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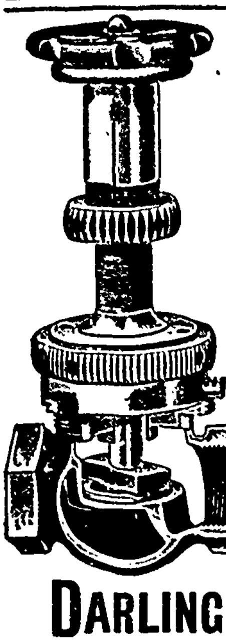

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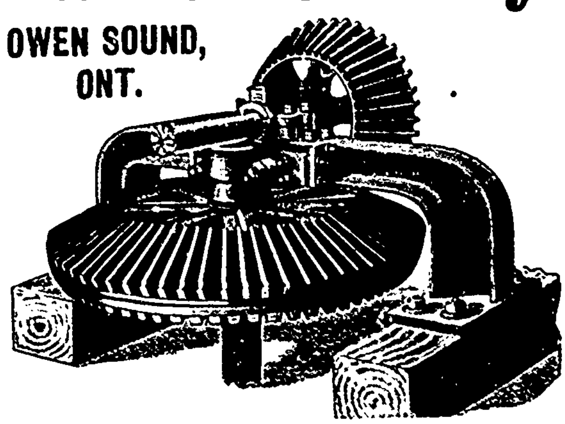

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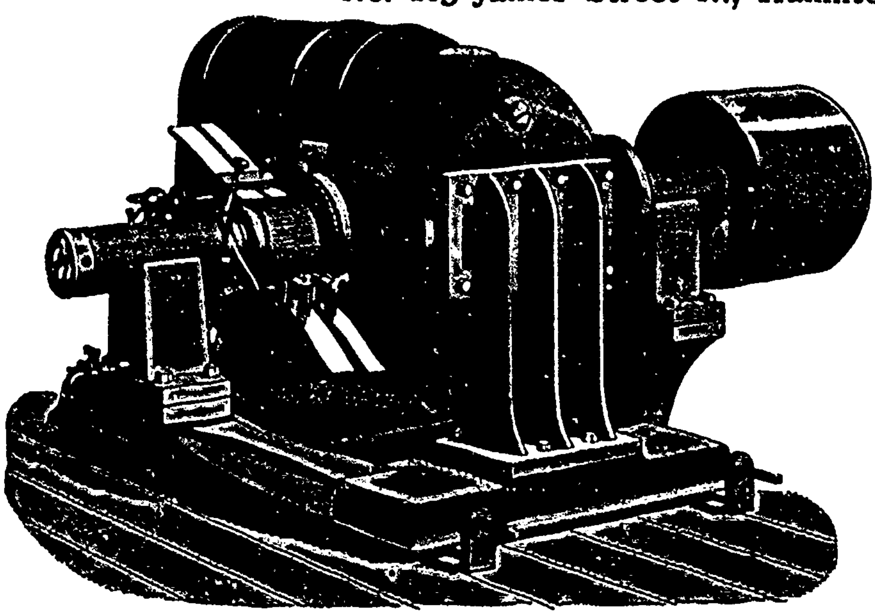

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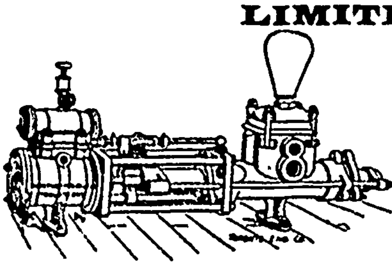

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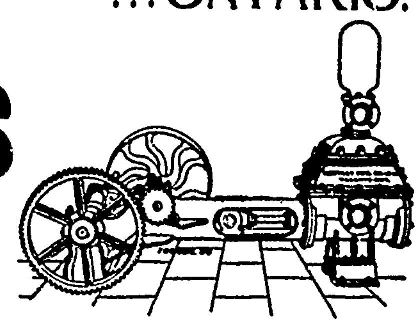

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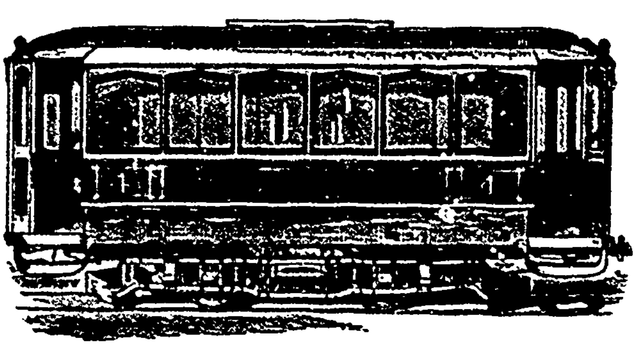

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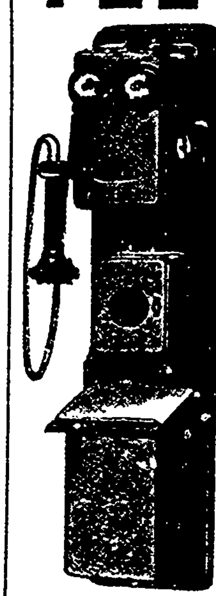

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THE BURSTING PRESSURE OF CYLINDRICAL BOILERS.

SEVERAL correspondents have recently asked for an explanation of the rule for finding the bursting pressure of boiler shells. The following article is offered as a general answer to all these inquiries.

Figure 1 shows an end view of such a shell, with the thickness purposely exaggerated. Let us assume that when the shell bursts it will separate along the line *AB*, so as to come apart in the manner indicated in Fig. 2. Now, although the steam pressure acts perpendicularly to the curved shell at every point, as indicated by the arrows, yet, so far as blowing the two halves of the boiler apart is concerned, the *effect* is the same as though the steam pressure acted vertically against a flat plate equal to the boiler in length, and equal in width to the diameter of the boiler. To make this plain let us consider Fig. 3, which shows each half of the boiler with a flat plate welded to it along its open side. Now it is a matter of common experience that a structure like one of these halves will not move upwards or downwards, when steam is admitted to its interior. That is, if it were put on a pair of scales the pressure of the steam against its inner surfaces would not make it weigh less or more than before. It follows, therefore, that the total *upward* pressure of the steam against the shell is precisely equal to the total *downward* pressure against the flat plate; the greater area of the curved shell being exactly compensated by the obliquity of the pressure against it.

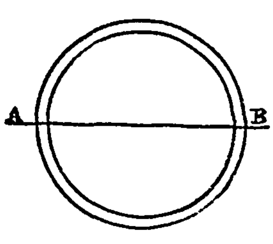

FIG. 1.

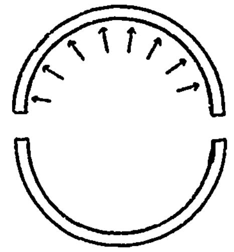

FIG. 2.

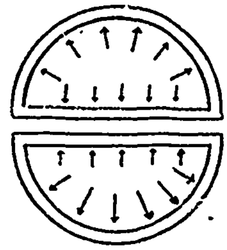

FIG. 3.

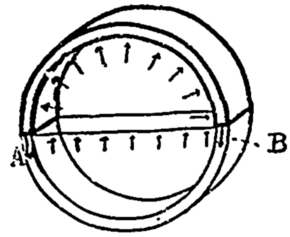

FIG. 4.

Let us now consider Fig. 4. The total *upward* pressure of the steam against the upper half of the shell is equal, as we have seen, to the pressure against a flat plate such as that shown in the cut, extending across the middle of the boiler. That is, it is equal to

Pressure per sq. in. × *area of flat plate.*

But the area of the flat plate is equal to the length of the boiler multiplied by its diameter; so that the total upward pressure, tending to blow off the upper half of the boiler is equal to

Pressure per sq. × *diameter* × *length.*

This upward force is resisted by the strain on the boiler shell, as indicated by the arrows at *A* and *B*. The total strain on one square inch of sectional area multiplied by the number of square inches of sectional area that would be broken across if the boiler should burst. The area of the fracture along each side of the boiler would be

Thickness of boiler × *length of boiler.*

and since there is one such strip on each side of the boiler, the total area broken across would be

2 × *thickness* × *length,*

and therefore the total strain at *A* and *B*, tending to hold the boiler together, is

2 × *strain per sq. in. of section* × *thickness* × *length.*

So long as the boiler does not burst, the force tending to blow it apart must be exactly equal to the force tending to hold it together; so that

Pressure per sq. in. × *diameter* = *2* × *strain per sq. in.* × *thickness* × *length.*

This is equivalent to saying that

Pressure per sq. in. × *diameter* = *2* × *strain per sq. in.* × *thickness.*

And this, again, is equivalent to saying that

Pressure per sq. in. × *radius* × *2* = *2* × *strain per sq. in.* × *thickness.*

That is,

Pressure per sq. in. × *radius* = *strain per sq. in.* × *thickness.*

Now, when a boiler bursts it does so because the strain on the shell has become equal to the tensile strength of the material; so that in this case our last formula becomes

Bursting pressure × *radius* = *tensile strength* × *thickness.*

This is the ordinary rule for finding the bursting pressure of a cylindrical boiler, except that it is usually expressed in the following slightly different manner:

$$\textit{Bursting pressure} = \frac{\textit{tensile strength} \times \textit{thickness.}}{\textit{radius}}$$

The bursting pressure of a boiler shell, therefore, is found by multiplying the tensile strength of the material in pounds per square inch, by the thickness of the shell in inches, and dividing by the radius in inches.

In this demonstration we have assumed the shell to be a solid sheet of metal, without joints. In practice the strength of a boiler is reduced exactly in proportion to the strength of its longitudinal joints, so that we must multiply the result obtained by the foregoing rule by the decimal representing the efficiency of the joint. (The question of the efficiency of joints has been so frequently and fully considered in the *The Locomotive* that it is not necessary to discuss it in this place.) The foregoing formula therefore becomes

$$\textit{Bursting pressure} = \frac{\textit{tensile strength} \times \textit{thickness} \times \textit{efficiency of join}}{\textit{radius}}$$

which means that in actual boilers we find the bursting pressure by multiplying the tensile strength of the material by the thickness of the plate *and by the efficiency of the joint*, and then dividing by the radius.

In conclusion we shall give a few numerical examples of the use of the foregoing formula and rule.

EXAMPLE 1. What is the bursting pressure of a steel boiler (tensile strength 55,000 lbs.), 48 inches in diameter and five-sixteenths inch thick, with single riveted longitudinal joints whose efficiency is 56 per cent.? ANS. The radius of this boiler is 24 inches, so that the rule gives

Bursting pressure = 55,000 × 5/16 × .56 ÷ 24 = 401 lbs. per sq. in.

EXAMPLE 2. What is the bursting pressure of a steel boiler (tensile strength 55,000 lbs.) 60 inches in diameter and 3/8 inch thick, with triple riveted longitudinal joints whose efficiency is 75 per cent.? ANS. The radius of this boiler is 33 inches, and the rule gives.

Bursting pressure = 55,000 × 3/8 × .70 ÷ 30 = 481 lbs. per. sq. in.

EXAMPLE 3. What is the bursting pressure of a steel boiler (55,000 lbs. tensile strength), 66 inches in diameter and ⅜ inch thick, with triple riveted longitudinal joints whose efficiency is 75 per cent.? ANS. The radius of this boiler is 33 inches, and the rule gives

Bursting pressure = 55,000 × ⅜ × .75 ÷ 33 = 469 lbs. per. sq. in.

EXAMPLE 4. What is the bursting pressure of a steel boiler (tensile strength 55,000 lbs.), 72 inches in diameter and ⅜ inch thick, with double welt butt longitudinal joints whose efficiency is 87.5 per cent.? ANS. The radius is 36 inches, and the rule gives

Bursting pressure = 55,000 × ⅜ × .875 ÷ 36 = 501 lbs. per sq. in.

After we have found the bursting pressure, the safe working pressure may be found by dividing the bursting pressure by a suitable factor of safety. We consider 5 to be the best factor of safety when all things are considered, though we sometimes allow 4½ when the workmanship is known to be first-class, and the materials of which the boiler is made have been carefully selected and tested. With a factor of safety of 5, the safe working pressures in the foregoing examples are as follows: Example 1, 401 ÷ 5 = 80 lbs., in Example 2, 481 ÷ 5 = 96 lbs; in Example 3, 469 ÷ 5 = 94 lbs.; and in example 4, 501 ÷ 5 = 100 lbs. —*The Locomotive.*

ELECTRICAL MEASURING INSTRUMENTS.*

BY L. M. PINOLET.

Notwithstanding its broad title, the aim of this paper is simply to describe some of the volt and ammeters most generally used in practical work and the principles of their operation. In such instruments the current to be measured, usually passes through a coil of one or many turns of wire and produces a magnetic field which is proportional to its strength. This extent of the movement gives an indication of the strength of the magnetic field and thus of the exciting current. The deflection must be opposed by a controlling force which is generally that of an opposing magnetic field, gravity or some elastic force such as that of a spring.

Ammeters have a low resistance for several reasons, the principal of which is, that, if their resistance were not low, the strength of the current to be measured would in many cases be reduced by this resistance, and an incorrect reading would be given. For a similar reason, voltemeters have a high resistance. If their resistance were low, the E.M.F. to be measured would be affected, if not considerably reduced, by the current shunted through the instrument. Voltmeters are, in fact, very sensitive ammeters, or more properly milli-ammeters; the sensitiveness being secured by having many turns of fine wire in the coil. The resistance of a voltmeter being constant, if the E.M.F. at its terminals be doubled the current flowing through the instrument will be doubled also, and will in every case be directly proportional to the E.M.F. Thus the readings, though produced by the current indicate the voltage of the circuit which is being measured. On the same principle, additional resistance put in series with a voltmeter increases the range of its readings. For example, if an instrument reading up to 100 volts, have its resistance increased ten times, it will then read up to 1,000 volts, for the current flowing through the instrument due to 1,000 volts will be the same as that formerly produced by the 100 volts.

In a large class of commercial instruments, the deflection of the pointer is produced by the action of the current upon a piece of iron. These instruments are of simple construction, but are open to the objection that the residual magnetism of the iron affects the correctness of the readings. However, by using very pure and soft iron, the residual magnetism can be eliminated to a large degree so as to render such instruments available for commercial use where extreme accuracy is not necessary.

Among this class may be mentioned the magnetic vane instruments, in which there are two vanes of thin soft iron, one of which is moveable and carries a pointer. The vanes are placed in a coil through which the current passes, and the repulsion between their similar poles which are adjacent to each other, causes the deflection. In the T-H ameters and voltmeters, a thin strip of iron carrying a pointer is pivoted eccentrically in the coil. The action depends upon the principle that, a piece of iron in a coil through which a current is passing, if not exactly in the center will be attracted to one side of the coil.

