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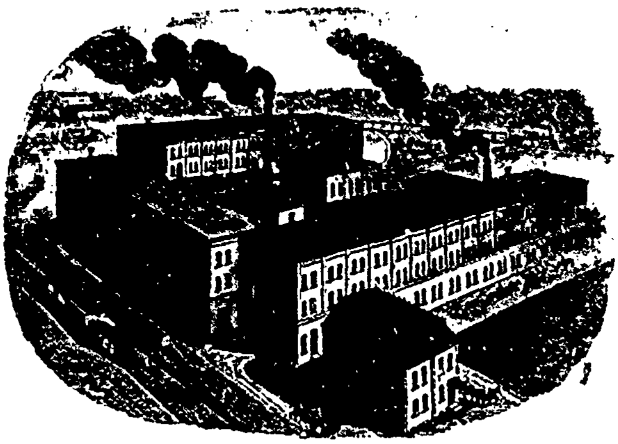

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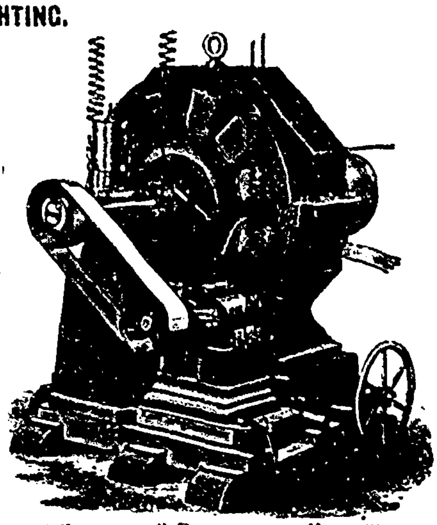

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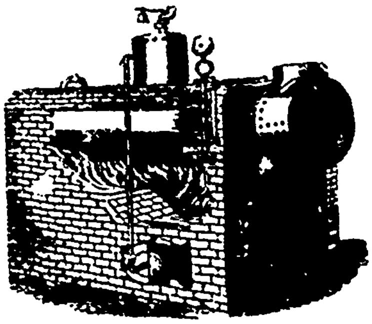

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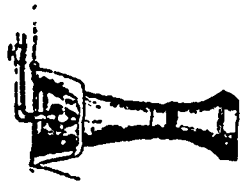

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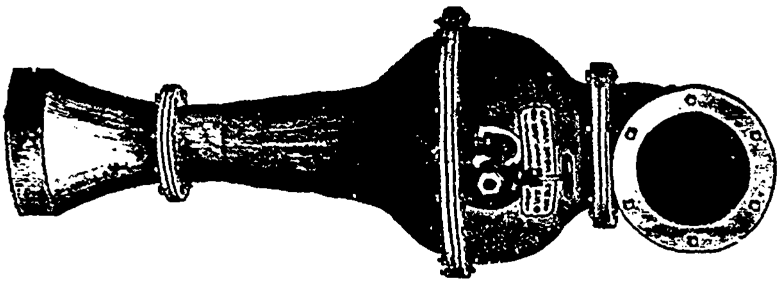

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SPARKS.

Song of the electric light company—"Ohm, Sweet Ohm."

A new metallic telephone circuit is under construction between Toronto and Peterborough.

The Bell Telephone Co. have purchased a cable with which to connect Toronto Island to the city. The cost of the undertaking will be about $6,000.

Work is being pushed rapidly forward on the new Ottawa Electric Railway, which will be equipped with Westinghouse gearless motors and other appliances.

It is understood to be the intention of the Edison Co. to erect stations in various parts of the city of Montreal for the supply of current for incandescent lighting and power purposes.

Mr. Stillwell, manager of the Electrical Manufacturing Company, of Hamilton, has interviewed the Hon. Mackenzie Bowell to ask for an increase in the duties on imported incandescent electric lamps, the lamps now being manufactured in Canada.

Through experiments made by English military authorities it has been found that whenever the atmosphere is laden with smoke or mist the power of an electric light is greatly diminished by crossing the beam of light by that of another at a certain angle. At the point of intersection the illuminated space is practically made a screen. It is proposed to utilize this knowledge, since the electric beam can thus be made to serve as a screen, back of which tactical operations might be conducted in secret.

CANADIAN

ELECTRICAL NEWS

AND

STEAM ENGINEERING JOURNAL.

VOL. I. TORONTO AND MONTREAL, CANADA, JULY, 1891. No. 7.

MR. JAMES BAIRD.

THE accompanying portrait is designed to make familiar to our readers the features of another engineer who is deemed worthy of a place in the ELECTRICAL NEWS portrait gallery, viz., Mr. James Baird, President of the Canadian Marine Engineers' Association.

Mr. Baird, who is about 30 years of age, was born in the "land of brown heath and shaggy wood," and served his apprenticeship in "Glasgow town." He was employed for some time as engineer in the merchant marine. Five or six years ago he came to Canada and to the city of Toronto, and by the way, since coming, has succeeded in pursuading a fair daughter of the Dominion to unite her fortunes with his.

About three years ago Mr. Baird became a member of the Canadian Marine Engineers' Association. The active interest which he manifested in its welfare led to his appointment last year to the office of vice-president, and to his promotion this year to the position of chief executive officer of the organization.

Mr. Baird is employed as chief engineer of the Steamer "Africa," which is engaged in the lumber trade between Parry Sound and Buffalo.

MR. JAMES BAIRD.

STEAM ADMISSION.

II.

HAVING determined that the steam pipe is large enough to keep up the boiler pressure or very near that pressure at the speed the piston is to travel, the next point to examine is the size of the steam chest or valve chamber. In some engines the chamber that contains the valve is made so small relatively to the size of the valve, that the steam cannot freely pass the valve to enter the ports. In some slide valve engines the steam can enter the end of the cylinder quite freely, but the valve seriously obstructs its passage to the other end. This sometimes explains the fact that a fairly good diagram can be got from one side of the piston and a very poor one from the other.

The port for the admission of the steam should be at least as large in area as the steam pipe. If the same port is used for the discharge of the exhaust steam it should be larger. How much larger, is a point upon which engine designers differ, but if made of such size that the steam when passing out as exhaust need not travel faster than seventy feet per second, good results will be obtained. From the rule given for the size of the steam pipe, the exhaust passages and pipe may be obtained by simple proportion, making the statement thus: as forty-two is to sixty, so is the *area* of the steam pipe to the *area* of the exhaust pipe and of the exhaust parts. Having the valves and the ports of the right size, the valves should be made to open and close the passages as quickly as possible. One method of doing this is to make the port as wide as possible, so that a small movement of the valve will open a large area. Another method is to make what is usually called a grid-iron valve, that is, having two or more openings into the main port. For example, in a cylinder eighteen inches diameter, and requiring a port twenty-seven inches in area, the port might be made eighteen inches wide by one inch and a half in the direction of the travel of the valve. To open this fully the valve must travel one inch and a half, but if two openings be made, each three-fourths of an inch, then the valve need only move half the distance, and if six openings be made, a travel of *one*-quarter of an inch will open as full a port as in the first case required one inch and a half. In high speed engines and engines cutting off steam automatically, this is a very important element, as it is necessary to get the steam into the cylinder as quickly as possible and then close the valve sharply. Take an engine making 120 revolutions per minute and cutting off steam at one quarter of the stroke, in what time must the steam valve open and close again? At 120 revolutions per minute, two revolutions are made in each second. In order to make a revolution, two steam valves have to be opened and closed, this reduces the time for each to one-quarter of a second if carrying steam full stroke, and when cutting off at one-quarter stroke the whole operation of opening the steam valve and closing it again must be done in one-sixteenth of a second.

Automatic cut-off engines of large size often make 80 revolutions per minute, and cut off as early as one-sixth of the stroke. When thus running there are 160 valve openings per minute, and as the cut-off is at one-sixth of the stroke, the valve must open and close in the one-nine hundredth and sixtieth part of a second.

The necessity for large steam pipe, plenty of port area, and a quick movement of the valve apparatus is clearly seen, when the time for the admission of the steam into the cylinder is taken into account. The importance of having the valve set to open exactly at the right instant in relation to the position of the piston is made plain by this way of looking at the matter.

It is found to be good practice to have the steam valve begin to open before the piston is quite to the end of the stroke. In slide valve engines many engineers set the eccentric so that the steam port will be about one-sixteenth of an inch open when the crank is on the dead centre. This early admission of steam forms a cushion, and takes up all the slack motion in the moving parts, before they begin to reverse their motion, and so prevents pounding or knocking.

It is difficult to get the position of the eccentrics and valve gear so as to give the exact amount of lead to the valve, because when set the engine is cold and there is no strain on the parts. A useful and practical rule is to allow one-sixteenth of an inch for each joint between the eccentric block and the valve. That is if there are two joints in the rod, the valve when cold would be set with one-sixteenth of an inch lead for each joint and for actual lead, making apparently one-quarter inch of lead. When engine is running the lead will only be about one-sixteenth of an inch. Where a grid-iron valve is used, the lead may be divided among all the openings or made to be at only one of them.

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

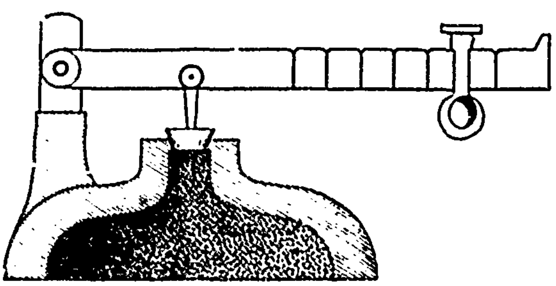
By William Barnet Le Van.

It is due to Papin to state, that no one whose labors have produced so many important results has in his writings shown so little of the vanity and absurd enthusiasm proverbially characteristic of an inventor. He is considered by his countrymen to be the true inventor of the steam engine, a claim strongly contested by some English authors of eminence who have written on the subject. The claim of his countrymen is based on communications by Papin to the *Acta Eruditorum* of Leipsig in 1685. One of these is a description of a new machine to raise water which is further noticed in the same journal in June, and again in the August following, and in the *Nouvelles de la République des Lettres* for July, 1687, is a reply by Papin to some objection raised against this apparatus by M. Nuit.

In 1687 Papin was appointed Professor of Mathematics at Marburg, in Germany.

Papin's claim to the invention of the safety valve, therefore, is not to the valve itself, but to the mode of applying it by means of a lever and movable weight, thereby not only preventing the valve from being blown entirely out of its place, but regulating the pressure at will, and rendering the device of universal application.

His safety valve consists of a conical valve retained in its sit by a weight



Papin's Safety Valve, A. D. 1685

on a lever, and from its resemblance to a steelyard, was called the "steelyard safety valve."

The ordinary commercial safety valve, as now made, is a disk with a bevelled edge, resting on a corresponding sit. The disk is kept down against the pressure in the boiler by external pressure variously applied, either by a weight acting with a leverage, or by a spring. This opening for the efflux of steam, created by the rise of the valve, is thus an annular opening. The opening through the valve must be understood to be the *effective* opening clear of bridges or other obstacles, and the area to be computed is the area of the smallest diameter of the valve. As before stated, the valve is chamfered on the edge, which edge constitutes the steam-tight surface, and the effective area is what corresponds to the smaller diameter of the valve seat and not to the larger.

All boilers should have an extra or additional safety valve, of the same capacity as the other which may act in case of accident to the first from getting jammed, or otherwise. When there are more than one boiler, a pair of safety valves in such a case must be put on each boiler.

Weighted safety valves are never employed on locomotives, and but seldom on steamships as much steam is liable to escape during the oscillatory motions of the ship. Every safety valve should be so located that it can be opened by hand at least twice each day; or, if not convenient to so place it, a cord should be secured to the lever or stem of the valve so as to operate it as above, to keep the valve free and in good working order.

FORCE.

The subject of safety valves is wholly embraced in the static branch of mechanics.

STATICS.

Statics is the science of force in equilibrium, or at rest. It embraces the strength of materials, of bridges and of girders, the stability of walls, chim-

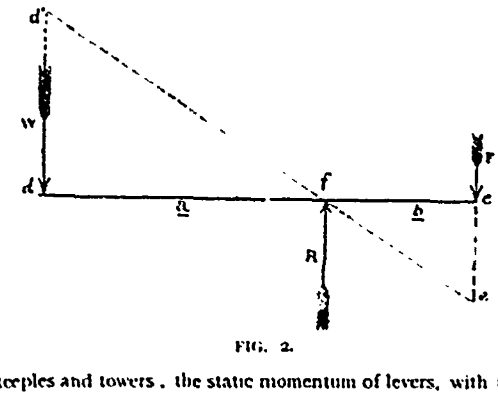


Fig. 2.

neys, steeples and towers, the static momentum of levers, with their combinations into weighing scales, windlasses, pulleys, furnicular machines, inclined planes, screws, catenaria, and all kinds of gearing.

