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CANADIAN

ELECTRICAL NEWS

— AND —

STEAM ENGINEERING JOURNAL.

VOL. II.

1892 :

C. H. MORTIMER, Publisher,

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INDEX.

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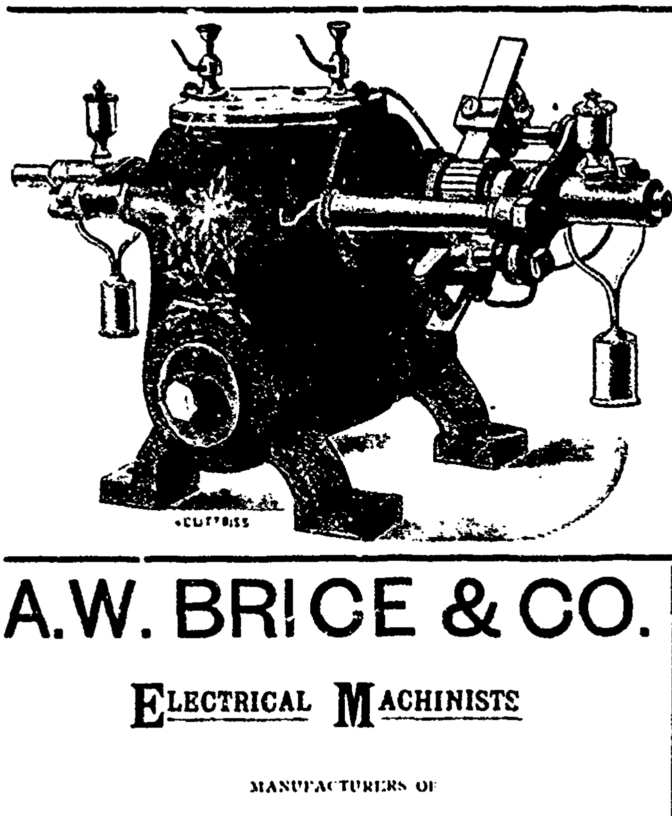

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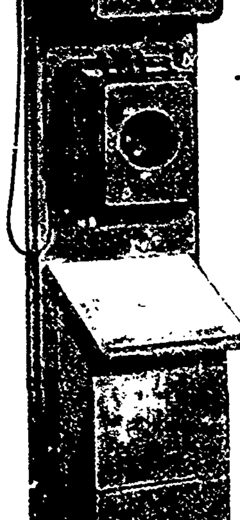