In another class, the current is measured by the attraction or repulsion between two parts of the circuit. One of the advantages of this type of instrument is, that it can be used for measuring continuous or alternating currents, for the attraction or repulsion between the two parts of the circuit is not affected if the current be reversed in both. A disadvantage is, that the action is proportional to the square of the current and, therefore, at one end of the scale the divisions are usually very close together, and at the other end they are far apart.

A recently devised instrument of this kind, is the Weston alternating and direct current voltmeter, which has been so perfected that its readings are direct and the divisions of the scale nearly equal. Other instruments of this class, are the dynamometers and Lord Kelvin's ingenious electric balances. In the latter, the attraction between a fixed and movable portion of the circuit is weighed, and the strength of the current is calculated from the weight required to balance its attraction.

*Abstract of a paper read before the Montreal Electric Club.

The permanent magnet instruments have desirable qualities which render them very suitable for practical use. In them, the current passes through a coil in the field of the permanent magnet. One of the advantages of this arrangement is that the force with which the movable coil is deflected is directly proportionate to the strength of the current. Not only does this permit the readings to be direct, but the indications are accurate through the whole range of the instrument, from zero to the end of the scale. Nearly all the other forms of instruments have what is called a "best of range," for which their readings are most accurate, and beyond which they are only approximate. In many of them no divisions are marked on the scale for 10 or 20 degrees from the zero point.

If the magnetic construction of a permanent magnet instrument be good, and proper care has been taken in selecting and artificially ageing its

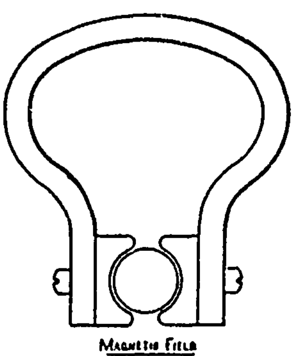

FIG. 1.

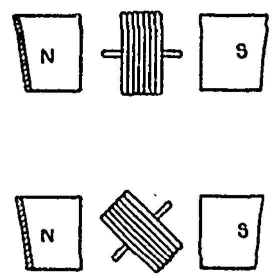

FIG. 2.

magnet, it will remain accurate for many years, provided it be used with due care. The change of reading has been found to be generally less than one per cent. after three years continuous use.

These principles of construction are illustrated in figures 1 and 2, which represent a Weston direct current volt or ammeter. This consists essentially of a permanent magnet provided with soft iron pole pieces, between which is a core of soft iron so as to reduce the magnetic lines of force and produce a strong, uniform field for the movable coil, which is pivoted on jewelled bearings and carries a pointer. The coil is set at an angle to the lines of force between the pole pieces, and when a current passes through it tends to turn so as to be parallel to these lines, and thus a deflection is produced.

Galvanometers are correctly speaking instruments in which a magnetized needle is placed in the center of a coil and the controlling force is the earth's magnetism or the field of a magnet at a distance. They are not suitable for general commercial use, for the controlling field is distorted by the proximity of masses of iron or of strong currents, and the accuracy of the instrument is destroyed. Very sensitive galvanometers are made, having a great number of turns of wire in the coils, using strongly magnetized needles, and weakening the controlling magnetic fields. Furthermore, the needles are usually provided with a mirror which reflects a beam of light on a scale, so that very small deflections may be visible and be accurately measured.

Hot wire instruments operate on an entirely different principle from those already described; the deflection being produced by the expansion of a wire by the heating effect of the current flowing through it. They are suitable for either alternating or continuous currents and are not affected appreciably by strong magnetic fields such as those of dynamos. They are specially

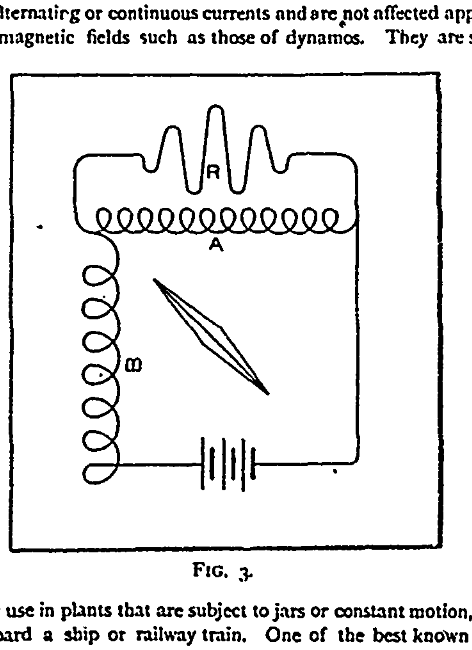

FIG. 3.

adapted for use in plants that are subject to jars or constant motion, such as occur on board a ship or railway train. One of the best known of these instruments, is the Cardew voltmeter, in which a very fine platinum-silver wire is enclosed and supported by a tube of compound metal, whose coefficient of expansion is equal to that of the wire. The ordinary pattern reads to 120 volts, and contains 12 feet of wire, which passes several times up and down the tube and finally passes around a pulley, geared with a small magnifying pinion carrying a pointer. In this way, a slight change in the length of the wire, produces a magnified deflection.

Though the magneto bell can scarcely be classed as a measuring instrument, it is so extensively used that some mention should be made of it. The magneto is a small electric generator, whose armature is turned by hand, and which generates an alternating current. The current actuates a polarized bell which is arranged to ring through any resistance up to the stated capacity of the instrument, usually from 10,000 to 50,000 ohms. Notwithstanding the fact that these instruments are unreliable and are subject to give false results, they are largely used owing to their cheapness and convenience. The principal source of error is due to the alternating current, which is affected by the self-induction and static capacity of the circuit which is being tested. Cases are liable to arise were the bell will ring on a perfectly insulated line, owing to its static capacity, or the self-induction of a continuous or grounded circuit would be sufficient to prevent the bell from ringing. To overcome these objections, the use of continuous current magnetos with high resistance buzzers or detector galvanometers, has been advised.

In England, portable magneto generators are used in connection with direct reading ohm meters. All that has to be done to measure the insulation resistance of any circuit, is to connect the instrument with the circuit and the ground. Upon turning the handle, the needle points at once to the resistance. The ohm-meters usually have a range of from five thousand to five million ohms and are graduated in thousands of ohms. The generator generates a continuous current having a voltage of 100 to 120 volts, when the handle is turned at about 120 revolutions per minute.

The operation of ohm-meters is based upon the law that the resistance of a circuit is equal to its voltage divided by the current. In these instruments, two coils at right angles to each other act upon a needle, as shown in figure 3. The coil B has a comparatively low resistance and is connected in series with the line or resistance R. The other coil A has a high resistance and is connected as a shunt across the terminals of the generator. The field of the coil A is proportional to the E.M.F. and that of B to the current through the circuit. The field of B opposes that of A, and the needle is moved more or less to one side or the other according to which field is the stronger. In this way the resistance of the circuit is indicated approximately.

MICA FOR ARMATURE INSULATION.*

The introduction of mica into practice appears to have been brought about in the following manner.—An accident would happen to an armature, and before the next night it must needs be repaired. In order to make the temporary remedy, mica sheets or bars would be interposed. In the case of subsequent accidents, the portion prepared by mica was the last to yield. Therefore it was proposed to build the armature primarily with mica. But this change took place very, very gradually, but surely. Manufacturers of stoves, the leading houses being also importers of mica, soon experienced a growth in the mica department of their business, until at present some import more for the electrical industry, especially for armature use, than for stoves. Why it was not employed from the first, no one could positively assert, otherwise than to guess that no one probably thought of it, or insulation was not considered of much comparative importance, or cheapness of material in construction was allowed to counterbalance efficiency of action and durability.

Of all substances, mica probably is the best material for use in armatures, if it is desired to obtain not only efficient electric insulation, but also durability under the influence of heat. The highest temperature to which an armature is subjected, even by short-circuit or bad construction, will have no injurious effect upon mica. Mica, thick or thin, may be held in a gas flame without cracking, burning or melting. It remains unaffected. The reason of this is better understood when it is remembered that it consists of aluminic silicate, containing also potassic, sodic and lithic silicates, and some ferrous and ferric and manganic oxides. Its chemical constitution varies.

One quality of mica is that which is commercially termed amber mica, and is usually mined in Canada. It is so named from its appearance and not because it is amber or in any other way similar to it than in its color. India mica is a commercial form noted for its uniform cleavage, extreme thinness of its laminæ, flexibility without fracture and its resistance, which is much higher than that of amber. Carolina mica is another variety. It is obtained in sheets in the western part of North Carolina. It is the best mica for stoves, but it is too hard for some electrical purposes. Mica occurs in so many specific forms that particular names have been given to it.

Muscovite is one of the most common varieties. It occurs in different colors, namely, a dark green, yellow, brown, white and gray. This is the form usually found in small scales in granite, gneiss, and mica schist, and at the same time it occurs in larger, tougher sheets than any other form. A complete scale is irregularly hexagonal in shape. Lepidolite, or lithia mica, has a pearly lustre, as distinguished from the vitreous luster of muscovite. Its scales are usually very small, and it is found in limited varieties of granite and gneiss. Cryopholite is a subvariety of lepidolite. A characteristic feature of the form meionite consists in its occurring much cracked within. It has been found in geodes. Biotite is a form found in volcanic rocks in small scales. It contains much iron and magnesia compounds. Phlogopite occurs usually in limestone. Its subvarieties are aspidolite and manganophyllite. A very little variety is lepidomelane. It is also practically opaque. Its subvariety is astrophyllite.

The insulating power of mica is superior to that of any other substance applicable to armatures. An advantage, peculiar to itself, is its even, laminated structure. How wonderful is the thinness of its individual layers! A piece of ordinary writing paper is about .005 inch. Mica layers have been obtained of a thinness of .00003 inch. Mechanical difficulties prevent its being split thinner. By pasting it upon a hard surface and splitting it off as much as possible, the remaining fragments are so thin as to become beautifully iridescent. The builder of armatures can therefore split the sheets into any desired and uniform thickness with great ease and accuracy. An interesting property of mica and one not generally recognized, is its homogeneity of structure and clear transparency, although so black when thick. The writer used a piece one-quarter of an inch thick for observing the late solar eclipse. The effect was better than with smoked glass and as efficient as black glass much thicker.

A valuable property of mica in connection with commutator insulation is its proper degree of hardness, whereby it does not wear away too rapidly under the action of the brushes. If rubber were used, for example, even if it did not burn, yet it would wear off and sparking result, because the commutator surface would not be truly cylindrical. The brushes would be set in vibration. Again, mica is capable of the finest pulverization, so that any wearing which does take place does not result in the liberation of gritty particles, which would also cause sparking. Such mishaps occur with hardened artificial plastic insulators. The insulation should be just so thick that the current cannot jump across from one section to the other.

* From a paper on "Armature Insulation" by Chas. W. Jefferson and H. W. Dyer, read before the American Institute of Electrical Engineers.

CANADIAN ELECTRICAL ASSOCIATION.

A meeting of the Executive Committee of the above Association was held in Toronto on May 17th. Several gentlemen upon application were elected to membership in the Association. It was decided that if satisfactory arrangements can be made, the second annual meeting of the Association shall be held on the Industrial Exhibition Association grounds, Toronto, on Tuesday and Wednesday of the second week of the Exhibition. The arrangement of the details was left in the hands of the Toronto members of the executive. The Secretary was authorized to communicate to electrical manufacturers the time and place of the annual convention and suggest that they make application for space for exhibits. A resolution of thanks was passed to the President and Mr. A. B. Smith for having in the interest of electric lighting companies successfully opposed at Ottawa the passing of legislation which would have operated most injuriously to the electric lighting business.

The Secretary read letters from six or seven members of the Association who have kindly consented to prepare papers for the annual convention. In order to facilitate the proper discussion of these papers, it is intended to have copies of them printed and distributed to members prior to the date of meeting.

The outlook for the coming convention is a most promising one. It devolves upon every member to do what he can to making the September meeting one of the greatest possible interest.

QUESTIONS AND ANSWERS.

"SUBSCRIBER," Chatham: Can you give me the name of a firm in Canada who manufacture steam traps.

Ans.—As we do not know of any firm in this line, we would feel obliged if any of our readers would furnish the required information.

THE COST OF STEAM POWER PRODUCED WITH ENGINES OF DIFFERENT TYPES UNDER PRACTICAL CONDITIONS, WITH SUPPLEMENT RELATING TO WATER POWER.*

(Concluded.)

By Charles E. Emery, Ph. D.

(34) The writer finally presents in columns *G* to *N* inclusive the total cost per net horse-power per year for coal at the several prices stated, first for ordinary working hours, and second for 20 hours per day for the full year. An examination of the several columns shows clearly that for cheap fuel and short hours the engines of fair economy and least cost give the most economical results when both the cost of fuel and the collateral and interest charges are considered. Such a result would be anticipated in relation to non-condensing engines, but *it is somewhat surprising to find that the compound engines of comparatively moderate price show better economy, everything considered, than the higher priced triple-compound engines*, if we reject the results shown in the last line, which, as already stated, it is believed cannot be obtained in average practice. For the 10 hours' day with coal at $2 per ton, the lowest result is, for the assumed conditions, shown in line *I*, referring to special triple compound high speed condensing engines. Unfortunately more conditions have had to be assumed in relation to this type of engine than for any of the others. They are being made specially for electrical purposes of extra weight and with extra length of bearings, and the prices available would, with proper allowance for erection, give prices higher than stated. However, the result is very little different from that shown in lines *G* and *H* for compound engines high and low speed, or even for the simple low speed condensing engine, line *F*, on the one hand, or the triple compound, lines *J* and *K*, on the other. This similarity in final cost is certainly very interesting, and examining columns *H*, *I* and *J* referring to cost at $3, $4, and $5 per ton, we find that although the total cost per year increases, the relative cost for engines of different kinds varies but little. At the $5 rate the high speed compound engine, line *G*, has fallen $1.43 per horse-power per year behind the low speed compound engine, line *H*, and $2.67 behind the high speed triple compound, line *I*, on basis assumed, but the latter with its lower assumed original price and higher coal consumption is holding its own substantially with the higher priced compound engine, line *J*. The same relations practically hold for 20 hours per day with cheap coal, and it is not until we reach column *N* for 20 hours per day and coal at $5 per ton that the higher priced engines (rejecting as before line *L*) show any decided superiority, and even under these circumstances the difference is comparatively not great.

(35) The writer next presents in columns *O* to *V* inclusive the total cost per horse-power per year for electric railroad and other variable work requiring 50 per cent. extra plant to obtain the average power. In making these comparisons the insurance has been increased to 1½ per cent., the engine renewals to 4 per cent. and the boiler renewals to 5 per cent.

