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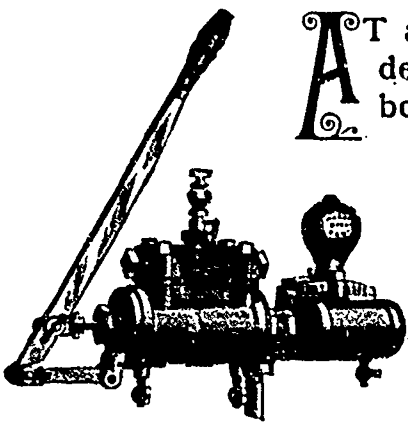

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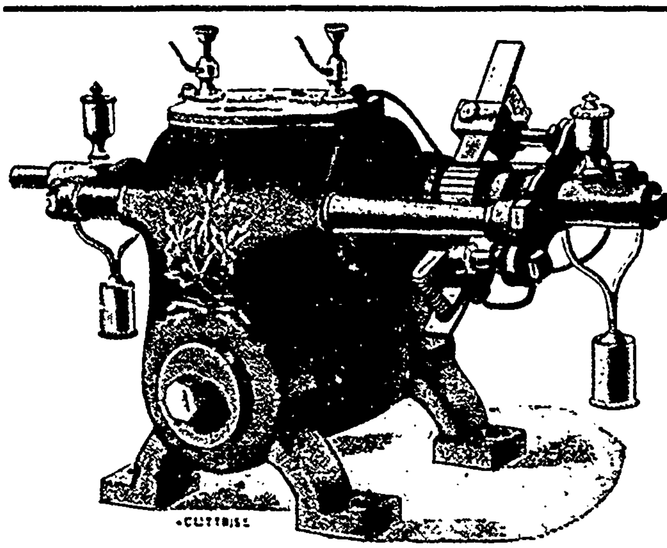

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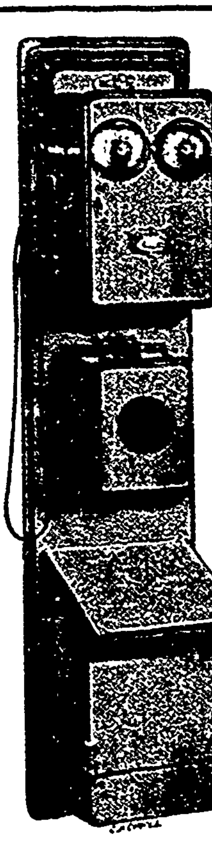

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STEAM ENGINEERING JOURNAL.

VOL. I. TORONTO AND MONTREAL, CANADA, JUNE, 1891. NO. 6.

S. R. EARLE'S AIR AND STEAM INJECTORS.

THIS device, invented by Mr. S. R. Earle, of Belleville, Ont., is for the better combustion of fuel in furnaces connected with steam boilers, enabling any one to use a cheap grade of fuel such as waste coal, hard and soft coal screenings, tan bark, saw dust, &c. It takes the place of fans for creating a forced draught, using, it is claimed, a much smaller amount of steam, and is very desirable in any place where the draught is poor. It will also be found advantageous where even the best fuel is used, but is especially adapted to burn hard coal screenings, maintaining as strong a blast as desired. The injector is built in the wall of the furnace, the nozzle passing underneath the grate bars. The ash chamber having been made tight, the air and steam is compressed in the ash chamber, the commingled air and steam passing through the ignited fuel, the steam being converted into hydrogen gas. This mingled with the air is the hottest fuel known. The steam is not lost as applied in operating fans, but is turned into fuel after creating the blast.

The air injector (Fig. 1) shows the device as applied to the side wall of a furnace, this circumstance being an exceedingly convenient feature of its application and necessitates no structural change of any furnace to which it may be applied, and it is entirely out of the way. The device consists of a tapering section of an injecting tube having a straight portion or neck at the smaller end, preferably, an outward peripheral flange, to which is connected a flaring, round, oval, or elliptical tubular discharge section, having, preferably, a flange, which is bolted to a flange to allow the straight outlet to be removed and an elbow section having a flaring mouth substituted to adapt the injector to suit marine and locomotive boilers. The larger end of the tapering section of the injecting tube is closed by a cap. A series of perforations are made in the periphery of the tapering section, near the larger end, to admit air into the injector. The injector is preferably of oval or elliptical shape in cross section throughout its length to obtain better distribution of the commingled air and steam, especially in furnaces of large size. A steam pipe enters the tube through the outer or closed end, terminating with a series of branches, each having a small orifice to discharge a small jet of steam into the injector longitudinally, and the branches extend past the series of perforations and cause an induced current or indraft of air, which becomes incorporated with the steam to assist combustion while passing through the fuel. The noise caused by the discharge of a considerable jet of steam against the air in the injector is greatly moderated by smaller steam jets more or less distributed. A bell shaped hood surrounds the larger end of the tubular section and peripherally incloses the series of air perforations. The open end of this hood projects beyond the larger end of the injector and is provided with doors, closing over the end cap, the hood, when the doors are closed, preventing direct indraft through the perforations, to economize fuel when the fire is banked or slow combustion desired after the steam valve has been closed. The middle portion of the injector is embedded in the wall of the furnace below the bars. The commingled steam and air discharged from the injector pass up between the furnace bars and through the fuel to promote combustion. The perforated portion of the injector projects from the outer face of the wall of the furnace to allow air to freely enter the perforations, and by embedding the middle portion of the injector in the wall of the furnace the noise of the steam and air passing through the injector is lessened, and an objectionable feature thereby removed. This is one of the simplest as well as the most satisfactory injectors of its class yet designed.

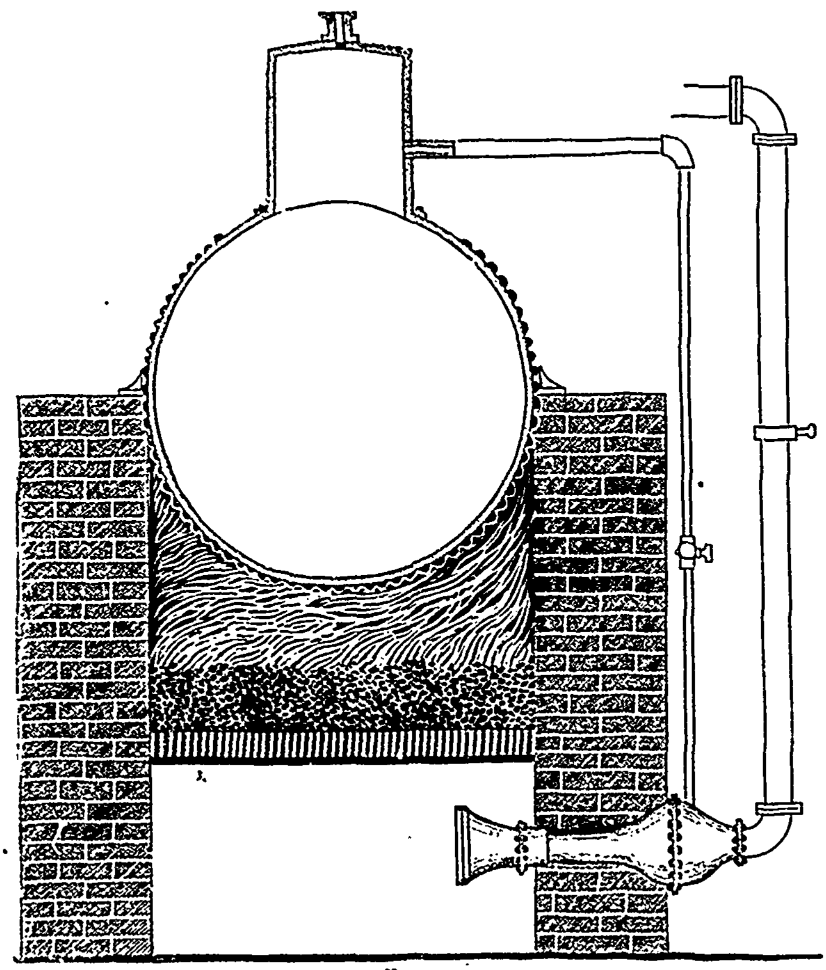

FIG. 1.

Fig. 3 is the combined air injector and exhauster, and will do all that the air injector will, and in addition will exhaust the gases from mines, ventilate ships, buildings, etc. This machine is practically noiseless when applied as shown in Fig. 1.

These machines have been in successful operation for some months, and are now working boilers, driving electric light plants and other machinery, also operating gas-producer cupolas, one of which may be seen working at the Consumers' Gas Company, Toronto, Ont.

Fig. 4 is the grate bar used in burning hard coal screenings, sawdust, tanbark, or any fine fuel.

The town of Port Arthur invites tenders until the 15th inst. for the purchase of $75,000 of debentures. The money realized is intended to be expended in building, equipping and operating an electric street railway.

NUMBERING AND RECORDING ARC LAMPS AND LOOPS.

By W. H. MARKLAND.

SOME time ago I inaugurated a system of numbering and recording arc lamps which has worked well in practice and may be of assistance to others.

My plan briefly is as follows. The dynamos are lettered "A," "B," "C," &c., and the loops, or lamp circuits, are numbered 1, 2, 3, &c.

In numbering the position of lamps, be they hanger board or

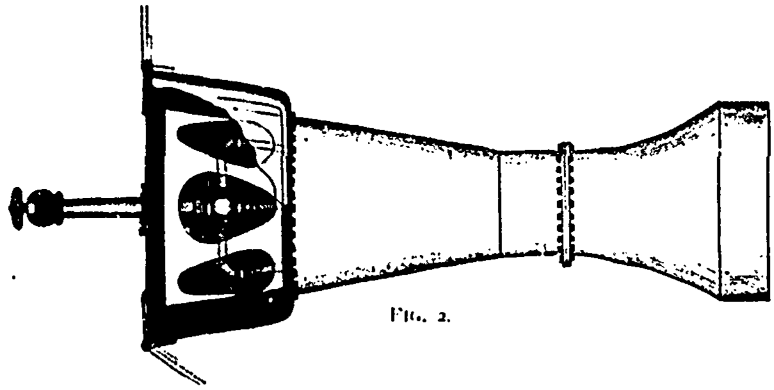

FIG. 2.

pole inside or out, the number of loop or circuit is indicated by numbers to the left of a decimal point, and the number of lamps starting out on the positive wire by numbers to the right of the decimal point, thus: the first lamp on loop one would be marked 1.01, the next 1.02, &c. The first lamp on loop 2 would be marked 2.01, the tenth lamp 2.10, the twentieth 2.20, &c. On loop 12, the first lamp is marked 12.01, the tenth lamp, 12.10, &c.

As before mentioned the number to the left of the decimal point indicates the number of the loop, and that to the right the number of the lamp. This plan, as can readily be seen, is easily remembered. A person familiar with the loops can tell the number of any particular position of a lamp by simply counting the lamps on the loops.

If additional lamps are put up they can be given a higher number than those on the loop; or, if only a few intermediate lamps are added they can be numbered with a third number to the right of the decimal; thus, if two lamps are put on loop one between 1.01 and 1.02, they could be numbered 1.011 and 1.012. The men would readily remember these numbers as they are different from the regular run. When a loop gets too badly mixed up it is a short job to renumber.

A tin tag having a number painted on it is nailed to the lamp board or the pole. Where the poles or hanger boards are numbered from one up, without reference to loops, it is difficult to remember on which loop the lamps are run, the number not indicating the loops. By this plan the loop number is always known. Trimmers notice the numbers while trimming and become familiar with them very readily.

I consider it is very much better to number loops than to name them, it being much easier to tell the dynamo man to put on loop 1 at 6 p.m., than to say "Put on Jersey Swamp loop at 6 p.m."

In the dynamo room a sign is posted, giving the number of the loops, where they go, and the number of lamps on each.

The trimmers and inspectors in making out reports of lamps

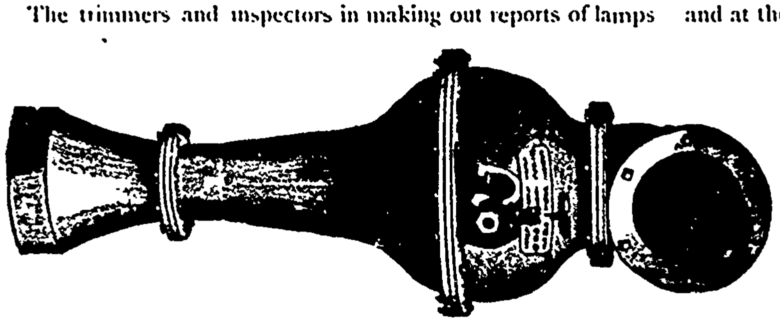

FIG. 3.

simply report lamps of such a number as giving trouble. The blanks for inspector's reports are made out as follows:

"S" Started Lamp No. —

"U" Unable to Start Lamp No.

"A"—Adjusted or Repaired Lamp No. ——

"R"—Renewed Lamp No. ——

"G" Globe put on Lamp No.

In the log book, which need be nothing but a common blank book or ledger, a line is used for each lamp. When anything goes wrong a record of it is made thus. Suppose on March 14, 1891, the inspector reports it necessary to start lamp 1.08. On the line for that number would appear "1.08 S, 3/14/91," the letter "S" indicating what was wrong and followed by the date. If three days later the lamp would not burn, the record would appear thus: "1.08 S, 3/14/91. U. 3/17/91;" if afterward the lamp was adjusted or repaired the entry would read. "1.08 S, 3/14/91. U. 3/17/91. A. 3/17/91." If it is necessary to replace it with a new or repaired lamp, this would be the record: "1.08 S, 3/14/91. U. 3/17/91. A. 3/21/91. R. 3/24/91;" or if a globe was put on, a "G" before the date would be used to indicate what was done to that lamp.

In the same book a record of each lamp should be kept giving the number, position, kind of lamp, how hung, and the date put in service; also a route diagram giving the run of the wires, their position on the poles and to which lamps they go. A trouble report of dynamos, &c., should also be kept. One very important point is to date everything entered.

This plan, as can readily be seen, takes but little space in a book, and gives clear and accurate information. At a glance it is possible to tell where the difficult places to maintain arc lamps are.

