilton made an offer of track, car and motor for a test on their line, which offer we respectfully refused, as we did not care to be trammelled by an agreement that rendered necessary the possible subversion of our ideas.

We have the battery, experienced engineers, and the advent of our company will at once dispel "forlorn hopes," by the recognition of the end, and object of the work of years.

A few days ago, at the invitation of the T. H. overhead system, Ald. Saunders, the mayor and a number of city gentlemen enjoyed the hospitality of the President, and after expressing their approval of everything, yet said that the storage battery would be the only permissible electric system allowed in the city.

Yours truly,

WM. ROBERTS.

THE ELECTRICAL NEWS is in receipt of an invitation to be present at the first annual dinner of the Montreal Branch, Canadian Association of Stationary Engineers. The event will be celebrated at the Richilieu Hotel, Montreal, on the evening of Feb. 14th. The NEWS hopes to be represented, and to be able to present in its next issue a picture of the good time enjoyed.

The Owen Sound Electric Illuminating and Manufacturing Co. (limited), write: "We received your pioneer copy of Canadian ELECTRICAL NEWS, and are glad to welcome it as a purely Canadian publication. We trust it will receive the support it so justly merits. We enclose P. O. order in your favor for $1.50 as our subscription for 1891."

SPARKS.

Four large dynamos are to be added to the Ottawa electric station.

The citizens of Lucknow, Ont., are about to enjoy electric street lighting.

An electric street lighting plant has lately been installed in the village of Iroquois, Ont.

The electric street lighting plant which was lately installed at New Westminster, B. C., has undergone a satisfactory test.

The capital stock of the Toronto Electric Light Co. has recently been increased from $200,000 to $300,000.

The Toronto Incandescent Electric Light Co. are placing in their station on Teraulay street, 2 new engines with a capacity of about 200 horse power.

The lady operators of the Nova Scotia Telephone Co. recently manifested their desire for the comfort of their general manager, Mr. Harris, by presenting him with an easy chair.

The people of Rat Portage complain that the telephone service has been ruined or destroyed by the placing of the electric light wires on the same poles with the telephone wires.

Mr. Cogswell, Superintendent of the Halifax Illuminating and Motor Co., was recently presented by the workmen with a smoker's outfit, accompanied by an address expressive of their esteem for him.

The new C.P.R. opera house at Vancouver, B. B. is to be lighted by 300 sixteen candle power incandescent lights, with a magnificent pendant of 50 lights in the centre. The Royal Electric Co. of Montreal are doing the work.

The Telephone Fire Alarm Co. of Halifax, N. S., will shortly apply for incorporation. The capital stock will be $50,000. The names of the promoters are. C. J. Spike, Dr. Hopkins, G. E. Falkner, H. V. McLeod and B. F. Pearson.

An Act of Parliament is being petitioned for to incorporate the Montreal Water and Power Co. to construct and operate systems of water-works, and works for the production of heat and distribution of electric light, heat and power throughout Canada.

The Ontario Telephone Co., who recently commenced business at Peterboro, Ont., appear to be meeting with fair success. They report having now connections with 243 subscribers, with more remaining to be connected. They have put up 420 poles and strung 11 miles of No. 12 galvanized iron wire and 5,600 feet of aerial cable.

Incorporation has recently been granted the Niagara Falls Electric Light and Power Co. (Ltd.), with a capital stock of $20,000. The promoters are: Jas. Bampfield, hotel keeper, Wm. Doran, manufacturer, Hiram Bender, Revenue Officer, Frank LeBlond and Richard Carter, steamboat owners, Thos. Quillian, accountant, and Andrew Greg ry Hill, barrister, all of Niagara Falls, Ont.

A charge has been laid against Mr. Crawford, City Electrician, London, Ont., by Mr. A. Alexander of Toronto, that when the city required certain electric supplies in the year 1885, Crawford received a commission from the rival firm and used undue influence to secure for the said firm the contract. Mr. Crawford submits proofs of his innocence, and the whole matter is under consideration by the City Council.