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CANADIAN

ELECTRICAL NEWS

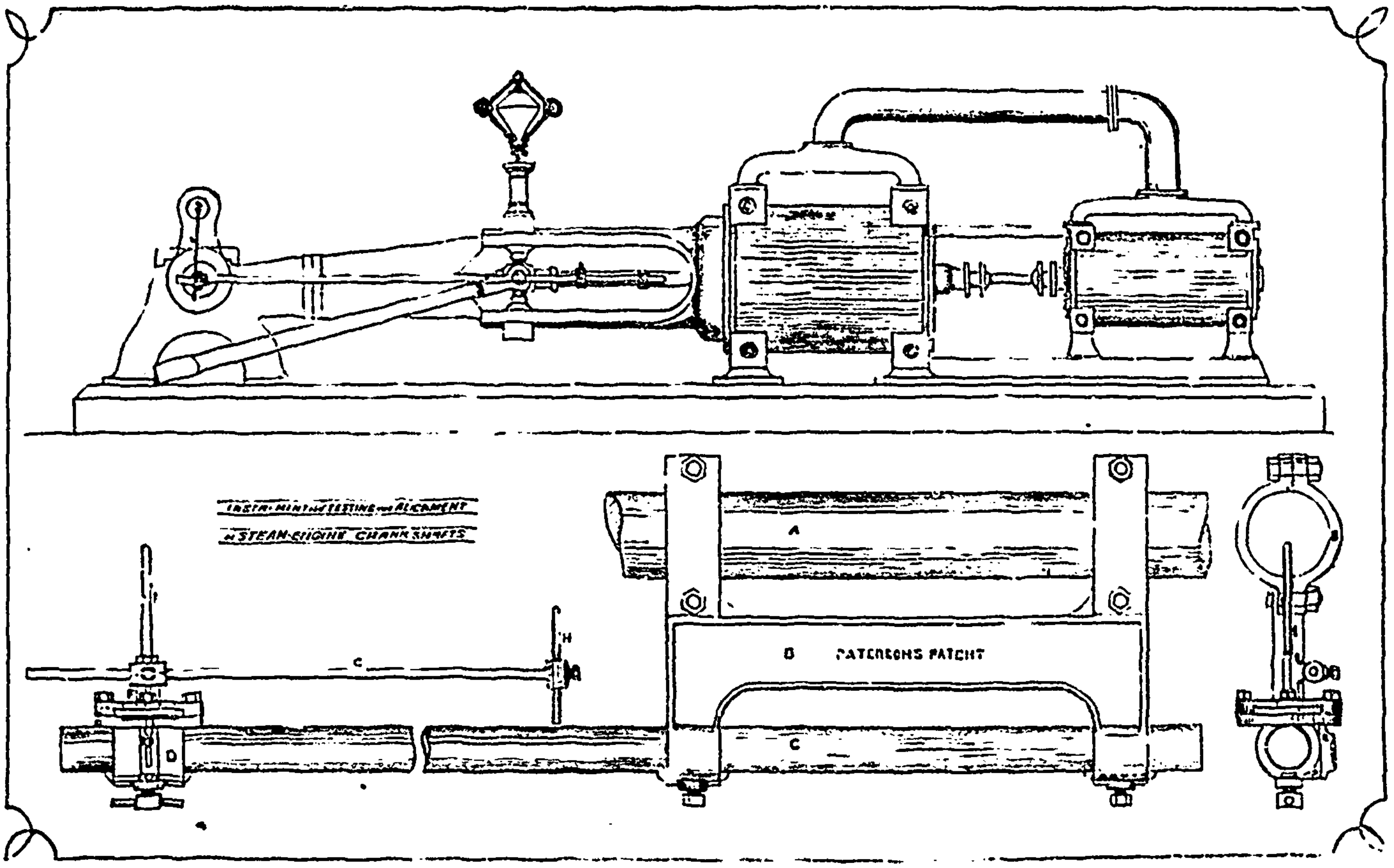
AND

STEAM ENGINEERING JOURNAL.

VOL. II. TORONTO AND MONTREAL, CANADA, JANUARY, 1892. NO. 1.

TESTING THE ALIGNMENT OF CRANK SHAFTS.

AN instrument, for testing the alignment of steam engine crank shafts, an illustration of which appears in the accompanying engraving, has been patented by Mr. Paterson, of 7, Airlie-terrace, Dundee, which should prove very useful. It is specially designed for factory engines of the Corliss, Wheelock, and similar types, obviating the necessity for stoppage of a department to open the engine for readjustment. In fact, it only requires the connecting-rod released from crank pin, when the instrument will show the relative rectangular position of engine and shaft, pointing out at the same time the slightest inaccuracy in the level of the shaft, which may be caused by the settlement of foundations or unequal wear. Being particularly devoid of complexity, a short description, reprinted from *Invention*, will suffice. A is the piston rod; B a frame, preferably of brass and proportionately light for the duty which it has to perform; C a tube of steel; D adjustable head of brass fitted on its top side with a small level E; F a disc fitted to rotate in head D, said disc being provided with a socket carrying the radial arm G, adjustable lengthwise and having fitted to it adjustably a steel pointer H; I a pointer fitted in the end of disc F, and adapted to move endways therein, being for the purpose of setting the instrument in order that the pointer H may rotate concentric with the path of the crank pin, being subject to no strain during application other than that imparted by touch. Lightness forms an essential feature in their construction, and, although not liable to get out of order, their accuracy can be ascertained at any time. In extensive establishments, where a number of engines are employed, one instrument will generally be found to meet the requirements of all. Being made for the largest engine it is only necessary to have bushings bored and in halves to fit the various sizes of piston rods, and turned outside to fit the frame, while any convenient length of tube may be used, as well as a number of pointers of various lengths. While not intended for use on engines with cylinders less than 10 in. diameter, they will be found a valuable adjunct to the class of engines for which they have been designed. The immunity from stoppages for readjustment, referred to above, is by no means the only source of economy derived from the periodical testing of engines with those instruments. Hot bearings resulting from cross wear are avoided, a saving of brasses and oil thereby effected, and increase of power, while the risk of breaking connections is reduced to a minimum. The instrument may be tested thus:—By gauging a plumb line with the pointer H, the level will show the slightest inaccuracy, and by reversing said pointer and gauging the tube the other two points are found. To test the accuracy of the frame no explanation is required.