This plan can be further extended if desired, by putting the maker's number of the lamp under the year. A lamp when repaired should be as good as new.

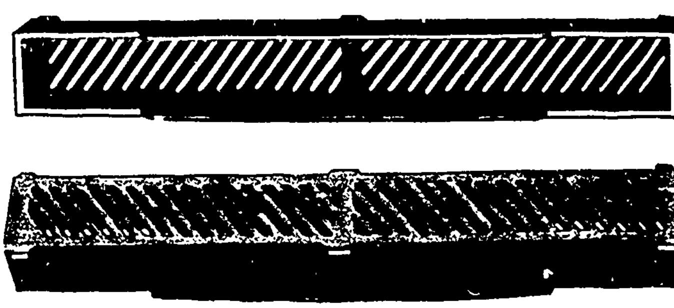

FIG. 4.

A very simple manner of telling the cost of running arc lamps is as follows:

HOURLY RECORD OF ARC LAMPS, MARCH, 1891.

Loops	Dates	1	2	3	4	5	6	7	8	9	10 etc.	Total Hours for Loop	Lamps	Total Lamp Hours
1														
2														
3														
4														
.														

By entering every day the number of hours a loop was in use, and at the end of the month adding these hours together and multiplying by the number of lamps on the loop, total hours for one lamp is obtained. By adding together the total or lamp hours for all the loops, and dividing that into the cost of running the plant, the cost an hour per lamp is readily obtained. This gives one of the very best of records. *Electrical Age.*

The first electrical power in the province of Wurtemberg has just been put into operation in Konigshbronu, where steam power has been replaced by electric power in the Royal Foundry. The installation has been carried out by the Esslingen Engineering Works. Until recently the strong source of the Brenztopf was used only in connection with a forge situated in dilapidated buildings. These have now been demolished and a small house built in their place at the side of the source. It contains a turbine which drives a dynamo at 600 revolutions per minute, and which gives 40 electrical horse power. The current from this dynamo is transmitted by means of overhead conductors across the town to the Royal Foundry, where 25 turning lathes and polishing machines are actuated by electro-motors. Suitable regulating appliances have been provided, so that should variations take place in the quantity of water of the Brenztopf, the power transmitted shall remain constant.

THE H. P. OF ENGINES.

TORONTO, May 11th, 1891.

Editor ELECTRICAL NEWS.

SIR,- I see by Mr. D. W. Ross' letter in the last issue of the ELECTRICAL NEWS that he is still off on the H. P. of engines. I think Mr. Ross must have got the old rule for finding the nominal H. P. of engines somewhat mixed up with the rule for finding actual H. P. The rule adopted by the Admiralty to determine the N. H. P. of engines is based on an effective steam pressure of 7 lbs. per sq. inch with a piston travel of 220 ft. per minute, but I do not think this 220 ft. has anything to do with the rule for finding the actual H. P.

I had the pleasure of listening to Mr. J. Galt's lecture in the Free Library on "The Mechanical Principles of Work," and I must say that he made everything appertaining to his subject very plain indeed (to me at all events, and I am only a practical engineer, not an M. E. or C. E., though I wish I was). Friend Ross was there also, and he did not seem satisfied on this H. P. business, hence the discussion. Mr. Ross gives formula for finding H. P. of engine as follows: $\frac{A \times P \times S}{33{,}000 \times 220} = \text{H. P.}$ This is all right until he comes to multiply by 220. The correct formula is $\frac{A \times P \times S}{33{,}000} = \text{H. P.}$ All we require in this formula is the speed in feet per minute the piston is travelling, in order to find how many times 33,000 lbs. is raised 1 foot in 1 minute. There is no need for multiplying by the speed that any horse travels. I would like to ask Mr. Ross, if he were to indicate an engine and figure out the card, would he use his formula to do so, and if so, does he think he would be correct? I know this much, *i. e.*, if he thinks he would be correct, he is about the only man (engineer) in Canada who would think so.

Friend Ross, says. "We are all differently constructed, think, see, feel, &c., differently, and have different opinions." Well, I should say so! It would be a queer world if we did not. Any way, I'll wager anything that there is not an engineer in Canada but will differ from Mr. Ross on this question of H.P. of engines. Mr. Ross must get himself properly counter-balanced before he can act as an automatic governor to Mr. J. Galt, as I am afraid from present indications that his regulation is not perfect.

Any way the discussion will do no harm, and may put friend Ross on terra firma.

Yours respectfully,

"SAFETY."

(Practical Engineer.)

Editor ELECTRICAL NEWS.

DEAR SIR: In your last issue I see a letter from D. W. Ross, C. & M. E., in which he seems to have got somewhat mixed in his ideas of applying the foot pound to the h. p. of an engine. I had the pleasure of attending Mr. Galt's lecture in which he made the statements Mr. Ross has taken exception to. I thought Mr. Galt made the application of the foot pound, as used to measure power, quite plain—at least it seemed so to me The formula that Mr. Ross has constructed to demonstrate what 1 h. p. is, seems far-fetched, and is not correctly stated. Taking his statement and writing it correctly, using the h.p. of steam engine for numerator and the power of a horse for the denominator, we would have:

$$\frac{33{,}000 \text{ lbs.} \times 1 \text{ foot} \times 1 \text{ minute}}{33{,}000 \text{ lbs.} \times 1 \text{ foot} \times 1 \text{ minute}} = 1 \text{ h. p.}$$

That is, either the numerator or the denominator would equal 1 h. p.

If Mr. Ross wants to move the load faster than one foot in one minute, we can do so, and by reducing the number of pounds raised, increase the speed, still having the same result in work done, viz., 330 lbs. × 100 ft. × 1 minute = 1 h. p. If we raise 33,000 pounds 1 foot high per minute we have a horse power. If we raise 330 pounds 100 feet high per minute, we exert the same amount of power.

In steam engine practice we use a piston speed of say 600 ft. per minute. Now the value of 1 pound of steam pressure on a piston containing 110 square inches area would be $\frac{600 \times 110 \times 1}{33{,}000 \times 1}$ = 2 h. p.; and if the speed of the piston was only 300 feet per minute, it would be $\frac{300 \times 110 \times 1}{33{,}000 \times 1} = 1$ h. p.

I cannot find anything in "The Mechanic's Own Book," Rankine's "*Manual of the Steam Engine*," Roper's "*Marine and Land Engines*," Reid's "Engineer's Hand-Book," or any other mechanical publication that tells me I must multiply 33,000 by 220 to get a h. p.

I am very sorry that I cannot write C. and M. E. after my name, but I hope this will assist Mr. Ross to see the h. p. of an engine in its correct light.

N. GINERE.

TORONTO, May 25th, 1891.

Editor ELECTRICAL NEWS.

DEAR SIR,—I am getting mixed somewhat regarding the horse power of an engine. If Mr. Ross is right, I am wrong. I *am running an engine 10" x 28", revolutions 90, steam 85 lbs.* The indicator man says I have 32 lbs. mean effective pressure. The diameter of my cylinder area = 78·54 and 90 revolutions = 420 feet. The formula is:

$$\frac{10^2 \times {\cdot}7854 = 78{\cdot}54 \times 420 \times 32}{\text{H.P.} = 33{,}000 = 31{\cdot}9168 \text{ H.P.}}$$

Our engine was sold to us for 35 H. P., and I am of the opinion that it is capable of doing 10 H.P. more than we are doing at present if speeded up some. I am at a loss to know the reason that Mr. Ross multiplies by 220, for in his formula it is thus:

$$10^2 \times 78{\cdot}54 = 78{\cdot}50 \times 420 \times 32$$
$$33000 \times 220 = 726000 = {\cdot}1453$$

nearly 7-16 of a H.P. I cannot understand it. I want to be right. Will Mr. Ross please explain? I should be most happy to meet him any evening he could conveniently appoint, in order that I might be put right, or that I might put him right.

ONE WHO WANTS TO BE RIGHT.

QUESTIONS AND ANSWERS.

"W. H. K." writes: I have a common plunger pump as a feed pump, and it is pumping cold water through a National feed water heater. The size of plunger is 3", stroke 8", suction and discharge pipes 1½", suction lift about 10 feet, with a horizontal distance of 200 feet to the water. The pump valves are new and in good order. *Our trouble is, that the pump pounds* so badly that the valves soon give out, besides making a very disagreeable noise that is heard all over the factory. I would like to know the cause and remedy for this, if there is one.

ANS. You do not state the speed of the pump, but supposing the speed is 60 strokes per minute, your 1½ column of water would have a speed of 40 feet per minute. Now this body of water must be started and stopped 60 times each minute, and will most likely cause the pounding you complain of. Put an air chamber in the suction pipe close to the pump valves and you will get over the trouble; you can make one by putting a T in the suction pipe, say with a 2" central hole, then screw a piece of 2" pipe, standing perpendicular, into it. Make it about 5 feet long and put a cap on the top of it.

Will the judges in your recent competition for engineers show through your paper how they get at the amount of fuel saved in question No. 9? Mr. Edkins' answer is 55 lbs; Mr. Mooring says 87. If they will show how to work these two problems out, they will very much oblige

MEMBER C. A. S. E.

"ENGINEER," Toronto, writes: Will you please answer the following question through the columns of your valuable paper. I have a back pressure valve, 6" diameter, with a spindle through centre on which it swings, and a lever 24 long keyed to spindle. On the end of lever is a 40-lb. ball. What pressure would be required under the valve to raise it? Please give formula for this, and oblige.

ANS.—There seems to be something wrong with your description of the construction of your valve. You say it is 6" diameter and swings on a spindle through centre. If it swings on a spindle passing through the centre, there will be as much pressure on one side of the spindle as on the other, and being thus balanced, the pressure will neither open it nor close it. Better give a fuller description of the inside arrangement, and we will try and answer your question.

A charter has been applied for by parties desirous of operating electric light in Kentville, Nova Scotia.

MAGNETISM.*

MAGNETISM and electricity are very closely allied, each being more easily converted into the other than into any other form of energy. In fact, as will be seen later, the presence of an electric current implies magnetism, or, as it is termed, a magnetic field around the conductor through which it is passing; while any change of the magnetism of any body or system, —or, as it is technically expressed, any change in the strength of the magnetic field, —immediately gives rise to electric currents.

Like electricity also, we know very little of its nature, though rather more than we do of the sister science. We know, for instance, that an iron bar when magnetized is longer than when not magnetized; and from various researches, principally by Professor David Hughes, we gather that the act of magnetization consists in an attempt by the molecules of the body to turn on their axis, and to place themselves in line with the direction of the magnetizing forces. All bodies conduct magnetism, some with greater facility than others, but of all bodies, iron and its compounds, steel and cast iron, alone exhibit appreciably the magnetic properties, which are:

1. The property of pointing, when freely suspended, to those spots on the earth's surface known as its magnetic North and South Poles, one end, or one pole, as it is termed, turning always towards the magnetic North Pole, and the opposite one to the magnetic South Pole.

2. The property of repelling the pole that, if both were freely suspended beyond the influence of magnets other than the earth, would point in the same direction, and of attracting the opposite pole. Thus, two north-seeking ends of a magnet; or, as they are called, two north poles repel each other, and two south poles repel each other; while a north and south pole attract each other.

3. The property possessed by a magnetized body of inducing magnetism in other bodies not in contact with it, and in such a manner as to cause motion between the two, if either is free to move, or if the inducing force is sufficiently powerful to overcome the mechanical resistance to motion.

As with electricity also, we have a magnetic circuit, which consists of a closed ring of attractions, and whose resistance to magnetization varies with the substance and with the dimensions of the magnetic conductor. Thus, a long, thin bar offers a greater resistance to magnetization than a short, thick one; and, stated shortly, the magnetic resistance offered by any body varies directly at its length in the direction of the magnetic circuit, and inversely at its cross section.

Steel offers a greater resistance to magnetization than pure wrought iron, as also does cast iron; and all three have the property of retaining their magnetism to a certain degree, when once they have been magnetized. As might be expected, upon the theory that the operation of magnetizing consists in a twisting of the molecules, those bodies, as steel and cast iron, which offer most resistance to the inducing force, as it is termed, retain more of their magnetism, and far longer than wrought iron. With very pure iron, such as Swedish, Farnley, or Lowmoor, it is very difficult to find any traces of magnetism when no inducing force is present, while either will give a very high return for a given magnetizing power that is applied. With steel or cast iron, on the contrary, it is by no means easy to induce them to accept of magnetization, but when once it has been accomplished, they retain a very large percentage for some considerable time.

These properties are of very great importance in the construction of electric and electro-magnetic apparatus. Thus, the needles of compasses and miners' dials are always made of steel, their property of pointing north and south being all the service that is required of them. In any apparatus where a selective action is required (or where an attractive power is required in a light, portable form, as in the magneto-telephone receiver), a piece of magnetized steel, or a steel magnet, as it is called, is used.

Where it is required to control the magnetic effect for producing motion, pure wrought iron is generally used, for the double reason, that a smaller weight will answer than with cast iron for the same work, and that it responds more readily to the magnetizing influence—usually an electric current—taking up and losing its magnetism readily at the will of the operator.

In dynamo electric machines,—where parts of the apparatus are required to retain their magnetism in the same sense, that is, with the same polarity, as it is termed, as long as the apparatus is working—those parts may be constructed from wrought iron or cast iron, according to the fancy of the designer; but he will have to provide a heavier weight of the latter, to do the same work.

Those parts containing iron which are in motion and continually changing the direction of their magnetization, as the iron core of the armature, are always made from the purest wrought iron obtainable.

It has been stated that there is a magnetic circuit of attractions, or a continuous path for the magnetism, just as there is a continuous path for an electric current; but with this difference, that magnetism always passes, no matter how great the resistance, and the effect of the magnetic resistance is simply one of degree.

Air, for instance, has an enormously greater resistance than iron, some 1400 times, according to a recent investigator, Mr Kapp, to whom dynamo manufacturers are very much indebted for his able researches, and above all for his exposition of the law of magnetic resistance. Yet, if no other path be open, the magnetic influence will pass through air, imperceptibly, of course, until some body, such as a piece of iron, able to denote its presence, is placed within its influence.