FORCE.

The term *force* means any action which can be expressed simply by weight, and which can be realized only by an equal amount of reaction. Force is derived from a great variety of sources; but whenever it is simply force, it can invariably be expressed by weight, without regard to motion, time, power or work. The magnitude and direction of a force can be represented by a straight line; but no force can be realized without an equal amount of resistance in the opposite direction, which likewise can be represented by a straight line.

To illustrate: Let it be proposed to find the resultant of two parallel forces F and W, acting at the ends of an inflexible line *d e*.

Prolong the line W until *d d'* is equal to F, prolong F until *e e* is equal to W, then join *d'* and *e'*, which will cut the inflexible line at *f*. Draw from *f*

PROBLEM I.

the resultant R, equal and parallel to W + F, then R represents the magnitude and direction of the resistance which balances the two forces F and W. The distance *a* = *d f* is the lever for the force W, and *b* = *f e* is the lever for F, which quantities bear the following relation.

F . W = *a* . *b*, static momentums W *a* = F *b*.

STATIC MOMENTUM.

The product of a force multiplied by its lever is called *static momentum*. The resistance at *f* is called the *fulcrum*. It is supposed in this case that the forces W F act at right angles to the levers *a* and *b*. The lever of any force is equal to the right angular distance from the fulcrum to the direction of that force. When the static momentums W *a* and F *b* are equal, then the forces W and F are in equilibrium.

LEVERS.

Levers are classified into three different kinds with reference to the relative position of the force F, weight W, and fulcrum *f*.

When the fulcrum *f* is between the force F and the weight W, the lever is called the lever of the *first order* (Fig. 3).

When the weight W is between the force F and the fulcrum *f*, the lever is of the *second order* (Fig. 4).

When the force F is between the weight W and the fulcrum f, the lever is of the *third order* (Fig. 5).

The two forces F and W will be distinguished by considering F the applied force, acting on its lever L, to lift the weight W, acting on its lever *l*.

LEVERS OF DIFFERENT KINDS.

Algebraical and Geometrical expressions of the Fundamental Principles of Statics of Levers of different kinds.

PROBLEM II.

First Order.

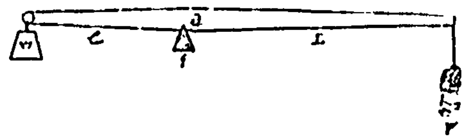


Fig. 3.

F . W = *l* . L, or F L = W *l*

$$F = \frac{W\,l}{L} \qquad W = \frac{F\,L}{l}$$

$$l = \frac{F\,a}{W + F} \qquad L = \frac{W\,a}{W + F}$$

PROBLEM III.

Second Order.

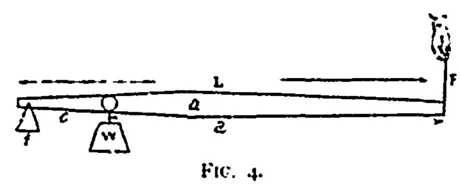


Fig. 4.

F : W = *b* : L, or F L = W *l*

$$F = \frac{W\,l}{L} \qquad W = \frac{F\,L}{l}$$

$$l = \frac{F\,a}{W - F} \qquad L = \frac{W\,a}{W - F}$$

PROBLEM IV.

Tdird Order.

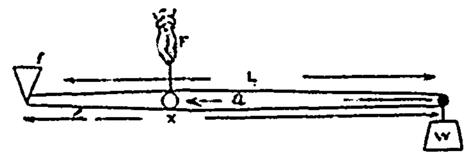


Fig. 5.

F : W = *l* : L, or F L = W *l*

$$F = \frac{W\,l}{L} \qquad W = \frac{F\,L}{l}$$

$$l = \frac{F\,a}{F - W} \qquad L = \frac{W\,a}{F - W}$$

This latter is the lever that is common to all safety valves now in general use on steam-boilers.

CENTRE OF GRAVITY.

The centre of gravity of a body, or of a rigid system of bodies, is a point in which, if they were suspended, the body will be in equilibrium in any position, like that of a wheel or circle-plane suspended in the centre.

A body suspended freely from any point *h*, will hang with its centre of gravity in the vertical line *h k*. Now suspend the body from another point *s*, and the centre of gravity will be on the line *s m*; then when the centre of gravity is on both the lines *p o* and *s m*, it must evidently be at *g*, where the two lines cross one another (see Figs. 6 and 7).

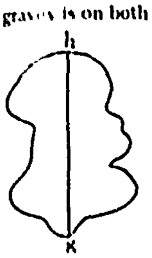


FIG. 6.

The lines *p o* and *s m*, or the centre of gravity *g*, can also be found by balancing the body on a sharp edge. The centre of gravity of any figure or body is thus found by suspending or balancing the same in two different positions.

PROBLEM V.

In the foregoing (Figs. 3, 4 and 5), we have considered the levers to be inflexible lines without weight, which will answer when the centre of gravity of the material levers is in the fulcrum, like that of a weighing balance, or that of a wheel; but this centre of gravity is often located at a considerable distance from the fulcrum, as may be illustrated by Fig. 8, which is a lever of the first order, Fig. 3. The levers *l* and L are in the form of a beam resting on the fulcrum *f* and its centre of gravity at *g*. Let the weights of the

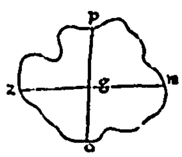


FIG. 7.

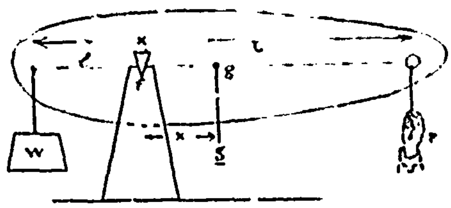


FIG. 8.

beam be represented by *g*, acting on the lever *x*; there will be two static momentums F L and *g x* on one side of the fulcrum, against one W *l*, on the other side.

$$W l = F L + g x \qquad F L = W l - g x$$
$$g x = W l - F L \qquad W = \frac{F L + g x}{l}$$
$$F = \frac{W l - g x}{L} \qquad g = \frac{W l - F L}{x}$$
$$l = \frac{F L + g x}{W} \qquad L = \frac{W l - g x}{F}$$
$$x = \frac{W l - F L}{g}.$$

PROBLEM VI.

Fig. 9 is a lever of the third order, representing a safety valve as made and sold commercially.

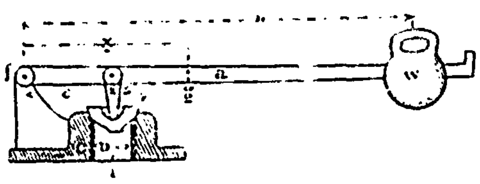


FIG. 9.

$$F l = W L + g x \qquad W = \frac{F l - g x}{L}$$
$$W L = F l - g x \qquad g = \frac{F l - W L}{x}$$
$$g x = F L - W L \qquad l = \frac{W L + g x}{F}$$
$$F = \frac{W L + g x}{l}$$
$$x = \frac{F L - W L}{g}$$
$$L = \frac{F l - g x}{W}$$

The formulas above are the same as those for the lever of the second order (Fig. 8).

The centre of gravity *g* may be found experimentally by balancing the beam over a sharp edge, when the distance *x* can be measured from the fulcrum *f*. It is here supposed that the levers *l* and L are in a straight and horizontal line. The form of the beam affects the location of the centre of gravity *g*, as shown in Fig. 7; but when this centre is known, the shape of the beam does not affect the static momentums. The pressure on the fulcrum *f* is equal to W + *g* — F.

Fig. 10 will better show the different functions of a safety valve when in service on a boiler under steam pressure.

A safety valve consists, primarily, of a movable disk, ring or plate, held from without, in the majority of cases, by a weight or a spring, over an orifice in a containing vessel against the pressure of a fluid within, so that it will resist any required pressure to which it may be adjusted, at the same time that any greater pressure will move it away from its seat and permit some of the contained fluid to escape. In the case of a steam safety valve, the contained fluid is steam in contact with water, the containing vessel is a steam boiler and the chambers and pipes in unobstructed communication therewith; and the office of the safety valve is to discharge all the steam which may at any time be generated within the boiler in excess of the steam drawn from it, after a certain pre-determined limit of pressure has been reached. Safety valves are generally circular or annular plates of brass or iron, with corresponding seats; and omitting as irrelevant many special forms, are of two classes:

First. Those which are held to their seats against internal pressure by weights, either acting directly or through levers, in most general use with stationary boilers.

Second. Those which are held to their seats against internal pressure by springs, either acting directly or through levers, used almost exclusively upon locomotives, and to a great extent on portable steam engine boilers.

The form of safety valves in general use to-day, as before stated, were used by Papin in 1680, and are, therefore, two hundred years old, and probably much older.

If the contact between a safety valve and its seat were the contact of two sharp edges, like two circular knives edge to edge, *the action of a valve in* opening and closing would be simpler than it can generally be in practice. In fact, the surface in contact must have, for constructive reasons, a breadth very considerable in proportion to the diameter of the orifice closed by the valve; and since *the areas of circles are to each other as the squares of their* diameters, the area of the circle circumscribed by the outer border of the valve seat is materially larger than the area bounded by the inner border of the seat. The smaller area alone, within the seat, is acted on by the confined steam *while the valve is closed; the larger area, within the outer* border of the seat, is acted on by the escaping steam while the valve is open. It was, therefore, not unnatural to suppose that a safety valve, once opened against a resistance nearly constant, would immediately open still more widely, *so as to give free outlet to the steam; and that it would remain* open until a very sensible reduction of pressure in the boiler should enable a force, at first overcome by the higher pressure on the smaller area, to overcome in its turn the reduced pressure on the larger area.

That *the reverse is true is well known. A safety valve, opened so as to* permit the escape of a thin film of steam, can be further lifted so as to permit the free escape of steam, only by considerable increase of pressure, or by some special contrivance. It is usual to explain this phenomenon entirely *by the increased resistance of springs due to increased tension, but this* cannot be the sole cause, since the same thing is observed in a less degree where weights are used to close the valve. An additional cause is to be found in the expansion of a film of escaping steam between the valve and its seat, as in the familiar "pneumatic paradox" *described by Bourne* as "the tendency which escaping steam has to suck the valve down." There is also a little sluggishness and hesitancy about a movement produced by a very slight preponderance of nearly balanced forces. All motion is attended with some friction and some inertia; and decided preponderance is required to produce decided movement. To counteract this inertness, and to give promptness and decision—in a word, to give "pop!" to the action of a safety valve, both in opening and closing, many expedients have been invented, and will be described further on.

Reference being had to Fig. 10, the letters denote as follows:

1. D represents the diameter of the valve chamber C, also the smallest point of contact of the valve *v*.
2. W represents the weight acting on the long lever L.
3. *w* represents the weight of the lever arm *a*, valve *v*, and stem *s*, acting on the lever *x*.

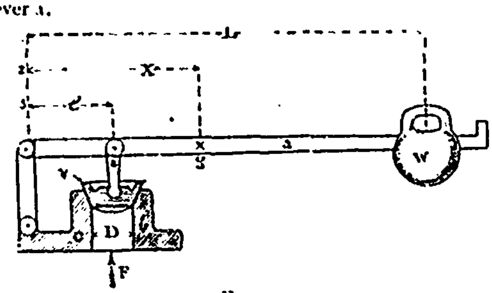


FIG. 10.

4. L represents the long lever, and is the distance from the centre of the weight W, to the fulcrum *f*, on which the lever arm *a* rests.
5. *l* represents the short lever, and is the distance from the centre of the valve stem *s* to the fulcrum *f*.
6. *x* represents the distance from the centre of gravity *g*, to fulcrum *f*.
7. *f* represents the fulcrum, and is the support on which the lever arm *a* rests.
8. *a* represents the lever arm, on which is placed the weight W, and to which is attached the valve stem *s*.
9. *v* represents the valve covering the chamber C.
10. *s* represents the valve stem, or guide, of valve *v*.
11. *g* represents the centre of gravity of the lever arm *a*, valve *v*, and stem *s*.
12. *p* represents the steam pressure above that of atmosphere (as shown by the steam gauge).
13. A represents the area of the valve chamber C, and is the square of the diameter D, multiplied by the decimal 0.7854; or $0.7854 \times D^2$.
14. F represents the force *p* due to the weight W, multiplied by the long arm L added to the momentum *w x*, this latter being obtained simply by multiplying the weight *w* by the distance *x*, which is a constant quantity in the graduation of the lever for different pressures of steam.