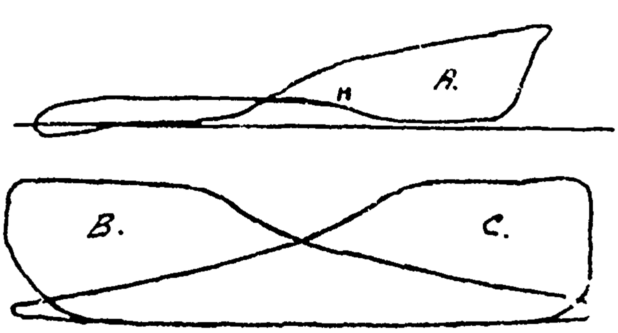


The application of the instrument is as follows: The connecting-rod being released from the crank pin, as shown, the cross-head is placed about one inch from its extreme outward travel, the frame B is then clasped on to the working part of the piston rod A, tube C is placed in position, head D is then set by its pointer I and level E, pointer H being adjusted to the centre of crank pin, pointer I is withdrawn clear of the shaft, which must have a true centre mark for setting, and be prevented at all times from being moved endways while being tested. If the outside of the crank pin is flat, or has been bruised, a small hole is drilled in its centre and a pin inserted which is allowed to project one eighth of an inch, in order that the indications of the pointer H may be more accurately observed. The shaft is now turned through one revolution, stopping at the two horizontal and vertical points at which the pointer H is brought in contact with the pin by the hand. The variations in those points of contact showing the direction in which the shaft requires moving to become true with the line of the cylinder and perfectly level. This test will be repeated when alterations are completed. The instrument can be applied in a short time, and arrangements being afterwards made for alterations little and in many cases no time is lost or stoppage required to keep the main working parts of the engine in their true working position.

QUESTIONS AND ANSWERS.

R. B. Emery, Guelph, asks what would be the cause of armature coils getting on fire, also what would be the effect on the dynamo if there were more lights on it than it was made for. Dynamos are running 300 incandescent lights each, thirteen hundred revolutions per minute, 16 candle power, 90 volts, and who is to blame for the accident.

Ans. Our friend appears from his letter to be either one of those sanguine people who think that nothing should ever happen to a dynamo, or honest-minded enough to believe the antiquated yarn of the agent who sold the machine that "our dynamos *never* burn out, it is only the other fellows'." It seems to us that if electric light men had flourished in the days of the late lamented Annanias there would be frequent and sudden vacancies in the selling staff of most concerns. However, the burning out of an armature coil is due to a short circuit in the coil which may be caused by a variety of means. There may be a particle of metal or copper dust between two adjacent segments of the commutator, or from want of cleanliness copper dust may have accumulated on the coil itself, or the dynamo may have been overloaded and the armature wire heated sufficiently to carbonize the cotton insulation of the wire. This would be liable to happen if the dynamo had many more lamps on circuit than it was originally intended to drive, or, as is more likely, the gradual process of decay that overtakes all things finite sooner or later, may have got in its work, and the frequent expansion and contraction caused by heating and cooling the armature have so disturbed the insulation as to produce contact between adjacent wires. As to where the blame should rest, we cannot say. If the dynamo has been properly attended to and kept clean and not seriously overloaded, our friend need not let his conscience disturb his slumbers, especially as he appears to possess the skill to repair the damage and get his machine agoing to work without delay.



A correspondent sends the above diagrams stating that they were taken from a Tandem compound engine which has no condenser and discharges the steam into the atmosphere.

Diagram A from one end of low pressure cylinder is peculiar. Our correspondent states that when there is a heavy load on the engine, there is no distortion of the diagram. It will be noticed that when the steam is expanded in diagram A, it falls below the atmospheric pressure but rises again immediately on the discharge of the steam commencing. He suggests that it is due to the admission of air; but why an admission of cold air into a cylinder containing steam at a pressure lower than the atmosphere should cause a sudden rise of pressure does not seem clear. Nor does it seem clear why it should remain at that pressure till the point H is reached and then suddenly drop to the normal line. A much more likely explanation is that there is a leakage of steam, either through the steam valve or past the piston, for part of the stroke. B and C are from the high pressure cylinder and there is nothing out of the way in them, nor anything to account for the peculiar shape of diagram A.

A correspondent asks the proper rule for determining the horse power of an engine and of a boiler.

The horse power of an engine is found by multiplying the area of the cylinder by the average pressure of steam on the piston, and by the number of feet travelled by the piston in one minute, and dividing the product by 33,000.

Example. An engine with a cylinder 15" diam. and 30 stroke, makes 80 revolutions in a minute, the average pressure of steam on the piston is 19 lb. per sq. inch. What is the horse power?

The area of a cylinder 15" in diameter is 176.71 sq. inches. The average pressure is 19 lbs., and the piston travels 400 feet in a minute. According to our rule, 176.71 × 19 × 400. ÷ 33,000 = 40 6-10 horse power. By increasing the steam pressure, the horse power may be increased. In determining the horse power it is usual to find the average pressure by means of an indicator diagram. If an engine of above size and speed were supplied with steam of 70 lbs. pressure, and cut off at ¼ stroke, the average pressure would be about 30 lbs. per sq. inch, and the horse power would then be 64 h. p.