Perhaps the method adopted for explaining the working of the electric circuit may be of service here. Imagine a ring of iron or steel, not covered. Iron or steel, because, as has already been explained, these substances conduct magnetism better than any others, so far as we know at present; uncovered, because we know of no substance that will act as an insulator for magnetism in the same sense that india-rubber or gutta-percha does for an electric current. The bodies which offer the highest resistance do conduct magnetism, even under moderate exciting power, to a very appreciable degree.

If we apply to any part of our ring an exciting power, such as an electric current passing in a wire wrapped round the iron, moderate in proportion to its resistance—that is, which will develop a moderate degree of magnetization in opposition to the resistance of the ring—we shall find scarcely any traces of magnetism anywhere outside the ring, though we can show, by suitable apparatus, as will be seen when we come to deal with transformers, that the magnetism is there, and is a perfectly measurable quantity. It has only passed by way of the ring, just as the electric current passes by way of a wire, because, with the force available, that is for practical purposes the only path open to it. Now let us cut out say one-sixteenth of the ring; and we shall find that we have created a totally different set of conditions, giving rise to totally different phenomena.

First, then, the piece we have cut out—if free to move, and placed at such a distance that the magnetic power is sufficient to overcome the friction, mechanical inertia, etc., present—will move back exactly into its old place, or as nearly as it can, when the exciting power is applied.

We shall find also that, if our ring is made of steel, it has retained a certain power of attracting the piece that we have cut out after the exciting power has been removed. If our ring is made of wrought iron, it will pull the piece up sharply when the exciting power is applied; while, when the current is broken, it can easily be removed, and may even fall off itself if it is heavy in proportion to the attracting power. If we pursue the matter a little further, we shall discover another and very important phenomenon. It has just been remarked that, in the case of wrought iron, the piece of the ring we had cut out might detach itself under certain conditions. Let us find the conditions under which it will not detach itself. Let the piece we have cut out of the iron ring be replaced by a piece fitting very exactly, the four surfaces being planed true to each other. Now, we shall find that we have a slightly increased holding power when the ring is excited; and further, that after the exciting power has been removed, it will still require the expenditure of a certain amount of energy to pull it away. The reason is, that while the magnetic circuit is complete, a certain amount of magnetism remains in the iron even after the exciting power has been removed. Forcibly pulling away the armature, or keeper—as the piece of iron employed to close the magnetic circuit is usually called—dissipates this residual magnetism; and so, if we replace the keeper ever so truly and carefully in

* Walker's "Electricity."

its place, we shall not require the same effort to remove it as before. This phenomenon would form a very serious drawback to the working of many forms of electro-magnetic apparatus if there were no means of getting over it. Fortunately there are. It is sufficient if we break the iron magnetic circuit by a film of air, a layer of paper, or, more conveniently, a thin plate of brass, to get rid of what would otherwise be the troublesome effects of residual magnetism.

We shall also find another phenomenon arise from our having broken our ring by taking out a sixteenth part as described. It has been explained that the magnetic influence always passes, no matter what may be the medium; the effect of the insertion of a resisting medium being merely *the reduction of the strength* of the magnetism; and it was also explained that though magnetism passed invisibly, it could be rendered evident by the presence of iron. This may be shown in a very striking manner. If we take our ring minus its sixteenth, place a sheet of paper or glass over it, and sprinkle iron filings over the aperture, we shall find these filings, when free to move under the influence of the exciting power, arranging themselves in regular order from one end of our ring to the other, across the break; and if we investigate the matter further, we shall find that the reason these iron filings arrange themselves in this way is because each has become a small magnet under the influence of the exciting power of our ring, and each places itself in accordance with the two laws before stated, viz.:--

1. That, it being a magnet, having a N. pole, that should point to the S. pole of the large magnet, and the S. pole of the filing to the N. pole of the large magnet.

2. That the N. poles of the filings repel the N. poles of other filings, and the S. poles the S. poles; and the joint operation of these two laws produces the curves shown, which Faraday termed the lines of force, or the direction in which the magnetic force is manifested.

As a ring would not usually be a convenient form for a magnet that is to be used in electro-magnetic apparatus, the horse-shoe form is generally adopted. For permanent steel mrgnets, a strip of steel is bent into the form shown in Fig. 1, and its magnetic circuit is closed by another strip of steel or iron, or by some portion of the apparatus of which it is to form a part. For electro-magnets, the horse-shoe form is also generally adopted, but it is made in four pieces instead of two, viz., two limbs upon which the wire that is to carry the exciting current is wound; a yoke, or back piece to complete the magnetic circuit on that side; and the armature, facing the poles, and moving in accordance with the will of the operator who controls the electric current, to complete the magnetic circuit on the other side, as Fig. 2.

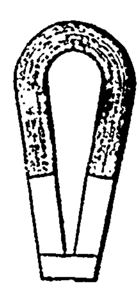

FIG. 2—HORSE-SHOE STEEL MAGNET.

Lines of Force.—Before going further, it will be as well to deal with Faraday's very beautiful, but somewhat puzzling, conception, the lines of force.

Lines of force bear the same relation to magnetism that current does to electricity. The production of lines of force is the result of the work done by a given magnetic exciting power, in opposition to the magnetic resistance opposed to it; just as an electric current is the result of a given E.M.F. acting in opposition to a given electrical resistance. Moreover, the number of lines of force passing at any point is a measure of the strength of the magnetism at that point, just as the number of amperes passing in any electric circuit, or part of a circuit, is the measure of the strength of the electric current passing. As in an electric circuit also, the current strength is the same in every part of the circuit, so too in the magnetic circuit, the number of lines of force passing is the same in every part; with the proviso, as with the electric circuit, that if two or more paths are open to the lines of force, they will divide between those paths or branch circuits in the inverse ratio of the resistance of the several paths. Thus, if there be two paths open to the lines of force, one *through the air and the other through iron, the* dimensions being the same, they will divide in the ratio, according to Mr. Kapp's figures, of 1440 . 1. One part passing through the air and 1440 through the iron. It can easily be seen, however, that if the air path should be short and of large cross sections, while the iron path was the reverse, an appreciable portion of the lines would pass through the air. This point comes out very strongly in the matter of designing dynamo machines; what is known as the leakage path being in some cases of comparatively low resistance, owing to the form of the machine.

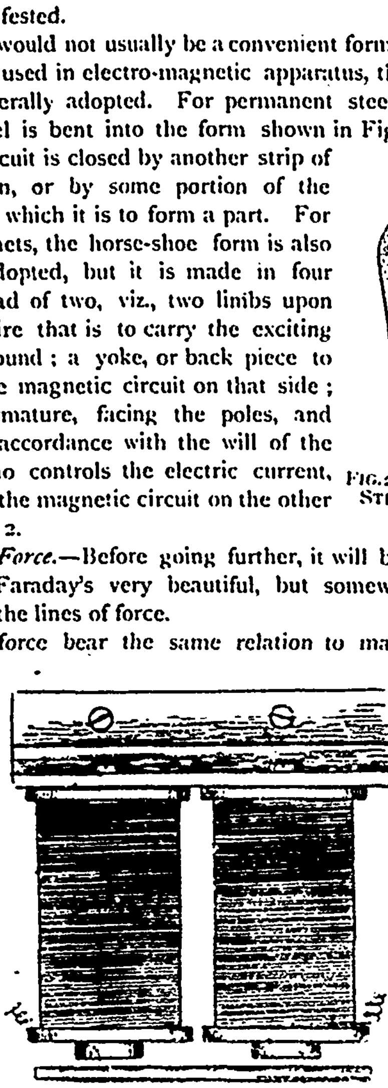

FIG. 2.—FOUR-PIECE ELECTRO-MAGNET WITH ARMATURE.

As with amperes also, lines of force are definite measurable quantities. Dynamo manufacturers calculate how many lines of force they have passing into an armature, and what the section of the iron should be to accommodate them, just as they calculate the number of amperes required in a given case, and the section of conductor required to accommodate them. But we have *no convenient quantities as yet, like the volt and the* ohm and the ampere, that we can refer to as analogous to the foot-pound in mechanics. We have no familiar name representing so many lines, though probably it may not be long before we have one. In order to render the subject clear, therefore, we can only refer back to the foundations of all these units, those of force, mass, and time. The unit line is that force which will move the unit body, the gramme, over unit distance, the centimetre, in unit time, the second. Therefore, when we say that there are so many lines of force passing into the armature of a given dynamo, we mean that we have the power present within the armature to do that number of centimetre-grammes of work in unit time, under the influence of the magnetism created in the machine; and, as engineers well know, these quantities are directly convertible into the more familiar foot-pounds, and H.P.

Lines of force, then, show the direction in which the magnetism present will cause any free magnetizable body to move; and the number of them at any point, referred to unit quantities as detailed above, show the force of magnetism available there, or, as it is termed, the strength of the magnetic field.

It must not be imagined that magnetism and lines of force represent continuous motion of the molecules of the body through which the magnetism passes; or that we should be justified in calling what we now know as lines of force, a magnetic current. They are nothing of the kind, nor are they analogous to an electric current, except in so far as has been described, and for two reasons. First, because magnetism is an *influencing* or inducing force, like gravity, and not a moving force like heat or electricity; and secondly, we *have* a magnetic current, viz., the motion that takes place in the magnetic circuit, among the molecules of the bodies through which the magnetic influence passes, at the moment the exciting power is applied, and at the moment when it ceases.

It will be easily understood from what has passed, that as the lines of force passing through air, say from pole to pole of a magnet, can radiate in all directions, unless their path is shaped for them by the introduction of some piece of iron, such as the armature, the force exerted varies, as in all similar cases, inversely as the square of the distance from the poles. It is doubtful, however, if this law holds good in a sufficient number of cases to be of any value, as it is evident that it must be subject to modification by every change in the conditions present.

FIG. 3.

It has been mentioned that the existence of an electric current passing through a conductor, implies a magnetic field around the conductor. Thus, if a current be passing in a wire, lines of force are created in concentric circles around it (Fig. 3). That is to say, a small magnet such as a magnetized steel filing, if free to move, would place itself tangential to a circle of which the wire formed the centre, and simple iron filings take up positions in concentric circles round the wire, just as they do in curves across the poles of a magnet. As before, the lines of force show not only the direction of the magnetic influence, but their number

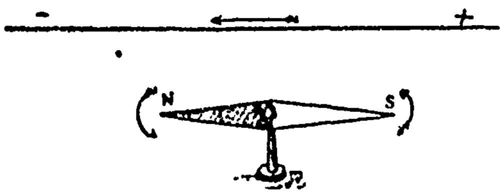

FIG. 4.

or density shows the strength of the field surrounding the wire, and this again is proportional to the strength of the current passing, and inversely to the distance from the conductor.

The first effect of this property of electric currents that became of any practical value, was the power which it gave of deflecting a magnetic needle out of the positions we have seen it assumes, pointing parallel with the line of the earth's N. and S poles Thus, if a magnetized compass needle be suspended under a wire, it will be found that when a current passes in the wire, the needle will be deflected, the N. pole going to the *left* when the

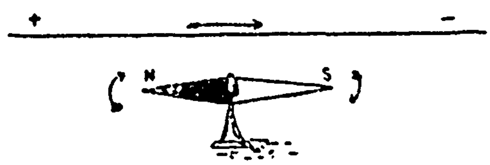

FIG. 5.

current passes from S. to N. (Fig. 4) *over* it, to the *right* when the current passes from N. to S. (Fig. 5) *over* it, to the *left* when the current passes from N. to S. *under* it (Fig. 6), to the *right* when the current passes from S. to N. *under* it (Fig. 7). Thus, a current passing from N. to S. *over* the needle and coming back from S. to N. (Fig. 8) *under* it, will deflect the needle in the same direction, the N. pole turning to the right; while a current passing from N. to S. under, and coming back from S.

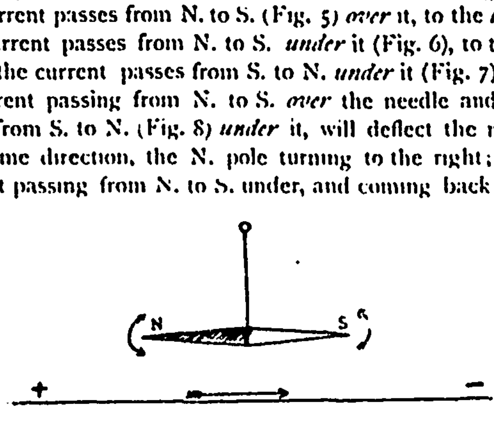

FIG. 6.

to N. over, deflects the N. pole to the left; and on this principle a large number of electrical measuring instruments are made; an insulated wire being passed continuously round the needle in the same direction. It will be obvious that such an apparatus enables us to discover the direction of any current passing through the wire coils, and further, that, as the influence of the current upon any given needle will vary with the number of

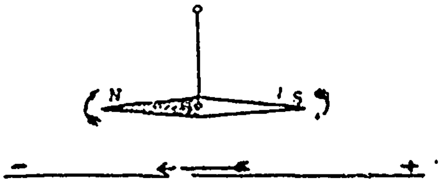

FIG. 7.

turns, and with the current passing through the coils, we have to our hand the means of measuring the strength of the currents we are using. This will be dealt with fully when measuring instruments are under consideration.

Electro-Magnetism. The law which has been enunciated which rules the deflection of a magnetic needle when suspended under or over a wire, or inside a wire coil, holds good equally if, in place of a movable magnetic needle, we have a bar of iron or steel, surrounded by a coil of wire in which a current is passing. If the current passes over the bar from us, and returns under towards us, as shown in Fig. 10, the N. pole is on the left and the S. pole on the right.

From this it will be seen that we are able to magnetize a bar in either direction, with any given wrapping of wire, by simply reversing the direction of the current passing in the wire.

It will be understood also, that the number of lines of force, or the amount of magnetization developed in any bar, will vary in accordance with the law we have stated, viz.: –it will depend directly on the exciting power, and inversely on the magnetic resistance opposed to it.