From the above illustration it will be seen that there are three forces.

First. The weight W acting on the long lever L.

Second. The weight of the lever arm *a*, valve *v*, and stem or guide *s*, acting on lever *x*.

Third. The force due to the steam pressure *p*, per square inch, multiplied by the area A, of the valve *v*, in square inches, acting on the short lever *l*.

(To be Continued.)

AN APPRECIATIVE LETTER FROM THE FAR NORTHWEST.

GOVERNMENT TELEGRAPH SERVICE,
DEPARTMENT OF PUBLIC WORKS,
DOMINION OF CANADA,
EDMONTON, N. W. T., 19th May, 1891.

Editor ELECTRICAL NEWS.

DEAR SIR, I have often wondered why we could not have a home journal devoted to electricity, and gladly welcome the NEWS. I hope you will soon issue it weekly, or at least semi monthly. I enclose a year's subscription. Send me the numbers for Jan., Feb., and April; I have those for March and May.

Yours truly,
ALEX. TAYLOR.

CORRECTION.

TORONTO, June 16th, 1891.

Editor ELECTRICAL NEWS.

DEAR SIR, Kindly make the following corrections of typographical errors in my answers in your Engineers' Competition: Question No. 2 instead of "71 saving" should read "7·1 saving," which makes considerable difference

In No. 12 "highest variations of speed" should read "slightest variations of speed."

I am sorry you did not meet with more success in your effort to benefit engineers, and I should have considered more credit due the winners had there been many more competitors May say I am quite satisfied with the decisions given by the judges.

Yours truly,
G. C. MOORING.

A CHEAP AND VALUABLE ASSISTANT.

NEW HAMBURG, June 1st, 1891.

Editor ELECTRICAL NEWS.

DEAR SIR, Enclosed please find the sum of one dollar for ELECTRICAL NEWS to Jan. 1st, 1892. Your paper has been of good service to my electrician who has charge of my plant here, and has been useful to me on several occasions. Am sorry it could not be published every two weeks instead of once a month.

As representative of above firm, I take considerable interest in advocating the benefit derived by pursuing the columns of your journal. I think no mechanic in the country should be without it.

Wishing you unbounded success in your enterprise, I am,

Yours respectively,
CHAS. F. ERNST,
Prop. New Hamburg Electric Light Co.

ANOTHER BOILER EXPLOSION.

TORONTO, June 4th, 1891.

Editor ELECTRICAL NEWS.

DEAR SIR,—I am informed that a boiler explosion took place in Bailey's wood yard on Dufferin street, in this city, on June 1st. The damage resulting is said to be about $1,000. Fortunately no lives were lost, but of course this fact is to be attributed to good luck, as I presume there was no person near the rotten old scrap heap at the time.

The cause of this explosios no doubt was: 1st, A rotten old boiler, which was unable to hold the pressure it was subjected to, and, 2nd, An incompetent man placed in charge.

Will the city authorities take this matter up and investigate it? Not they! But if half a dozen people had been blown into eternity, they would have been compelled to do so. In that case, ten chances to one the so-called engineer would have been among the killed, and the men who made the investigation would have laid all the blame on him (of course because he was dead). They would never lay any blame on the owner of the boiler (death trap) for buying a second-hand, corroded old tank, and then placing it under the care of an incompetent man—probably a man who had never fired a boiler in his life before.

I say that the steam user who puts into operation an unsafe boiler and places an incompetent man in charge of same, and an accident follows in which lives or property is lost, should alone be held responsible.

However, after this month all stationary engineers will be able to obtain certificates of competency, under the new Act passed at the last session of the Local Legislature, and steam users will do well to see that their engineers obtain the necessary certificate to prove that they are not ignorant of the duties of the positions to which they aspire. And all steam users when engaging engineers will study their own interests by insisting that applicants must hold an engineer's certificate. They will, by so doing, have the satisfaction of knowing that they have a man in charge of their steam plants who is sober, steady, and has the necessary qualifications to prove himself a reliable and practical engineer.

Yours respectfully,
"SAFETY."

THE NEED OF QUALIFIED ENGINEERS.

TORONTO, June 22nd, 1891.

Editor ELECTRICAL NEWS.

DEAR SIR, I hear that Mr. Hamilton, the "steam fitter," who was appointed to the position of chief engineer in the Canada Life building, has been discharged, and it was no more than I expected. No person could expect that a man who had served his apprenticeship at steam fitting (and had worked at his trade all his life) could turn out to be a competent engineer, without the necessary study and experience which is required to make a man a good engineer.

I feel that I am safe when I say that there is not one steam fitter in every one hundred who knows anything about the proper handling of a steam boiler, to say nothing of his being able to compute the safe working pressure, or whether the boilers are of sufficient strength and stayed in accordance with the rules of the Board of Trade (English), which rules all competent engineers are familiar with.

Yet in the face of all this, the officers of a concern like the Canada Life and several others in this city, will go to work and appoint a man to take charge of a battery of boilers and engines who has no knowledge whatever of the dangerous apparatus he is supposed to be master of. At the same time, much valuable property and (what is still more valuable) many human lives are at stake.

It is high time that the authorities at our City *Hall* took the matter in hand, as the citizens of Toronto have a right to demand that the men who are operating as engineers in the many large buildings and under sidewalks be compelled to *prove that they have at least the necessary knowledge to enable* them to operate the steam plants under their charge with perfect safety. It does not follow that in order to do this a man must be an expert mathematician or chemist, but he must be a *practical engineer.*

It is only a week or two since a man who calls himself chief engineer in an electric light station in this city, ran a boiler night and day for over two months, so that the boiler became so *foul with mud and sediment* that one of the sheets was bulged and blistered. At the same time he had five other boilers lying idle, and after washing this boiler out, he ordered the fireman to fire her up again, but the fireman (more power to him), refused to do so until the sheet was repaired. Yet this man holds a position as chief engineer, although he could'nt pass an examination as a good fireman.

Yours, &c.,
S.

THE H. P. OF ENGINES.

Editor ELECTRICAL NEWS.

DEAR SIR,—*Mirabile dictu!* No engineer that has written on the subject at least, has been able to see the point aimed at, or properly explain it, although some come near it. All see something different in it to what they have heard or seen I will now try to explain.

I will try, as I have hitherto done, and avoid technical terms and formulas, as only few engineers have a technical education and will better understand my meaning if put before them in plain words. I am writing to the young engineer and those who wish to learn. There is a very erroneous idea prevalent, and among scientific men too, about h. p. I am now confining this term strictly to its original meaning. Some think that it makes no difference at what rate the horse travels whether he raises 33,000 lbs. 1 ft. high, or 1 lb. 33,000 ft. That sounds very well in theory, but this is where the error creeps in. This theory would be all right if the horse's power decreased as his speed increased, but such is not the case; as his speed increases his power decreases inversely as the square of the next number, according to Leslie and other experimenters. If a horse travelling at the rate of two miles per hour can carry 100 lbs., the same horse travelling three miles per hour can only carry 81 lbs., four miles per hour, 64 lbs., five miles per hour, 49 lbs., &c. Then there comes a time or rate when the horse can with great difficulty move his *own* weight *only*- not an ounce or fraction more. Then what becomes of the 33,000 lbs.?

Some will say that he is overcoming or moving against atmospheric resistance. True, but he is an expensive ornament only, which men concerned in matters of this kind would not keep up.

If the horse could keep up this high speed and go around the world, when he got around to the 33,000 lbs. again, he would not have moved or raised it the 1,000 part of an inch. This fact is but little understood by engineers, as any can tell who understands his business or gives the subject a thought.

Again, if a horse moves a carriage on a level road at the rate of 2½ miles per hour, and exerts × lbs., at 4 miles it would be 2 ×, &c.,

Mr. Galt was all right until he said it did not matter at what rate the horse was moving or travelling, and took the average horse; then he struck a hidden snag.

A h. p. is a power that can raise 33,000 lbs. 1 ft in one minute travelling at the rate of 220 ft. per minute, (see any of the authors quoted). *The reason that 33,000 lbs. is not multiplied by 220 in the text books is that 220 ft. per minute is the standard rate at which the horse is travelling.* Any one who has watched horses on a race course or have themselves run a foot race know this, or ought to know it.

Seeing is believing, but feeling is the naked truth, so is it with theory and practice. *Theory will not stand alone.* As a rule, there is too much theory and conservatism in our schools and colleges. Practice goes before theory every time. Theory is founded on practice.

C. W. Ross,
C. & M. E.

THE N. E. L. A. CONVENTION.

MEETINGS of the Executive and Exhibition Committees to consider the advisability of postponing until September the Electric Light Convention to be held in Montreal, were held in that city on the 8th and 9th of June.

The following gentlemen were present: C. R. Huntley, president of the Association; F. R. Redpath, of the Redpath Refinery; Profs. Bovey and Cox, of McGill University; M. D. Barr, of the Edison Company in Toronto; W. J. Morrison, Fort Wayne Electric Company; Fred Nicholls, of Toronto Incandescent Electric Light Company; H. H. Fairbanks, of Worcester (Mass.) Electric Light Company; E. F. Peck, Citizens' Electric Illuminating Company of Brooklyn; J. W. Beane, secretary and treasurer of the Association; S. C. Stevenson, Council of Arts and Manufactures, Montreal; A. J. Corriveau, Canadian Electrical Construction, Manufacturing and Supply Company; and John Carroll, Eugene Phillips Electrical Works, Montreal.

The members of the above Committees were cordially welcomed by the Mayor and Ald. Stevenson on behalf of the City Council, and by ex-Mayor Beaugrand especially on behalf of the French-Canadian citizens.

Professors Bovey and Cox, of McGill University, and Mr. John Carroll, of the Phillips Electrical Works, representing the Reception Committee, read the following report:

MONTREAL, June 8, 1891.

The committee has held three meetings. A Reception Committee is being formed which already includes a large number of the most influential citizens of Montreal.

His Excellency, the Governor-General, has signified by letter that if the visit of the Association takes place in September, he hopes to be present, but under any circumstances will be glad to give his patronage to the meeting.

A number of plans for offering entertainment to the Association have been considered, but the final adoption must depend upon the date adopted for the visit, and the programme of the Association. Among the suggestions already considered by the committee are plans for a citizens' ball, a lacrosse match, an excursion to the Rapids, drives around the mountain, a promenade concert at Sohmer Park, visits to the G.T.R., C.P.R., and Dominion Bridge Works.

A Press Committee and Ladies' Committee will be formed, and special entertainment provided for the ladies of the association.

The officers of the Executive Committee, with Mr. John Carroll, were instructed to wait upon the executive of the association on June 8, and convey to them a cordial welcome to Montreal.

The report was enthusiastically received and adopted.

After due deliberation, it was decided that the Convention should open on the 7th of September, and that the Exhibition should remain open each day and evening from the 7th to the 16th inclusive, during which time the machinery will be *in motion.*

The powers and duties of the Exhibit Committee were defined, and the following local sub-committee appointed to co-operate with the chairman of the Executive in carrying forward the exhibition arrangements: F. R. Redpath, chairman; Prof. Bovey, Prof. Cox, Fred. Nicholls, S. C. Stevenson, John Carroll and A. J. Corriveau.

The Executive Committee took into consideration the papers to be read at the Convention and a number of other important matters.

The outlook for a pleasant and profitable convention were never so bright. The demand for space at the Exhibition is so great that it is thought extra accommodation may have to be provided.

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

THE meetings of this Branch during the month have been of unusual interest and were well attended.

On the 4th Thursday in May an interesting discourse on "Indicator Diagrams and the Method of Finding the M. E. P. by the Hyp. Log," was delivered by Mr. Thomas Norton.

The meeting held on the first Thursday in June was devoted to a discussion of "The Expansion of Steam," by several members.

At the second meeting, Messrs. Thompson and Nadin gave a number of rules for ascertaining the speed of pulleys, transmission of power by belts, also for bracing boiler heads.

Mr. H. Nuttall, at the third meeting told in his own amusing way of his experience with a gas engine, one of which he described as a Turkish bath of four hours duration. Mr. Thompson at this meeting worked out on the blackboard several safety valve problems. In this connection it should be remarked that the blackboard is an excellent institution which has come to stay.

At the fourth meeting Mr. John Oades gave a short lecture on "The Errors of the Lever Safety Valves," illustrating his subject by means of drawings. He did not conclude his remarks, it being his wish that the members should give the subject further thought and come prepared to renew discussion upon it at a future meeting.

Four applications for membership were received during the month.

The members of the Montreal Branch extend to those of the western branches their best wishes for an enjoyable time at their picnic.

TRADE NOTES.