The horse power of a boiler is not so easily determined. The term horse power applied to boilers has a totally different meaning from what it has when applied to an engine. The horse power of a boiler is measured by the amount of water it can turn into steam in an hour.

It used to be considered that a cubic foot of water made into steam in an hour was a horse power. In Canada and the United States at the present time, it is usually reckoned that 30 pounds weight of water of 100 temperature converted into steam of 70 lbs pressure in one hour is a horse power. To determine the horse power of any given boiler is not easy because the amount of water evaporated depends upon the cleanness of the boiler, the setting, the draught and the fuel used. In a rough way it is often done by calculating the number of square feet of heating surface and allowing 12 to 15 sq. feet to the horse power.

A correspondent asks for a formula for the safe stress on shafting, also for breaking stress.

There are many different rules given for calculating the size of shafts or the safe load for any given shaft. Materials of which shafting is made vary so much in quality and the effect of bending combined with the torsion is so great, that a little difference in quality of metal or a little bending of the shaft may lead to the break down of a shaft, which, according to the rule, ought to be quite safe. The following is a sample of the rules given by writers on this subject and may be what our correspondent requires:—

Rule.—To determine the diameter of a pulley shaft of any material, multiply the force transmitted by the belt by the radius of the pulley, divide the product by the greatest safe shearing stress in pounds per square inch for the material of the shaft, extract the cube root of the quotient thus obtained, and multiply the result by 1.72.

To express the above rule in algebraic form and applicable to steel, wrought iron and cast iron

Let d = diameter of shaft in inches.

P = the total force applied to twist the shaft.

R = the distance from centre of shaft to point at which P acts.

The safe shearing stress for steel may be may be taken at 12,000 pounds per square inch, for wrought iron 8,000 pounds per square inch, and for cast iron 4,000 pounds.

Then for steel $d = 0.075\sqrt[3]{P.R.}$

For wrought iron $d = 0.086\sqrt[3]{P.R.}$

For cast iron $d = 0.108\sqrt[3]{P.R.}$

The same rule may be used when the load is reckoned by horse power and the speed of the shaft in revolutions per minute is known.

Let H = horse power.

" N = number of revolutions per minute.

For steel $d = 2.984\sqrt[3]{\frac{H}{N}}$

For wrought iron $d = 3.422\sqrt[3]{\frac{H}{N}}$

For cast iron $d = 4.297\sqrt[3]{\frac{H}{N}}$

An international Electrical Exhibition is to be held in St. Petersburg, Russia, beginning with the 1st of December, 1892, and to close on the 15th of March succeeding.

Mr. S. R. Parker, manager of the Owen Sound Electric Light Co., has just returned from a visit to Europe. He states the rate at which the electric companies in London are installing incandescent lamps is marvelous. The arc light, however, is employed but little. One cause of the popularity of incandescent lighting is the poor quality of London gas, the efficiency of which is described as about 16 or 17 candle power.

The Toronto Electric Light Co., owing to the increase of their business, find it necessary to enlarge their station. They are the owners of the water lot immediately west of their present premises, and they have decided to erect thereon another building equal in size to their present one, thereby doubling their capacity. Mr. J. J. Wright, the manager, is now making preparations to proceed with the work. Another chimney, 120 feet high and 12 feet square, will also be erected. Seven hundred horse power will be added to the present capacity of the steam plant. The dynamos, etc., required will be manufactured in the company's own machine shop. The completion of these improvements will give the Toronto Electric Light Co. one of the largest and most complete central stations on this continent.

CROSS-TALK IN TELEPHONE LINES.*

In one of our earlier numbers we gave an account of Mr. Carty's experiments on the cause of cross-talk in telephone lines. Mr. Carty, as will be remembered, endeavored to prove that dynamic induction cannot be considered as the cause of the phenomenon, but that cross-talk is due to electrostatic effects. The results of these experiments clearly prove that static induction plays an important part in producing distorting effects, and even, under certain conditions, may be considered as their only cause. An attentive observer, however, of the working of various telephone lines will notice certain facts leading to the conclusion that static induction is not the main cause of cross-talk It is generally known that in lines fastened to wooden poles the disturbances are strongest in very dry weather, and that when rain begins to fall, even very slightly, these effects are suddenly diminished, even to a very considerable extent. According to Carty's theory, the very reverse ought to take place, for through the moistening of the insulators the conducting surface, and with it the capacity, is increased.