The exciting power, again, varies directly as the strength of the current passing in the wire, and as the number of times it

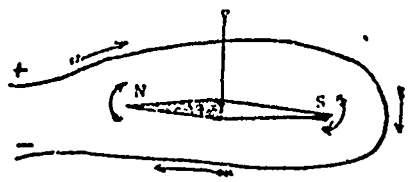

FIG. 8.

passes round the bar, or, shortly, as the ampere turns. And it will follow immediately from these two, that with a short thick magnet we require less exciting power, fewer ampere-turns, than with a long thin one; since, other thing being the same, the magnetic resistance of the former is less than that of the latter. The resistance of each leg, taking the horse-shoe form, is less; and also the resistance of the back, or yoke, of the

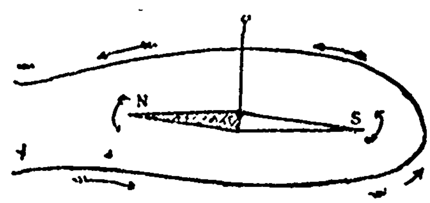

FIG. 9.

armature and of the air space between the poles and the latter, because the cross section will be necessarily larger.

This is in direct contradiction to the ideas that prevailed in the early days of electricity, and to those which are to be found in some of the older text-books. In those days it was thought that you gained power by increased length. The error was probably due to the actual fact that you may gain power by using a long electro-magnet, but from a totally different cause, viz., the increase of the exciting power. Electro-magnets are often constructed by taking a piece of iron and wrapping on it as much wire as you can. As each succeeding layer of wire is

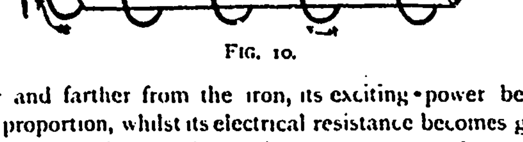

FIG. 10.

farther and farther from the iron, its exciting power becomes less in proportion, whilst its electrical resistance becomes greater in proportion to its length, so that you soon reach a point at which there is no advantage gained by adding more wire. If you take a longer bar, you increase your magnetic resistance, but not so much as to balance the increased exciting power that you gain from the additional wrapping space.

Steel is never used for electro-magnets, except in special cases, and cast iron only in the case of the field magnets of dynamo, where the direction of magnetization does not change. For all other purposes, wrought iron of the very purest quality obtainable is used; the dimensions are either calculated or determined by experiment, or calculated from *data* furnished by experiment; and the exciting power is an electric current passing in a cotton or silk-covered wire, wrapped round and round each limb of the magnet.

Messrs. Hy. S. Thornberry & Co., proprietors of the Toronto Electrical Works, have recently removed to new and more commodious premises at 35 Adelaide street west, and address themselves to the users of electrical materials through the columns of the present number of the ELECTRICAL NEWS.

ONTARIO ASSOCIATION OF STATIONARY ENGINEERS' ACT.

For the information of those of our readers who may have been unable to obtain a copy of the Act recently passed by the Ontario Legislature incorporating the Ontario Association of Stationary Engineers, it has been deemed advisable to print the measure in full. It reads as follows :—

Whereas it is deemed expedient to incorporate the persons hereinafter named, and all persons who shall hereafter cause their names to be registered as an association for the purpose of holding examinations and granting certificates of qualification and efficiency as stationary engineers.

Therefore Her Majesty, by and with the advice and consent of the Legislative Assembly of the Province of Ontario, enacts as follows :—

1. Prof. J. Galbraith, John Galt, M.E., A. E. Edkins, William Sutton, A. M. Wickens, J. A. Wills, all of Toronto; Hugh Fairgrieve, Robert Dickinson, Robert Mackie, Sylvester Potter, all of Hamilton; Arthur Ames, of Brantford; James Devlin, of Kingston; and all persons who shall cause their names to be registered under the provisions of this Act, shall be, and are hereby incorporated under the name and style of "The Ontario Association of Stationary Engineers," hereinafter referred to as "The Association."

2. The Ontario Association of Stationary Engineers shall be a body corporate by the name aforesaid, having a perpetual succession and a common seal, with power to acquire, hold and dispose of personal and real estate, for the purposes of this Act, and to sue and be sued, in the manner usual with such corporations.

3. Every person registered under the provisions of this Act shall be a member of the said Association.

4. There shall be a Board of Management of the said Association, to be appointed in the manner provided for in this Act and hereinafter referred to as "The Board."

5. The said Prof. Galbraith, John Galt, M.E., A. E. Edkins, William Sutton, A. M. Wickens, J. A. Wills, Hugh Fairgrieve, Robert Dickinson, Robert Mackie, Sylvester Potter, Arthur Ames and James Devlin shall be the officers and Board of the said Association until others, under the provisions of this Act, shall be elected to fill their place.

(2). The members of the said Board shall meet in the city of Toronto, in the county of York, for the purpose of organization, within one month after the passing of this Act.

Any five members of the Board shall form a quorum.

(4). The members of the Board shall hold office for the term of three years, and there shall be an election each year of three members, the first Board hereby appointed determining by lot the order of their retirement at the expiration of one, two and three years respectively, and any retiring member shall be eligible for re-election.

6. All subsequent members of the Board shall be elected by ballot, in such manner as may be provided for by the by-laws of the Association, at the annual meeting of said association, or at a special meeting called for that purpose, and the member or members obtaining the greatest number of votes shall be declared elected.

7. No person shall be eligible for election to the Board, or qualified to fill any vacancy thereon, or to vote for any member thereof unless duly qualified under the provisions of this Act and the by-laws of the Association.

8.—(1) In case of the resignation or death of any member or members of the board not exceeding four, the other members of the board shall have power to fill all vacancies so caused, until the time of the holding of the next annual meeting; provided said annual meeting is not to be held within a period of three months of the occurring of such vacancy or vacancies.

(2) In case of the resignation or death of five or more members of the Board, the president or vice-president of the Association, or in case of their, or either of their default for a period of ten days, any five members in good standing shall have power to call a special meeting of the Association upon a notice of not less than ten days, for the purpose of filling the vacancies so caused.

(3) In case of an election to fill the vacancies referred to in sub-sections 1 and 2, the member receiving the greater number of votes shall be considered the member elected to fill the vacancy which shall require the longer time to expire, and so on until all the vacancies are filled.

9. In case of any doubt or dispute as to who has or have been elected a member or members of the Board, or as to the legality of the election of any member or members of the Board, it shall be lawful for the other duly elected members to be, and they are hereby constituted a committee to hold an enquiry and decide who, if any, is or are the legally elected member or members of the Board, and the person or persons, if any, whom they decide to have been elected, shall be and be deemed to be the member or members legally elected, and if the election is found to have been illegal, the said committee shall have power to order a new election.

10. Meetings of the Association and the Board shall be held at such times and places as may be fixed by the by-laws of the Association or Board respectively; and in the absence of any rule or regulation as to the summoning of meetings of the Association or of the Board, it shall be lawful for the president, or in the event of his absence or death, for the registrar, to summon the same at such time and place as to such officer seems fit, by circular letter to each member.

11. In the event of the absence of the president from any meeting, the vice president; or in his absence, some other member to be chosen from among the members present shall act as president.

12. All questions submitted to the Association, or the Board, shall be decided by a majority of the members present, not being less than five in number in case of the Board, and twenty in case of the Association.

13. At all meetings, the president for the time being shall have only a casting vote.

14. There shall be paid to the members of the Board such fees for attendance, and such reasonable travelling expenses as may be fixed by by-laws passed by the Association at the annual meeting.

15. The Board shall annually elect from among its members a president and vice-president, and shall appoint a registrar, treasurer, solicitor, and such other officers as may be necessary for the working of this Act, who shall hold office during the pleasure of the Board, and who shall, as well as being officers of the Board, hold the like position as officers of the association.

16. The Board shall have power to fix by by-law the salaries or fees to be paid to such officers, and to the board of Examiners hereinafter appointed.

17. The said Board may make rules and regulations for their own conduct and for the uniform inspection of steam plant, for the conduct of examinations, for fixing all fees to be charged and for such other purposes as are necessary under this Act, but nothing herein contained shall be deemed to give the Association any powers of compulsory inspection.

18. The Board or a Committee thereof shall examine all persons applying under this Act, and shall have power to issue certificates, and such certificates shall in plain terms name the particular steam plant the holder is qualified to operate.

19.—(1) All persons shall on application for examination, pay such fee for such examination, including certificate as may be prescribed.

(2) No certificate or renewal thereof shall be granted to any person addicted to the excessive use of intoxicating liquors, and such certificate may at any time be revoked when the holder thereof has been shown to have been guilty of gross carelessness, incompetence or intemperance.

10. The expression "steam plant," wherever the same occurs in this Act, shall include boilers and steam engines and every part thereof or thing connected therewith, and all other apparatus and things attached to or connected therewith or used with reference to any such engines or under the care of the engineer.

THE FELINE MOTOR.

THE INVENTION OF A WESTERN GENIUS AND ITS MODE OF OPERATION.

Stoughton, Dane County, Wis., May. 19.—Prof. Richard de Long, the inventor of the new feline motor, is a tall, pale-faced man, with a three-storey, bay window forehead, overhanging a pair of deep set, sky blue eyes, set on each side of a large, thin hooked nose. He is not a beauty, but he is a genius.

His feline motor, which at present is creating such a sensation in scientific circles in Stoughton, is a marvellous machine, unique in appearance, and wonderful in operation. It may be described as a curious combination of large and small fly-wheels, great balance-wheels, bright steel rods, and an almost innumerable number of coils of copper wire, all joined to a brightly polished cylinder of brass, one end of which projects into a wire cage filled with ordinary cats. Its operation is very simple, but surprising in its results. A slight pull on a small nickel plated lever starts the machine. Then like lightning from out the end of the cylinder projecting into the cage there shoots a long steel arm and hand, grabbing one of the cats by the nape of the neck and yanking it into the cylinder, where it disappears with a yowl of more than feline terror. In a moment the fly wheels, the great balance-wheels, and all of the complicated machinery begins to move, at first slowly, but soon with startling rapidity. At the proper moment, which is indicated by a small clock-like attachment, the operator pulls another lever, when from out of the other end of the cylinder, with hair and tail erect, scintillating eyes, and a caterwaul dislocating to one's spinal column, the cat is projected into a tub of cold water prepared for its reception.

This operation, surprising as it may seem, extracts from the cat electricity equivalent to the power represented by ten horses, working for one hour, and this power can be stored in the cylinder until needed. As a cat can be run through the motor every three minutes and all the accumulating electricity be stored the power of the machine is practically limitless. The same cat can be used once in every ten hours without in the least impairing its health and general usefulness.

The professor is jubilant over the success of his invention. He is satisfied that he has overcome every difficulty, and intends soon to put the machines upon the market. In speaking of the origin of the invention and the probable results of its use, he says:

"I have long believed that the cat is nature's Leyden jar, charged with an enormous amount of electricity, but in such a manner as to require a peculiar process to extract it. This process it has been my good fortune to discover. The discovery will be of incalculable benefit to mankind. It will revolutionize the mechanical world, and be felt in every department of life. By its means every family, no matter how poor, can have its home brilliantly lighted with electricity at a less cost than to have it poorly lighted with kerosene. By simply running the now practically useless house cat through the machine twice each day a sufficient amount of electricity can be engendered to illuminate brilliantly any medium-sized house. Think how advantageous it would be to a large city. Take New York, for example. Carefully compiled statistics show that there are at present within the city limits 9,997,347 cats. This represents very nearly a 20,000,000 continuous horse power, or enough to light the entire city and furnish all the motive power needed to do its work. The feline motor will do away with steam. Ten years from now, I venture to say, there will not be a steam engine in active operation in the United States."

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SUBSCRIPTIONS

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

EDITOR'S ANNOUNCEMENTS.

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

OUR SPECIAL CONVENTION NUMBER.

The National Electric Light Association of the United States has conferred honor upon Canada by selecting the city of Montreal as the location of its next semi-annual convention.

The Electrical News proposes to mark appreciation of the event by publishing early in August a special Convention Number, which is designed to be attractive in form and interesting in contents.

This Convention Number will set forth the progress which electricity is making in Canada by descriptions and illustrations of a number of the most prominent enterprises established here within the last decade. Other features of equal interest will assist in making it one of the most attractively interesting publications ever issued in Canada.

A large number of copies will be printed and placed in the hands of owners and managers of electrical industries throughout Canada and the United States A liberal distribution of copies will also be made at the Convention.

Several Canadian and American manufacturing companies have already engaged advertising space in this Convention Number, and many others will doubtless see the advantage of being represented in its pages. The terms have been made as reasonable as possible, and we have no hesitation in saying that those who have announcements to make to the users of electrical and steam apparatus can by no other means reach so effectively and economically the desired constituency.

Some of the leading spirits in the Canadian Association of Stationary Engineers are of the opinion that the reading of two or three papers on pertinent subjects would form an interesting and instructive feature of the annual meeting in September, and negotiations are in progress with a view to carrying the idea into effect. The step is in the right direction and should be heartily received by the membership.

As there will be a considerable number of delegates to the forthcoming convention of electric light men in Montreal who will pass through Toronto either going or returning, or both, it would be a graceful act on the part of Toronto electricians to make some provision for their entertainment and convenience in the city. We suggest a meeting of local electricians to devise ways and means to keep up the reputation of the Queen City for hospitality and goodfellowship. A headquarters should be established as a rendezvous for the electrical pilgrims while in the city, with representatives of the electrical fraternity on hand to do the honors in the most agreeable manner and make their stay amongst us a feature of the convention. Let us hear from our Toronto representatives without delay.

"A little laughter now and then
Is relished by the wisest men."

For this reason we do not apologize for printing in another column a telegraphic report from Dane County, Wis., to a Toronto daily paper, under the caption of "The Feline Motor" The electrician, notwithstanding his daily struggle with the equation $C\frac{E}{R}$ and its concomitants, is as capable of enjoying a good joke as well as any man that breathes. Having also a keen appreciation of what is becoming known as the "electric fake," he will be abundantly repaid by perusal of this piece of richly humorous satire. Colonel Sellers died too soon, for this so-called "electrical age" would have offered brilliant opportunities for his peculiar genius. The enthusiastic way in which the Dane County professor figures up the millions of horse-power available, and his anxious solicitude that the poor man's family should have all the luxuries of electric lighting, reminds us of a half-forgotten face we used to know in former days, but in the closing paragraph we recognize and welcome an old, familiar friend "Ten years from now, I venture to say there will not be a steam engine in operation in the United States." The most suggestive and absurdly funny climax to the whole business, however, is that the man who called our attention to the report in question believed it to be the relation of a solemn and actual fact.