The Royal Electric Company have installed a motor plant in the large wholesale warehouse of E. A. Small & Co., as well as a large number of fan outfits.

The Royal Electric Company are making an addition of a 150 light dynamo and the necessary lamps, etc., to the plant already installed in the Hotel DeLotinbiere at Vaudreuil.

The Royal Electric Company are building two 1500 light alternating dynamos for their lighting station in Montreal, and are busy preparing plans, etc., for a 3,000 light dynamo.

Messrs. Robin & Sadler, of Montreal and Toronto, have lately manufactured and put in operation in one of the Royal Electric Company's stations in Montreal, a 3-ply leather belt about 100 feet long, 38 inches wide.

A company has recently been formed to purchase and put in operation the rubber factory at Port Dalhousie, Ont., which has lain idle for a number of years. The promoters of the company, which has a capital of $200,000, are: Capt. S. Neelon, of St. Catharines, and Messrs. T. McIlroy, J. McPherson, Taylor, M. Matheson and Pearson, of Toronto. It is stated that the works will go into operation at once. The development of electrical industries has largely increased the demand for rubber goods.

PUBLICATIONS.

We have received from the Dodge Wood Split pulley Co., of Toronto, a copy of their new catalogue for 1891 numbering 36 pages.

The June *Arena* which opens the fourth volume of this able review is unusually attractive. A fine picture of Bishop-elect Brooks, printed on cardboard paper suitable for framing, is given as a supplement with this number. The frontispiece is a steel engraving of the editor, who contributes a paper of great interest on "Society's Exiles," dealing chiefly with life in the slums of Boston. The interest in this paper is enhanced by the admirable reproduction of ten flashlight photographs taken in the North End of Boston expressly for this contribution. These pictures, together with a full-page engraving of the artisans' apartment house, recently erected in Liverpool, are printed on heavy plate paper.

CANADIAN ELECTRICAL NEWS AND STEAM ENGINEERING JOURNAL

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ADVERTISEMENTS.

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SUBSCRIPTIONS.

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

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

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

EDITOR'S ANNOUNCEMENTS.

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

OUR CONVENTION NUMBER.

IN consequence of the postponement by the Executive Committee of the date of the National Electric Light Association Convention in Montreal from August to September, the special Convention Number of the ELECTRICAL NEWS announced to be published in August will not be issued until about September 1st.

From the interest already manifested, and the amount of advertising space contracted for, there is no reason to doubt that a satisfactory measure of success will reward the effort of the ELECTRICAL NEWS to fittingly mark this important occasion.

AS we go to press arrangements are being completed for the picnic at Oakville under the auspices of the Canadian Association of Stationary Engineers. The affair is certain to be a success. An interesting series of athletic contests has been arranged, and prizes to the value of $300 are awaiting the winners. A report of the proceedings will be printed in the ELECTRICAL NEWS for August.

WHAT is the matter with our electrical men? There are the managers of two of the principal companies in Toronto who are the owners of steam pleasure craft. The question has been asked why it is that they still stick to steam with all its disadvantages, instead of using electricity as a motive power, when they are supposed to know all about electricity and what it is able to do that way. The best answer we can give is, that perhaps that is the principal reason. "The bearings of this here observation," as Bunsby would say, "lies in the application on it."

IT is interesting to know, in view of the probability of electricity being shortly used on our streets, that a recent decision of a United States Court of Appeal reverses a decision of a lower court in favor of a telephone company. The telephone company, as usual, claimed the earth by right of prior occupation and the court sustained them, but on appeal the decision was reversed on the ground that the streets were intended primarily for public travel and facilities therefor, and not for the convenience of subscribers to the telephone exchange. There is no doubt that the single trolley system of street railway, with ground return, is a source of serious annoyance to the telephone user in proximity to the route. The remedy, however, is in the hands of the telephone companies, and it is gratifying to the users of these instruments to know that the companies are awaking to the fact, and are more willing to apply the remedy of a metallic circuit inasmuch as it will eliminate a multitude of other troubles incident to the telephone as well as those caused by the proximity of the electric railroad.

CITIZENS of Toronto may be congratulated on the outcome of the negotiations of the Council with the telephone company. The demagogues of the Council aforesaid used their utmost endeavors to have an unconditional franchise granted to an opposition company, but it is fortunate that the older and wiser heads were able to command a sufficient majority to defeat the destructive scheme. The offer of the Bell Telephone Company to pay into the City Treasurer four per cent. of their gross receipts, to materially enlarge the scope of their underground operations, to supply telephone facilities to private residences at a reduced rate, as well as offering facilities in their conduits for city wires, was an eminently fair and business-like one. It would have been a great pity to have lost all these advantages, besides burdening the business man with a double telephone service and having the streets crowded with another set of poles and wires, but that is a consummation the citizens of Toronto have only missed by a very narrow chance, thanks to the peculiar constitution of some of the gods that the people have chosen to rule over them.

THE long distance transmission of electric power shortly to be tried between Lauffen and Frankfort, is provoking much adverse criticism among experts in Europe. We mentioned in our last issue, in connection with the Niagara Falls power scheme, the small likelihood of its being a commercial success, and we still think—while not being quite so pessimistic as the experts aforesaid—that the experimenters will meet with developments that they may not be quite prepared for. The power in the primary circuit is to be about 186,000 watts, say 30,000 volts and 6.2 amperes. There will be 3500 poles and 7000 insulators. At a low pressure, allowing a resistance to each insulator of 1000 megohms, the loss would not be more than 3.2 per cent. But at the pressure of 30,000 volts the leakage in fine weather may be as much as 15 watts, or 100,000 watts altogether on the Frankfort line, without taking into account possible fog and rain. But this is not all. There will be some loss between the conductors themselves. It is a large contract, that of carrying 300 horse power at a pressure of 30,000 volts over a distance of 100 miles, and the result will be looked forward to with interest.

THE indulgence of our readers is asked while with becoming modesty the statement is made that one hundred and fifty persons have become subscribers to the ELECTRICAL NEWS since the publication of the June number. This record was exceeded by at least twenty-five per cent. in May, and bids fair to be equalled by the present month. Letters are frequently received expressive of the satisfaction with which the NEWS is received by subscribers. This fact gives cause for gratification to the publisher, and should be no less satisfactory to every reader and advertiser. It is pleasing to observe the growing desire on the part of subscribers to make requests through these pages for information required by them in the discharge of their daily duties. This is precisely what we desire to see. Every reader who has an opinion to express or a question to ask pertaining to the subjects of electricity or engineering, is earnestly and cordially invited to make use of the columns of this journal for that purpose. The free exchange of opinions will render the paper increasingly valuable to every reader, and assist to a surprising degree the diffusion of technical knowledge.

THE argument on final hearing in the patent case of the Edison Electric Light Company vs. the United States Electric Lighting Company is now being made in the Circuit Court of New York. It goes without saying that this is the most important case to the electric lighting industry on the other side of the line that has occupied the attention of the courts for some time. The claims made by Edison cover broadly the manufacture of the incandescent lamp, and if allowed will give that company an immense advantage over their competitors. The business has grown to enormous proportions in the hands of rival companies, greater, in fact, than in those of the claimant company itself. An adverse opinion, therefore, would carry with it an enormous amount of responsibility for damages. In Canada, however, it is a matter of very little moment, comparatively, as under the peculiar patent laws of this country the owners of a patented article are compelled to sell to all comers at what is termed in the statue "a reasonable price." A reasonable price, of course, would be held to be a price at which the article in question could be imported at or manufactured for sale at a profit by parties other than the patentee. There being no other lamps manufactured in Canada at present except by the Edison concern, and as the protective tariff gives that concern an ample profit, it is as much to their interest to sell as it is the consumers' to buy from the patentee, and thus avoid any responsibility for infringement. Without expressing any opinion as to the validity of the patents in question, it is safe to say that what the rival companies in the United States consider their rights will not be surrendered without a long and bitter struggle.

THE death of Sir John Macdonald while marking perhaps the most important epoch in the history of Canada, seems not likely to result in a present disturbance of affairs political or commercial. Inasmuch as in the minds of many persons a national upheaval was believed to be the inevitable result of the event which all deplore, there naturally exists a feeling of anxiety regarding our national future. It is yet too soon, of course, to be able to form a well founded opinion on the subject. Certain it is, that the removal of Sir John Macdonald from the position he so long occupied at the head of affairs, will be an important influence in hastening the solution of the problem. It is not generally believed that the Dominion will continue to occupy its present position for any lengthened period. If there exists any widespread feeling in favor of separation from Great Britain, it may now be expected to become manifest. If no such feeling obtains, we may expect to see a movement in the direction of closer commercial relations between the Dominion and the mother country. Meanwhile, all who have at heart the prosperity of our commercial and industrial interests must rejoice to observe the patriotic spirit in which the colleagues of the late Prime Minister have assumed the great responsibilities which he was forced to lay down, touching the nation's development and welfare. Canada has already attained to a position of no small importance, and the death of the one to whose efforts her past progress is so largely due, should serve as an incentive to those who shall hereafter be entrusted with the shaping of her legislation and consequent destiny.

THE inability of the average municipal corporation to successfully conduct a business enterprise, is receiving one more exemplification in the case of the Toronto Street Railroad. Though it has been a little over a month in the hands of the city, the receipts have shown a falling off of over a thousand dollars by the time they have reached the city treasury as compared with the same period last year, the expenses have increased fifty per cent., the cars are dirty and uncomfortable, and the state of the roadbed is simply villainous. Unless the railroad is speedily handed over to a private corporation the chances are that in a short time there will be no railroad to hand over. There have been handsome offers by a syndicate of citizens to take the property and pay the amount of the arbitrators' award and a handsome sum per year for the franchise, with an undertaking to make the change from horses to electricity within two years. Why this offer is not accepted is a mystery. Its acceptance would mean the expenditure of two millions of private funds in the work of construction. One of the largest steam and electric plants in existence would be at once installed, and a rapid and comfortable service given to the citizens. The success of the electric method of propulsion is now demonstrated beyond question, and the citizens should no longer be deprived of its advantages. The overhead method of construction would have to be employed, as nothing successful has as yet been evolved in the way of a conduit, but while properly constructed, it need not be considered a permanency, as it could be changed in the future if the development of the art ever permits of its being done. Let the Mayor and Council respect the pledge they gave the people when the funds to purchase were provided, that the city would in no case attempt to run the road, and hand it over to the company who will pay the most for the privilege, with the undertaking to provide electrical rapid transit at the earliest possible moment.

ONE of the most difficult problems that confronts the electrical engineer is to decide which of the many methods or systems in vogue may be most profitably employed in the particular location he has chosen as his field of operations. If it is an incandescent system of lighting that he is exploiting, and his source of power is at some little distance from the point of consumption, the question has to be decided between a direct and an alternating current with transformers. Of course we would all prefer the low tension direct current system, provided that the cost of copper for conductors does not make it prohibitive. If a system of this kind is considered to be feasible, the engineer has then to strike a balance as it were between the interest on cost of his copper conductors and the required size of his coal pile. By enlarging the wire there is less loss in transmission, but on the other hand, it may be made so large that the interest on cost of construction would be more than the extra cost of coal required to drive the current through smaller mains. Then, if a straight incandescent system is impracticable by reason of distance, a choice must be made between a series or an alternating current system with converters. Both involve higher tension on the wires, but this is becoming every day a matter of smaller moment, as improved insulation is a large factor both as regards safety and immunity from loss of current through leakage. If a power distributing circuit is contemplated, the problem is even more intricate. To get any distance from the generating station, a considerable voltage must be employed, and this precludes the use of very small motors, it being almost impracticable to build a motor as small as one-eighth horse power to work a 500 volt constant potential circuit. The constant potential method of distribution is the most suitable for motors, though in case of greater distances a series system may be employed. The motor on a series current is not self regulating as on a constant potential, and requires special regulating devices. Throughout the whole range of the electrician's duties, this problem of doing the right thing at the right time and in the right place is the most important one, and the failure of many a promising venture in the electrical field has been brought about by the inexperienced manipulator endeavoring to fit a square peg into the inevitable round hole.

THE MONEY VALUE OF HEAT.

THE *Journal of Industry* discusses the money value of heat, which it argues will in the future become a standard of value perhaps more stable than gold or silver just now. The gist of its investigation just now is: In its primary form of fuel representing power, light and a resolvent in the various industrial processes in which it is an agent, heat is now one of the most important commodities we have to deal with. Without fire and power we would be in barbarism, or some other undesirable state.