(36) Attention is called to the fact that although all the costs have been raised in the latter case, the general relations have been very little modified. For short hours and low priced coal, the medium priced engines show, if anything, still better results than on the previous basis. The engines requiring the least fuel only show to advantage for long hours and high priced coal, and even then as will be seen in column *V*, the results for the last four lines, excluding *L*, are remarkably near uniformity.

(37-38) The writer then discusses the effect of using boilers of less first cost than first assumed and presents a comparison on this basis in Table II (not here reproduced). The result is to favor the engines requiring most fuel, for the reason that they require more boiler power for a given net power. Attention is called to the fact that the same effect would result for reducing either the cost of the coal as previously stated, or the cost of handling and firing the same.

(39.) The writer states that a reduction in the cost of the numerous attachments and appurtenances necessary, or claimed to be necessary, in connection with a steam plant will decrease the interest charges generally, in a higher proportion for the more economical engines.

* An abstract of a paper read before the American Institute of Electrical Engineers, March 21, 1893, and printed in the N. Y. *Electrical Engineer*. For convenience of reference to the original paper, the paragraphs in the abstract have been numbered to correspond with the original paper.

(40) The rules adopted for calculating the various columns of Table I are shown by algebraic formulæ; the notation being in terms of the letters distinguishing in several columns.

(41) The writer discusses the losses in economy due to the use of non-condensing engines, with varying loads, for the reason that the back pressure forms a very large proportion of the total resistance to overcome when the loads are light and the expansion is limited when the loads are very heavy. The former consideration partly militates against the use of triple compound engines without a vacuum, unless the steam pressure is 200 pounds or upward.

(42-45) The writer then shows that considerable changes in either one of the various items will not greatly vary the final result. The following table is presented to show for four of the various engines referred to in Table I the distribution of the various items of cost. An examination of this table shows that the collateral charges, line 2, or the operating expenses except coal and interest are very nearly constant, or about equal to the cost of coal, line 1, for the economical engines, and decrease the percentage of saving due to economy of fuel simply by increasing the amount upon which the saving is to be applied. The interest, line 4, on the contrary, tends to neutralize the economy due to increased coal consumption and therefore makes the cost of power under ordinary circumstances, when everything is considered, substantially the same for a number of different kinds of engines showing considerable differences in coal consumption.

	Simple High Speed Non-Condensing.	Compound High Speed Condensing.	Special Triple Compound High Speed Condensing.	Triple Compound Slow Speed Condensing.
Lines of Table 1.	A	G	I	K
(1) The costs of coal at $3.00 per ton, Col. *r*, for a ten hours day are for the engines stated in the headings at the right.	$19.09	$17.57	$ 9.84	$ 8.91
(2) The collateral operating expenses, excluding interest, are (Line E- line D)	$10.69	$ 9.18	$ 9.06	$ 9.11
(3) The interest charges, Col. D, are	$ 6.39	$ 5.61	$ 5.95	$ 7.30
(4) The total costs, Col. H, are	$36.17	$26.36	$24.85	$25.32

(47) The writer states that the paper should not be considered a criticism of the practice or views of others or serve to discourage the higher development of the steam engine. The investigation simply shows under what conditions the higher-priced machinery is more economical and under what conditions the saving in fuel is balanced by other considerations. In some cases other conditions must be included for a complete solution of the problem. For instance, in large steamers making long voyages economical machinery secures in addition to the saving in the cost of fuel a saving in the space required to carry the machinery and fuel and thus increases almost in geometrical ratio the efficiency of the ships. This may not be true for vessels making very short trips or stopping a large proportion of the time in port. Reference is made to the high expenditures warranted in some mining regions where coal is very high-priced and illustrated by the remarkable work of Mr. E. D. Leavitt in this direction. The paper, however, states that the development of the great West is now so modifying the conditions that a change of policy will be initiated even at the Calumet & Hecla mines in the near future. The writer during a recent business investigation with an electrical outlook ascertained that the prices of coal in Duluth and Superior, beyond the Calumet & Hecla peninsula, are even now reduced even to those ruling on seabord, due to the construction and operation of large whaleback steamers which take wheat eastward and coal on their return trips.

(48) The writer states that the considerations expressed in the paper may prevent the use of specially designed pumping engines in the future where coal is reasonably cheap and concludes that the further perfection of the steam engine will not be hindered by the general facts stated, since with the deve-

lopment of mining industries at great distances from coal fields the closest economy in the use of fuel will secure the best commercial results. In order, however, to secure such results for growing enterprises, electrical and otherwise, in the cities and towns along lines of communication already established, the writer believes that the field will be occupied by cheaper engines of simple construction, which, though not securing the maxium economy in fuel, will so reduce the capital upon which interest and dividends are to be paid as on the whole to represent not only better commercial policy but better engineering, because based on more complete conditions.

SUPPLEMENT RELATING TO WATER POWER.

(49) The writer states that it will be impossible in connection with his paper to make a satisfactory comparison of the relative advantages of steam and water power under different conditions, but as the cost of steam power has in the paper been considered on a somewhat different basis than customary previously, he considers it important to examine the cost of water power briefly in the same way, more particularly to show what amount can be paid for the development of a water power in competition with steam power. He does not think that examples should be selected where Nature has specially favored the development of water powers at a nominal cost or where the operations of the general government have assisted the mill owners at the Falls of St. Anthony, but that the question should be discussed under more general conditions such as have been developed on the Merrimac.

(50-52) From the paper of Prof. Swain in the census reports and testimony in various water suits, he concludes that the development of water-power on the Merrimac has cost about $142 per horse-power, to which the Merrimac owners, are, however, obliged to add the greater part of the cost of a steam plant for use when there is no surplus water, and continues that it has long been known that the water power on the Merrimac has cost so much for development that could the expenditures be recalled it would be more economical to locate where coal can be obtained at cheaper rates and steam power used exclusively. Notwithstanding these considerations, however, a new water power is being developed at Sewall's Falls near Concord, which, it is supposed, however, will not be subject to the initial costs of the other large plants.

(53) The writer considers the highest allowable cost for the complete development of a water power, from the dam to the jack shaft, to be about $140 per horse power utilized on a 10-hour basis. The sum of the various items of cost such as depreciation, taxes, interest and operating expenses, he considers to be about 17 per cent. of the original expenditure. If the expenditure be $140 per horse-power, such percentage represents $24 per horse-power per year or about the same as shown in the tables for economical engines and coal between $2 and $3 per ton. If there were one company to furnish the power and another to utilize it, the balance in favor of steam power would be somewhat greater. When, however, the power is used for 24 hours per day a much greater original cost is permissible.

(54) When the power of waterfall is to be delivered at a distance, the allowable cost of actually developing the power must be decreased by that necessary to transmit the power and actually deliver it to a jack shaft at a given distance. An electric transmission is undoubtedly the most economical for such a purpose. If we add to the cost of the dynamos, that of buildings, of the hydraulic connections to the canals, of the turbines, of the line and of the installation, and finally add the cost of the motors, so that the power is according to the assumption delivered to a jack shaft, and total cost of what may be called the "electrical transmission plant" cannot probably at present prices be put in for $140 for each net horse-power delivered, so on a 10-hour basis no expenditure could be allowed for the general development of the water power, but only for the simplest hydraulic connections to existing canals, etc. If, however, power can be sold throughout the whole twenty-four hours, more than double the price can be obtained for the same and this will warrant doubling the total cost of development unless a greater percentage of income is desired. At the cost of the electrical plant remains the same, the whole allowance increase may be applied to the development of the hydraulic plant, thereby entirely changing the conditions.

(55) The writer has not hesitated to recommend an original expenditure of $200 per horse-power for a combined hydraulic and electric plant near large cities, where not only the customary income due to incandescent and arc lighting and the use of small motors at high rates would be available for comparatively short hours, but where the industries are such that large units of power could be sold at remunerative prices on a 24-hour basis. Even higher costs for development would appear to be warranted in some locations, but there is no general rule on the subject. The allowance expenditure in a particular case can only be determined from calculations based on the actual conditions.

STUDY OF ELECTRICITY BY ENGINEERS.

THE following are extracts from an address delivered before the Nashville (Tenn.) Association, No. 1, N. A. S. E., Jan. 13 1893, by F. G. Heeger:

I will once more call your attention to the necessity of studying, and as regards electricity. In the year 1889 Mr. Hobart, said that about the year 1895 engineering papers will contain advertisements like the following:

WANTED.—By a small manufacturing firm, a capable engineer, must be able to use indicator, keep his plant up and get the best possible results from fuel burned. A knowledge of electricity indespensable. Must know how to r n dynamo electric machines, and keep them in good shape. Good pay to right man.

How far did Mr. Hobart miss it? This is sufficient to demonstrate the great necessity of providing yourself with an indicator and learning how to use it with precision. How many of us would pass muster, if put to a rigid test, to-day? Can we look at a working dynamo and tell in a minute whether or not the machine is doing its full duty? I fear many a good steam engineer would get sadly left were he to be judge according to the standard of 1895. "Why should I know anything about electricity?" asks the gentleman on my right. "Why, I have run engines for thirty years and I see no reason why I should become an electrician now. It is my business to run the engine and not the machinery it drives. If that manufacturer wants to make electricity out of steam let him hire an electrician to do it, and I will stay by my engine, as I have always done."

Such argument sounds all right; but it won't work, all the same. Electricity is a very peculiar thing to deal with, and it cannot be handled by any other than electrical methods. There is no one so capable of undertaking it as an intelligent engineer. Give him an extra dollar per day and it ought to be sufficient inducement for any man to apply extra knowledge to a few minutes work through the day.

Engineers—is there a man among us worthy of being called by that name, who does not hope some time to get above his present level and be "chief engineer" of some large establishment? Certainly every one of us have such ambition and should put in all his leisure time in fitting himself for such a position.

Imagine the chief engineer of a large building, which uses hundreds of electric lamps, who had no knowledge of electricity. "Well," you say, "what of that?" You can see at once that he would be at the mercy of every young dude of an electrician who chanced to visit the plant, and even if such a man acquired such a position he would not be qualified to discharge his duty.

THE TELEPHONE GIRL.

DOES it ever occur to any one of many men, that he is daily taking part in a strange proceeding that was never indulged in up to a few years ago? Nearly every day he is conversing with a person whom he does not see, perhaps never did nor never will see. And yet the conversation is as purely a matter of course as his conservation with his wife at the breakfast table.

The particular reference is to the Telephone Girl, that Sweet-Voiced Mystery at the Other End of the Wire, that Desirable Unknown, and Tantalizing Incarnation of Thouartsonearness and Yetsofarness.

There are others unknown with whom one converses in the course of a busy day, but they are nothing compared with the Electric Goddess of whose material charms we wot not, but whose voice is like the thrumming of an elfin harp on a star-lumed night in June, or the tinkling of the lily bells that call the fairies to their revels, or the murmur of a crystal brook gliding over pebbly bottoms in a sun-filled meadow.

But we know not her Identity; we wonder who she is, when the 'phone vibrates click-clickety with whirring and with whiz. Implore of her to call her name, she merries at our bellow; with laugh like pour of molten pearls she answers only "Hello!"—Toronto *News*.

CANADIAN ASSOCIATION OF STATIONARY ENGINEERS.

Note. Secretaries of the various Associations are requested to forward us matter for publication in this Department not later than the 20th of each month.

The annual meeting of this Association was held on the 24th of May at Shaftesbury Hall, Toronto, the president, Mr. A. M. Wickens, presiding. There were about forty delegates present, from London, Brantford, Galt, Hamilton, Peterboro', Kingston and Toronto. The meeting was called together in the morning about 11 o'clock, when the president opened the proceedings with a short address. He referred to the satisfactory progress the Association had made since its legal organization two years ago, pointing out the difficulties which had to be contended against during the first year on account of the scarcity of funds. He, however, anticipated that its prosperity would greatly increase during the coming year as funds were largely on the increase owing to the entrance of many new members. He estimated that by the end of the year over 300 new certificates would be issued, because the examiners had now better opportunities to visit the different manufacturing centres in the province This work, he thought, should be encouraged and helped as far as possible. Although much had been done in the past, yet he hoped that the large expectations of the coming year would be realized.

The Registrar (Mr. John A. Wills), presented his report for the year, which was considered very satisfactory. It showed that there were 180 certificates in force in the province, and that the financial condition of affairs was good. After the report had been received and adopted, the election of four officers took place to fill the four vacant places left by members retiring at effluxion of their time of office according to the by-laws. The result of the election was as follows. Mr. James Delvin, (re-elected); Mr. Fred. Mitchell, of London; Peter Stott, of Hamilton and Fred. Donaldson, of Toronto.

The officers for the coming year were next appointed as follows: President, John A. Wills, Toronto; Vice-president, Robert Dickinson, Hamilton; Treasurer, Robert Mackie, Hamilton; Registrar, A. M. Wickens, Toronto.

A discussion took place with regard to improving the examinations, and a committee was appointed to consider the advisability of improving the questions and making them more searching, especially as regards the first-class certificates. Up to this date the Board of Examiners have received no pecuniary remuneration for their services, but as their work is greatly on the increase a by-law was passed after some discussion, allowing them a small sum.

The meeting adjourned at 3 p.m. until the 24th of May, next year, when it will meet at London, Ont. At the close of these proceedings the visiting delegates were conducted over the Toronto Electric Light Company's station, with which they were highly pleased. Many of them afterwards left for their homes, but a few remained over until the following day and visited other places of interest.

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

At the meeting of the above held on the 26th inst., about 50 were present. Among the business transacted one new application was received and the following resolution passed:

Whereas—It has pleased our allwise Creator and Heavenly Father to remove from this earth the little daughter of our worthy friend and esteemed Brother T. Graham, therefore be it resolved, that while we bow in humble submission to the Divine will of our Heavenly Father, we at the same time extend our sincere and heart-felt sympathy to Brother Graham, his wife and family in this their hour of sorrow, and be it further resolved, that a copy of this resolution be sent to Brother Graham, be spread on the records of this association; and also that a copy be sent to the ELECTRICAL NEWS for publication.

At the close of the business meeting the association celebrated its seventh anniversary with a social and musical entertainment. Mr. A. M. Wickens was asked to preside. In the course of his opening remarks he said he believed these social evenings were the means of bringing the members closer together, and of making the new-comers feel more at home. He would like to see more of them. The Association was a means of mutual improvement to all, but members should also encourage sociability. There was no doubt that a large future was before them, for their certificates were becoming of great value, and already they were of many times more value to the holder than the cost of obtaining them

Mr Edkins corroborated the last speaker in reference to the desirability of encouraging sociability among themselves. There were many benefits to be derived from an association like this, and during his visit to other places he found a better feeling was being shown to stationary engineers. He also referred to the coming convention at Montreal, and invited the members to prepare some papers on interesting subjects to read there At any rate he hoped all would make an effort to be present, as a great time was expected.