In these days when everything that savors of monopoly is unsparingly denounced, it is refreshing to run across a business which can best serve the public while it remains a monopoly, and in which competition has the effect of raising prices instead of reducing them. This unique position is held by the telephone exchange. It is a business that can best be described as a natural monopoly. When that feature is destroyed, its usefulness is gone. A competing exchange, if established, would only succeed in dividing the business so that public offices or business men would require the instruments of both concerns in order to reach their clients. The outcome of the fight now going on in Toronto where an opposition to the existing order of things has been inaugurated, is being watched with the deepest interest by not only the citizens here, but by the other cities in the province. Owing to real or fancied grievances the opposition at first developed considerable strength, but as soon as it was realized that competition did not compete, the feeling grew that if the existing company met the citizens' views in a fairly reasonable manner, it would be better to leave them in undisturbed possession of the field. Two companies, each receiving half the present rates, could not long exist. The result would inevitably be amalgamation in the future, with increased rates and the streets disfigured with a double lot of lines and poles, so that the last state of the citizens would be incomparably worse than the first.

Water power has heretofore been considered a very desirable factor in electric lighting operations, and where it can be obtained within reasonable distance it has considerable value. There are few water powers, however, that have sufficient capacity for electric purposes on a large scale, and when they do exist, are already in use and have a value that leaves but a small margin of advantage over steam. A number of small plants throughout the country that have been established on small water privileges of over estimated capacity have had to resort to steam. The troubles incidental to ice in winter and drought in summer, have in a many cases reconciled the proprietors to the change. The rival of the water privilege is, however, looming up with considerable prominence. We refer to natural gas. The immense gas wells near Welland, from which the product is now being piped to Buffalo, are a case in point. It is evident from indications that cannot be mistaken by the practiced eye that these veins of natural gas underlie a great portion of the province. We believe that in or near Toronto gas may be obtained in large quantities, and we base the belief on the fact of gas having been actually obtained in small quantities in several localities. The deepest bore probably is the one on the asylum property at Mimico, which was put down for the purpose of obtaining water. Gas is produced by this well, and if the drilling had been done with a view of obtaining gas it would probably have been reached in large quantity. A gas well must be a dry hole—that is, must have the water cased off as it goes down. The water has a tendency to drown out and shut off whatever gas may be present. As water was the prime object of this well, it was, of course, not cased off consequently the usual result, not much gas. With a liberal supply of natural gas near his plant, the electric light man will have no occasion to sigh for Niagara or any other falls to enable him to compete with any and every system of illumination that has yet been devised.

It is a pleasure to know that several meetings have already taken place in Montreal for the purpose of making proper arrangements for the reception of the members of the National Electric Light Association on the occasion of the approaching convention. Prof. Bovey, of McGill College, is at the head of the undertaking, and many prominent citizens are lending their assistance. There is, therefore, no reason to fear that the credit of the city of Montreal for hospitality will be fully sustained, and the pleasure of the visitors during their brief sojourn among us assured. His Excellency, the Governor-General, has communicated to Prof. Bovey the assurance of his deep interest in the convention, his pleasure that it is to take place in Montreal, and his purpose if possible to be present. The following gentlemen have been appointed as the Exhibition Committee: James I. Gulick, Chairman National Electric Light Association, 136 Liberty St., New York; M. D. Barr, W. A. Johnston, Frederic Nicholls, W. J. Morrison and J. Wright, Toronto, John Carroll, Prof. John Cox, A. J. Corriveau, Frank Redpath, S. C. Stevenson, Montreal, Gen. C. H. Barney, W. J. Hammer, New York, Henry Hines, Pittsfield, Mass., F. Ahern, Ottawa, Ont., A. A. Dion, Moncton, N. B. The advisability of postponing the date of the convention from August to September is being considered, and will be decided upon by the Executive Committee at a meeting to be held in Montreal a week hence. We incline to the belief that the weather in September would be found to be much more conductive to comfort and pleasure than in August

It has been our opinion for some time that a successful and commercially practicable storage battery will only be obtained by a radical departure from the well-thumbed method that was the outcome of the experiments of Faure. Experience with accumulators of the lead type—in which one inventor's only differed from another in the various forms of leaden grid intended to hold the oxide or active material in position—has but confirmed us in this belief. The deterioration constantly going on in the cell by irreversible chemical action, and the mechanical result of this chemical action in disintegrating and distorting these plugs of active material, results in the speedy destruction, or disability of the positive plates; and when in street car work the severe demands made on the battery, many times in the course of a trip, together with the disorganization caused by the shaking up they inevitably receive, are added to the inherent disabilities of this form of battery, it is no wonder that successful realization is not within reach. A more promising system is now under experiment in which the electrodes are respectively iron and copper, with an electrolyte of caustic potash, or more strictly speaking, potassium zincate. The idea is not new, but this is claimed to be a radical improvement on the alkaline accumulators brought out a year or two ago by Desmazure and his associates. The weight for a given power is about 55 or 60 lbs. per horse-power hour as against 100 lbs. for the best form of lead storage batteries. The electromotive force of the couple is small, being about ·8 to ·9 of a volt, but the output is considered very great in proportion to the weight. The experimental trips of a car equipped with this battery appear to have been successful, and to give promise of commercial practicability, which is more than can be ordinarily said of storage battery cars, but of course with this, as with those that have gone before, time alone will tell what its success will be when operated under adverse conditions and by unskilled labor. Some electric appliances have a knack of working triumphantly when operated by an expert scientist, but collapse lamentably when subjected to the everyday test of wear and tear in the hands of the ordinary mortal

It is somewhat singular that up to the present time the enormous energy developed by the falls at Niagara has been so little utilized. Even with the close proximity of the manufacturing and shipping port of Buffalo there appears to have been but a small measure of success in the various attempts that have been made. The hydraulic canal which was inaugurated with such a flourish of trumpets landed its projectors in bankruptcy, and after changing hands several times, is now but of small account. It is a strange comment on the enthusiasm which references to this mighty power almost universally evoke that the electric light station supplying Niagara Falls village with illumination, though well within sound of its deafening roar and almost watered with the spray of the cataract, is driven by a steam engine. There must be a good reason for all this. The principal one, we take it, is, that before factories can be established, there must be a market for the manufactured goods. The fact of power being present in unlimited quantity is no justification for the establishment of factories making goods that nobody wants, simply to use it up. Then again a water power, even under favorable circumstances, costs considerable to reclaim, and the interest on the outlay for real estate, flumes, waterways, turbines and so forth, has to be counted against the cost of steam, which, as a rule, is much less expensive to put in operation in the first place. Fuel is cheap in Buffalo, and the manufacturer has the advantage of his market around him, and is at the headquarters of railroad and navigation communication. It has been found much cheaper to produce the power for the entire electric lighting of the city on the spot than to take advantage of the hydraulic canal already built and practically unused at the falls of Niagara. Although quite feasible to carry arc lighting currents over the intervening space, the initial cost of the water power and interest on cost of the poles and wires would greatly exceed the cost of coal laid down on the spot at Buffalo In 1878, Professor Thomson, then occupying the chair of chemistry in the High School at Philadelphia, demonstrated in the *Journal of the Franklin Institute* the entire feasibility of transmitting by means of electricity the power of Niagara to Buffalo and even New York, but with the level headedness that has since placed him in the front rank of his profession, he saw at once that commercially it would not pay, so to-day it remains the possibility of the scientist rather than the speculation of a man of capital.

There are several schemes before the public at the present time having for their object the utilization of the power of Niagara, the prospectus of some of which combine in a curious manner the cupidity of the speculator and the benevolent intentions of the philanthropist. They want no profit on the land (?), but by figuring the horse power of the famous cataract at so much per horse power per year they are able to run up the profits to a tidy sum. There is a gentle flavor of Montague Tigg about the figures, likewise a suggestion of the Dane County professor, elsewhere referred to, in his elaboration of his scheme to utilize the latent electricity concealed about the 9,997,347 cats in New York city. Unfortunately the inexorable law of supply and demand here again stands in the way The prospective inhabitants of the modern Utopia are expected to buy the land, and *pay* for their water power and undertake the expense of establishing their factories themselves. What chance they are likely to have when we find municipalties elsewhere, with the best of transportation facilities, offering *free* land, *free* water power (unlimited), and exemption from taxation as an inducement to the coveted factory to locate in their midst. But it is the electrical part of these schemes that we wish particularly to comment upon It is quite easy to talk about enormous power works by which enough electricity is to be generated to supply the towns of Hamilton, London, Toronto and so forth, with all their electric lights, street cars, and power for their manufactories. It is quite easy, we say, to *talk* about these things, but another thing to *do* them It is true that elaborate experiments are now being tried in Europe to transmit power over long distances without so great a percentage of loss as to be commercially prohibitive, but from the extreme care that has to be taken at every step, and the fact that with the most perfect insulators suspended in oil the experiment can only be conducted in dry weather, the chances for Toronto would seem to be somewhat remote. An alternating current of tremendous tension has to be employed, making the maintenance of the insulation an almost impossible task. As alternate current motors are as yet somewhat problemetical for distributing purposes, it would be necessary for the receiving transformer to work a large motor, which again would drive a dynamo of lower tension to distribute a direct current. We thus have (1) a low tension alternating current generated at Niagara; (2) then transformed to a current of intense electromotive force; (3) re-transformed to a lower e.m.f.; (4) utilized to drive an alternating motor; (5) which again would drive a direct current dynamo, (6) to distribute to consumers. Take into account loss at each of these changes, interest on cost of all this equipment, copper conductors 80 miles (as it is impracticable to cross the lake), cost of operating plant at generating and receiving end, repairs to all this high pressure business, and we think we are safe in saying that coal can be laid down in this city for equal power at one-fifth the cost. We think the youngest engineer that now manipulates a throttle in this the Queen City of the West, will grow grey in the service if he waits until he is displaced by the advent of electricity, "Monumental" or otherwise, that is generated by the power of the cataract of Niagara.

MONTREAL NO. 1, C. A. S. E.

Editor ELECTRICAL NEWS.

DEAR SIR,—As things are running nicely to-day, I thought I would embrace the opportunity to send you a word from Montreal No. 1, C.A.S.E. We have at present about 50 members in good standing, and at nearly every meeting we have a candidate for initiation. The officers are all live, wide-awake men, and I am sure work hard for the interests of the Association, but somehow they do not receive proper support from the members. There has been from the start a lack of interest on the part of some of the members. There seems to be an improvement now, but not to the proper extent. We have very small meetings at times, and this has a discouraging effect, as very few men care to talk to empty seats.

I would say to those members who stay away, that the day is not far distant when they will be sorry that they did not take advantage of the discussions that are held in our hall every Thursday evening.

Some will say "I am a practical engineer, and don't want any theory or book learning." To these I would say, remember the Vice-President's charge, viz., "Practice and theory combined will make you succeed where ignorance and carelessness will surely fail." They must remember that it is not the trade that elevates the man, but it is rather the man that dignifies the pursuit or calling; and that muscular power, though very good in its place, is not the most essential requisite of an engineer, but that the cultivation of the mind is the first step towards eminence in any trade or profession.

Again, you will often hear the remark, "What is the use of a man wasting his time learning all these rules and formulas, when there are so few openings for a first-class man?" My answer is: Get the information to make you a first-class engineer, and you will find scores of openings—in fact you will be in demand. You will seldom find a good mechanic walking the streets looking for a job. They are in demand. As I have taken up more of your valuable space than I intended I will cut this short, hoping that it may set some of the boys thinking.

Yours truly,

JOHN JACOB MCGINTY.

THE FIRST IN CANADA.

We have recently gone into the manufacturing of copper and brass for electrical purposes," said Mr. Fairman, President of the Dominion Wire Manufacturing Company, Montreal, to an ELECTRICAL NEWS representative. "You see," he continued, "we discovered in the Blue Book for 1889 that over 250 tons of copper wire was annually imported from the States to this country, and we thought there was an opening for us in the drawing of copper wire. The prospects were that the business would be small to begin with but in a few years would grow considerably larger In anticipation of this trade, we entered into communication with the largest copper mill in the States and made arrangements by which they agreed to roll down the pure lake copper bars into rods for us at a reasonable figure and also to assist in building a mill here. This was carried out We were obliged to add a large wing, 150 feet by 60 feet, to our works at Lachine, also to put down expensive furnaces and machinery, costing, when completed, over $35,000. This plant and machinery, we fear, possessed greater productive capacity than the requirements of the country demand, producing ten tons per day of pure electric copper wire, which means about 3,000 tons yearly, while the consumption of Canada to-day is not more than 400 tons annually. This being the case, we can only run our furnaces two days in a week, and then let them cool down. Were it possible to keep running all the time we should be able to turn out the wire as cheaply, or even cheaper, than it is made in the States. Experienced men from there, to whom we have submitted samples for inspection, give testimony that it is of superior quality. Our mill is the first ever established in the Dominion for the manufacturing of copper wire. This is, as I said, a new branch for us. But, in addition, we manufacture all kinds of steel and iron wire, also barbed wire for fencing, brass wire, hay-bale ties and brass and steel wood screws."

Mr. Fairman then gave the reporter some interesting information about his works at Lachine, in which it came out that the company employs about 350 men, and have a monthly pay roll of over $10,000. The coal bill is also a large item, as payment for over 5,000 tons of coal is sent to Nova Scotia every year.

ONTARIO ASSOCIATION STATIONARY ENGINEERS.

THE incorporators as named in the Ontario Engineers' Act met in Toronto on the 25th ult. pursuant to the requirements of the Act, for organization.

Officers were elected as follows. President, A. M. Wickens, Toronto. Vice-President, R. T. Dickinson, Hamilton. Registrar, John A. Wills, Toronto; Treasurer, Robert Mackie, Hamilton.