A further contradiction will be found in the following consideration: Whilst cross-talk is already clearly perceptible in lines of one kilometre length, fastened to wooden poles, not a trace of these effects can be noticed in urban lines of equal length fastened to iron poles. Now, the charge of the former lines amounts to about 0.1 microfarad, while in urban lines, owing to the closer grouping of the wires, the capacity rises to .1 microfarad. Another factor must, therefore, come into play to produce cross-talk, and the factor is, according to Mr. Müller, the direct leakage of current from one line over the insulators to another line. The case is illustrated in Fig. 1.

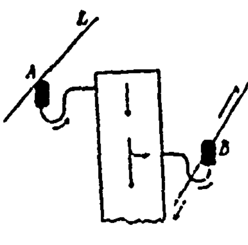


Fig. 1.

From the line L, at the insulator A, part of the current will pass into the pole to be further split up at the support of insulator B. One portion goes to earth along the pole, while the other portion reaches line L' over the insulator B and thence flows off in both directions. The conditions of resistance of these two current paths influence in a great measure the amount of cross-talk, and explain the apparent contradiction of the preceding remarks. In very dry weather the resistance of the current path along the pole to earth is very large. It is true that the resistance of the current of the current path of the leakage current over the insulators *a* from one line to the other is also very large, but a relatively large portion of the current escaping from L will reach L', and will there go to earth at both ends.

If, now, the pole is moistened by rain it forms a good earth shunt, and only allows the smallest possible fraction of the leakage current to pass from L to L'. This fraction is the smaller the better the shunt from the pole to earth. The iron poles on the roofs of houses are, as is well known, carefully jointed to especially good earth connections.

On considering the current path in two parallel telephone lines, it will be found that a neutral point must exist in the line.

If the state of insulation is quite uniform, there must exist for each point of support another point of support at the other end of the line where the currents are equal. In the same way, at two other points the currents will be equal. These currents, therefore, neutralize each other, and there must exist, almost in the middle of the line, a spot which remains with current, and where no cross-talk is perceptible.

The author remarks, at the same time, that more than six years ago he expressed an opinion on the existence of a neutral point near the middle of the line, but was unable to prove the correctness of his view from want of the necessary apparatus.

From the above remarks we are led to the conclusion that, although static induction play an important part in cross-talk, yet to diminish these effects the best possible insulation and the most intimate possible connection between the insulator support and earth must be provided. When using wooden poles a special wire rope for earth connection will have to be supplied. If this rope is to fulfil its purpose, it must not terminate in the hole dug for the reception of the pole, but it must extend as far as the underground water.

* By E. Muller in *Electrotechnische Zeitschrift.*

THE NATURE OF ELECTRICITY.

By Alexander Jay Wurts.

"Electric current" and "electric fluid" are convenient terms used to express a certain condition of matter, but their use is misleading, in that they imply a flowing motion of some material thing. They are expressions which, in the early days of electricity, appealed readily to the imagination, and were consequently adopted by common consent. They are now used because they are in use, and because they express what seems to take place. They are used for the same reason that the "setting sun" is used.

An electric current has direction without without any flow or transmission of matter. To illustrate: Imagine a horizontal brass rod with a lamp under one end. First, the rod becomes hot directly over the lamp, then further and further away, and we say that the heat "creeps" over the rod. If the rod had been previously coated with wax, the wax would gradually melt from one end toward the other. In this illustration the heat is guided by the conducting properties of the rod, and it therefore had a direction along its length; but there is no transmission of matter—no flow or a tangible substance. In other words, heat is not a material thing. It is a kind of motion—*a motion* of molecules or body particles—and being a motion, it is a form of energy. When this energy is transmitted from one place to another we notice the direction, and say that it "flows." Electricity is also a form of energy, and when this form of energy is transmitted over a wire there is direction without transmission of matter.

The latest researches indicate that heat is a motion of the particles of which matter is supposed to be constructed. It must not be understood here that heat causes this motion, or that the motion causes the heat. It is the motion itself that has been given the name of heat. It is heat motion. Expansion due to heat is then explained in this way. A pendulum vibrating with a given amplitude may be said to *correspond to a given* temperature. If the temperature is increased, the motion—that is, the amplitude of vibration—will be correspondingly increased, and consequently more room (expansion) will be required for this increased motion. If we imagine a mass of marbles, each marble moving and vibrating with respect to the mass, and never touching its neighbor, much as the heavenly bodies move and vibrate with respect to the universe, and then imagine further that by some outside influence those marbles are caused to move more rapidly, this is, with an increased amplitude of vibration, it will be easy to understand that they must have more room—"elbow room," so to speak. In steam we have an excellent example of expansion due to heat, in that the molecules are by their own motion driven so far apart that their mass becomes invisible. If we could magnify the molecules to such an extent as to make them visible, steam would look something like the universe with its worlds and interplanetary spaces.