Mr Lewis said he had much to thank the C. A. S. E. for. With hard study and its help he had been able to secure a first-class certificate which he had found of great value to him. He hoped all stationary engineers would endeavor to go in for the examinations, and as far as he was able he would be pleased to help any brother in this matter.

Mr Gilchrist hoped that the social evenings referred to and desired would not be the means of letting them forget their main object, education A noble work was being done by the Association. It had elevated their work to a point which nothing else could have done.

After a few remarks from the vice-president and all present had partaken of some light refreshments, Mr. J. Marlland was called upon for a piano solo, which was followed by Mr. Blackgrove singing "Wonders of the Deep." A duet followed by Messrs. Blackgrove and G. Grant, which received a well earned encore. An instrumental trio by Messrs. Walmsley (guitar), Mills and McHenry (banjo), was well rendered, as was Mr. G. Grant's song, "Under the Poplar Trees." Mr. McHenry gave a banjo solo, which was followed by a solo from Mr. Walmsley, entitled "Many Changes I Have Seen," its reception compelling him to give an encore. Mr. Henry's song "On the Bowery," and Mr. Grant's "Brawley, How's Yersel," were well received. After another banjo solo from Mr. McHenry, Mr. Walmsley concluded the enjoyable entertainment by singing "Always Do to Others as You Wish to be Done By."

After a vote of thanks, proposed by Mr. G. C. Mooring, and seconded by Mr. J. Wadge, was passed to the several musicians for their talented services, the meeting was brought to a close by singing God save the Queen.

TELEPHONIC COMMUNICATION WITHOUT A SPECIAL LINE.*

BY G. MARESCHAL.

I have noticed that if I attach one wire to a gas pipe and another to a water pipe and connect the two to a telephone, the existence of a current will be proved by the sound in the instrument upon opening and closing the circuit. To measure it I have substituted a galvanometer for the telephone and as nearly as I have been able to determine with the primitive apparatus at my disposal, the deviation corresponds to a quarter of a volt. What is especially remarkable about the current is its continuity. The needle of the galvanometer has remained almost stationary for a year, varying one or two degrees to the right or the left during the course of each day.

It was my first impression that I had proved the existence of an earth current, but in view of its continuity I came to the conclusion that the action was rather that of a battery of which the water and gas pipes formed the elements, which were attacked by the media in which they were located. The positive pole is the water pipe and the negative the gas pipe. I have repeated the experiment with success in many houses in Paris and elsewhere; but no current was found in places where the pipes were in close contact.

At my own home the current disappeared for about two months in consequence of the introduction of gas pipes in a certain room. It is likely that the workmen unwittingly established a contact between the two pipes. The experiment is an interesting one to make; all those who have a common galvanometer, or better yet, a telephone, can investigate the existence of the current.

But can the current be utilized? The current strength is so small that perhaps it is not likely. However, it would be easy to design some little motor that would revolve indefinitely and this movement might be utilized perhaps by a skillful mechanic for operating a tiny clock.

It is a sequence of this experiment that the pipes are relatively insulated most of the time, and I wondered if they could not be used as the two wires for telephonic communication. As a matter of fact I have been able to talk with a friend living six doors away, using the pipes as conductors. The experiment was conducted in a very simple fashion. In my own room were placed three bichromate cells and in the circuit was connected a microphone without the induction coil; in the neighboring house was arranged the telephone connected to the two pipes. An article from a daily paper read in my room was heard perfectly in the house of my friend. We then elaborated the experiment. The microphone was placed behind the piano and music was heard in several houses on the same street and on a neighboring street.

* Abstract of an article in *La Nature*.

THE EFFICIENCY OF THE STEAM ENGINE JACKET.

The Institution of Mechanical Engineers of England sometime since created "The Research Committee on the Value of the Steam Jacket." The second report of this committee was recently presented. In addition to collecting what information they could from outside sources, they presented in detail the records of five original sets of experiments, most of which were made specially for this report. In each case the investigation covered the performance of the same engine, both with and without steam in the jackets. The first set of experiments was made on a compound jet-condensing beam pumping engine, the second on a triple-expansion pumping engine, the third on a compound mill engine, the fourth on the experimental engine at the City and Guilds of London Central Institution, and the fifth on an experimental vertical engine.

From the records thus obtained it appears that the expenditure of a quantity of steam in an immense jacket produces a saving of a greater quantity in the cylinder. The ratio between these two quantities is an important factor in this investigation. Unfortunately, the jacket water has not been recorded in many of the experiments of which the results have been collected, but in all trials made by members of the committee it has been carefully measured. In the summary column q gives the percentage saving in feed water resulting from the use of the jackets; column p gives the actual saving in pounds per indicated horse power per hour; and column r gives the water condensed in the jackets in pounds per indicated horse power per hour. The following examples are taken from the tables.

	Saving in feed water with jacket.	Actual	Water condensed in jacket.	Ratio.
a	q	p	r	p to r
No.	Per cent.	Pound	Pounds per h. p. per hour	
41..	17.4	5.15	3.29	1.9 to 1
42..	8.6	2.76	1.20	2.3 to 1
43..	10.3	3.50	1.72	2.0 to 1
44..	19.0	5.82	1.13	5.2 to 1

No. 44 shows that for every 1.13 pounds of steam expended in the jackets there is 5.82 pounds less feed water passed through the cylinder, the net saving being thus 4.69 pounds.

The experiments showed that, generally, the smaller the cylinder the greater is the percentage of gain from the use of the jacket, arising doubtless, from the fact that a small cylinder gives a larger jacket surface for a given weight of steam passing through it than a larger cylinder does.

In some of the experiments it was possible to measure both the consumption of coal and that of feed water and as these figures have considerable practical value and interest, they are in every case added to the results. Some, therefore, form complete engine and boiler trials, but it must be remembered that the effect of the jacket is measured only by the consumption of feed water and not of coal.

The single-cylinder condensing engine experimented with had a cylinder 15 inches in diameter by 30 inches stroke. The body and both ends of the cylinder were jacketed. The pressure in the jackets ranged from 48 to 187 pounds per square inch above the atmosphere, the result being that the pounds of feed water per indicated horse power with the low pressure were 28.85 and with high pressure 19.85. Other experiments made with engines of the same type showed an economy due to the use of the jacket varying from 7 to 12½ per cent.

In experiments with a compound non-condensing engine the pounds of feed water per indicated horse power per hour were 26.29 without the jacket and 25.25 with the jacket. Two other jacket experiments are also recorded which show an economy of 15 per cent. In the test of a triple expansion condensing vertical inverted engine, having cylinders 5, 8 and 12 inches in diameter, and 10, 10 and 15 inch stroke, the engine being on three uncoupled cranks, the results showed that without the jacket 16.42 pounds of feed water were recorded for each indicated horse power per hour, while only 13.56 pounds were recorded with the jacket. In this engine 64.7 per cent. of the internal surface of a high pressure cylinder was jacketed, 67.1 per cent. of the internal surface of the intermediate cylinder, and 75.2 per cent. in the low pressure cylinder.

The discussion following the presentation of this paper brought out as the most prominent feature the fact that the opinions of English engineers vary about as much regarding the actual efficiency of the steam jacket as do those of American experts, and further, that the Institution of Mechanical Engineers resembles our own Society of Mechanical Engineers, in one respect, viz., that of being fearful of advancing a positive opinion on any disputed topic either through one of its authorized committees or as a body. Professor Unwin said he was sorry the committee had decided not to express any opinion, as that curtailed the possibility of criticism. He thought it an extraordinary fact that the experiments had not produced a case in which the jacket had done any harm.

English engineers, as was brought out during the discussion, are practically unanimous in the belief that the steam jacket is economical, but they are not united as to how far the jacketing should be carried. One speaker noted that there was no case mentioned in the report of the pistons being jacketed, and said he had known instances in which the required power had not been developed until the pistons had been arranged to take steam inside. He also advocated the jacketing of the piston rods, as they must carry off a good deal of heat by passing from the interior of the cylinder to the air. He would also jacket the steam pipe. He illustrated the value of the jacket by stating that the power of an engine had been increased from 41¾ horse power to 49½ horse power in five minutes by putting the steam jacket into use.

It is not necessary to further review this report or the discussion it elicited. Our knowledge of the real work done by the jacket and of the efficiency its use produces is being increased little by little; yet there remains much to be done and many experiments to be made before we shall possess facts establishing the true value of the jacket under all conditions. In this connection the paper by Professor Carpenter on steam jackets, read at the last meeting of the American Society of Mechanical Engineers, and the discussion by Prof. Thurston will be read with interest.—*Iron Age.*

PRACTICAL RULES.

SEVERAL correspondents of the *London Electrician* contribute a number of approximate practical rules, among which are the following:

To reduce centimetres to inches multiply by 4 and deduct one inch in every five feet. To reduce metres to yards, add one-tenth, deduct one-tenth of this correction and add one-third of the last correction. To reduce kilometres to miles, multiply by 6 and add one mile in every thirty.

To ascertain velocities in miles per hour, take any convenient distance in yards, measure the time, divide yards by the seconds and multiply by two; this will give the miles per hour approximately.

A horizontal belt, one inch wide, running at ten feet per second, will transmit one horse power if the pulleys are not too small; an increase of width or speed will transmit a proportional increase of power.

A pipe one inch in diameter holds one pound (or 1 gallon) of water in one yard running the capacity of a yard of any pipe in pounds may therefore be represented by its diameter in inches squared; for greater accuracy, add one-fiftieth. To find the capacity of a cistern, remember that eight cubic feet contain 500 pounds, or 50 gallons of water.

The resistance of any copper wire is the length in feet divided by the cross-section in square inches and multiplied by .000008. For greater accuracy add 10 per cent.

For finding approximately the current in a wire, place it parallel to the magnetic meridian, place a small watch charm compass under or over it and move it until the deflection is 45 degrees, then the difference from the needle to the wire in centimetres multiplied by .9 is the current in amperes. If the deflection is 48 degrees it is not necessary to multiply by .9 If the distance is measured in inches, multiply by .35. It will be close enough to divide the distance in inches by 3.

The Yarmouth electric street railway have declared a dividend of 6 per cent. on the eight months their system has been operated.

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

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FOR several months past the incandescent electric lamp has held a prominent place in public attention. Soon, however, its glory will in a measure be eclipsed by that of the half-forgotten, fly and heat dispelling, comfort-giving electric fan.

THE Canadian Pacific Railway has locomotives running between Toronto and Montreal which have steam cylinders 19 inches diameter, 24 inches stroke, and using steam of 180 lbs. pressure. It is probable that when running at full speed, these engines are capable of giving out 700 horse power. This power has all to be produced in one boiler and the engine has to carry its coal supply, its water supply and its chimney. What a saving in some respects there would be if the trolley system were used.

IN Toronto the other day an old gentleman undertook to disembark from an electric car while in motion. Result his leg got under the wheels and was completely cut off. The account of the accident which appeared in the daily papers was headed "The Cruel Trolley." It should have been headed "A Foolhardy Act." It is full time that the press and a section of the public should cease to charge to the trolley system calamities which are due to lack of discretion on the part of those making use of electric cars.

THE value of mica as an insulating material is creating for it a large demand on the part of manufacturers and users of electrical apparatus. Canada fortunately happens to be one of the few localities where deposits of this material are found. In the provinces of Ontario and Quebec exists in abundance. Now that its value has become apparent, there is an eagerness displayed by local and foreign capitalists to secure control of these Canadian deposits, which will doubtless yield handsome profits in the near future to the owners.

THE conspicuousness to be secured by advertising matter attached to telegraph poles leads wide-awake patent medicine and other business concerns to constantly seek to obtain for their announcements this coveted position. These announcements, like Jonah's gourd, spring into existence in a night, and poles that the previous evening bore no inscription, blazon forth next morning the merits of somebody's liver cure. The alertness of the telegraph companies' officials suffices to reduce the evil to a considerable extent, but seems powerless to entirely prevent it.

CANADIANS have been accustomed to congratulate themselves on their freedom from destructive cyclones such as are of frequent occurrence in some parts of the United States. The grounds of their gratulation have been severely disturbed, however, by wind storms of hitherto unknown severity which have lately swept over this country, the last of which occurred about ten days ago and caused great destruction of property. These storms entail heavy damage on telegraph and telephone poles and wires, and should they prove of frequent occurrence will no doubt hasten the adoption of the underground system.

METHODS of saving coal are numerous, too numerous to mention. One, however, deserves a brief notice. For some time past packages of a mysterious compound have been for sale which was guaranteed to effect a saving of from 15% to 40% by merely dissolving it in water and sprinkling on the coal before putting it in the furnace. It was sold in paper packages at 25 cents per package. It has recently been discovered that the wonderful compound is crushed rock salt, worth about as much as the paper in which it is put up, rather less than more. Its value as a fuel saver, resides very largely in the water used. Let us have bottled sea water next. Perhaps it is to get fuel saving mixture for their locomotives that the C. P. R. Co. have sunk the salt wells up near Windsor.

ACCIDENTS from the bursting of fly wheels still continue, and probably will so long as wheels designed for use with slow speeds are put upon high speed engines. It has been estimated that for a cast iron rim of solid metal, the bursting strain produced by the centrifugal force will equal the tenacity of the metal when the velocity of the rim is about 430 feet per second. If there be joints in the rim, the strength of the joint must be found, as it may be much less than that of the solid rim. A factor of safety of 10 should be used, which will reduce the highest safe speed for a solid cast iron rim to about one mile per minute.

MENTION was made in the ELECTRICAL NEWS for May of the fact that according to the provisions of the Railway Act, a street railway becomes in the eye of the law a railroad when horses are discarded and electricity is adopted as the propelling power. The Customs authorities were brought to a recognition of this fact recently when the Niagara Falls and River Railway Co. brought suit to recover $4,320 paid in duty on rails imported from England on the ground that the tariff provides for the free entry of steel rails weighing not less than 25 pounds per lineal yard, for use in railway tracks. The Crown at first contended that electric "railways" should be classed as "tramways," but subsequent to the trial abandoned this contention, and consented to judgment being given for the amount sought to be recovered.

POOR economy in the operating of an electric light or power plant is that which saves a few dollars in wages but allows dirt to accumulate and general disorder to become part of the plant, so much so that a break down or some similar occurrence eventually happens, which then costs infinitely more to repair or renew than it would otherwise have done. Let it be understood that we are not opposed to the strictest economy possible on the part of those who are the responsible heads of electrical companies, for in this economy the dividends are sure to appear. What we have reference to is that parsimonious economy that is sometimes used to produce large profits at the expense of the good running and perfect maintenance of the plant. Nor is it good policy in constructing a plant to pursue economy to such a point that with the expenditure of a few more dollars the work might be done in a more substantial manner such as would save a lot of expense in the future care and running of the plant. We have in mind a large station that for fine work and expensive construction up to the floor line could not be improved upon, but from that floor line to the roof consists of a flimsy frame and iron structure that is bound to cost more to keep in order than if built with brick or stone walls and an iron roof, not to say anything of the danger of fire wiping it entirely out of existence. Had the construction been of the reverse order, fire could not find anything to start with or feed upon, hence a lower rate of insurance, less repairs, and last but not least, considerable less anxiety and worry for fear of fire. It would not then be necessary to dot the place all over with fire extinguishers, the cost of which could have been much better employed in buying bricks and mortar.