It is not very long since heat and its relations were a mystery. If we call it fifty years since it became a recognized element in all natural forces, it is easy to see how rapidly it is working its way to becoming a "commodity" that we will have to measure and price the same as wheat, cotton, or iron. At this time there is a singular variation in its price, due to various means of its generation and application. In coal, wood and petroleum, example, when used as fuel their measure of value should be the heat contained and the relative expense of converting this heat into useful form. That this will be the end no one can doubt, but the claims of economy for various different kinds of engines, and systems of lighting and warming show that the price of heat is far from fixed at this time.

In science, or even in the treatment of steam and gas engines, units of heat have become a tangible and convertible quality, having a constant symbol of $T - t$ or total heat units, less units lost, and it will not take long to find a common price for this indispensable commodity.

The Montreal Metal Works (Limited), Montreal, will be incorporated with a capital stock of $50,000, to manufacture and deal in wires, rods, cables, and every description of apparatus and metals used in connection with the business of telephone, telegraph, electric light, electric railroad or cable companies.

QUESTIONS AND ANSWERS.

T. W. asks: What is the derivation of the words "ohm," "watt," "volt," "ampére," etc., used by electricians as their units?

ANS. They are mostly derived from the names of men distinguished in their special fields of study. The unit of capacity is one farad; of resistance, one ohm; of work, one joule; of activity, one watt; of quantity, one coulomb; of current, one ampére; of magnetic field, one gauss; of pressure, one volt; and of force, one dyne, and are from the names of Michael Faraday, George S. Ohm, James P. Joule, James Watt, André M. Ampére, Chas. A. Coulomb, Carl Gauss and Volta, the Italian discoverer. The "dyne" is derived from the root word of dynamo, itself meaning force.

JOHN M. MORRIS, Hamilton, writes: I wish to know the required weight of a receiver containing stored electricity to the amount of one horse power for one hour.

ANS.—The weight of storage battery required to return the amount of power you name would be between 225 and 240 lbs. This would be sufficient weight to allow of the battery being about half discharged. It is not advisable to entirely discharge a storage battery at each time of using.

"SUBSCRIBER," Listowel, Ont., writes. Will you kindly answer the following questions in the next issue of your valuable paper: Is a compound engine, one in which the steam is exhausted from one cylinder into the other, more economical than a single cylinder engine whose cylinder is of as great capacity as the two cylinders? If so, please state the reasons why.

ANS.—It is generally conceded that a compound engine is more economical than a single cylinder, more especially when a condenser is used. Among the reasons assigned for this are the following: (1) It is possible to get a greater ratio of expansion with two cylinders than can be got with one; (2) The loss from internal condensation is very much less with the compound. Using an automatic cut-off engine with everything about her in good order (that is, no leaky valves or pistons), an indicated diagram taken with 65 lbs. steam initial pressure, and cut-off at 20% of the stroke, should give a result of about 28 lbs. of water per h. p. per hour. The water consumption in a compound engine, figured from the indicated cards in the same way, would give us at 20% cut-off, and same initial pressure, about 15 lbs. water per h. p. per hour.

USEFUL NUMBERS FOR ASCERTAINING THE AVERAGE PRESSURE OF STEAM IN AN ENGINE CYLINDER WITH ANY CUT-OFF.

BY WM. COX.

In a former number (Jan. 3, 1891) we gave a number of equivalents or useful numbers for purposes of calculation and for slide-rule practice. In the present article we give a similar series for computing the average pressure of steam in lbs. per sq. inch for the whole stroke of a piston, when the initial pressure and the portion of the stroke at which the steam is cut off are known. They are based upon the formula:

$$p = P\frac{1+H}{R}$$

in which P = initial pressure in lbs. per sq. inch, including atmosphere.

R = ratio of expansion.

H = hyperbolic logarithm of R,

and p = mean pressure during stroke in lbs. per sq. inch, including atmosphere.

No allowance is made for imperfect vacuum. If, for instance, the steam is cut off at half stroke, we have from the table initial gage point 13, and average gage point 11, and for ordinary calculations we multiply the initial pressure by the average G. P. and divide the product by the initial G. P., the quotient is the average pressure for the whole stroke, or

$$\text{Average pressure} = \frac{\text{initial pressure} \times \text{A. G. P.}}{\text{I. G. P.}}$$

For slide rule practice, for which these gage points are specially suitable, as they all fall upon *marked* divisions of the rule and slide, and require, therefore, no estimation of the intervals of the one or the other, we place the initial G. P. for the given cut-off on scale C of the slide, so that it coincides with the average G. P. on scale D of the rule. We then have on the slide a series of initial pressures, and coinciding with the same, a series of average pressures on the rule, all corresponding with *the given cut off. The diagrammatical demonstration is as* follows:

C	Set initial G. P. for given cut-off	Under initial pressure.
D	To aver. G. P. for given cut-off	Find average pressure.

Example. Given an initial pressure of 75 lbs. per sq. inch, with the steam cut off at three-quarters of the stroke, what is the average pressure for the whole stroke?

$$\text{Average pressure} = \frac{75 \times 53}{55} = 72.27 \text{ lbs.}$$

On the slide rule,

C	Set 55	Under 75 lbs.
D	To 53	Find 72.27 lbs. average pressure.

Portion of stroke at which steam is cut off.	Initial G. P.	Average G. P.
7/8	250	248
3/4	55	53
5/8	37	34
1/2	13	11
3/8	31	23
1/4	57	34
1/8	65	25
9-10 —	200	199
8-10 —	139	136
7-10 —	139	132
6-10 —	167	151
4-10 —	214	164
3-10 —	30	152
2-10 —	46	24
1-10 —	100	33
5-6 —— —	68	67
4-6 —— —	80	75
2-6 —— —	10	7
1-6 —— —	43	20

NOTE.—These gage points are intended for the Mannheim slide rule, scale C on the slide and scale D on the rule, being both graduated alike.—*Engineering News.*

NOTES.

The Montreal boiler shops are said to be filled with orders at present.

A boiler in use in Daniel Reichert's brickyard at St. Clement's, Ont., exploded a few days ago, seriously injuring the son of the proprietor and killing instantly a sixteen year old lad named Mickens.

Line shafting should never be placed along the side of a room so that all the machinery will be belted from one side. Equalize the strain on the shaft by putting the machines on both sides. For this reason the shaft should be run through the center of the room.

The experimental section of the Magdeburg society of boiler users communicates the fact that ordinary cement made into a stiff paste with water (so that it adheres to a vertical wall) is admirably adapted for closing the manholes of boilers, and holds the two surfaces well together. The cement becomes sufficiently hard in 8-12 hours, and can then be submitted to pressure.

At a meeting of Toronto Branch No. 1, Canadian Association of Stationary Engineers, held on June 26th, the following officers were elected for the ensuing year. President, A. E. Edkins, Vice-President, W. Lewis, Recording Secretary, W. G. Blackgrove, Financial Secretary, E. Phillip; Treasurer, W. Sutton; Con., W. Butler; Door Keeper, C. Mosely; Trustees, A. E. Edkins, W. Sutton, S. Thomson.

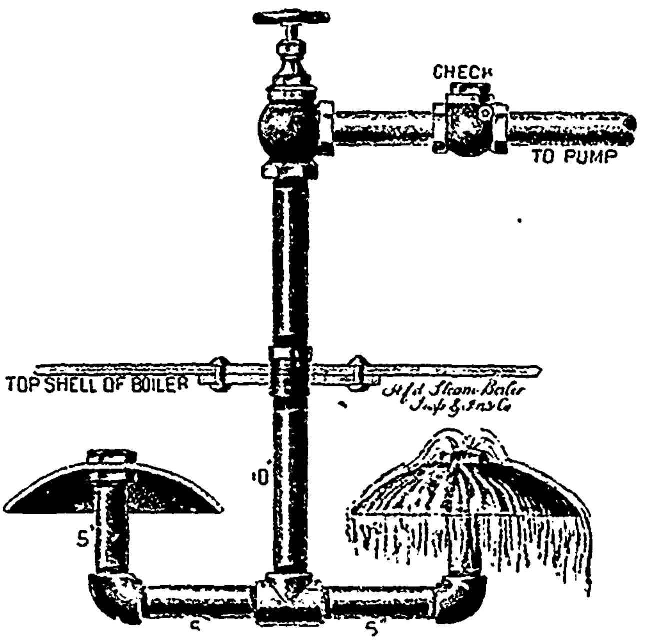
Boiler users who desire simple tests for the water they are using, will find the following compilation of tests both useful and valuable: To test for hard or soft water, dissolve a small piece of soap in alcohol, and let a few drops of the solution fall into a glass of the water. If it turns milky, it is hard water, if it remains clear, it is soft water. To test for earthy matters or alkali, take litmus paper dipped in vinegar, and if, on immersion, the paper returns to its shade, the water does not contain earthy matter or alkali. If a few drops of syrup be added to a water containing an earthy matter, it will turn green.

*Notwithstanding the many years the steamboiler has been under observa*tion, there are conditions of steam making which play strange tricks, as indicated by the steam guage, the pressure, without any discoverable cause, at times increasing 40 to 50 degrees in as many seconds, and not infrequently leading to disaster. In a big electric light station in Philadelphia there has recently occurred a series of mishaps to the boilers extending over a period of 12 or 14 *months, the strongest bolts being inadequate to keep the bends* and headers intact. Experts have examined and studied, but without being able to agree upon the cause, and though a coroner's jury, made up of boilermakers and engineers, called to inquire into the cause of an explosion which killed one man and frightfully scalded two others, brought in a verdict against the electric company, it was unable to explain wherein there had *been want of precaution, or point out the safeguards required to prevent a* similar occurrence.—*Scientific American.*

TOP FEED IN BOILERS.

PROBABLY few engineers or owners of steam boilers appreciate the effect that the introduction of feed-water has upon a boiler, so far as its life is concerned, says a writer in the *Locomotive*. If it could be introduced at a steady stream, and at a uniform temperature *all the time* the boiler is in operation, the location of the point of introduction would be of little importance, particularly if the water was free from scale-forming substances. Such favorable conditions, however, are rarely met with. Most boilers are fed intermittently, the feed varying in temperature between say, 60 degrees and 200 degrees. In every case its temperature is *lower than* that of the boiler, and if care is not taken it will chill the shell and start leaks or cracks, if it does nothing worse. Then, too, the deposit of scale cannot be considered to any great extent. The present article is designed to show how all expansion and contraction of shell-plates may be avoided, and deposit of scale largely prevented. These can be accomplished, in the writer's experience, by spraying the feed into the steam space of the boiler. Experience has shown that this can be done without noticeably increasing the moisture in the steam passing over to the engine.

A simple device for accomplishing this is shown in the accompanying cut. It is made of pipe of the same size as the feed line. The spray plates are 10 inches in diameter, made of iron (16 gauge being a good thickness), and hammered into convex



TOP FEED APPARATUS.

shape. The short upright pipes shown in the cut pass through them, and to these the plates are secured by lock nuts above and below. The water bubbles up to the top of the plates, and runs off as it would from an umbrella. The trap form of the arrangement prevents steam from entering the feed line and causing snapping or pounding noises from condensation. There are two free openings, each of which is the full size of the main feed pipe.

By spraying it into the steam space in this way, the water becomes thoroughly heated before mingling with that in the boiler below, and, as it is in small particles, it is carried along in the general circulation, and does not come in contact with the shell in such a way as to cause contraction. Furthermore, the scale-forming material is precipitated in a finely purvulent form *in the water*, and not on the tubes or plates, so that instead of adhering to the boiler it remains in suspension, and is readily gotten rid of when the boiler is emptied for cleaning. My experience shows that boilers can often be kept clean by this method of feeding, when the scale was very troublesome with the ordinary arrangement.

When the water is very bad some scale will be deposited, though the amount will be much less than with any other method of feeding, and the location of the deposit can be pretty well controlled. It will form close to the feed pipe discharge.

We have next to consider the best place to put the delivery. No absolute rule can be given for this, but, generally speaking, it should be as near the front head as practicable, in tubular boilers; for the deposit, if it forms, will then be least likely to injure the tubes or cause leakage. In long flue and plain cylinder boilers the rear end is preferable, for in these types the shell is most likely to receive the deposit, and the rear end is the coolest portion of the shell. In any case the spray feed should be as far from the main steam opening as possible, in order that the strong current of steam passing out may not catch the particles of water and carry them over into the engine.

In some sections of the country the top feed is used very generally, and in all cases it gives satisfactory results when properly set in.

MINING BY ELECTRICITY.