Heat motion is transmitted from one particle to another by the influence of such particles on each other. If we stand a number of blocks on end and in a zigzag direction across the floor, in such a way that when the end block is tipped over it will cause all the others to fall in succession, it will be easy to understand how that motion, that is energy, can be transmitted and guided in its direction by the effect of one particle on another without actual transmission of matter. The connecting link between the above remarks and electricity is this: Heat is one form of molecular energy and electricity is another. Energy, in its broadest sense, is a condition of matter having the power to do work. A moving train, a lifted weight, gunpowder, compressed air, etc., etc., are all forms of energy. Energy is a universal characteristic of matter. Its natural form is that of vibratory motion without transmission of matter. If we start a pendulum vibrating, it will tend to vibrate forever, but friction forces it to come to rest. If we could drop a stone through the centre of the earth, the stone would vibrate back and forth forever, were it not for friction. The heavenly bodies, meeting with no friction and having been once set in motion, move forever. It is their natural state, and their motion is vibratory. —*The Phonogram.*

It is highly desirable that the regular pressure guage be supplemented by a recording gauge.—Robert Grimshaw's Hints to Power Users

THE ELECTRIC TRANSMISSION OF POWER.

By Gisbert Kapp.

(Continued from December Number.)

Now let us see how such a system of transmission will have to be worked, and what the working expenses will be. I take, by way of example, five miles as the distance between the generating station, which may be the tramway depôt or a central electric light station on the line of tramway, and the delivery station. At either terminus we must have mechanical appliances for loading and unloading the batteries from the car, such as are generally used in connection with storage cars. Early in the morning a charged battery is put on the car, and run out to the delivery station, where it is unloaded and connected to the motor. The other battery, which has served during the previous day, is loaded on the car and taken back to the depôt to be charged up again. In this manner the car need only make one journey out and one journey home daily. As its speed may be very moderate, say from three to four miles an hour, the cost of running this car will be much less than that of a passenger car, which must stop and start every few minutes, and run at a higher speed. I take 3d. per car mile as the cost of haulage, including the use of plant, and I further allow 2s. a day for labour in loading and unloading the batteries. The account of working expenses will now stand somewhat as follows:—

	£	s.	d.
Power at generating station at £10, allowing 65 per cent. total efficiency*	77	0	0
Haulage ..	37	10	0
Labour	30	0	0
15 per cent. interest and depreciation on batteries (£340)...	51	0	0
10 per cent. interest and depreciation on electric machinery (£150)	15	0	0
Total annual cost...	£210	10	0

This works out at £42 2s. per annum per horse-power delivered, and is therefore quite as high, if not higher, than the cost of power obtained by a small and uneconomical local engine. On the score of economy there is consequently no advantage in transmitting power by storage batteries in the present case, where the distance of transmission is five miles. Had the distance been less, the working expenses would also have come out smaller, but not by any considerable amount. The only item in which we could save is cost of haulage, and if we neglect this altogether we have still to pay £34. 12s. per annual h. p. delivered. Battery transmission can therefore not compete against power produced by a local engine, even if the latter be of the rather uneconomical type which users of small power still tolerate. But how stands the case if for some local reason the employment of a heat-engine of any kind is precluded? We have, then, the choice between electric transmission by means of batteries, and directly by means of a pair of wires. Which will be the more economical? As the dynamo and motor, except, perhaps, in the matter of voltage, will be the same in either case, the answer to this question turns upon the comparison of the batteries and line of wires. The first question to consider is whether our wires may, in the case of direct transmission, be carried overhead on poles and insulators, or must be put underground. If the former be the case, the line need not cost more than £130 per mile; and I may at once mention that, from the experience gained with various power transmissions, which I hope to bring before you, this item can be estimated with a fair degree of accuracy. As I shall have to deal more in detail with the cost and construction of live power transmission plants later on, I shall not enter into details at present, and must ask you to take my statements as to cost of line and cost of power transmitted as correct, though I do not now show how the account is made up. As regards transmission by wires placed underground, there is, as far as I know, no example of such an installation, and we can, therefore, not verify our estimate by reference to work actually executed, as we can in the case of overhead transmission. We are thus forced to calculate the cost of the line according to the data obtainable for electric light mains, and I take for this purpose an estimate made by Mr. Crompton in his paper on "Central Station Lighting," read before the Institution of Electrical Engineers, on the 12th of April, 1888. In this paper Mr. Crompton gave tables for the cost of underground mains of various types and sizes, and by reference to his tables I find that a main of the section required for the transmission of 5 h. p., and insulated so as to safely bear a pressure of 1,000 volts, would cost about £670 per mile. We have now all the necessary particulars for making a comparison of the cost of battery transmission and direct transmission, the latter by both overhead and underground wires. The following table gives the result. The cost includes the charge for power at the generating station (taken at £10 per annual h. p.), and interest and depreciation on the plant, which is taken at 15 per cent. for the batteries, and 10 per cent. for the line and electrical machinery.