HIGH tension transmission of power from the Niagara Falls will soon be an established fact, if the assurance of those having the matter in hand is to be relied upon. We particularly refer to the scheme to furnish power to the manufacturers of Hamilton as put forth by Mr. John Patterson, of that city. The promoters of the undertaking now promise that within a month they will commence putting up a pole line and stringing wires for this purpose. That they have every confidence in the success of their scheme there can be no doubt, they having already offered the power at a price per H. P. to several of the larger concerns who are now operating steam plants. They do not specify as yet whether they will operate two phase, three phase, or single phase motors. The power to start with will be taken from the American side of the falls until the tunnel on the Canadian side is finished and in working order, when it will be transferred. It is proposed to use step up and step down transformers and a pressure of 17,000 or 18,000 volts on the mains. We are not at present in a position to give particulars relating to the class of construction that they will employ, or as to the nature of the precautions that will be taken to keep their high tension currents on the wires, but our readers shall know all that it is possible for us to learn as the work progresses. We are well aware that some of our best and most prominent electrical men are skeptical as to the successful carrying out of an undertaking of this kind, but if this line is constructed—which now seems certain—and works properly, their skepticism must vanish, whereas if it is a failure their doubts will be more firmly rooted than ever. Of this fact we are firmly convinced, that if it is possible to carry power from the Falls to Buffalo—and we are told that they are already constructing the line to that city—it is equally possible to carry it to Hamilton, which is only a few miles more distant from the source of power. It is now rumored that a company has been formed in New York State with a capital of $10,000,000 with the avowed purpose of carrying power by means of buried wires to all important cities in New York and even as far as New York City itself. This of course, from the present standpoint, seems preposterous, but in this age of electricity who shall say that it will not be a possibility in the near future.

THERE are many villages and small towns within close range of one another that might form a combine of some sort and have themselves supplied with electric lighting, the current being generated in one of them and carried by means of wires, etc., to the others. This would be especially feasible if one of them should happen to have a small water power, or if not sufficient water to run a turbine, at least enough to use for condensing purposes. In either case power would be produced at a cheap rate, and sold by the parties operating the plant at a nice profit. The wonder to us is that there are no plants in operation under such conditions, it being such a simple matter to both equip and operate them. Not only does this apply to arc lighting for street service but to incandescent lighting for house service as well. With the high tension alternating system such lighting can easily be carried a distance of a few miles at a very little loss, particularly as such lighting would only be required from shortly before dusk in the evening until midnight, when the dynamo would be stopped, differing in this respect from large cities where the run is constant for the 24 hours of each day. The pole line could be constructed at a comparatively small cost, as small poles on country roads answer as good a purpose as large ones. The fact that such poles can be obtained frequently at a very low price is decidedly in its favor. There would not be required the preciseness and care in line building that is necessary where a multiplicity of other wires are met with, as in cities. This would tend materially to lower the cost of construction. Expensive hangers would not be needed for the lamps, the main object being to have them put up in a good and strong way, so as to be able to resist windstorms and such like. The wires would be required to be well put up for similar reasons. The size of arc adopted should be 1000 or 1200 c.p. both in stores and in the streets, a single lamp using 7/16 in. carbons being sufficient for the purpose on account of the service not being required later than midnight. One man with ordinary intelligence could be taught in a very short time to operate the plant, from the trimming of the lamps to the running of both engine and dynamo. A plant of this kind operated in connection with some manufacturing business already established could undoubtedly be made a paying business.

THE recent decision given at St. Louis in the now famous Edison Lamp Case, will no doubt have a marked effect on the Incandescent lamp industry in the U. S., and while being a decided set back for the would be monopoly, its effect as regard lamp users both in Canada and the United States will be decidedly beneficial. On this side of the line lamp users were beginning to feel the effect of the closing up of several factories in and about Boston and Chicago, to overcome which some of them have even gone so far as to import lamps from Germany, with what result we are yet unable to say, except that we know there was a saving in price of about 25 per cent. This saving is of great importance to a plant renewing say from 5000 to 10,000 lamps a year, if the life of a lamp is, as represented, 600 to 800 hours. But now that a decision adverse to the monopoly has been given, users will be enabled to purchase again at the old figures. What the effect of a confirming decision on this side of the line would be it would be hard to say. It seems to be the popular opinion that the patents in Canada are not worth the paper they are written upon, notwithstanding the fact that a decision given some time ago by the Assistant Commissioner against them was reversed on a re-heating before the Commissioner in Chief. This fact however would have little or no bearing on the case should it ever be taken into the Courts here and decided entirely on its merits, for while the Canadian patent laws are proverbially not the most strict in existence, yet to live up to them there can be no importation of other then raw materials. The question then would hinge on whether the importing of the glass bulb ready for the fusing in of the filament and the importing of filaments ready for mounting, not to say anything of the occasional bringing in of a batch of complete lamps, would constitute in the eyes of the law, the importation of raw material only. We certainly think it would not, but the vagaries of the law are such as to make one wary of passing a positive opinion under these conditions. That the owners of the patents did on various occasions import finished lamps and that they still continue to import both bulbs and filaments is we understand an open secret with quite a number of individuals connected in one way or another with electrical matters in Canada, but aside from all this, our opinion is that they will never press their claims here. In fact only as far back as a couple of months ago they had not succeeded in producing a 50 volt lamp that could be classed as a commercial article, for while giving full candle power to start, they in many cases dropped off fully 75 % in the course of 300 or 400 hours burning. There can be no question but that the incandescent lamp is anybody's property both in Canada and the United States, and that lamp users generally owe a debt of gratitude, if nothing else, to Mr. Rhotehamel, President of the Columbia Incandescent Lamp Co. of St. Louis, for the active manner in which he pursued and carried to a successful issue a defense remarkable for its clearness and conciseness, which we feel sure he was confident would win even before the trial came off.

Deputations representing twenty town and city municipalities waited upon the Ontario Government a fortnight ago to ask for legislation which would enable them to grant exclusive telephone privilegesf or a period of five years in return for a percentage of profits of companies to whom privileges might be given. This step was taken in view of the judicial decision recently given affirming the illegality of such action on the part of municipalities. The petition of the deputation was opposed by the legal representative of an automatic telephone company, which was not a matter of wonder. It was altogether surprising and amusing, however, to see a delegation from the Toronto Trades and Labor Council present in opposition to the granting of the required legislation. The telephone has been properly termed a natural monopoly. One efficient telephone company in a town or city is more satisfactory to the public than two or more companies would be. The existence of more than one company makes necessary the renting by every telephone user of as many instruments as there are companies in order that he may be in a position to communicate with every other telephone user. This means additional expense and trouble. It means, so far as the companies are concerned, that they will be unable to make a fair profit, and consequently will not be in a position to pay any tribute to the municipality. Thus it is that with exclusive privileges granted to one company, telephone users get a better and more efficient service, the telephone company is able to make a fair profit, and the municipality is enabled to exact in return for the exclusive privilege, a considerable percentage of the net earnings of the company with which to lighten the rate of municipal taxation. Strangely enough, there are found people like the Trades and Labor Council, who, while always complaining of their condition, will refuse to allow anybody to assist them in paying their taxes The Legislature, like a wise parent, saw where these short sighted people's interest lay, and granted the municipalities the power they sought.

PERSONAL.

Mr. L. H. Packard, of Montreal, has been elected first vice-president of the International Y. M. C. A.

Mr. William McKenzie, president of the Toronto Railway Co. has returned from a trip to Egypt and the Holy Land.

Peter Fairgrieve, formerly an employee of the Bell Telephone Co., London, died of consumption, at his parents' residence, Detroit, on May 15th.

MOONLIGHT SCHEDULE FOR JUNE.

Day of Month.	Light.	Extinguish.	No. of Hours.
	H.M.	H.M.	H.M.
1......	P. M. 7.50	P. M. 10.40	2.50
2......	" 7.50	" 11 30	3.40
3......	" 7.50	A. M. 12.10	4.20
4......	" 7.50	" 12.40	4.50
5......	" 8.00	" 1.10	5.10
6......	" 8.00	" 1.30	5.30
7......	" 8.00	" 1.50	5.50
8	" 8.00	" 2.20	6.20
9......	" 8.00	" 2.40	6.40
10......	" 8.10	" 3.10	7.00
11......	" 8.10	" 3.30	7.20
12......	" 8.10	" 3.30	7.20
13......	" 8.10	" 3.30	7.20
14......	" 8.10	" 3.30	7.20
15......	" 8.10	" 3.30	7.20
16......	" 9.20	" 3.30	6.10
17......	" 10.00	" 3.30	5.30
18......	" 10.30	" 3.30	5.00
19......	" 10.50	" 3.30	4.30
20	" 11.10	" 3.30	4.20
21......	" 11.30	" 3.30	4.00
22......	" 11.40	" 3.30	3.50
23......	" 11.50	....	{ 3.40
24......	....	" 3.30	
25	A. M. 12.20	" 3.30	3.10
26.	" 1.10	" 3.30	2.20
27......	" 1.50	" 3.30	1.40
28......	No light.	No light.	....
29......	No light.	No light.	....
30......	No light.	No light.	....
		Total,	133.00

SPARKS.

Messrs. A. A. Wright & Co., of Renfrew, have purchased an incandescent lighting plant.

Messrs. Anderson & Goddard, dealers in electrical supplies at Ottawa, have dissolved partnership.

It is announced that work will commence immediately on the construction of the Kingston electric street railway. The rails for the road are said to be on the way out from England.

The unusual rise of the Ottawa River recently gave occasion for much anxiety at Ottawa, as the water threatened to submerge the power plants of the electric railway and lighting companies. Fortunately, these apprehensions were not realized.

A company exists at Calais, N. B., with the object of constructing an electric railway five and a half miles in extent through the streets of that town and of St. Stephen which lies directly across the river. Negotiations are already in progress for the necessary poles and sleepers.

The Order of Railway Telegraphers of America spent a week in Toronto early in May in the consideration of matters affecting their organization. They were welcomed to the city by the mayor, and although sticking close to business, managed to see a good deal of the city and to all appearances enjoyed their stay among us.

The Ottawa Street Railway Company announce that they will immediately set about converting to the electric system the present horse car line between New Edinburgh and the Suspension Bridge. An order has been given for 750 tons of rails for the purpose. The work is expected to be complete by the middle of August. Ornamental iron poles will be used. The cost of building and equipping the new road is estimated at $118,000.

Mr. John Patterson, projector of the Hamilton radial electric railway, says that Siemens & Halske have been granted the contract for supplying the wire and electric machinery and plant necessary to convey power from the Falls to Hamilton. Work will be commenced at once, and by October the company will be prepared to supply power. The company expects to supply power to the Hamilton Electric Light Company and the street railway. The construction of the radial road will not be commenced until next year, as under the company's charter it has not the right to expropriate. Mr. Patterson has advertised for 1,600 poles to be used in stringing the wires between Hamilton and the Falls.

The Canadian General Electric Company have bought out Hunt Bros.' electric lighting and power business at London Ont., and will make it the nucleus of their new plant and business in that city. Mr. Chas. B. Hunt will be in charge of the business. A location has been chosen on the river bank for the new central station which is to be erected. It will be a substantial brick building 171 feet by 52, with six engines of about 1,100 horse power in the aggregate. The arc lighting plant will be placed in the south end of the building, with two engines of 200 horse-power each to drive the dynamos. This part of the building will be two stories, with the repair shops up-stairs. In the centre of the ground floor will be the incandescent lighting and power plant, driven by 700 horse power engines. The boilers and furnaces are to be in the other end.

RULES FOR FINDING PROPER DIMENSIONS OF STEAM PIPES.

A question that an engineer is very often called upon to consider is whether the size of the steam pipes leading to his engine is sufficient to let through the amount of steam necessary to supply the engine without a considerable fall from pressure. The engineer taking an indicator card, measures the height of his steam line above the atmospheric line and gets at once the pressure that was in the cylinder at the commencement of the stroke and while the engine was taking steam. If this comes within a very little of his boiler pressure he feels more satisfied says the *Journal of Commerce*, but if, on the other hand, it shows a considerable fall from the pressure in the boiler, he at once asks himself what he is carrying a certain pressure in his boiler for, if it is not to get it into his engine, and looks about to see the cause of the loss in pressure. Naturally the steam pipe is the first object to look at. If it is not sufficiently covered there will be a loss in pressure from this cause, and besides this a loss of heat that represents a considerable loss of fuel as well. An engineer can very readily figure just what this loss from naked steam pipes will be. A steam pipe will lose very nearly three heat units per hour from each square foot of radiating surface of the pipe, for every degree difference in temperature between the steam inside the pipe and the air outside. Suppose he had 50 feet of 6-inch pipe uncovered, carrying steam at 80 pounds pressure, and the temperature of the room was 90°. It takes .57 of a foot in length of 6-inch pipe to give one square foot of heating surface, and in 50 there would be 87.5 square feet of heating surface. At 80 pounds pressure steam has a temperature of 324°, and the difference between it and the engine room would be 324 - 90 = 234. As 87.5 x 3 x 234 = 61,425 heat units, and as one pound of coal is not good for more than 1,000 heat units, this lost heat will require 61,425 ÷ 1,000 = 61.4 pounds of coal per hour, to say nothing of the loss in pressure. It would be quite an easy thing for an engineer to put an indicator on his steam pipe, connect it with the reducing motion of his engine and take a diagram from the steam pipe just as he would take a diagram from the cylinder. This card would show the fluctuations of pressure in his steam pipe and where the piston was when those fluctuations took place. This would prove whether any loss in pressure might be between the pipe and chest or between the chest and the cylinder. If the diagram showed that immediately after the engine piston moved, there was a noticeable fall in pressure in the steam pipe and that this continued until the engine had cut off, then it would be conclusive evidence that the steam pipe was not large enough to supply the demand for steam and keep up the pressure. If, on the other hand, the card showed that the pressure in the steam pipe varied little from that in the boiler, then the diagram would show that any loss in initial pressure in the cylinder was due to the inability of the steam to get into the cylinder, and would show that the ports were restricted in area. A pipe diagram is the surest way of proving this, but it can be approached by means of figures. The best engineers have found that in supplying steam to an engine through a pipe, the steam should not be obliged to move faster than 100 feet in a second. This is to say, that if the pipe was more than 100 feet in length, that particle of steam in the pipe 100 feet from the cylinder should have reached the cylinder in one second. It will make no difference whether the steam is cut off early or late in the stroke, for the steam must move at that rate of speed to fill the cylinder while the valve is open. If the cylinder was required to be filled once in a second—entirely filled, without cut off—it should take all the steam in 100-feet length of the steam pipe in that second. If it is cut off at half-stroke only 50 feet of the length of the pipe will be taken, but that 50 feet has been moved through in one-half of a second and that is at the rate of 100 feet in a second. So with one-quarter cut off, only 25 feet of the length of the steam pipe is relieved of its steam, but it was relieved in one-quarter of a second. The rate, therefore, is the same for all cut-offs, for, if there is less space to fill because of the cut-off, the time in which it is to be filled is lessened in proportion.