The *Free Press*, published at Nanaimo, B. C., tells as follows of how coal mining is done at the Union mines, Vancouver Island, by electricity :—

A *Free Press* representative called on A. Dick, Government Inspector of coal mines, on his return yesterday from an official visit to the Union Colliery at Comox. Mr. Dick then gave a description of the electric machine—the first of the kind he had seen—as wonderful and doing its work with the utmost ease and the precision of clockwork. He timed the machine while at work and found that it "mined" 6 feet by 39 inches, and four inches deep, in five minutes. It also took five minutes from the time of finishing cut until it commenced work on the next. To move it from one stall to another takes about half an hour. Mr Dick expressed the opinion that it will greatly facilitate the mining of coal, and also that the coal will come out in a more merchantable condition. In fact Mr. Little, manager, and Mr. Russell, overman, said the refuse from the machine was not half that by the ordinary mode of mining.

D. N. Osyer, electrician of the Jeffrey Electric Company, of Columbus, Ohio, is at present at Union placing the machinery in order, and instructing the operators. Mr. John Ead is in charge of the cutting machine, having one helper, who, with an engineer in charge of the dynamo, is the entire working force. The steam is supplied from the colliery boilers.

Mr. Osyer expects to remain at Union about two weeks longer, and says that in the long stall system of coal mining the machines can do a much greater percentage of work than in the small stall system. The machine simply does the undermining, then the miner comes along, drills the holes, fires the shots, and loads away the coal.

Following is a brief technical description of the machine as given by the manufacturer.

The machine consists of a bed frame occupying a space two feet, by eight feet six inches long, composed of two steel channel bars firmly braced, the top plates on each forming racks with their teeth downward, into which the feed wheels of the sliding frame engage. Mounted upon and engaging with this bed frame, is a sliding frame similarly braced, consisting mainly of two steel bars, upon which are mounted, at the rear ends, the electric motor, from which power is transmitted through straight gear and worm wheel to the rack, by means of which the sliding frame is fed forward. Upon the front end of this sliding frame is mounted the outer bar, held firmly by two solid steel shoes, with suitable brass boxes. The cutter-bar contains bits, made of tool steel, held in place by set screws. When the cutter-bar is revolved by an endless curved link steel chain from the driving shaft, and as it is revolved, is advanced by the above mechanism into the coal or other material to be undercut to the desired depth.

The electric motor occupies a space of about twenty inches square. The current required is 50 amperes at a pressure of 220 volts; the motor is wound to develop 15 h.p., though frequently in some veins of coal the machine only uses 30 amperes or 7½ h. p. in making cuts. The machine is started by means of a switch located on a suitable resistance box, on the rear end of the motor, the same being arranged with buttons; the current is gradually turned on by simply passing the lever over these buttons. The armature of the motor is calculated to run at a speed of 1,000 revolutions per minute, from which the speed is reduced so as to run the cutter-bar 200 revolutions per minute. The momentum of the armature is such, that ordinary obstructions met by the cutter-bar in the coal are not perceptible, causing the machine to run steadily and comparatively quiet.

Mr. Harry Eckhardt, manager of the Bell Telephone Co.'s Brantford agency, was married a few days ago to Miss Mary Campbell.

NOTES ON THE DESIGN OF MULTIPOLAR DYNAMOS.*

THOUGH comparisons have frequently been made of the capabilities of machines having two poles and those having a greater number, I am not aware that the design of the multipolar dynamos has yet received systematic treatment in any communication, or that a very satisfactory basis for comparison of the two types has up to the present been suggested. A perusal of the notes scattered about in technical journals, proceedings of societies, and text-books shows that the ideas on this subject are of the vaguest character, their expression having a most uncertain tone, and generally manifesting some erroneous notion. It is with the view of clearing the ground a little, and inducing some expression of correct ideas from members present, that these notes are brought before the Institution.

1.—PREVENTION OF SPARKING IN MACHINES GENERALLY.

In the paper which I submitted for your consideration twelve months ago, attention was directed to certain empirical formulæ relating to the armature loads for direct current machines. From the data furnished by a large number of examples, some of which were given in the paper, an expression for the load which could be safely carried by armatures without causing sparking was obtained; this expression, though admittedly of an arbitrary character, having been proved by my own experience, and that of my colleagues, to have been of some service. In that paper the term "ampere turns" was employed to denote the product of the number of conductors on the exterior of the armature and the current carried by each, and I am afraid this may have led to some confusion; at least, so it appears from the discussion. In order that there shall be no misunderstanding in the present case, I shall call this product, quite irrespectively of the number of poles, the *volume* of current carried. The volume is therefore the total current flowing parallel to the armature shaft, independently of direction and whatever the number of poles, and it is obtained by multiplying the conductors on the exterior of the armature by the current flowing in each; or, considering the exterior winding as a copper cylinder, it is the total current flowing in it parallel to the axis.

In his paper on "Armature Reactions," read here last year, Mr. Swinburne had worked out the limiting load from a theoretical point of view, and those who were present will remember that to obtain the results given in his paper the author assumed that the brushes were placed almost close to the polar tips. So far as the practical consideration of the subject goes, it matters little, I think, whether this is strictly accurate or not, because, while moving the brushes back from the tips increases the ampere turns producing the cross field, the magnetic resistance of the cross circuit is at the same time increased, due to the interposition of an increased air gap. For the moment, however, it will be assumed that the brushes are somewhere near the pole tips—in their vicinity, let us say—and that the only conductors concerned in producing the cross field are those covered by the pole pieces. This is sufficiently near the truth for our purpose. Under these circumstances the magnetizing force in ampere turns producing a cross field is, of course, $\frac{v\,\phi}{360}$, where v is the volume and ϕ the angle embraced by each pole piece in degrees. Call l the length of the air gap, measured from the surface of the armature core to the polar surface, and I the induction per square centimetre which would be produced in the gap due to field magnets alone. When a current flows in the armature, the field is weakened at the pole tips nearer the brushes, and strengthened at those farther from them. Imagine that the armature is loaded so that the forward induction under the nearer pole tips is just balanced by the cross induction, and we have $\frac{v\,\phi}{360} = 2\,l \times .8\,I$, assuming that the components of the cross circuit, other than the air gap, have no resistance. According to this equation with a value $v = \frac{576\,l\,I}{\phi}$,* the forward and cross induction at the pole tips would be equal, the field would be *nil* at the brushes, and the machine being unstable, any increase of current would at once cause great sparking.

The above expression gives what might be called the theoretical load limit, on the assumption that no field is required for reversing the current in the sections as they pass the brushes, but it need scarcely be pointed out that in practice the volume is always much under what would be given by the formula. In the nature of things, one expects in the dynamos of different makers a considerable variation in the relation which the actual load bears to the limit above indicated, and such differences undoubtedly exist; but while one finds, on examining a large number of machines, several under, in few cases are there any having for v a greater value than half that given by the equation. This large margin must be considered in the light of a safety factor, for it would be folly to build machines the commutators of which would be liable to ruin by an occasional increase of current over the normal. No one expects machines to stand in continuous working a current of 50 per cent. over their normal output, for the rise in temperature would then be excessive; but, from the sparking point of view, this increase in a well-designed machine ought to make but little difference to it. Generally, the relation existing between the volume, gap dimensions, and induction in the best machines is expressed approximately by the equation,

$$v = \frac{288\,l\,I}{\phi} \qquad (1)$$

which gives, I consider, a very good rule for use in practical work. According to this, the working volume has about half the value expressing the absolute limit, this relation indicating

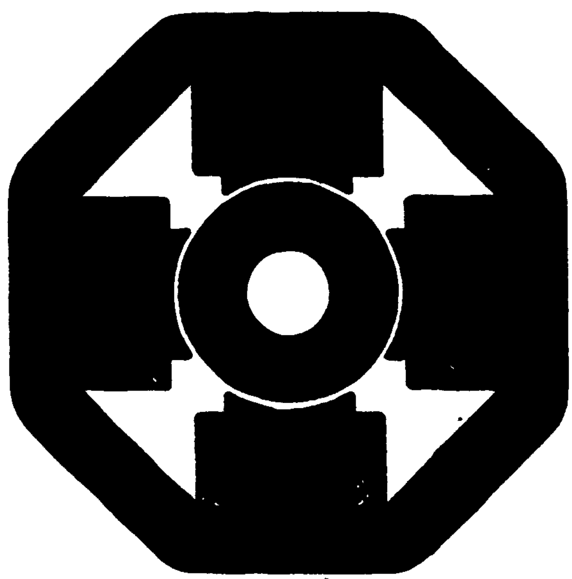


FIG. 1.

the margin of safe working dictated by practice and experience. The formula expresses, in fact, an empirical relation which has a certain degree of flexibility. But with such a large margin it will be readily perceived that the strict accuracy of our assumption about the position of the brushes is of trifling importance, as is also our assuming that the whole of the magnetizing force of the cross-field is spent in the air gap.

It is easy to translate the above expression into the form I previously used for cylinder armatures. Call r the radial depth of the armature core, w the width of the pole piece and I_2 the induction in the core. The induction, I, in the gap is $\frac{2\,r\,I_2}{w}$; and substituting for I its value, we have

$$v = \frac{576\,r\,I_2\,l}{w\,\phi}. \qquad (2)$$

Taking the induction in the armature core at from 17,000 to 18,000 C. G. S., per square centimetre, and inserting an average value of ϕ we get for bi-polar Gramme-wound machines the expression

$$v = \frac{r\,l\,85{,}000}{w} \qquad (3)$$

*I have pointed out to Mr. Swinburne that the equations $A = \frac{10\,b\,g\,B_a}{\Theta_2\,r}$ and $A_2 = \frac{10\,B_a\,r\,R\,l}{w^2}$ which he gave last year on p. 266 of his reply, ought to be $A = \frac{5\,b\,g\,B_a}{\Theta_2\,r}$ and $A_2 = \frac{20\,B_a\,r\,R\,l}{w_2}$ respectively. In looking over his paper and reply Mr. Swinburne finds other slips which he will probably correct as discussion on the present paper proceeds.—W. B. E.

* Paper read by W. B. Esson before the Institute of Electrical Engineers, London, April 9, 1891.

which I had used for some time, and which was given in my last year's paper. This is only a rough approximation, for, as Mr. Swinburne has pointed out, to be quite accurate, the angle should appear in the denominator as in 1 and 2. The simplest form the expression can take is given in 1. This contains nothing but the length of the air gap, the induction in it, and the angle of the pole-piece. It will be observed that it takes no notice of the diameter of the armature or of the number of poles. So far as the sparking limit is concerned, it gives a rule which may be employed in designing machines of any size and with any number of poles.

2.—THE RELATION OF v TO THE DIAMETER OF THE ARMATURE.

But besides taking care that the armature load does not approach the sparking limit, we must provide ample surface for getting rid of the heat generated in the conductors. The first thing to be settled in designing a new machine is what the amount of heat shall be; or in other words, we must fix the ratio which the energy appearing at the terminals shall bear to the total electrical energy produced. Having settled this, sufficient radiating surface must be allowed to prevent too great a rise in temperature—a point to which due consideration has already been given.

The principal factors which determine the relation of the volume to the diameter of the armature are efficiency and temperature. It will be seen that the equation (1) gives no direct information respecting the diameter for a given volume, and as long as 1, l, and Φ remain unchanged, the tendency to sparking would be the same whatever the diameter. But it is not so with the heat generated or the temperature rise, for assuming v and l to be related as shown, the smaller the diameter, the greater would be the temperature. To carry a given volume we must have, consistent with the waste of power permissible, a certain section of copper; and this copper should be disposed so that a cooling surface is provided sufficient to keep the rise in temperature within the specified limit, while the gap, being of sufficient length to prevent sparking, should have only the dimensions necessary for accommodating the conductors and allowing of proper clearance.

Through the kindness of members of the Institution and others, who have liberally supplied me with figures, I have been able to ascertain the nature of the relation between the diameter and volume existing in all the best known machines, from the smallest to the largest sizes. The figures refer to both cylinder and drum-wound armatures, and include machines with two, four, six and eight poles. Though I am not at liberty to publish the data in full, the general results are given. There is not so much agreement between the dynamos of different makers in respect to this relation as might have been expected, and for v we have all kinds of values, ranging from 200 to 1,000 times the diameter of the armature in centimetres. If full advantage of the length of the air gap were taken, and the thickest possible conductor used in each case, the diameter, to give a uniform temperature for all sizes, would be about proportional to the square root of the volume, but there are several reasons why this proportion should not obtain in practice. With this relation the ratio of the stray to the useful field would increase with the diameter, thus entailing an extravagant expenditure of energy in producing the requisite gap induction. Again, while the total field through the armature would increase simply as the diameter, the volume carried would increase as the *square* of the diameter, this being at variance with the well-established rule that the total field through the armature increases rather than diminishes relatively to the volume as the size is increased. It will be understood, of course, that precisely the same result is arrived at whether we consider the volume fixed and endeavor to find the best diameter, or consider the diameter fixed and seek for the best volume. It is simply a question of obtaining the most economical construction, having regard to cost of materials, efficiency, prevention of sparking, and temperature limit, though the figures at my disposal show estimates of the relative values of these factors to be by no means uniform.