Transmission plant for 5 H. P.

Distance of transmission in miles.	Annual cost per h. p. delivered, if transmission is		
	By batteries.	Direct.	
		Overhead.	Underground.
1	£36·1	£22·8	£33·6
2	39·1	25·6	47·2
3	37·9	28	60
4	40·6	30·6	74
5	42·1	33	87

We see from this table that if there is no objection to an overhead line, the electric transmission of stored power by means of batteries cannot compete against the direct transmission of live power by means of a pair of wires, even if the distance is considerable. But in towns we cannot have, or at least we ought not tolerate, overhead lines, and if we work with an underground line we find that, for distances exceeding one mile, the battery is a more economical transmitting agent than the wire. Here we have at last found a case where it will be advantageous to transmit power by means of storage batteries, but there are so many conditions attached to the case that the field of application of such a system must necessarily remain very limited. First, the power must be required, so to say, in small parcels; secondly, there must be a tram line handy, and the customer must have facilities for loading and unloading the batteries and accommodating them on his premises; thirdly, there must be a charging station on the line having similar facilities: fourthly, the use of an overhead line must be excluded; fifthly, the distance must exceed one mile; and, finally, there must be some reason why a local engine cannot be used. I need hardly point out that a system of transmission fenced in by so many conditions cannot have any commercial importance. Thus far, the result of our investigation is entirely negative. We find that transmission of power by means of storage batteries, whether the power transmitted be large or small, is not so economical as other methods of transmission, and has, therefore, no commercial value for all cases where these other methods are applicable. If I have, nevertheless, devoted some part of this lecture to the subject of battery transmission, it was because the idea of distributing power, so to speak, bottled up in batteries, seems to have a fatal charm for many inventors. It is an old idea, but is always coming up again, and for this reason I thought it advisable to go a little into figures and show you how the case really stands. It might perhaps be objected that as no distribution of stored power by means of ambulant batteries has as yet been practically introduced, it is premature to give an opinion as to the possibilities of such a system. The idea of battery distribution of power is, as a matter of fact, entertained not only by amateur electricians, but also by practical engineers. As an example of this fact, I may quote a passage in a report written about two years ago by Mr. J. F. Fanning. This gentleman, reporting to the Cataract Construction Company on the question of utilizing the power of Niagara Falls, says:—"Power and lighting currents may be electrically transmitted to neighboring cities, and possibly storage batteries may be electrically charged and re-charged, and many times forwarded for use in surrounding cities." When writing this, Mr. Fanning had, of course, in view cheap water-power, and probably canal transportation. If, at the same time, batteries could be made cheaper, lighter, and more durable than they actually are at present, then, but not until then, will they become commercially possible as transmitting agents in competition with other

*In this case, the efficiency is the ratio of the power supplied to the charging dynamo to that obtained from the motor, and does not include power spent in transmission being charged for in the account at 3d per car mile.

systems of power transmission. Taking batteries as we find them at present their use as agent in the transmission of power is only justifiable in cases where the direct transmission by means of conductors cannot be employed; and this brings me to the consideration of the only case of the electric transmission of stored power which as yet has attained to practical importance namely, the use of batteries for locomotive purpose.

Although electric tram-cars come, strictly speaking, within the title of my lectures, I do not propose to consider them at any length, the reason being that this branch of power transmission alone, if treated in detail, would absorb all the time at my disposal. I shall, therefore, content myself in taking up the subject only so far as is necessary to show in a general way what is the present practice in this branch of power transmission.

We have in this country two very good examples of battery tram-cars, the one being the cars now running in Birmingham, and the other the cars on the Barking-road line in the North of London. Of the former I have not been able to obtain much information, but of the latter I have by the kindness of Mr. Thomas Fraser, who superintended the erection and working of the plant, been able to obtain all the information required for my purpose. I am also indebted to Mr. Reckenzaun for information regarding his cars, which are in use at Philadelphia. The following table gives the principal data of these cars, conveniently arranged for comparison and reference.