It is a fact that the area of the opening of a pipe, multiplied by its length, will give the volume that pipe will contain. Thus a steam pipe having an area of opening of 20 square inches, and 500 inches in length, would contain a volume of 20 x 500 = 10,000 cubic inches. Dividing this volume then by its length will give the area of opening of pipe. If we know, then, how much volume of steam must be supplied to an engine in a second, and wish to put it into a pipe 100 feet long we have only to divide this volume by 100 and get at once what the area of the pipe must be to contain this volume of steam. We will have then a volume of steam in 100 feet length of the pipe just equal to what the cylinder demands, and the steam will therefore move at the rate of 100 feet in a second.

If the engine makes 60 revolutions a minute, then the piston makes two strokes in a revolution, or one second, and the cylinder must be filled twice in this second. Multiplying the area of the piston by its length will give the volume to be filled in one stroke, and by 2 will give the volume to be filled in one second. If the engine moves 90 revolutions per minute, then this is 1½ revolutions a second, or three strokes, and this must be the volume to be filed, the space swept through by the piston in three strokes. The proper way to figure this is to multiply the area of the piston by the number of feet the piston moves through in a second. Suppose an engine of 42-inch stroke, and running 66 revolutions a minute, or 2 x 66 = 132 strokes. Then 42 inches equaling 3½ (feet) x 132 (strokes) = 462 feet in a minute, divided by 60 = 7.7 feet a second. Multiplying this by the area of the piston in square feet gives the volume swept through by the piston in a second, and this volume must just equal the area of the steam pipe times 100 feet long. All there is, is to get a steam pipe large enough so that 100 feet of it will just equal the volume swept through by the piston in a second.

The rule is as follows: To find the proper area of steam pipe, multiply the area of piston in square inches by the piston speed in feet per second and divide by 100. Quotient is area of steam pipe in square inches. From this area the diameter is obtained by well known rules.

There is a loss in pressure at the elbows and through globe valves, but this may be disregarded unless there are more than five of them, in which case they will produce a loss in pressure in the friction of the steam passing through them.

It will be seen that if this is the proper area of a steam pipe, the area of the port should be just as much. It is here that the difficulty comes. The port should be open to an amount that will equal this area by such time as the piston, starting from a state of rest, gets to a movement equal to this rate of speed per second. The object of all recent improvements in Corliss engines has been to open the port nearly the full amount at the commencement of the stroke and to cause the valve to move slowly until cut off. No good valve gear will have such a motion that the port is slowly and gradually opened. What it needs is a quick opening of the port at the start, and valve gears that will not give this quick opening are defective. When there is a fall in pressure between the steam pipe at the chest and the cylinder, this insufficient opening is the cause, and it will be found that the valve is slow in opening, or sometimes it is the case that the ports are too small. A valve can be set so that the opening will be slower than at other times of setting. This should not be. We will touch on that matter after. In figuring for the exhaust pipe and port, the steam should not be required to move more than 75 feet in a second. In the rule, therefore, divide by 75 for the exhaust pipe instead of 100 as for the steam pipe.—*Scientific Machinist.*

So far as invention is concerned, says the Canadian *Patent Review*, attention seems to be more and more concentrated on electricity. In the December 1891 issue we published a few lines anent the paucity of electric heating, and it is a striking coincident that one of our worthy fellow citizens should since have procured patents for about a dozen different inventions of that ilk. A drug store, only a few doors from this office, is being exclusively heated this winter by electricity, a battery of five heaters circulating the water through the coils and keeping the place warm even if the mercury hovers about the lower forties, as it is recently reported to have done. The electric street cars are made comfortable in the same manner, lumber kilns and green houses are worked similarly, bread has been baked in electric ovens and a numerous party sat down to a dinner with elaborate menu, every morsel of which had been cooked by electricity. But practical every day house warming by electricity, is still a luxury which only the proverbial millionaire may enjoy, unless current can be obtained at a mere nominal price. Current is or ought to be cheaper in this city than elsewhere, but still it cannot be bought commercially at $10 per horse-power. So there is still room for improvement. The primary battery is still an unsolved problem and so is the secondary, or storage battery, as far actual commercial demonstration is concerned.

ELECTRIC MOTORS.

By Geo. D. Shepardson.

There are many interesting points about the operation of electric motors. A number of books and many articles in the papers give a good discussion of the dynamo, but when it comes to the motors we cannot say quite so much. Writers generally presume upon so much previous knowledge that one who knows little of the subject finds it difficult to follow them. There are a number of interesting points about the operation of motors that puzzle even "experts." Some are comparatively easy to solve if one is adept in higher mathematics. There are others that one can understand without much need for mathematics if they are only explained in simple language.

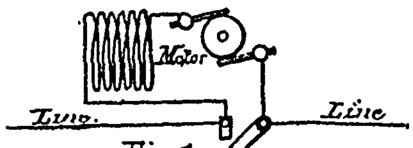


Fig. 1.

The writer has been working with motors of various sorts for a number of years and in a series of articles in the *American Mechanic* he expects to discuss some of these points in a way that he hopes will prove of interest to many. Questions and criticisms will be welcomed at all times and from any source.

In order to save time let us suppose that we have a motor ready to be wired up and put to work. Then while this is running and paying for itself, we will consider what it is doing and what it might do. Motors for direct currents may be classified as series motors. The field magnet coil is wound with coarse wire and is connected in series with the armature so that the whole of the current passes through them both. In the shunt motor the field coil is wound with many turns of fine wire so that it has a resistance three or four times that of the armature. In the shunt motor the current divides, a small part of it going through the field coil while nearly all of it goes through the armature. Motors for arc light or series circuits are always series machines and generally must have some mechanical regulator. Motors for constant potential circuits may be either series or shunt according to the work which they are doing.

Motors for arc light or "series" circuits are connected into the circuit in the same way as arc lamps. Some of them are provided with a simple switch that short circuits the motor as shown in Fig. 1. It is preferable to

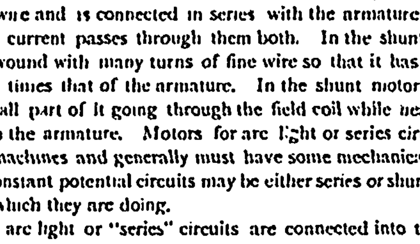


Fig. 2.

use a double pole switch in order to cut the motor entirely out of the circuit when not running. This is for the purpose of safety, in order that one may not be liable to get a shock from the motor in case the line was grounded. The method of connecting by a double pole switch is shown in Fig. 2. To start the motor this switch is opened, thereby throwing the motor into circuit. No rheostat or resistance is needed since in no case can the current through the motor become greater than that in the main line and this is kept approximately constant by the dynamo.

On starting up a motor on a constant potential circuit, it is necessary to have a certain amount of resistance in series with the armature in order to prevent an excessive current from flowing. As the armature comes up to speed it develops a higher and higher counter-electromotive force which opposes the electromotive force of the line and so regulates the amount of current passing through the armature. When series motors are used on constant pontential circuits, as is the case with the electric railway motors,

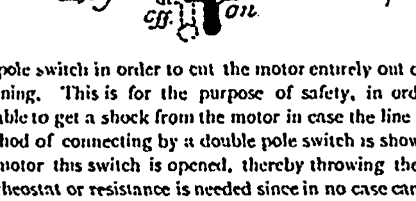


Fig. 3.

a variable resistance is connected between the motors and one of the mains. The other terminal of the motor is connected to the opposite main, as shown in Fig. 3. In this case also it is better to use a double pole switch.

Series motors are not self regulating on constant potential circuits and are not suitable where constant speed is desired. In such cases shunt wound motors are preferable and are generally used. These are connected up, as shown in Fig. 4, so that the field circuit is complete when the switch is first closed. The armature circuit is then closed through a variable resistance which is gradually cut out of the circuit as the armature comes up to speed. This leaves two separate circuits through the motor, the field and armature, each being connected directly across the two mains, each taking its own current.

It is sometimes desirable to reverse the motor so as to make it rotate in an opposite direction. This is accomplished by changing the direction of the current through either the field or the armature. If we reverse the current through both the field and the armature, the armature will run the same direction.

There are some other interesting points about the regulation of motors. It is well known that motors will of themselves regulate the amount of cur-

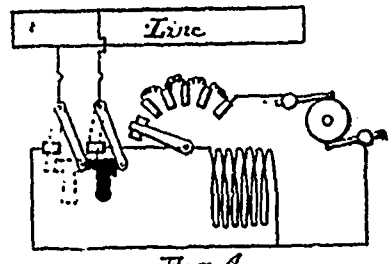


Fig. 4.

rent, taking more or less according to the work to be done, the speed being kept nearly constant all the while. These points will be left for a later article.

CONDENSING BY AIR.

The author, having been led by the rise in the price of coal to adapt a condenser to a non-condensing steam engine of 70-horse power, and being unable to obtain a fresh supply of cold well-water for more then ten minutes at a time, was obliged to resort to the principle of artificial cooling in order to use the same water continuously. After discussing several methods, such as cooling tanks, open gradation works, and others, he describes the plan adopted, which is to divide the hot water into narrow streams, which fall through a system of vertical channels against a rapid current of air, moving in the opposite direction. In the first form the apparatus consists of a rectangular wooden tower 7.5 metre high, 1.9 metre long and 1.3 metre broad, the upper half of which is divided into narrow passages by twenty-six boarded partitions spaced 10 centimetres apart, while the lower half is in air chambers supplied by a fan with spiral blades 1.2 metre in diameter fixed in one of the sides. The water to be cooled is delivered from a pipe at the top and passes through the intervals between the boards against the upward current of air, which moves at about 6½ metres per second. The effect is two-fold; the air acting partly by directly absorbing heat and partly by evaporating and absorbing water vapor, the relative value of these two factors being different at different times of the year. In winter the air works principally by direct cooling, but in summer, when its absorptive capacity for vapor is increased two and a half fold, the cooling is mainly due to evaporation; the final result being tolerably constant throughout the year, the vacuum in the condenser varying between 70 and 73 centimetres of mercury. The cooled water is reserved entirely for condensing, being too greasy for feeding boilers, so that it is constantly receiving new water in the discharge from the condenser. Theoretically, therefore, this should give some increase of volume in the circulating water after allowing for evaporation to the air, but in practice it is found that the quantity is constant, except occasionally on the coldest days of winter, when a small amount is sometimes run to waste from the collecting cistern, which is placed underneath the air chamber.

A curious consequence of the use of the same water over and over again for condensing is that a higher vacuum is obtained from it than might be expected from its temperature. Thus, in five comparative experiments, the same reading of the vacuum gauge (70 centimetres) was obtained with the same water, returning at intervals of ten minutes to the condenser as with fresh well water; the temperature in the former case being 27° to 28° C., and in the latter 12° to 13°. This is due to the circumstance that the rapid circulation causes the injection water to be practically free from air, while in the case of spring or other natural waters the air pump has to remove the dissolved gases, and thus a worse vacuum is obtained than with distilled water. It might be supposed that the intimate mixture of water and air would lead to reabsorption of the latter, but this does not take place, partly from the short time of contact, but more particularly from the circumstance that the energy promoting separation of air in the air pump is measured by the pressure of the atmosphere, or 10,300 millimetres, or one-two-thousanths part of the former.

The space required for the apparatus is only about one-one-hundredths of that of a cooling pond; a surface of 3.5 square metres being sufficient for 100-horse power, that of the boards being calculated at 3 square metres per horse power. The air pressure is 5 millimetres of water, the velocity is 6.5 metres per second, and the volume required about 2000 times that of the water, with 2 per cent. of the latter being absorbed as vapor. In order to promote intimate contact between air and water, it is found to be better not to use boards in single lengths of the full height of 6 metres, but to divide them, placing the lower half at right angles to the upper one, whereby any dry kernels of air from below are brought into contact with the wet surfaces in the upper part. Care must be taken to lay the water onto the boards so as to flow smoothly over them and to prevent all spiriting. The cooling effect of the apparatus when the boards are placed horizontally is only one-half of that of the vertical form.

The wear of the apparatus is very small, the fatty matters brought over by the condensed steam are partly deposited in fine films on the surface of the boards, and protect them from rotting, while the remainder collects on the surface of the water of the tank and is collected at intervals of two months for conversion into wagon grease. The load on the engine is increased by about 3 per cent. by the work of the fan and from 1½ to 3 per cent. by the circulating arrangement, which may be effected by the air pump directly or by a centrifugal pump. As the advantage gained by condensing is about 30 per cent. in an engine of moderately good quality, the net saving is about 25 per cent. Numerous examples of the application of the method to engines of different kinds are given in the paper. It has been adopted or is in course of construction in thirty-five different establishments, the largest example being on a central condensing plant for engines of 2500-horse power, at the iron and steel works of Dudelingen, in Luxemburg.—[Inst. C.E.

ELECTRICAL RECORDING METERS.*

By Carl D. Haskins.

I propose to briefly describe and discuss the leading elements which, singly or combined, have gone to make up the typical meters presented to the public up to the present time. I find myself limited to generalities, and the mathematical theory and strictly technical considerations have necessarily been neglected that the field might be approximately covered.

The earliest meter patent was granted in 1872 to Mr. S. Gardner of New York City, and the principle of a magnetic or electro magnetic release for a simple clock movement is preserved in two or three so-called time-counters to-day and is doubtless very useful for many purposes, as for example in the Spaulding clock for registering the hours of use of a motor, or other similar devices of registering the hours of use of arc circuits. These devices I shall neglect; they are not meters within the true sense of the word, and their simplicity is obvious.

The earliest successful meters, if we consider classes rather than individual instruments, were the chemical meters, closely followed by thermo-meters.

The chemical meter is obviously capable of giving most accurate results: in fact with proper manipulation, it is very doubtful whether any measuring device which has up to-day been designed could more correctly sum up passing power. It is in the manipulation and care which such meters require that their fault lies—if fault there be.

An electro-plating bath in its meter form as generally used does not, however, give a dial indication, and the consumers ask for a dial indication almost invariably, unless they have already become thoroughly familiarized with Edison meters as used by many large Edison stations.