Members of the Board will retire in the following order: S. Potter and R. T. Dickinson, Hamilton, A. Ames, Brantford, John Galt, M. E., Toronto, 1st year; Jas. Devlin, Kingston, Hugh Fairgrieve, Hamilton, Wm. Sutton and Prof. J. Galbraith, Toronto, 2nd year; R. Mackie, Hamilton, Wickens, Edkins, Wills, Toronto, 3rd year.

On motion of Jas. Devlin, Kingston was selected for the next annual meeting, which will take place on May 25th, 1892.

A Committee to draft by laws was appointed, consisting of the Toronto members of the Board; also a Committee on a form of certificate. These Committees are expected to work quickly and report forthwith. If possible it is intended to have every thing in shape to issue certificates by the 1st of July.

The meeting was very interesting and harmonious, and it is evident from the interest taken that a great number of engineers will avail themselves of the opportunity to take out certificates.

TORONTO BRANCH NO. 1 C.A.S.E.

AT last regular meeting of Toronto Branch No. 1 C.A.S.E., held in room D Shaftesbury Hall, on Friday, May 22nd, President A. E. Edkins, presided. After routine business had been disposed of, Mr. A. M. Wickens commenced a series of short lectures on electricity and dynamo machinery. He commenced by giving a list of the terms most commonly used in the study and applications of electricity, explaining these terms and comparing them with the terms used in steam engineering, and which have the same meaning in steam engineering (to the engineer), as the volt, ampere, ohm, etc., have to the electrician in electric engineering. Mr. Wickens also went into magnetism, and explained how magnets and permanent magnets were constructed, as well as the construction of the dynamo and motor in all their parts, in such a plain and comprehensive manner, that every member of the Association present, who gave attention to his remarks, could not fail to learn something of the (supposed) mysteries of the electric dynamo and motor.

Before the Association adjourned, a hearty vote of thanks was tendered to Mr. Wickens for his interesting lecture, to which he made suitable reply.

On motion of the vice-president, a committee of five were appointed to purchase some of the best books on steam engineering and electricity, the same to be kept in the Association's room for reference in settling, when necessary, any question or argument on these subjects.

Any engineer in or around the city of Toronto who feels that he would like to become a member of the C.A.S.E. and help the cause—and *himself*—can get all necessary information by applying to the Secretary, W. G. Blackgrove, *27 Brant street, engineer with Jas. Morrison, Adelaide street* west, or to A. E. Edkins, President, 22 Agnes street, engineer with T. Eaton & Co., Yonge street, or to W. Lewis, Vice-President, engineer with Toronto Silver Plate Co., King street west.

The various Associations of the C.A.S.E. intend meeting for a picnic at Oakville on Dominion Day, when they will be glad to have the company of all engineers, whether members or not, who will join them.

WIDTH OF SINGLE LEATHER BELTING.

By R. GRIMSHAW.

THE following table, here published for the first time, gives the widths of 7/32 inch leather belting required to carry various horse powers at various speeds per minute; the belt being in good condition and wrapping half-way around cast iron pulleys, also in good condition. The tensions allowed for are such as to put no injurious strain on single leather lacings while permitting no slippage of the belt on the pulley.

The conditions and results are such as would be approved and desired by leather belting manufacturers for belts of their own make running in their own shops; in other words, where they wished, as consumers, to get the best life, drive, and money's worth out of the belts used.

WIDTHS OF SINGLE LEATHER BELT REQUIRED.

H. P.	Belt Speeds, Feet per Minute.								
	1,000	1,250	1,500	1,750	2,000	2,250	2,500	2,750	3,000
5	3.25	2.60	2.17	1.86	1.63	1.45	1.30	1.18	1.08
10	6.50	5.20	4.34	3.72	3.25	2.89	2.60	2.36	2.17
15	9.76	7.80	6.50	5.57	6.88	4.34	3.90	3.55	3.25
20	13.01	10.41	8.67	7.43	6.50	5.78	5.20	4.73	4.34
25	16.26	13.01	10.84	9.29	8.13	7.23	6.50	5.91	5.42
30	19.51	15.61	13.01	11.15	9.75	8.67	7.80	7.09	6.50
35	22.76	18.21	15.17	13.01	11.38	10.12	9.10	8.28	7.59
40	26.01	20.81	17.34	14.86	13.01	11.56	10.40	9.46	8.67
45	29.26	23.41	19.51	16.72	14.63	13.01	11.71	10.64	9.75
50	32.52	26.01	21.68	18.58	16.26	14.45	13.01	11.82	10.84
55	35.77	28.62	23.85	20.44	17.88	15.90	14.31	13.01	11.92
60	39.02	31.22	26.01	22.30	19.51	17.34	15.61	14.19	13.01
65	42.27	33.82	28.18	24.16	21.14	18.79	16.91	15.37	14.09
70	45.53	36.42	30.35	26.01	22.76	20.23	18.21	16.55	15.18
75	48.78	39.02	32.52	27.87	24.39	21.68	19.51	17.74	16.26
80	52.03	41.62	34.69	29.73	26.01	23.12	21.81	18.92	17.34
85	55.28	44.22	36.85	31.59	27.64	24.57	22.11	20.10	18.43
90	58.53	46.83	39.02	33.45	29.27	26.01	23.41	21.28	19.51
95	61.78	49.43	41.19	35.31	30.89	27.46	24.71	22.47	20.59
100	65.03	52.03	43.36	37.16	32.52	28.90	26.01	23.65	21.68

—N. Y. *Electrical Engineer.*

BOILER INCRUSTATION.

SOME experiments made about twenty years ago, on the non-conducting properties of boiler scale, gave astonishing results. The effect of scale accumulation is given as follows: 1-16 in. thick requires 15 per cent more fuel; ¼ in. 60 per cent. more fuel; and at ½ in. thick, 150 per cent. more. This we presume contains some guess work, but if varying from the truth, is not too great an estimate of loss by incrustation. This, however, is by no means the main fact in the matter, at least where fuel is cheap. The destruction of boilers, and danger, are more important still.

To produce steam at 90 lbs. pressure in a clean boiler, only 325° of heat are required, but with heavy scale this temperature must be increased 200° to 300°. For ½ in. of scale the heat must be 700°, or almost a low red heat for the iron. The life of a boiler has no measure of time under these circumstances; so there is neither security nor economy in working encrusted boilers, and no one will do it who is acquainted with the facts above given.

We have had a good deal of experience in the use of solvents and precipitants, also without them, especially with water depositing scale of the carbonates of lime and magnesia, and believe there is scarcely any case where scale may not be prevented by the use of proper compounds chemically adapted to their purpose. As to picking and chaining off hard scale, we believe it to be impracticable. Men can not be trusted with such work, even if it could be done.—*Industry.*

RIBBED TUBES FOR BOILERS.

A SERIES of experiments have just been concluded with a new kind of marine boiler tube, which promises to have considerable effect on the future of steam propulsion. The external surface of the tube shows no difference to the ordinary pattern, but internally it is ribbed longitudinally according to a plan patented by M. Serve. These ribs are spaced one-eighth of the internal circumference apart, and are about one-sixth the internal diameter apart.

The experiments were conducted with two boilers of the same size and pattern in all respects, excepting in the matter of tubes. The boilers are ten feet six inches in length, and the same in diameter. The grate surface in each is 31 square feet. The total heating surface of the boiler fitted with the Serve tubes is 1,536 square feet, and of the other 956 square feet. The tubes are of the same diameter in each boiler, and each has 126. A twelve hours' trial was carried out on October 22, each boiler under the same conditions burning 11,872 pounds of coal, but whereas the Serve boiler evaporated 114,600 pounds of water, the other only evaporated 103,000 pounds; or, the Serve boiler made 9.65 pounds of steam for every pound of coal burned, and the other 8.67. That is to say, the Serve boiler evaporated one pound of water more than the other did for each one pound of coal. If this advantage should prove to be the same in the actual practice of using the steam, the efficiency of the ordinary marine tube boiler will have been increased more than ten per cent., and this, added to the advantages gained by the use of steam at high pressure, will bring down the coal consumption per I. H. P. per hour almost to the vanishing point. London *Field.*

WHERE TO CUT-OFF.

A CORRESPONDENT of *Power and Transmission* asks: "I want to get 55 pounds mean effective pressure on my engine, and wish to know where to cut off if I have 60 pounds on the boiler, and where if I have 75 pounds. I am told that the clearance is 5 per cent." Our contemporary's answer is as follows: In the case with only 60 pounds on the boiler, you would probably have only about 55 or so in the cylinder to start with, and could not cut off at all; you would need full steam. *In fact*, you might start with 55 pounds initial pressure and by reason of condensation, wire drawing, etc., have less than 55 pounds M. E. P., even with full steam all the way out.

To get 55 pounds mean effective pressure, requires $55 + 14.7 = 69.7$ pounds average total pressure. This with 74.7 pounds initial, calls for $69.7 \div 69.7 = 0.933$ as much average total as total initial pressure. Allowing 5 per cent. clearance we shall try various actual expansion rates until we catch one which figures up right; for this problem in engineering must always of necessity, where there is clearance, remain one of "cut and try."

We shall try 1.1 actual expansion rate. Its hyperbolic logarithm is 0.0953 and as with clearance 5 per cent. it would call for cut off at 0.9045 stroke, it would give an average total pressure of 0.9955 times the initial total. This would be too much.

Trying 1.3 actual expansion rate, which has 0.2624 as its hyperbolic logarithm, it calls for cut off at $(1.05 \div 1.3) - 05 = 0.7577$ stroke, and gives an average total pressure which is $.8077 \times 1.2624 = 9696$ the initial total. Still too much.

Trying 1.6 (hyp. log. 0.47) this calls for cut off at .6063 stroke and gives average total 0.9148 not enough, so we must search between 1.6 and 1.3.

Trying 1.5, which was hyperbolic logarithm of 0.4055, and calls for cut off at 8.65 stroke, we find that it yields 0.9339 as much average total as initial total. This is practically what is wanted; so very trifling less amount too late that it is not worth considering.

For 75 pounds boiler pressure by the gauge (69.7 pounds absolute) the same class of calculations can be carried on.

RECENT CANADIAN PATENTS.

No. 36261. J. E. Waterous, Journal box.
No. 36264. F. Field Steam boiler.
No. 36270. C. Carlyle, Steam engine.
No. 36280. M. Johnson, Steam pump.
No. 36350. E. McCluer, Metallic circuit system.
No. 36355. D. Dorrance, Grate bar.
No. 36363. C. Ouston, Fuel saving compound.
No. 36380. F. L. Decarie, Stop valve.
No. 36381. J. Wood, Dynamo.
No. 36382. " Arc lamp.
No. 36383. " Journal bearing.
No. 36387. P. Hathaway, Galvanic battery.
No. 36398. D. C. Adams, Smoke consumer.
No. 36401. W. H. Hodge, Pulley.
No. 36402. J. A. Woodman, Electric wire protector.
No. 36435. R. James, Cut off valve.
No. 36448. H. Coodson, Valve.
No. 36453. E. Tregurtha, Steam boiler.
No. 36470. J. Van de Poele, Electric railway.
No. 36473. W. Morrison, Boiler.
No. 36481. H. Peterson, Furnace.
No. 36482. W. Hodgdon, Telephone.
No. 36490. A. Barrett, Electric conductor.

COMPOUND COMBUSTION.

At this day, probably, more than at any other, has the subject of fuel and combustion received the greatest consideration. From a sanitary point of view the question of smoke abatement is a serious one and one that is receiving attention not heretofore given it. The question of economy is a considerable item in the consumption of fuel, as the greatest amount of serviceable heat from the least amount of fuel is an end desirable to attain. The *Irish Textile Journal* contains an article on this subject which is of present and practical interest, and it deals with the subject from the correct view:

In connection with commercial and industrial enterprise, the efficient and economic generation of steam probably affords a wider field than any other for the profitable application of technical skill and inventive ingenuity. The best practice in modern boilers shows that little more than one-half of the available heat contained in the fuel is transmitted to the water for its conversion into steam, while it is notorious that the bulk of this surplus heat is wasted in the chimney. Nor is the enormous pecuniary loss resulting from this wasteful misuse of coal less objectionable than the injury and inconvenience arising from the escape of the unutilized constituents of the fuel; for it is indeed only in rare and isolated instances that the generation of steam is effected at all without the concurrent production of voluminous clouds of poisonous smoke. For half a century mechanical ingenuity has been exhausted in striving to remove or mitigate these evils. Enough has been written to prove the utter inefficiency of the present means of burning raw coal, until the conviction has now been established that that method is irremediably wrong.

COMPOUND COMBUSTION.

The general adoption of its correlative will enable the enormous annual loss resulting from the present wasteful use of coal to be almost entirely avoided by the expedient of placing fuel in a closed chamber, and maintaining it at an incandescent heat by forcing in a supply of air, the oxygen of which combines with the fuel to form what is generally called for want of a better or exact definition producer gas. The formation of this gas is but a preliminary step toward complete utilization of the fuel, and its generation by incandescent heat is referred to as primary combustion. This subdivision in the generation of heat marks its divergence from the present wasteful practice, and emphasizes the means of attaining the consummation now under review, viz. complete combustion without smoke. This preliminary transformation of solid fuel into combustible gas is simple and complete. Its chief peculiarity lies in the fact that all the fuel disappears from the closed chamber with the gas, and leaves no residue but clinky or other earthy matter.

THE GAS PRODUCER.

Passing for a moment from the immediate problem before us to a consideration of the closed chamber just referred to, which is known as the gas producer. Its proper construction is a matter of great moment in the all important point of smoke prevention for it cannot be too thoroughly understood that once formed it cannot be annihilated. The chief provocative of smoke is the volatile hydrocarbons contained in all bituminous coal. That these are given off on the first application of heat is indicated by the appearance of smoke. hence it is of the first importance that this chamber, or gas producer, be constructed to transform these hydro-carbons into permanent or fixed gas, and this can be assured by causing them, in a properly formed structure, to pass through the heated body of fuel before they escape to the outlet pipe or gas main.

Having thus traced the preliminary part of this process for treating coal, the next step claims attention. This consists of oxidizing the producer gas with the oxygen contained in air, or, in other terms, by mixing producer gas with air and igniting them, secondary combustion takes place, resulting in a temperature of about 3,500 deg. F., without smoke. This result is best accomplished in a combustion chamber specially constructed of fire brick, which becomes red hot. and tends to maintain a constant equable temperature, although this is of lesser moment when the air supply is already warmed by radiant heat from the producer, which can be surrounded with an air casing constructed of thin iron plates for this purpose.