Though the relation lacks definiteness to some extent, I find in the data of a large number of machines indications sufficiently pronounced to justify us in regarding the volume carried by the armatures of two-pole dynamos as proportional to the diameter for all sizes. In designing cylinder machines, the value of v may be taken as 400 times the diameter of the armature in centimetres, while for drum armatures the volume is obtained by multiplying the diameter by 600* The cylinder armature has for a given volume a larger diameter, because of the influence of the interior wires. These being heaped inside to one and a half or twice the depth of the exterior winding, also being longer, a larger diameter is required for a given volume, both from efficiency and temperature considerations Necessarily, the relations here given are not of a hard-and-fast character, and may be varied considerably But whatever the proportion adopted, it is absolutely essential that the sparking limit already considered be not too closely approached

In machines having four and six poles, the same average relation between the volume and diameter holds in practice for both cylinders and drums In the calculations which follow these figures will therefore be adopted.

3. OUTPUT OF DIRECT CURRENT ARMATURES

If we call N the total number of lines of force entering the armature from all the poles, however many, and n the number of revolutions per second, the average E.M.F. generated in each conductor is, of course, $N\,n\,10^{-8}$. If C be the total current flowing, each conductor will carry with the sections coupled in the ordinary way $\frac{C}{p}$ amperes, p being the number of poles.

The electric work due to each conductor, is $\frac{C}{p} \times \frac{N\,n}{10^8}$; and the

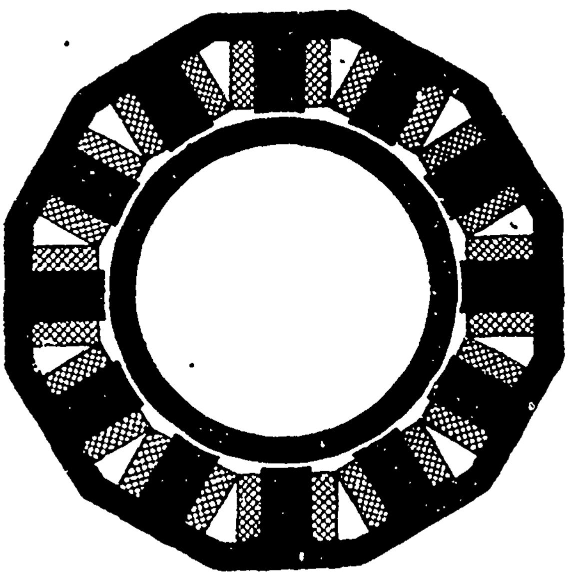


FIG. 2.

total work, $\frac{w\,C}{p} \times \frac{N\,n}{10^8}$, where w is the number of conductors, counted all round the exterior of the armature. The quantity $\frac{w\,C}{p}$ is what we have called the *volume*, and we get for the total electrical output in watts the expression,

$$W = N\,n\,v\,10^{-8} \qquad (4)$$

which is quite independent of the manner of coupling up the armature sections. It will be evident, I think, that with the same relation existing between v and d for two, four and six poles, the output of an armature of given diameter and length, running at the same speed, is quite independent of the number of poles. It matters not whether N be furnished by two poles only, or by four poles of half the angular width provided its value remains unaltered.

The volume, then, may be expressed in terms of the diameter. The quantity, N, may be expressed in terms of the diameter × length of the armature. Taking an induction of 5,000 C.G.S. units per square centimetre in the air gap — a very usual figure—and assuming that the fraction of the armature circumference covered by the pole pieces = 2.25 d, we get, calling L the length of the armature in centimetres, 11,250 $d\,L$ as the total number of lines of force entering the core. Call this, in round

* In my last paper the number given was .7. This I now amend as above.—W. B. E.

numbers, 12,000 $d L$. Substituting for N and v their values, the output becomes for cylinder armatures

$$W = .048 d^2 L n \qquad (5)$$

and for drum armatures

$$W = .072 d^2 L n \qquad (6)$$

This applies to all direct-current machines, whether bi-polar or multi-polar; though it will be understood of course, that the induction in the gap may be greater or less than what has been assumed. In that case the coefficients .048 and .072 would be altered, without changing, however, the form of the expression.

4.—OUTPUT OF ALTERNATING-CURRENT ARMATURES.

The armature loads for alternators, though producing a cross magnetization, as in direct current machines, raise no considerations, of course, as regards sparking. But on account of the greater proximity of the poles, and the greater stray field resulting, it is desirable to make the layer of copper on the armature core as thin, and the air gaps as short as possible. As a consequence, probably, of the increased ratio of stray to useful field, the induction is less in the gaps of alternating than in those of direct-current machines. Here it will be assumed that the virtual induction is 4,000 C.G.S. units per square centimetre, meaning that this represents the induction to which the resultant E.M.F. is due. The impressed E.M.F. is greater than the resultant, and the induction due to the field magnets alone is greater than 4,000; but what I am dealing with is the field resulting from the inter-action of the magnet and armature fields; it is the field to which the resultant E.M.F = C R is due, this and the current being coincident in phase. Usually the poles cover a fraction of the circumference = 1.5 d, the value of N for alternators being then 6,000 $d L$. About half the circumference being covered with wire, under usual conditions of temperature and efficiency we have for v a mean value of 400, which gives for the product of mean resultant E.M.F. and mean current = .024 $d^2 L n$. In some cases, as in the Westinghouse machine, the conductors cover more than half the circumference, and v is therefore greater. But here, on account of the differential effect produced on the separate wires of the same section, the added turns have nothing like a proportionally increased value, and the expression will give approximately the value of the product of mean resultant E.M.F. and mean current, even in these machines. Assuming that the E.M.F. is a sine function of the time, to get the watts we must multiply by $\frac{\pi^2}{8}$, which gives us, therefore, as the output of the alternator

$$W = .0296 d^2 L n \qquad (7)$$

or rather over 40 per cent. of the work done by a drum wound direct current machine having an armature of the same external dimensions. Some comparisons have been made of the output of direct and alternating machines of the same weight, but these, in the nature of things, must be misleading. The two types are quite unlike in their proportions, as Figs. 1 and 2 show, and no one would think of making them the same. Fig. 1 represents the magnetic system of a four pole direct, and Fig. 2 that of a twelve-pole alternating machine of the same output; and while it will be observed that the iron parts—core and yoke rings—are much heavier in the former, it will be noticed that the copper in the magnet coils is much heavier in the latter. In fact, though the iron in the alternator is only 55 per cent. of that in the direct current machine, the copper required is no less than 250 per cent. It is difficult, then, to understand what useful purpose is served by comparisons such as I have alluded to.

(To be Continued.)

The Royal Victoria Hospital, Montreal, is being wired for some 600 incandescent lights. This will be one of the most complete installations made in Canada and the first interior conduit work. The Royal Electric Company of Montreal have received the contract for doing the work.

The Queen's Hall, which was opened in Montreal under new auspices last week, is lighted throughout with electricity. The arrangements are very perfect. All the stage, border, foot, bunch and proscenium lights are controlled by separate switches, and have kicking coils or reducers for dimming the lights. This work was installed by the Royal Electric Company, of Montreal, and reflects credit on them for the novel features. The proprietors state that the electric light is far more flexible than gas, and there is much saving effected in insurance, besides entirely doing away with any heat in the building.

WAYSIDE NOTES.

(By a Travelling Correspondent.)

The town of Mitchell is now well lighted with electricity, Mr. John Byers being superintendent.

It is a pity more of the engineers in Berlin do not try and read English. They don't know what they lose.

Wallaceburg has now its electric light, the plant being under the superintendence of Mr. Martin Markins.

The town of Preston, comprising one street, is well lighted. The plant is owned by Mr. Tenwick, who also superintends.

The man who wanted a "certificate" with his paper still runs a plant in Guelph. He'll get one, if he reads the I. N. & S. E. J.

The branch of the C. A. S. E. in Stratford is now reduced to very few members. It is time the engineers outside took advantage of the Society

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Clinton is now a well lighted town, the plant being under the superintendence of Mr. Jonathan Brown and his assistant, Mr. Marshall Morvish. Clinton to a man takes the NEWS. Other towns and cities please copy.

Goderich is now well lighted, having 33 street lights and 40 arc lights in the stores, supplied by the town's Electric Light Co. Mr. W. H. Smith is superintendent, and the light gives great satisfaction to the town and store keepers.

The Stratford Water Works have now the whole of their pumps in working order, having a capacity of 374 million gallons per day. The plant is under the superintendence of Mr. Thos. Clark and his two assistants, Messrs. Corrie and Evans.

It is about time, with the material in the City of Guelph, that a branch of the C. A. S. E. was inaugurated. It was mooted, but seems to have died owing to the apathy of some of the men. There are still quite a few who want it if they could get a leading hand.

Engineer Thos. McCoughland, of the St. Clair Tunnel, is now prepared to pump fresh or bad air, or light the tunnel. The plant is now in working order and waiting for the completion of the tunnel. He has under his charge two 20 h. p. high speed engines, air and water pumps, and two Ball dynamos supplying 250 incandescent lights.

The Berlin Electric Light Co. are now in successful working order. They have two 25 light Ball dynamos, and will soon have a four ampere machine for incandescent and arc lighting, for which the Ball Electric Light Co. have the contract. They have 52 arc lamps in the city and stores. The plant is under the able supervision of Mr. Wm. Aldrich, who has many improvements of his own make on the plant.

The Stratford Electric Light Co.'s plant, which is under the able superintendence of Mr. Robert Wells, is now in full working order. The Company have the best supplied power in the county, consisting of a 75 h. p. Wheelock engine (Goldie & McCulloch's make), a gas engine and water power. They have three 35 and two 25 light machines, and now have in use 129 lamps, including 30 private contractors.

THE Guelph Electric Lighting Co. have now one of the neatest and best equipped engine and dynamo houses in the Dominion. They have one Royal and two Ball dynamos, which are worked by a turbine wheel (when there is sufficient water in the river). Failing this, the engine (Goldie & McCulloch) runs the plant, which is under the supervision of Mr. C. J. Jorden. The whole plant works successfully, and the city, stores, and hotels are well lighted.

The Chatham Gas Co. supply the town with electric light. The company have one Royal arc dynamo, 40 light, and one 500 incandescent light; one Ball dynamo, 25 arc light, and one Brush machine, 30 arc light. They have in operation 90 street lights and 300 incandescent lights. The plant is in charge of Mr. Albert Frott, with Mr. Lamon as general manager. The engineers here have a good chance of getting a branch of the C.A.S.E. Many men express a wish to this effect. The president of the Toronto branch will give them all the assistance necessary.

The St. Mary's Electric Light Co. is owned and run by Mr. L. H. Reesor, with W. T. Brown as electrician. They borrow their power, and have three Ball dynamos for incandescent lighting, and a 35 arc light dynamo. They supply 60 arc and 145 incandescent lights to the town and stores. They had a curious incident happen to the poles and incandescent lamps during a thunderstorm. Whilst the current was turned off, the lightning seems to have struck the wires, entirely burning out two lamps and splintering the poles. The St. Marys men don't seem to understand how it happened.

The thanks of this paper are due to the engineers in all the cities and towns visited for the very courteous treatment accorded to its representative. Many of them have gone out of their way to get him subscribers.

PRACTICAL SUGGESTIONS TO BE OBSERVED IN RUNNING DYNAMOS.

PLACE the oil catchers under the drip of the dynamo bearings, and never allow them to overflow on the floor.

Keep the floor of the dynamo room swept clean, so that no nails or other small pieces of metal can be drawn into the armature.

Never use or leave iron or steel tools near the machine, while at work, as these are also likely to be drawn into the armature if left too near it.

Oil cans made of copper or zinc are best for use about electrical apparatus.

Never allow oil to accumulate on the armature or shafts of the dynamo.

When the wires coming out of the shaft to the commutator become bare from cleaning, they should be re-covered with kerite or okonite tape, or gum cloth, and shellaced, and allowed to dry for about eight or ten hours before being used.

If the shellac on armature bobbins, or field magnets becomes worn off, these parts should be re-shallaced.

A good bellows will be of service in getting dirt out of the crevices of the armature, and around the commutator and rockers.

If the rocker springs are fastened to a wood base, see that the screws which hold them are kept tight as the wood dries.

See that all thumb screws in the binding posts are kept screwed down tight on the wires. Special care should be exercised in regard to this in the case of incandescence machines.

In placing brushes, take pains to clamp them firmly in position allowing them to rest squarely and evenly on the commutator. Be very careful not to screw down one side of the clamp tighter than the other, but clamp them evenly, so that both edges of the brushes will be held in place.