Many very ingenious and some quite successful attempts have been made to actuate a train of gears by the electro-deposition of an electrolytic bath. Thus we have two electrodes suspended at the opposite ends of a walking-beam, as shown in Fig 1. This walking beam is in various ways connected with a pole changer, and as but a small portion of the current being measured passes through the true meter (for of course almost all chemical meters are shunted) the pole changer is not perhaps a very serious objection.

The action of such a meter as this is obvious; we have a deposit from one electrode onto the other, until the second electrode becomes the heavier, when the beam tips and the recording device is set one notch ahead, the pole changer is thrown over, and the deposit takes place in an opposite direction, the former plus electrode becoming the minus, and so on. This device deposits and redeposits the same zinc, or rather electrode material. Again we have a modification of the same device in the form of a wheel bearing a number of electrodes, and on the same principle setting up continuous rotation.

It should be noted that in this first digression from the chemical meter we at once meet with the prime factor of difficulty in all motor meter construction—that of friction, which, if uncompensated, must invariably introduce more or less serious error.

Another form of self-registering electrolytic meter has a cathode plate suspended from a spring balance, an ordinary sensitive spring weighing machine, and the heavier the cathode grows so much greater is the registration of the spring indicator. This device is perhaps preferable to the reciprocating movement just described, but is limited in the capacity of the spring, and probably lacks sensitiveness to small amounts, being dependent of course solely upon the nicety of construction in the spring balance.

Mercury has at times been employed in the construction of electrolytic meters, and with at least moderate success, for with a mercury anode and a cathode of the same or other material, a record easily measured may be obtained, and such a meter may even be made self-registering in a graduated tube or by half a dozen other more or less simple means. Such are the more typical electrolytic meters.

Another form of chemical meter formerly quite popular among inventors depended for its registration upon the decomposition of water, generally acidulated water, and sometimes upon the decomposition of more volatile substances. This class of meter may very properly be divided under two heads:

First, those meters simply dependent upon the measurement of the gas developed by the decomposition of water through any gas registering device. In fact we may say that such meters are mere decomposing baths connected to a gas meter. There are some devices of merit which may be classed under this head, but the principle is probably not commercial, for we have nothing very successful of this kind in use to-day.

One of the more ingenious meters of this kind provides a diagonally placed rotating wheel with pockets; the decomposition takes place directly under each pocket progressively, and as the air pocket fills with gas the wheel rotates sufficiently to free this gas at the surface of the fluid, bringing another pocket into place. Others have a rising and falling diaphragm like the popular gas meter, and still others a delicately poised air fan over a minute aperture. This last device is obviously most inefficient.

The second group of meters under this classification bring us to the thermo-meters, a typical group containing a few meters of more or less pronounced merit.

Those thermo-meters depending upon volatization of a fluid generally have two or more sealed bulbs partly filled with some volatile fluid, as for example, naphtha or ether. When two such bulbs are used, they have generally been mounted on a walking-beam mechanism combined with a pole-changer, each bulb containing some kind of a rheostat or heat developing device dependent for its heat on the current passing through the meter, the two bulbs communicating with one another. The rheostat in but one bulb is in circuit. The heat developed in the rheostat in circuit volatilizes more or less rapidly the fluid contained in this bulb, according to the current passing through it. The gas developed either passes in gaseous form into the second bulb and condenses, or else, as is more common, forces the fluid remaining by the simple increase of pressure into bulb No. 2, which at once becomes heavier and causes its end of the beam to fall. This throws the pole-changer, and the rheostat in the second bulb is thrown into action, repeating the operation as just described. To be successful, such a device must be very sensitive, and to be sensitive, the construction must be of a more or less expensive character and so delicate as to be to a greater or less degree prohibitive. Like the walking-beam meters just described, instruments of this class have been designed with a number of bulbs mounted on a rotating wheel, the same actuating principle holding true for all such devices. Another ingenious form of thermo-meter, no longer in any sense a chemical meter is an instrument dependent for its action upon the heat in a confined but circulating atmosphere. Thus a rheostat dependent for its heat upon the amount of current passing is so arranged as to heat a body of air, which by the peculiar construction of its receptacle, at once commences to circulate more or less rapidly, dependent upon the heat. It is obvious that if a delicate air fan, a screw propellor in fact, be suspended over such a circulation of air, its speed would increase with the speed and volume of circulation, and one of the most ingenious and most interesting meters that it has been my good fortune to see is the Forbes meter constructed on this plan. But here friction is the most serious consideration, the torque obtained in this manner being necessarily small.

While the Forbes meter cannot perhaps be properly considered as a motor meter in the true sense of the word, it still must be classed as such in a certain sense, and I think it may safely be accepted as an axiom that to be successful in practical operation a motor meter of any kind must be of high torque, for it is only by the combination of high torque and compensated friction that accurate results can be obtained on light loads. I might say that almost any one can build a meter which will record fairly accurately on heavy loads; the difficulty is to build a sensitive and accurate meter for very light loads down to one lamp.

*Abstract of a paper read at the Seventy-third Meeting of the American Institute of Electrical Engineers, New York, January 17, 1893.

SPARKS.

The by-law to guarantee $400,000 bonds to the Vancouver Tramway Co. was defeated at the polls.

Electricity will shortly be applied to the working of the New Curran bridge, over the Lachine Canal, Montreal.

The Berlin and Waterloo Street Railway Co. has been authorized to construct works for the production of electricity.

At the recent examinations in connection with the Toronto Technical School, the following were the successful candidates in Electricity.—R. C. Plewman, J. W. Lawson, A. W. McCullough, A. Goode, and James Patterson.

President Myles, of the Hamilton, Grimbsy and Beamsville Electric Railway Co., recently stated that if the City of Hamilton did not grant a bonus of $30,000, the road would not be built. The projectors asked the city to take $50,000 stock and waive dividends for 15 years, but the application was not granted.

Her von Siemens, of the firm of Siemens & Halske, has arrived in New York and it is said will be in Hamilton shortly in connection with the project of the Hamilton Radial Electric Railway Co. for the transmission of power from Niagara to Hamilton. Should he concur with the high opinion held by the managers of the firm's branch factory in Chicago, it is probable that a large plant will soon be erected in Hamilton.

The Bell Telephone Co. has been authorized to issue $440,000 additional stock, making the capital $2,640,000. In a circular issued recently by C. F. Sise, President of the company, it is stated that each shareholder of record of date of circular, will be entitled to take at par, shares in the new stock in the proportion of one share to five shares of old stock held, until 2 p.m. June 1st. The balance of new stock shall then be disposed of as the directors may determine.

The City Railway Company of Windsor (Ltd.), have been incorporated for the purchase, construction, equipment and operation of a street railway in the city of Windsor, the towns of Walkerville and Sandwich, and the townships of Sandwich East and Sandwich West. The Company consists of John Coventry, John Davis, Wm. J. McKee, Wm. J. Pulling and James Anderson, of Windsor, Geo. M. Hendrie of Detroit, and Robert Thompson, of Hamilton. The capital stock of the Company is $250,000.

ELECTRIC RAILWAY DEPARTMENT.

SELLING POWER FROM TROLLEY CIRCUITS.

The number of railways selling power from their trolley circuits is surprising to those that have not investigated the matter says the *Street Railway Review.* The business has grown in a quiet way, generally requiring little effort on the part of the road, and so it has attracted but little attention. We could name a half dozen roads within 100 miles of Chicago that have a good income from this source.

They are many reasons why the average electric road can sell power from its trolley circuit more cheaply than the electric light stations in the same town. In the first place the power business in the majority of moderate sized towns, such as the greater part of the electric roads of the country operate in, is either so scattered or so small that it is only at great expense that the lighting companies can handle it. In order to supply these scattered customers, the electric light company has either to install a special high pressure circuit and dynamo for its power work, or to invest in a large amount of copper to bring its low pressure incandescent system to such customers. In either event the result is rather unsatisfactory to the company, and an investment is required over and above that necessary to the regular business of the plant. The running of a small engine and dynamo simply to supply a few consumers with power is liable to be unprofitable either to the company or the consumer. If the power is supplied from lighting circuits, the variations in load on the large motors does not conduce to steady light. Then, too, they are generally plants of some size that want power, but it is impossible to generate electricity and supply it at some distance and make it more economical than direct steam, unless the generating station is very large.

With the railway the case is different. It has an immense power capacity installed and running at the time when it is wanted. Its outlay per horse power of steady power generated is very low. Its lines are strung all over the city, and the ground helps furnish a return, so that the cost of installation is small. In short, what may be a very unsatisfactory business for the lighting companies may be a very satisfactory one to the street railways.

It is not advisable, of course, for the railways to enter into cut-throat competition with the electric light companies, but if the field is undeveloped there are good reasons why the railways can give the cheaper service. Such business generally does its own canvassing when once started.

ECONOMY IN ELECTRIC RAILWAY MANAGEMENT.

THE economy of electric over horse railways became evident very soon after the former were commercially in operation, but there remained a large margin of unnecessary expense in every electric road up to a recent date. Indeed, it is doubtful if any such road, however small or old, has yet reached a condition of just economy. There may be electric roads whose management is penurious, but penuriousness will never prove to be economical for a road in the long run. Among the various means of reducing cost and, at the same time, increasing the efficiency of service is the furnishment of complete information to the employees in regard to their duties, also technical information in regard to their special work. One large road has reduced the number of men employed in re-winding armatures one-half, and without hardship to the men. Similar economies have been accomplished in other departments. This result has come chiefly from the employment of trained electrical and mechanical engineers, who give careful attention to details; while men in charge of the motors and cars are furnished with a book giving clear explanations of the various parts of the car and its electrical equipment, with instructions in regard to their care, and the proper method of repair or procedure in case of accident on the road. Specially trained inspectors are traversing the line at all times, looking after motors that are not working perfectly. In all departments in the shops everything is made to gauge, so as to be interchangeable. Of course, the details of the boilers, engines and generators have, also, been properly adjusted and closely looked after,—greatly to the increase of current to the pound of coal. These improvements in operation tell to a demonstration that its skilful engineers and trained foreman are well worth their salaries to the company *Electricity and Railroading.*

COST OF OPERATING ELECTRIC CAR HEATERS.

THE Consolidated Car Heating Company, of Albany, New York, has just issued says the *Street Railway Review,* a table giving numerous figures on the cost of generating electrical energy under different conditions. The ultimate object, of course, is to get at the cost of running electric heaters, but the table has some interest aside from this. The course of 1-horse-power hour at the car is given at $0.1335 under the most unfavorable conditions, viz.: with coal at $3 per ton and high speed simple engines. This includes all the operating expenses—taxes, repairs, etc. The cost with triple expansion slow speed condensing engines is given as $.00748 with $2 a ton coal. With the heaters using 8.90 amperes, which is the amount usually reqnired in average winter weather, with the outside temperature between 20° and 0°, the highest cost per hour would be $.03649 and the least $.00943. This table has been compiled by the company's consulting engineer, James F. McElroy, from data given by Charles E. Emery, in the March 1893, Transactions of the American Institute of Electrical Engineers. It is computed on the basis of running 20 hours a day 365 days in the year. The table gives figures on over 500 items and will be found of great interest to those who are getting figures from their own plants as to cost per year of different items.

PRIZES FOR MOTORMEN AND CONDUCTORS.

The directors of the East Cleveland Railroad Company of Cleveland, O., have decided to give the motormen and conductors an opportunity of working for something in addition to their salaries. They have offered $3,000 in prizes for carrying out the rules of the company and avoiding accidents. There will be two awards: one on July 1, 1893, another January 1, 1894. At each award $1,500 will be distributed as follows: Fifty dollars as a first prize to each of ten motormen, and $25 to each of ten motormen as second prizes; $50 to each of ten conductors as first prizes, and $25 to each of ten conductors as second prizes. In order to determine who are entitled to the prizes a careful record of each man's services will be kept, and all accidents and complaints will be noted. The records will be submitted to a committee consisting of one man selected by the company, one selected by the employees, and a third chosen by the two. This committee will make the award of prizes.

MAXIMUM SPEED OF ELECTRIC CARS.

THE published abstract of calculation by J. Kramer in the *Elektrotechnische Zeitscerift* on the maximum speed for an electric railway is as follows: "The theoretical maximum speed of a perfect motor on rails is taken at 500 kilometres (310 miles) per hour. This is on the level, with curves not less than 20 kilometres (12 miles) radius, and 12-feet driving wheels. The problem of an electric locomotive and two cars is then investigated at length, and the author appears to have considerable doubts whether the proposed 250 kilometres per hour on the projected Vienna and Budapest line of Messrs. Canz is feasible. The author would put the maximum at not more that 200 kilometres (120 miles), if as high."

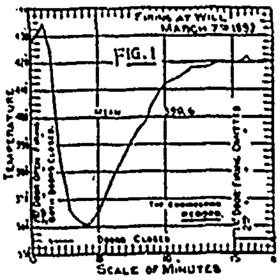
McFaul's Factory and Dealers Supply World informs us that if a bottle with a glass funnel, in which is placed lumps of calcium chloride, is placed in a case where cutlery, etc., is on exhibition, said cutlery will never rust, as the calcium chloride will attract every particle of moisture to itself, and that part which is dissolved will trickle into the bottle, leaving the solid part intact so that it is useful until entirely dissolved. We suggest that some of our engineer friends, whose engines are located in damp places procure a carboy and fit it up, so that if the statement be true, all of the rust producing ingredients in the atmosphere may be bottled up, instead of settling on the bright work of the engine.—*American Machinist.*

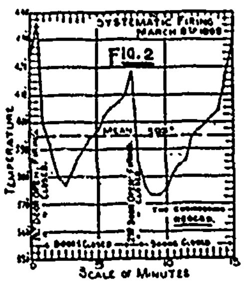
FLUE TEMPERATURES AS AFFECTED BY FIRING.

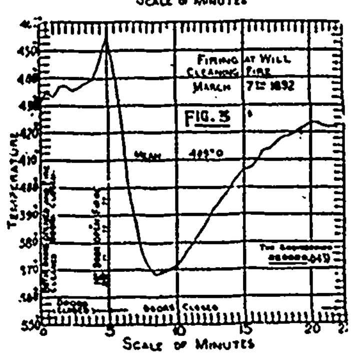
By David M. Greene, M. Am. Soc. C. E.

In March, 1892, while experimenting with one of a battery of 10 large steam boilers, in a New England manufacturing establishment, a variety of data were observed. Among these were flue temperatures of the products of combustion, as affected by opening furnace doors for firing and for cleaning fires. Believing that the observed facts will be of interest to others, the writer has constructed a series of temperature curves, three of which are furnished herewith.