This supply of heated air should be admitted through a grating, or regulating valve, so that the requisite amount only be admitted to the gas to insure the best results; also, a sight-hole is usually provided to afford inspection of the interior of the combustion chamber, so that these ends may be fully attained. Simplicity may be said to characterize this process, and this designation applies equally to the structure or plant as well as to its manipulation. The generation of gas and also its combustion are under instant and complete control, being regulated, in each case, simply by the admission of air. The entire process is simple, safe, and efficacious, requiring neither elaboration of plant, nor skilled labor. A wide range has already been afforded to the employment of

GAS FUEL.

Commencing with the splendid achievements of the late Sir W. Siemens in its application to metallurgical purposes, it has gradually been adopted for other industries requiring calorific intensity, until the principle has become familiar to many leading manufacturers, and its special suitability to steam boilers fully recognized. In this capacity a double economy is conferred, since it demands less labor and less coal, without necessarily increasing the first cost over ordinary boilers. Practical results are attained that place gas firing in an unassailable position as a simple means of perfecting combustion, and also a rational solution of the pestilential smoke problem. Several of these results have already been given in this journal, and it is intended to supplement the principles and practice then published by now supplying diagrams of a steam boiler combined with producers for supplying the gas, so that these means of attaining the economies now under consideration may be fully understood, and their general acceptance thereby facilitated, to the pecuniary benefit of manufacturers, and the sanitary improvement of bleach greens and other cognate industries.

MECHANICAL DRAUGHT.

With the abolition of smoke, the disappearance of chimneys may be reasonably anticipated, as the air supplied to furnaces no longer depends upon induced draught, but is supplied by mechanical pressure. It is generally asserted and believed, that from one-quarter to one-half the total available heat of boilers passes away to the chimney. During some steam trials conducted by government experts on the 9th of November, 1889, the temperature of escaping gases in the chimney frequently exceeded the limit of the thermometer then used, viz., 860 degrees F., thus showing how immense volumes of heat are lost, even under favorable circumstances and careful management.

LOSS OF HEAT IN CHIMNEYS.

There are many common errors as to chimney temperature, one of which is that a high temperature therein argues a considerable loss of heat from the furnaces; but this does not by any means necessarily follow, for, if the combination of fires be imperfect, a large proportion of the gases pass away unconsumed, with the effect of lowering the funnel temperature; but, on the other hand when the gases become thoroughly consumed a much larger amount of heat is generated, and, though the chimney temperature may be higher, yet a very much larger relative proportion of heat gets into the boiler to perform useful work. The temperature in a furnace in which incomplete combustion is taking place—that is, in which a proportion of the gases passes away in the form of carbonic oxide—may be, say, 2,000 deg. F., and the chimney temperature 500 deg. F. If the combustion is then completed, and the carbonic oxide instead of escaping becomes converted into carbonic acid, the furnace temperature may rise to 3,000 deg. F., and that of the chimney to 800 deg. F.

CHIMNEY GASES.

The Research Committee on marine engine trials have recently issued tables giving an analysis of chimney gases which show them to consist (approximately) of

Carbonic acid	10
Oxygen	10
Nitrogen	80
	100

while their temperature varied from 500 deg. F. to 800 deg. F., and as the whole of this heat passed away through the chimney, it was entirely lost. An American writer has remarked. "That the time is approaching when tall chimneys will serve no more useful purpose than that of monuments to the folly of their builders."

CHIMNEYS ABOLISHED.

This aspiration is now realized in a startling manner by a very simple device in connection with gas producers, which heralds a new era in the history of combustion. It is the advent of a discovery that enables part of the waste gases being revivified, and so converted again into combustible matter, in addition to the abolition of smoke. To make clear these simple means of utilizing waste heat and restoring chimney gases to a combustible condition, it will be necessary to explain how the principal combustible ingredient—carbonic acid—is first made.

In the ordinary gas producer, as is well known, air is admitted to support primary combustion by its oxygen combining with the fuel to first form carbonic acid; this (non-combustible) gas then passes through the superincumbent fuel within the producer, where it absorbs more carbon, and so becomes the potent combustible, carbonic oxide. The gas is then led to a combustion chamber lined with fire brick, when secondary combustion will take place on the admission of air, resulting in a temperature of about 3,500 deg. F. without smoke.

By now referring to the composition of the waste chimney gases, as given above, it will be clearly understood that, by abstracting from them the incombustible carbonic acid and returning it through the hot fuel of the producer, it absorbs more carbon, and agains becomes the potent combustible, carbonic oxide.

UTILIZATION OF WASTE HEAT.

By this simple and expedient method, much of the waste heat is also returned to the producer with the carbonic acid and profitably employed. The distinguished characteristic of gas firing is the absence of smoke; and by utilizing a portion of the waste gases as indicated above, no chimney will be required, as the air to maintain combustion is supplied at a pressure, so that a moderately sized outlet pipe only is necessary for dispersion of the remaining waste gases. By this system no chimney is necessary, either for creating a draught to induce a flow of air to the furnaces, or as a conduit for smoke. The only exit pipe required for the waste products of combustion may be compared to the exhaust pipe from a large gas engine, and it may be lead through a wall into an open space, or conducted to the roof of the boiler house.

GASEOUS FUEL

is thus shown to be an economical method of realizing the maxima amount of heat from fuel by a system that has been designated compound combustion, because it rationally converts the solid into the gaseous state by primary combustion, and then completes the process by secondary combustion. It is characterized by the entire absence of smoke, useful effect from all volatile hydro carbons is secured, no coke or cinders are deposited, and by revivifying a portion of the waste gases, the chimney, or at least that towering structure for dissipating heat, may be finally dispensed with.

That this beneficial process entails less expenditure for original cost, working expenses and maintenance than ordinary steam boilers, is worthy of serious consideration by those who sustain our national industries, often in the face of keen competition both at home and abroad. In those interests the principles, practice, and experience gained by its use have already been set forth on various occasions in the pages of this journal, and it is with the same regard for legitimate and well-directed economy that attention is again directed to a channel for securing the utmost benefits from—while rejecting some of those adverse conditions that have too long characterized—the combustion of coal.

REPAIRING INCANDESCENT LAMPS.

A FRENCH engineer (M. Pauthonnier) has devised a process of repairing incandescent lamps quickly and economically, that is, a broken or worn out filament is renewed. The French technical journals declare that the process is really practicable, and saves money. *L'Electricien* says that the process is to be introduced into the United States at once, and on an extensive scale. The London *Electrical Engineer* observes that the attempts have been made to render the repair of broken filaments a practical trade, and, in reference to the Pauthonnier process, says that the life of the repaired lamp is at least equal to the original

The process gone through is as follows:

The glass-blower takes the lamp and makes at the top a hole large enough to admit a new filament. The lamp thus opened is passed to a girl, who, by means of special nippers, cuts the broken filament, which she removes, being careful to leave on each platinum support about one millimetre (about one-twenty-fifth part of an inch) of filament. A second girl takes the prepared lamp and places it in a socket to which current is lead; she then fills the bulb with a hydro-carbon liquid, and introduces a new filament previously standardized. By the aid of a pair of special pliers she touches the filament to one of the ends left, and turns on the current. The liquid becomes decomposed into hydrogen, which rises through the liquid, and into solid carbon, which is deposited upon the joint, firmly connecting the filaments together. The same is then done for the other end of the new filament. The next process is the cleaning of the glass bulb, which, it is stated, becomes, if anything, cleaner than the new lamps. The glass-blower then takes the lamp again, attaches a tube of glass to the opening made, and the repaired lamp is then exhausted, the process of exhaustion taking three-quarters of an hour, each pump carrying five lamps. The bulb is then closed in the usual manner. The different operations described are performed very rapidly, and form an elegant and practical process, and may be repeated many times. For "Sunbeam" lamps the process is easier still on account of the size, and may be performed either to replace filaments or to clean the bulb.

ELECTRICAL ENTERPRISE IN MANITOBA.

MR. Wm. Bathgate, of the Manitoba Gas and Electric Light Company, recently invited the members of the city council to the works of the company in Winnipeg.

The boiler house is 70 ft. long by 40 ft. wide. There are nine steel boilers of 740 h.p. One hundred pounds of steam is carried. The smoke-stack is 100 ft. high, and five ft. in diameter. The engine and dynamo house is 80 ft. square and contains two pairs of compound surface condensing Brown automatic engines of 200 and 400 h. p. respectively. The driving wheel of the 400 h. p. engine weighs 16½ tons, and is 18 ft. in diameter and 40 inches face, and drives the largest belt that has been made in Canada—three ply, 3 ft. 4 in. wide and 88 ft. long. The shafting with which it is connected is fitted up with friction clutch pulleys made by the Vulcan Iron Company, from which are run two Thomson-Houston arc machines for city lighting and one 1,000-light incandescent dynamo, with space for two more large incandescent dynamos. Three incandescent dynamos of 2,000 light capacity are run from the shafting, driven by the 200 h. p. engine as well as the arc dynamos which are used for private lighting. The total capacity of arc plant is 125 lights, 2,000 c.p.; the total capacity of incandescent plant is 3,000 lights, 16 c.p., with capacity for two more incandescent machines of 2,500 lights, to be installed this fall. The pumps in connection with each engine consist of one Blake air pump, one circulating pump, one duplex boiler feed pump, and one large Northey auxiliary pump fitted up with 100 feet of 2-inch hose for fire protection purposes—all driven by steam. The workshop contains a 7 h.p. Otto gas engine furnishing power for blacksmith and machinery shops, which are fitted with two lathes, one 15 foot and one 14 foot bed, screw cutting machines, emery wheel, grindstone, drills and punching machines, all the necessary repairs for both gas and electricity, being done in these shops.

A GOOD SHOWING FOR ELECTRICITY.

CHIEF Inspector McDevitt, of Philadelphia, makes the following statement in his report to the underwriters:

"There are over 5,000 buildings in Philadelphia wherein electric currents are used for light and power purposes. Of this number, 287 buildings (seven of which are dwellings) have their own apparatus, the latter varying in size from a 20-light to one of 4,000 lights. The number of lights furnished by these private plants aggregates 80,258 incandescent and 3,325 arc lights. One retail store contains 482 arc lights. There are fifteen public stations distributing electric currents to all sections of the city, furnishing thousands of lights and power to dwellings, churches and other classes of buildings. The number of lights supplied by these respective stations varies from the small station furnishing 2,000, to the Edison, which furnishes over 40,000 incandescent lights, and current for a large number of motors. The electric motors in use are of a capacity ranging from one-eighth to thirty horse-power (being used to a great extent as a substitute for laborious hand or foot-power in dwellings and small workshops), and are being rapidly introduced as a more ready motor in place of steam and hydraulic power in propelling machinery. No insurance loss occurred in any building in our city during the past year from fire where the cause could be in any way attributed to the electric wires."

SPARKS.

The town of North Bay, Ont., is shortly to be lighted by electricity.

The question of electric lighting is being considered by the towns of Milton and Acton, Ont.

The village of Creemore, Ont., will soon be in the enjoyment of arc and incandescent electric light.

The directors of the Fort Wayne Electric Co. have declared a dividend of 75 cents per share to stockholders.

The municipal authorities of Lachine, Que., have entered into a contract with Mr. A. J. Corriveau, of Montreal, to light the town by electricity.

The New Brunswick Electric Light Company has just closed a bargain to supply the city of St. John with 125 arc lights, which are to be in operation in six weeks.

The Canadian Pacific telegraph line is now completed to the boundary at Sumas, and one wire is in operation from Seattle, Wash., through to the Canadian Pacific main line.

Joseph Pelletier, an employee of the Standard Electric light Company, Ottawa, while working on the top of a 50 foot pole missed his hold and fell to the sidewalk. He died while being conveyed to the hospital.

The Edison General Electric Company (Canadian district) have moved into their new warehouse, "The Edison Building," 77 Bay Street, Toronto. The offices are very conveniently arranged and nicely fitted up, and when their display room is completed, they will have quite an elaborate display of electrical apparatus.

The following is the rule for calculating the amount of exciting power that is required for an electro-magnet pulling at its armature, in the case where there is a closed magnetic circuit with no leakage of magnetic lines. Take the square root of the pounds per square inch; multiply this by the mean total length (in inches), all round the iron circuit; divide by the permeability, and finally multiply by 2,661; the number so obtained will be the number of ampere turns.

The Vancouver Coal Co. has ordered a complete electric plant for mining purposes, consisting of an underground tramway with power sufficient to maintain a speed of eight or nine miles per hour with 150 loaded cars constantly moving. There will be 600 incandescent lamps for use in the under-ground workings, and the drills and cutting machines will also be operated by electricity. The plant will cost between $50,000 and $100,000. This is understood to be the first introduction of electricity for mining purposes in Canada. The Edison Company are supplying the outfit.

We take pleasure in directing the attention of those engaged in electrical enterprises in Canada to the advertisement of the Vulcanized Fibre Co., which appears for the first time in the pages of this number. The Company began the manufacture of vulcanized fibre about ten years ago. The material is produced by treating specially prepared vegetable fibre with powerful chemical agents, whereby the exterior portion of each separate fibre becomes glutinous, and while in this condition the whole mass is consolidated under very heavy pressure and becomes practically homogeneous. After this the chemicals are extracted, the mass is manipulated, rolled, pressed, and cured by various methods. It is designed for use in railway, electrical and general mechanical work, and is said to be an excellent insulator for dry positions.

A project is on foot, the object of which is to hold a union pic-nic under the auspices of Toronto and Hamilton branches, Canadian Society Stationary Engineers, on Dominion Day. Oakville will probably be selected as the location. It is hoped that London, Brantford and Stratford Branches will also be well represented on the occasion. There is nothing like a dinner or pic-nic to promote acquaintanceship and indirectly the welfare of the Association. Here's to the pic-nic.

SPARKS.

The Royal Electric Co., of Montreal, have generously donated a 10 light arc dynamo to McGill University for use in the electrical engineering department.