SPARKS.

The town of Coaticook, Que., will shortly be lighted by electricity.

Mr. J. E. Saucier is fitting up an electric lighting system at Kamloops, B. C.

The Royal Electric Light Co. has just placed new engines in their station at London, Ont.

An international electrical exhibition is to take place in Frankfort-on-Main during the summer of 1891.

The city of New Westminster, B. C., expended last year on electric light works and apparatus the sum of $32,000.

The town of Milton, Ont., has arranged with the Ball Electric Light Co. for the purchase of an electric plant for street lighting.

A franchise for electric lighting has been granted a company at Prince Albert, N. W. T. The plant is being got ready for operation.

The contract for furnishing 13,000 ties for the proposed Ottawa electric street railway has been awarded to the Rathbun Co., of Deseronto.

A heavy storm of sleet caused a considerable amount of damage to the telephone, telegraph, and electric light wires in St. John, N. B., and vicinity on Jan. 18th.

A 400 horse power compound condensing engine has been constructed by the Albion Iron Works Co., of Victoria, B. C., for the Electric Tramway Co. of that city.

The Edison General Electric Co. is offering for sale its manufacturing premises at Sherbrooke, Que., in view of the intention to remove to the new works at Peterboro' in the spring.

The first electric passenger elevator to be manufactured and operated in Canada is being placed in the Sun Life Assurance Bldg. at Montreal by Messrs. Miller Bros. & Toms, of that city.

The Victoria Electric and Illuminating Co., of Victoria, B. C., has been re-organized with increased capital. A new board of directors has been appointed, with Mr. M. Hutcheson as superintendent.

Experiments are said to have proved that where electric lights have been used in place of oil lamps for lighting the compasses of vessels at night, an incandescent lamp brought close to the compass caused a deflection of the needle.

It is understood to be the intention of Messrs. Patterson & Corbin, manufacturers of electric street cars at St. Catharines, to remove their works from that place, and the city of Hamilton is spoken of as likely to be their new location.

Electricity, the temperature of feed water and the strength of boilers were subjects upon which interesting discussions took place at the last regular meeting of Toronto branch No. 1 of the Canadian Association of Stationary Engineers.

On the 18th January a fire broke out in Messrs. Weir & Weir's flax mill at St. Mary's, Ont., in which is located the electric machinery for lighting the town. Considerable damage was done, but fortunately the lighting plant was saved almost without injury.

An employee of an electric light company was injured while in the performance of his duty. He was engaged in trimming lamps upon a circuit which, under the rules of the company, should have been dead at the time he was working upon it. As a matter of fact it had come in contact, at a point where the insulation was weak, with a live circuit, and had become charged. It would unquestionably have been negligent for a company to turn a current of electricity into the circuit on which he was at work without notifying him of the fact, and it was equally negligent to permit the circuit to become charged by failing to exercise proper precautions as to the crossing of wires and the insulation; and whether the company or its officers actually knew of such defect or not, the company is bound by the effect of its own neglect, and is liable in damages to a workman so injured. This decision was rendered in the case of Kraats vs. Brush Electric Light Co., in the Supreme Court of Michigan.

Please mention the ELECTRICAL NEWS when corresponding with advertisers.

• The reason why platinum answers better than any other metal for the leading-in wires of the incandescent lamp is because of its rate of expansion and contraction by heat, which is about the same as glass. Thus the vacuum in the lamp is maintained as it could be by no other metal now known.

Determined attempts are being made in Chicago to suppress the blinding smoke that is blown ashore from passing steam-craft. An experiment was made recently to demonstrate the practicability of a new invention. A small tube with a perforated top like that of a sprinkling can, was introduced into the smoke stack, and through this steam could be injected upon the uprushing smoke, which immediately condensed. The little tube with its jets and sprays of steam, is not a steam consumer, but there seems to be little doubt of its utility in the prevention of smoke.