The clamps holding the brushes must be perfectly clean, so as to make good contact.

Brushes must bear on the commutator with a reasonable pressure, not too hard, nor so lightly as to allow them to flap or chatter. Occasionally, by accident or otherwise, the brushes will get bent, or sprung, and bear too lightly on the commutator. This condition of affairs is always attended with many sparks, and a very rapid cutting, or wearing, of commutator segments. In fact, segments may be worn out in a few days in this way.

If brushes are perfectly straight when put into the clamps, sufficient pressure will usually be obtained.

In an arc light, or high-tension machine, if the brushes are rocked too far forward in the direction of rotation of the commutator, the sparking will quite disappear, but the lights will go out occasionally, each extinction being attended by a few very long sparks on the commutators. This trouble may be corrected by rocking the brushes backward a short distance. If brushes are moved too far back, there will be sparking, and a consequent diminution of light in the lamps, and occasionally extinctions of the lamps, similar to those which occur when the brushes are too far forward.

The proper point for the brushes is as far forward as possible, so as to make the sparks small, and yet back of the point where flashing will occur. In low-tension, or incandescence, machines, the brushes should be adjusted to show no spark, or only a very minute one, otherwise the wear on the commutator and brushes will be very heavy.

Too much oil on the commutator will cause sparks similar to those which appear when the brushes are not properly adjusted.

When brushes are worn nearly through, clip them off squarely at the worn ends, and move them up to the same position as before.—*Western Machinist.*

SPARKS.

Electric propulsion has gained favor rapidly among the enterprising population of British Columbia. A line runs (four miles) from Victoria to Esquimalt; a line is projected to Saanich, a farming section, a distance of eight or ten miles; an electric tramway is being constructed from Vancouver to Westminster, 12 miles, to carry freight and passengers, another line has been surveyed south from Vancouver to Ladner's Landing; electric tramway charters have been obtained for Nanaimo, Vernon, Nelson and other places in the province.

A few days ago a middle-aged man entered the office of the Pittsfield, Mass., electric light station on business bent, says the *Journal* of that city. He produced a quart bottle and asked to have it filled with electricity. The genial manager of the concern soon discovered that the purchaser was in dead earnest, and further questioning revealed to the electrician, always on the alert for something new in his line, that the middle-aged man aforesaid had discovered a new use for the mysterious and, as Webster calls it, "subtle fluid." He with the bottle went on to explain that he had been told it was the best remedy known to remove lice from cattle, and that it could be bought in Pittsfield at the electric station for six cents a gallon. He only wanted a quart of it and was anxious to get it and be off. He was finally convinced that he had been imposed upon, but did not express himself on the subject of practical jokes. It is understood that the imposee has left Pittsfield.

A correspondent of the Montreal *Star* publishes the result of a recent interview with Dr. Selwyn, director of the Dominion Geological Survey, who is engaged experimenting on a new material for insulating purposes. The doctor was found with a long narrow box before him, which was filled with lumps of a peculiar black earthy substance glittering with sandy particles. It was not unlike lumps of brown, sodden coke. "This," he said, "is a sample of petroleum saturated sand which is found in almost immeasurable quantities in the Athabasca district, and for which, I believe, I have found excellent and practical use. It can, I have no doubt, be used to great advantage for insulating electric underground wires. Its insulating power has already been tested by Mr. Gisborne, Dominion Electrician, who says it makes a perfect insulator, and I am now about to make further tests to see how it will stand the frost and weather. The discovery of this sand is not new it having been known to and described by Sir Alexander Mackenzie, a hundred years ago. It has already been referred to in the Survey reports, and petroleum experts have given it as their opinion that a large amount of petroleum could be extracted from this great body of sand if the proper appliances were secured. It has also been referred to as a possible fuel, but its projected use as an insulator is new. It is about 170 miles from Edmonton to the sand regions, and as the Calgary and Edmonton road is now being built to Edmonton, it would, I believe, be built to Lake Athabasca, should the sand prove useful, as expected. In the Athabasca district are also found good indications of sulphur, gypsum, salt and lignite coal.

LAMINATED STEEL PLATES.

In the February issue, says the *Locomotive* we illustrated a laminated steel plate that came to our notice some time ago. At the time we first received the plate it was generally believed that steel was not liable to blister, since it is rolled directly from the ingot, and should, therefore, be entirely sound. Within a year or two, however, several instances have come to our notice, in which steel plates have been badly laminated. The cuts given in this issue illustrate two such cases.

Fig. 2 shows a plate that was cut out of a steel boiler that had been in use only six weeks. A blister developed on the lower side of the second fire sheet. It was raised about three inches at the highest point, and as nearly as it could be judged by the eye it covered an area of about twenty inches square. On cutting it out, however, it was found that the lamination extended in a thin line so as to separate the plates over an area about thirty inches wide and thirty-six inches long, the plate being so evenly separated as to closely resemble two plates, laid one upon the other. This appearance is represented in the cut. The outer layer, being exposed to the fire, had bulged over part of its extent, while the inner half showed no change in form and was free from any scale or deposit. The workmanship on the boiler is first-class in every respect, and the material was evidently intended to be, as the brand of one of the best mills in the country is stamped *directly on the blister.*

Fig. 1.—Laminated Plate Cut from a Steel Boiler.

Some correspondence passed between this office and the makers of the plate. A few extracts from it are appended. "We are very sorry," writes the manufacturer, "to learn of the lamination having occurred. It is not the result of any attempt to weld the steel, as some people suppose, but in casting the steel ingots bubbles or blow holes will be confined in the mass sometimes, and, of course, when the ingot is rolled out, the surfaces are flattened together, leaving what appears like a blister, sometimes large, sometimes small. In the earlier days of steel making we found frequent cases of this kind, but in recent years skill and experience have enabled the steel men to largely overcome it. We watch constantly for it, however, in examining and hammering our steel plates, but in this case the surfaces were evidently so closely in contact that the hammer did not detect any flaw, either with us or with the inspector at the boiler shop; and it did not show up until the heat separated the surfaces."

The piece of plate was cut apart through the middle of the blister, as shown in Fig. 1, and one-half of it was sent to the maker for examination. He says: "The plate shows up very badly, and is certainly a very unusual specimen. In all our years of experience in the steel plate business we have not seen its parallel; but we have seen defects of the same character, though much less extensive. It was caused, no doubt, by slag confined in the ingot. About nine years ago we bought some fire-box steel for a boiler for our own use, from a reputable manufacturer who sells a great deal of material throughout the New England States. Five plates out of the lot had to be rejected on account of blisters, and yet they were sold as the best open hearth fire-box steel. Such defects are likely to occur in the case of ingots poured from the top. It is now considered much better to pour from the bottom of the mold, through a pipe placed alongside and connected to the molds by underground channels. Our rolls are cast in the same way. The metal flows more freely, and without splashing; and any impurities contained in it will rise to the top more readily, and remain there." Again he says: "The case, we think, is the worst one that has ever escaped our hands; and we admit that to one acquainted with the difficulties in the manufacture of steel ingots it has the appearance of an attempt to weld steel together. In any case of this kind, however, the weld would gradually weaken and not come to a definite termination. One could readily satisfy himself on this point by cutting of a portion and splitting it back to the end of the fold, and noting how suddenly the solid metal begins."

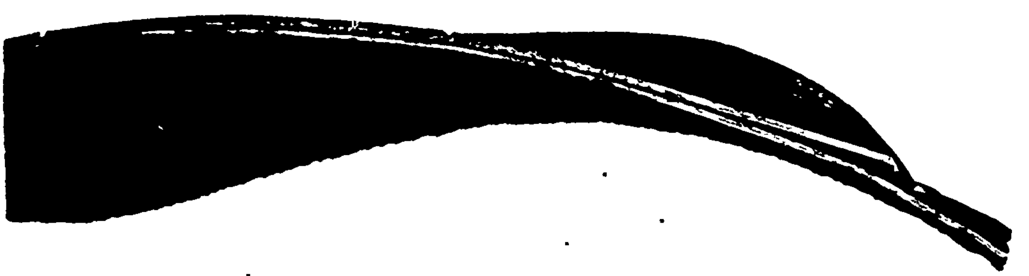

Fig. 2.—Laminated Steel Plate.

It is possible to leave too much of the top of the ingot in cutting off the crop ends of the slabs intended for plates. If the plates are sheared too close to the edge of the plates as rolled, lamination may appear on the edge of the finished product. This does not seem sufficient, however, to explain such extensive internal separation as in the present specimen.

In Fig. 3 a very curious blister is shown. It occurred some time ago on a boiler that was supposed to be constructed of steel, though at the time, not having had any such experience, we had some doubts about it being steel. The singular feature about it is the fact that it should have bulged so nearly equal in both directions. It has been suggested that a small fissure may have connected the original line of separation with the interior of the boiler, and that water penetrated the plate through this fissure, forcing the plates apart when it was afterwards turned into steam. This assumption looks reasonable, provided the fissure through which the water entered was very small, so that steam could not pass out of it very rapidly. Very likely, if this explanation is correct, the blister was developed gradually, by the entrance of water every time the fires were drawn, and its subsequent evaporation when the fires were again started. In the original specimen numerous small blisters could be seen on the interior surfaces of the large one.

Fig. 3.—Curious Blister from a Steel? Boiler.

TRADE PAPERS AS ADVERTISING MEDIUMS.

As indicating the important position which trade and technical papers occupy at the present time, says *Office*, it may be mentioned that the managers of the advertising departments of the prominent daily papers are at present instructing their canvassers to give no attention whatever to soliciting lines of business in which the general public is not interested, and in which the services of a trade paper would be more likely to bring results than a daily paper. The rate is so closely followed by a number of the leading papers of the country that it may be accepted as the general policy of the newspapers of the day. Trade papers are constantly occupying a higher place in the estimation of the business public, and more particularly in the estimation of the manufacturers and wholesalers who use them, and upon whose patronage they depend for support. While trade papers a short time since consisted of little more than mere advertising pages, with random clippings from various sources, they are at present the result of large corps of able and experienced writers; and, taken collectively, they exhibit more originality and more enterprise than perhaps any other class of periodicals at present published, not excepting the leading literary magazines.

SPARKS.

The Council of Thorold, Ont., have added to their electric plant a new dynamo for incandescent lighting.

The electrolytic method of sewage disposal would, it is believed, successfully solve Toronto's sewage problem.

The New Westminster, B. C., Electric Tramway Co.'s power house contains two dynamos and a 250 h. p. engine.

The Bell Telephone Company have recently been engaged in constructing a new line between Orangeville and Wiarton, Ont.

The citizens of Alexandria Bay have formed a stock company for the purpose of lighting the village throughout the year by electricity.

After a hard-fought contest, the Ball and Hesler Companies have secured the order for the electric plant required to light the town of West Toronto Junction.

The Eureka Tempered Copper Company, of North East, Pa., is having to enlarge its factory facilities to enable it to keep pace with the extraordinary demand for its specialties.

The citizens of Shelburne, Ont., celebrated with brass band accompaniment the advent of the electric light upon their streets. The plant consists of 25 arc and 19 incandescent lamps, and a o-ampere dynamo, and is owned by Dr Norton and Mr Jelly. Mr. John Anderson will be in charge.

A method of blasting by electricity has been tried in Sweden, says the *Electrical Review*, with good results. The means consist of a voltaic arc produced between two carbon rods placed parallel. When the arc is moved close to the spot to be blasted, an intense local heat is created, resulting in expansion that splits the rock.

One of the most delicate duties which the electrical man is called upon to perform is to set aright the mind and money of some lay friend who rejoices in the possession of a secure position on a "ground floor," totally unmindful of the existence of a yawning cellar and perhaps sub-cellar beneath.—New York *Electrical Review.*

In his recent address before the members of the National Electric Light Association, Prof. Elihu Thomson gave the folowing lucid and interesting account of the building up of an arc:—Let us suppose the case of two carbons touching each other with a current passing, and that we then very slowly separate them, stopping to observe the effects. When the contact is light, before actual separation, a visible heating of the meeting ends is seen. On attaining a small separation, the space between seems filled with hot vapor, and we have a short arc where the separation is perhaps not over two or three one-hundredths of an inch. There is also noticed an active transfer of carbon from the end of the positive, and a deposition of carbon on the end of the negative carbon. This deposited carbon takes the form of a mushroom after a time and finally breaks off. Meanwhile combustion goes on at both poles and wears away the sides of the positive carbon, while the transfer of carbon wears away its tip or crater. The burning also wears away the negative at the sides, while the tip is built up by the mushroom deposit from the arc. But the cutting in of the negative finally severs the mushroom tip and it falls away. Hence, both carbons are eventually consumed.