The arc light plant installed by the Edison General Electric Co. at Niagara Falls, was started up last week, and is pronounced by the local company an unqualified success.

The Edison General Electric Company have moved their works to Peterboro', and expect to get their machinery in operation about June 1st. They will employ a staff of about 500 men.

The Edison General Electric Company have closed contract with Hector McRae, Ottawa, for an electric percussion drill and hoist for use in his phosphate mines in Templeton. The plant will probably be in use in June.

The Edison General Electric Co. have recently closed a contract with the Winnipeg Street Rail. Co. for 100 h. p. generator and four extra car equipments. It is expected that this plant will be in operation about June 10th.

The Edison plant installed in the Ontario Rolling Mills at Hamilton, Ont., consisting of ten 2000 c. p. arc lamps and 135 incandescent lamps, is running very successfully, and the new arc system is pronounced a decided success.

The Eastern Electric Co., of St. John, N. B., operating Edison system, are making very rapid progress. They have already over three thousand lights in operation, and have recently added two 750 light Edison dynamos to their equipment.

The Royal Electric Co. report the following business for the past month: Sold the Roberval Hotel Co., Lake St. John, Que., a 300 light incandescent dynamo and a 15 arc light plant; the Sherbrooke Gas & Water Co., one 500 light alternating incandescent plant; the St. John Gas & Electric Light Co., of St. John, N. B., one 1200 light alternating incandescent plant; the St. Johns Electric Light Co., St. Johns, Nfld., one 30 light arc plant; R. B. Angus, of Montreal, for his residence at St. Annes, Que., one 50 light plant. On their large order for the Standard Electric Co., of Ottawa, they have installed and started successfully one 1500 light alternating plant, with one 80 H.P. generator, and several motors of different sizes. They have completed the installation in the Vancouver Opera House, Vancouver, B. C.; started up and completed a 300 light alternating plant at Moose Jaw, N.W. T.; installed for the Standard Shirt Co., of Montreal, one 30 light incandescent plant, and motors in the following places:—Sun Life Assurance Co., Montreal, 10 h.p. for passenger elevator; H. Burks & Co., 2 h.p.; J. D. Anderson & Co., clothiers, Montreal, 3 h.p.; D. Walker, Montreal, 3 h.p.; Joseph Fortier, stationer, Montreal, 5 h.p.

THE DIFFERENCE BETWEEN VOLT AND AMPERE.

THE following question was put to Thomas A. Edison in a recent law suit, in answer to which Mr. Edison gives a pretty clear definition of the words "ampere" and "volt":

Q. Explain what is meant by the number of volts in an electric current?

A. I will have to use the analogy of a waterfall to explain. Say we have a current of water and a turbine wheel. If I have a turbine wheel and allow a thousand gallons per second to fall from a height of one foot on the turbine, I get a certain power, we will say one horse-power. Now, the one foot of fall will represent one volt of pressure in electricity, and the thousand gallons will represent the ampere or the amount of the current; we will call that one ampere. Thus we have a thousand gallons of water, or one ampere, falling one foot or one volt, or under one volt of pressure, and the water working the turbine gives one-horse power.

If, now, we go a thousand feet high and take one gallon of water and let it fall on the turbine wheel, we will get the same power as we had before, namely, one horse-power. We have got a thousand times less current or less water, and we will have a thousandth of an ampere in place of one ampere, and we will have a thousand volts in place of one volt, and we will have a fall of water a thousand feet as against one foot. Now, the fall of water or the height from which it falls is the pressure or volts in electricity, and the amount of water is the amperes. It will be seen that a thousand gallons a minute falling on a man from a height of only one foot would be no danger to the man, and that if we took one gallon and took it up a thousand feet and let it fall it would crush him. So it is not the quantity or current of water that does the damage, but it is the velocity or the pressure that produces the effect.

FLUME AREA.

THE fraction of a square foot of orifice required for the discharge of a given number of gallons of 231 cubic inches each, under any desired head, in any given number of minutes, is found by dividing the number of gallons by 2265 times the number of minutes and by the square root of the head in feet. The table here given shows how much orifice will be required to discharge one gallon per minute, under various heads in feet.

HEAD FEET	SQ. FT. HEAD.	AREA SQ. FEET.	HEAD FEET	SQ. FT. HEAD.	AREA SQ. FEET.
½	.707	.00062	16	4.	.00011
¾	.866	.00059	17	4.123	.000107
1	1.	.00044	18	4.243	.000104
2	1.414	.00031	19	4.359	.000101
3	1.732	.00025	20	4.472	.000098
4	2.	.00022	21	4.583	.000096
5	2.236	.00019	22	4.694	.000093
6	2.449	.00018	23	4.796	.000092
7	2.646	.00016	24	4.899	.00009
8	2.828	.00015	25	5.	.0000883
9	3.	.000147	26	5.099	.000086
10	3.162	.000139	27	5.196	.000085
11	3.317	.00013	28	5.292	.000083
12	3.464	.000129	29	5.385	.000082
13	3.606	.00012	30	5.477	.00008
14	3.742	.000118	31	5.567	.000089
15	3.873	.000115	32	5.656	.000078

—*Power and Transmission.*

PERSONAL.

It is stated to be the intention of the Dominion Government to appoint Mr. John Dodds, of Kingston, to the position of steamboat inspector as the successor of Mr. O. P. St. John, whose resignation was noted in the ELECTRICAL NEWS for May.

The genial presence of Mr. H. M. Grant, general travelling agent of the Vulcanized Fibre Co., of Wilmington, Delaware, illumined for a brief space the other day the ELECTRICAL NEWS sanctorum. Mr. Grant visits Canada quite frequently, and finds among the electrical people of this country an ever widening constituency for the sale of the well-known insulating material manufactured by his company.

NOTES.

The first electric elevator to go into operation in Ottawa has been installed in the Russell House annex.

Mr. A. M. Wickens, President of the Executive Board of the Canadian Association of Stationary Engineers, was a visitor at the regular meeting of Hamilton Branch No. 2 on the 15th inst., and reported the result of the work of the Legislative Committee. Mr. Wickens also gave to the members a short talk on Electricity.

A valve for steam or water has been patented in Canada by Mr. Thos. Riley, of Toronto, Ont., on the 10th of January, 1891 (No. 35827). This invention consists of a removable seat of the valve; a washer is placed between these two seats; a cushion is placed on the spindle of the valve supported by a permanent plate. Above this plate is a recess in which a washer is forced to prevent leaking.

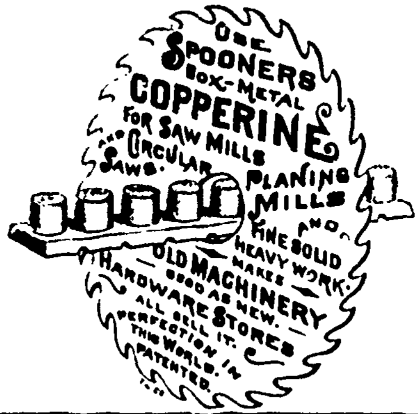
COPPERINE

Superintendent's Office, Water Works Dep't.
TORONTO, January 6th, 1891.

ALONZO W. SPOONER, ESQ.,
Port Hope, Ont.

DEAR SIR I am pleased to say that after nearly three years' constant use day and night, on our largest engine, your Copperine has stood its work well. I have not had to renew any of the heavy bearings yet, so I consider that speaks for itself. I am pleased to recommend it to any one in need of metal to stand heavy work

I am, yours truly
J. C. FERGUSON,
Chief Engineer Toronto Water Works.



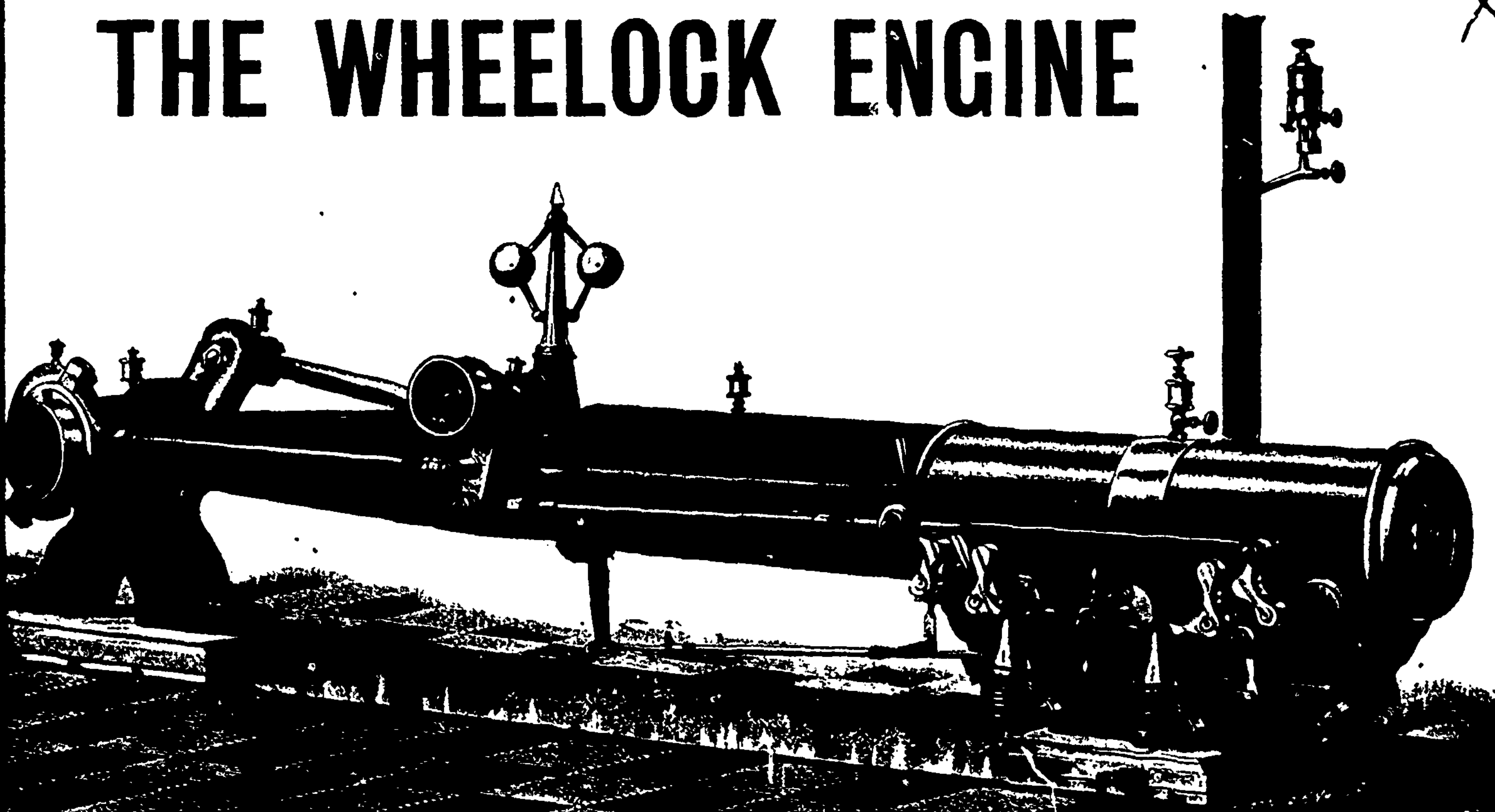
THE BROOKS MANUFACTURING CO., LTD.,

MANUFACTURERS OF

CARBON POINTS FOR ALL SYSTEMS OF ARC LIGHT,

PETERBOROUGH, ONT.

THE WHEELOCK ENGINE



The following firms and corporations are using the Wheelock Engine for electric lighting and electric street railway purposes:

Yarmouth Electric Light Co.	Yarmouth, N. S.
Fredericton Electric Light Co.	Fredericton, N. B.
Halifax Gas Co. (2 engines)	Halifax, N. S.
Oshawa Electric Light Co.	Oshawa, Ont.
Guelph Gas Co.	Guelph, "
Berlin Gas Co.	Berlin, "
Galt Electric Light Co.	Galt, "
Corporation of Town of Orillia	Orillia, "
Belleville Gas Co.	Belleville, "
Brockville Gas Co.	Brockville, "
T. Eaton & Co. Electric Light Station (2 engines)	Toronto, "
Renfrew Electric Light Co.	Renfrew, "
Brockville Incandescent Electric Light Co. (2 engines)	Brockville, "
Metropolitan Electric Street Railway Co. (compound)	Toronto, "
Leamington Electric Light Co.	Leamington, "
Ball Electric Light Co. (2 engines)	London, "
Woodstock Electric Light Co.	Woodstock, "
Cobourg Electric Light Co.	Cobourg, "
Orangeville Electric Light Co.	Orangeville, "
Mount Forest Electric Light Co.	Mount Forest, "
Hamilton Electric Light Co. (2 engines)	Hamilton, "
Corporation of Town of Goderich	Goderich, Ont.
Stratford Gas Co.	Stratford, "
Reliance Electric Light Co.	Waterford, "
Arnprior Electric Light Co.	Arnprior, "
Corporation of Town of Mitchell	Mitchell, "
Portage La Prairie Electric Light Co.	Portage La Prairie, Man.
Corporation of Town of Collingwood	Collingwood, Ont.
Corporation of Town of Picton	Picton, "
Kincardine Electric Light Co.	Kincardine, "
Palmerston Electric Light Co.	Palmerston, "
Strathroy Electric Light Co.	Strathroy, "
Corporation of Village of Markham	Markham, "
Hagersville Electric Light Co.	Hagersville, "
Pembroke Electric Light Co.	Pembroke, "
Niagara Falls Electric Light Co.	Niagara Falls, "
Full Electric Light Co.	Charlottetown, P.E.I.
Preston Electric Light Co.	Preston, Ont.
Listowel Electric Light Co.	Listowel, "
Lindsay Electric Light Co.	Lindsay, "
Winnipeg Electric Street Railway Co	Winnipeg, Man.
Essex Centre Electric Light Co.	Essex Centre, Ont.

FOR ESTIMATES AND FULL PARTICULARS APPLY TO

GOLDIE & McCULLOCH,

GALT, - - ONTARIO.

Dodge Wood Split Pulley Co.