The boiler was of the ordinary return tubular type, 17 feet long and 6 feet in diameter, with 140 3-inch tubes, 16 feet long. The fire grate was 6'4" x 6'—38 square feet. Bituminous coal







was burned in each case at the rate of 14.26 pounds per square foot of grate per hour, and steam was carried at about 65 pounds by gauge. The products of combustion after reaching the front of the boiler, through the tubes, rose to and passed backward over the top of the boiler to a flue connection at the rear. A high-grade mercurial thermometer was placed in the current of gases at the top, about midway between the front and rear ends of the boiler, which was read at intervals of 30 seconds.

Figure 1 is the temperature curve due to normal firing, or firing at will. At the end of the second interval of 30 seconds, both doors had been opened, the fire replenished and the doors closed. Observations were continued 18 minutes, about the ordinary interval between firing.

Figure 3 is constructed from observations taken on the same day (March 7, 1892), and shows the effect of opening the furnace doors for the purpose of cleaning fires, as well as for replenishing them. At the end of the second 30-second interval, both doors had been opened, the fire cleaned and the doors closed. After an interval of about three minutes, both doors were again opened and fired, one after the other, and closed again. Observations continued during a period of 22 minutes. On this day, the equivalent evaporation from and at 212 degrees was 10.51 pounds per pound of coal.

Figure 3 is constructed from observations taken on the succeeding day (March 8) when the rate of coal consumption was the same as it was on the 7th; but when an interval of 7½ minutes was required between the firing of the two doors of the furnace. Thus each door was opened and each half of the fire was replenished at intervals of 15 minutes. In other words, half of the furnace was fired every 7½ minutes, and the whole of it every 15 minutes. The temperature curve, Fig. 3, shows the effect of this change. On this day the equivalent evaporation from and at 212 degrees was 10.79 pounds per pound of coal.

The boilers in question constituted a then recent addition to the plant; owing to limited space, however, suitable proportions were impracticable, and the proportions of the boilers were left to the builders, while the settings were in accordance with the directions of the writer.

Discussion of, and further comment upon, the facts presented are purposely omitted. Each interested reader is therefore free to draw his own conclusions.

TRADE NOTES.

Twenty cars are being turned out by the Ahearn & Soper Car Works, Ottawa, Canada, for the Montreal Street Railway Company. They will be equipped with Westinghouse motors and delivered ready for operation on the tracks.

The following letter addressed to the Magnolia Metal Co. New York, by Mr. B. J. Jensen chief engineer of the steamship "Plymouth, of the Fall River Line, speaks for itself: In answer to your inquiry as to our experience with the Magnolia Metal, we desire to say that we have it in the intermediate crank pin brasses of the Plymouth, and it has given us every satisfaction, and from our experience with it we cheerfully recommend it for such work.

The Penberthy Injector Co., of Detroit, Mich., report that they again have their machinery in motion after a delay of ten days occasioned by a fire at their factory on May 9th, at which time their entire third floor and roof were burned, and the stock and machinery on two first floors badly damaged by water. Over 50 carpenters, masons, plumbers, roofers and steam fitters, have put in shape in seven days (three used in insurance adjustment) what looked to be a months work after the fire. They are prepared to fill orders as usual.

The St. Catharines Electric Light Co. have replaced two of their old dynamos by a new one with double their capacity and having all the latest improvements. They will also extend their circuits as soon as they have the power house completed.

CYLINDER LUBRICANTS.

Some interesting practical experiments were recently made to ascertain the expansion of oils under the action of steam, says an exchange. This point, together with its resistance of intense heat and freedom from acid-producing properties, fixes the value of a cylinder lubricant. Since the universal acceptance of hydrostatic lubricants as the only correct method of feeding, the minimum quantity of oil for a given amount of work can be readily determined. The automatic application of drop by drop, just as needed, preventing the waste of injection pumps and securing uniformity instead of the uncertainty of hand feeding has insured the steam user the saving of many dollars. The mistaken economy of selecting an oil on account of its attractive color or to meet the defects of the oil cup, that from some fault in construction or lack of sufficient pressure will not feed heavier oils, was very clearly demonstrated in the experiments referred to.

In filtered and light-bodied cylinder oils the color is obtained at the expense of the wearing properties. Facilitating the feed at the same time accelerates escape from the steam chest before the oil has performed the work intended. Failing to atomize and thus be distributed by the steam, such oils are blown out with the exhaust, leaving the cylinder without lubrication. Consequently, they must be fed up liberally in order to make up for this failure to disseminate.

There is also a waste owing to their lower fire test and more or less danger from their tendency to burn or bake. The tests also show that an apparent body can be produced by the compounding of foreign substances. To give seeming consistency gelatinous matter is used. This, as well as "fixed oils" and fluid results of animal fat, are not volatile. That is, they cannot be distilled without decomposition. When heated under the action of steam in the cylinder with the alkalies of the feed water, the fatty acids combine with the alkali, producing saponification, while glycerine is simultaneously formed. The effect of such a combination on metals is well known. Their heat only tends to make such substances more adhesive, and utterly failing to atomize, they drop into the cylinder to be worked and churned by the follower of the piston.

SPARKS.

The Corporation of Fredericton, N.B., has obtained power to issue debentures to the amount of $6,000 for the purchase of an electric plant for street lighting.

It is proposed to build an electric railway from Fredericton to Marysville, New Brunswick, a distance of four to five miles. It is proposed to cross the river by a light steel bridge.

All the cars on the Montreal street railway will now be built by the company at their own shops at Hochelaga. They will also equip, at a cost of $30,000, a shop for the manufacture of their electric motors.

About 70 miles of new electric railway tracking will be laid in and around Toronto, this summer, which will require the addition of 300 cars. Toronto will then have 128 miles of electric tracking and about 530 cars. Toronto has the best operated electric car service in Canada, if not in America.

SPARKS.

The National Electric Tramway and Light Company, of Victoria, B.C., have made arrangements to drive their generators and lighting by means of a water power station seventeen miles from the city. The steam plant will be ready at all times to be put in operation should this power fail.

A Montreal alderman has lately made the threat that unless the Bell Telephone Company agrees to the proposals of the city respecting reduced rates to citizens and a telephone tax payable by the company to the city on each telephone, the city council will proceed to grant permission to the Merchants' Telephone Company to put up poles and string wires.

It is an easy matter says the *Electrical World* to find whether there is a cross connection between a coil and its core, but when the cross is between the wires themselves constituting the coils the usual method cannot be used. For such cases, as also for a number of others a very ingenious and simple method is in use in the Thomson-Houston factory at Lynn, which is well worth the attention of those engaged in constructing apparatus containing coils in which cross connections may occur. It consists simply in placing the coils to be tested in the field of an alternating current coil and noticing whether or not parts of the coil become heated. It is evident that if there is a cross connection between the windings, the turns included between these points will form a short circuited coil in which currents will be induced when placed in this alternating current field, which will cause that portion to become heated. This method, therefore, not only shows when there is a cross, but, if there is one, it to a certain extent locates it. In some cases the coil to be tested is placed in the field with its core and in other cases without. For simplicity nothing more could be desired.

PUBLICATIONS.

The latest arrival in the arena of trade journalism is *The Canadian Engineer*, published in Toronto and Montreal, and devoted to the mechanical, mining, marine, locomotive, sanitary and other branches of the engineering trades. The subscription price is $1 a year. The address is: *The Canadian Engineer* Co., 62 Church street, Toronto, or, the Fraser Building, St. Sacrament street, Montreal.

The June *Arena* is a mammoth number. It is probably the largest magazine ever published as a monthly issue of a review, containing one-hundred and sixty-four pages, of which one hundred and forty-four are in the body of the magazine, and twenty pages of carefully written book reviews of such well-known critics as Rev. W. H. Thomas D. D., of Helen Chicago, Campbell, Hattie C. Flower, Hamlin Garland, and the editor of the *Arena*.

LEGAL DECISIONS.

The City and Suburban Electric Railway Company is being sued by a bricklayer named Mould, who met with an accident from an incoming car while he was repairing the brickwork of the company's power house on St. Clair avenue.

The Toronto Incandescent Light Company's appeal from the judgment given against them when the owner of a horse was awarded $100 for injuries to the animal through falling into a hole on Church street, Toronto, made by their workmen, has been refused. They asked the Court to determine the city to be liable.

The case against the city of Guelph and the he Guelph Gas Company brought by a man named Healy has ended in favor of the defendants. The plaintiff alleged that when returning home one evening he ran against a loop of an electric light wire on a street in Guelph, and received a severe cut. The defendants maintained that the light was lit and that it was impossible to run against the wire as stated.

SPARKS.

A scheme is being agitated for the construction of an electric tramway from Nanaimo to Wellington, B. C.

The directors of the Hamilton, Waterdown and Guelph Electric Railway Co have decided to oppose the granting of a charter to the Hamilton Street Railway Co. to establish radial electric roads.

The mica business is reported as being good and large quantities are being shipped to England. The Cleveland administration is expected to remove the duty off this material which will further increase the trade.

His Excellency, the Governor General, recently presented Messrs. John C Cooney and C. S. Hubbard, of the C. P. R. Telegraph Company, Ottawa, with a beautiful volume each in recognition of services rendered in the transmission of cable messages at the time of the critical illness of his son.

At a recent meeting of the Council of the town of Maisonneuve the electric railway question was brought up. Mr. J. L. Forget represented the Montreal Street Railway Co. and Mr. A. J. Corriveau, the Corriveau-Williams syndicate Both companies submitted propositions which were referred to a special committee. The matter will be brought up again at the next meeting of the Council.

The St. Jean Baptiste Electric Light Co. held a meeting for the election of officers under the new charter, when the following gentlemen were appointed directors Messrs Arthur Caron, O. Marin, M P, Hon L. Tourville, Charles Chaput, O Vanier, Joseph Girard, A Lalonde, E. David and P. Terrault, M.P At a subsequent meeting of the directors Mr O Marin, M P, was elected president. The company have been supplying light for some time, and it is said have a monthly revenue of $1,000, with about $500 expenses.

A joint stock company, composed of Ottawa capitalists, has been formed to buy up and deal in mica and phosphate properties in the Ottawa valley. At the organization meeting about forty business men were present. The capital stock was placed at a quarter of a million dollars, of which $200,000 was at once taken up. It is the purpose of the company to purchase the mining interests of the district, open and work sufficiently to show the quality of the mines, and dispose of them. English syndicates are most likely to be the purchasers.

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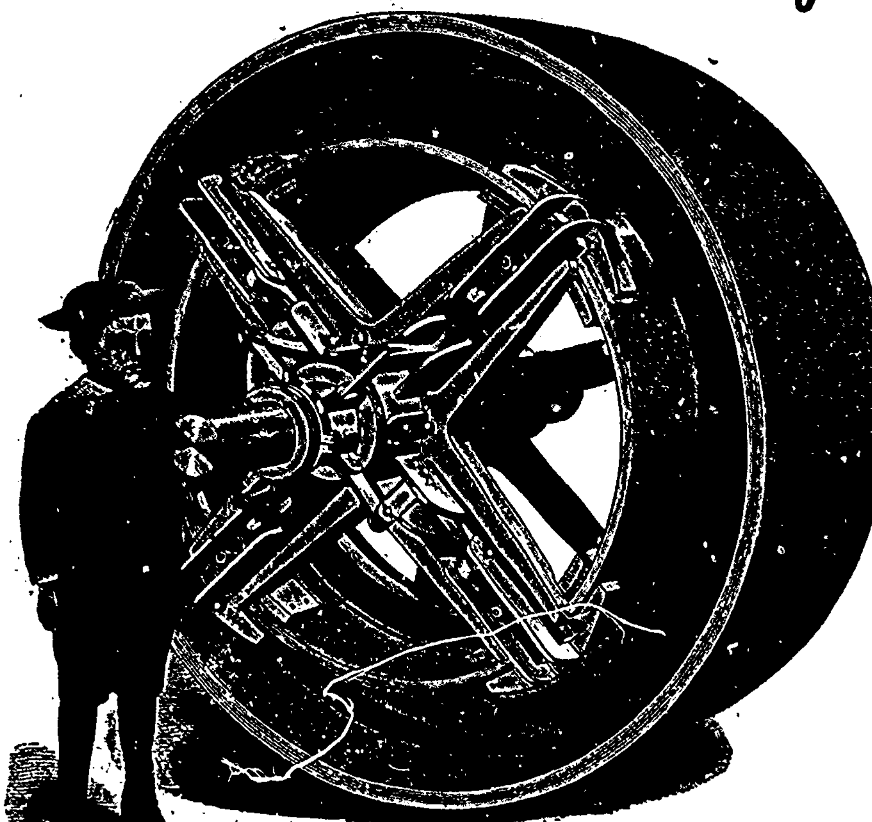

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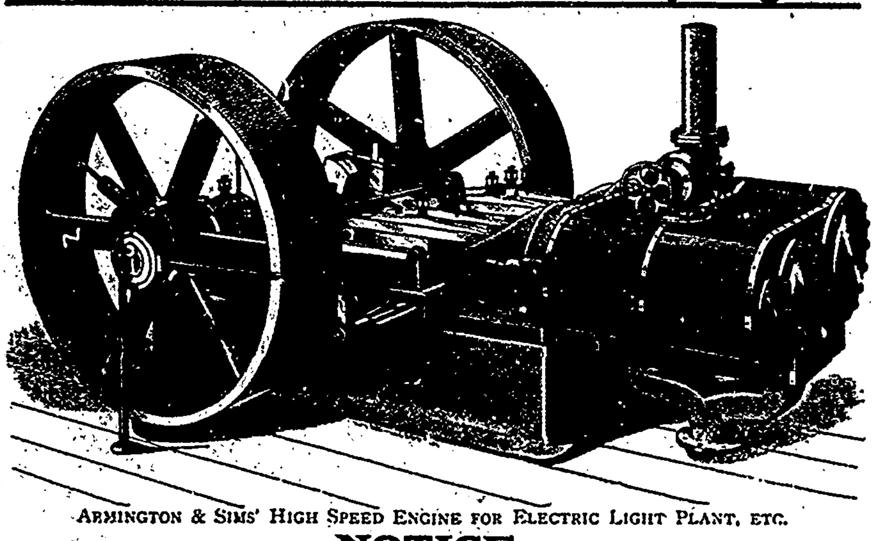

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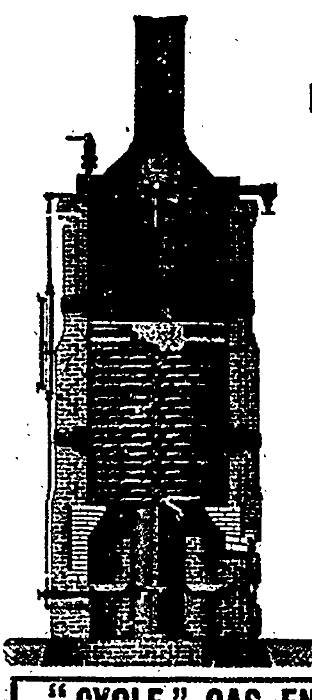

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