Taking the average of the last two lines in the table, we find that for a car representing a total rolling weight of 10 tons, we require a battery capable of giving a maximum output at its terminals of 19 E. H. P., and a mean output of 5·6 E. H. P. It must, however, be noted that the latter figure applies to the time the car is actually in motion, and does not include the power wasted in starting. Mr. Fraser has made very careful observations of the power flowing out of the batteries during the whole of the time the car is in service, and found that the integrated power divided by time came to 7·33 E. H. P.; that is to say, a motor taking from the batteries all day long 7·33 E. H. P. will take from the batteries the same amount of power that is actually taken under the intermittent work going on in the running of a tram-car. Of the 7·33 E. H. P. a good motor will yield about 6½ E. H. P. Taking the efficiency of the batteries at 60 per cent., a figure by no means too low when we consider the very irregular nature of the work done by these batteries when in service, we find that the E. H. P. of the charging dynamos required per car is about 12 E. H. P. The ratio between the indicated power of the engine and the output of the charging dynamo may be taken at 80 per cent., so that we shall have to provide engine-power at the rate of 15 I. H. P. for every car, provided the engines are worked for the same number of hours that the cars are in service. If the engines are worked for a longer time, say by night as well as by day, a corresponding reduction in the total indicated power of the station can, of course, be made.

Storage Battery Tram-Cars.

—	Birmingham.	Barking-road.	Philadelphia.	
			Small car.	Large car
Weight of car (in tons)...........	—	3.275	2.500	3.620
" motors gear (in tons) .	—	1.360	080	1.140
" batteries (in tons)	2.850	2.400	1.770	2.450
" passengers (in tons)....	3.300	3.600	2.230	3.600
Total rolling weight (in tons). .	10.50	10.63	7 48	10.81
Percentage of paying load.... ..	31.5	34	30	33.2
Number of cells....	96	96	84	116
Maximum current........... . .	—	70	70	80
Maximum energy at battery terminals (E.H.P.)...........	-	19	14	23
Average energy at battery terminals (E.H.P.)........ ...	—	6	4.8	5.4
Maximum energy per 10 tons of rolling weight (E.H.P.)......	—	17.8	18.7	21.3
Average energy per 10 tons of rolling weight (E.H.P.)......	—	5 65	6.42	4.95

Returning now to the subject of the cost at which stored power can be retailed by electric transmission to small consumers, let us briefly glance at the rival system, namely, the distribution of small parcels of live power from a central electric light station. One hears it often stated that the supply of power, and not that of light, must become the chief business of such stations. The argument in support of this view is somewhat as follows. The demand for light is very uneven, being less than a tenth of the capacity of the station for many hours during the day, and rising very rapidly towards evening. The period of large demand comprises only a few hours, and during that time the engines work, with great economy. During the remainder of the day the economy is less; and, in fact, the greater portion of the coal bill, cost of attendance, and interest on the capital outlay is chargeable to light running. If, therefore, by the sale of power, we could keep the central station plant economically working during the whole of the day, the increase of the working expenses would be slight, but the increase of revenue would be very considerable. This argument is perfectly sound, but it has the rather serious defect that it will not convince the very people from whom this large increase of revenue is to be obtained; for, let us see what it means to the use of power. As you know, electric current is supplied from central stations, at a charge varying from 4½d. to 8d., and even 1s. per Board of Trade unit. The usual charge in London is about 7d.

Now, suppose a small manufacturer, requiring only a few horse-power, determines to discard his small steam or gas engine, and put up an electro-motor, to be worked by current from a central station, what will the power cost him? This, of course, depends on the time that is, the number of hours in the year during which he requires power. If he has a small factory, in which work is steadily going on, day by day, you may estimate that the power will be required during 300 hours per annum. It is now very easy to calculate the annual cost of each brake horse-power. Allowing £1 10s. per horse-power for depreciation and interest on the motor, and £1 for petty stores, we find that, at 7d. per unit, the annual horse-power will be accordingly altered, as shown in the table:

Power Derived from a Central Station.

Cost of Board of Trade unit....	d. 1	d. 2	d 3	d. 4	d. 5	d 6	d. 7	d 8
Cost of annual brake horse-power for 3,000 hours.	£ 12.9	£ 23.3	£ 33.5	£ 43.9	£ 54.2	£ 64.5	£ 75	£ 8.54

It is clear, from this table, that the small user of power will only use an electromotor if he can get current at about 3d. per unit, and, unless electric light companies can supply at this price (which at the present time does not seem likely) there is no prospect of supplying electric power to small factories wanting the power continuously. Another disadvantage is that the demand for power must, in winter at any rate, overlap the demand for light, thus requiring the erection of additional plant. If, however, the power is only required intermittently, then the electromotor is by far the cheapest instrument for producing it, not only as regards first cost, but also as regards working expenses. There are many small trades in which power is wanted only for a few hours during the day. If, for instance, the actual running time of a lathe is two hours daily, then the cost of the annual horse-power with current at 7d. would only be £15, a figure which cannot be touched by either steam or gas. There is the further advantage of having the power always ready. There is no need to get up steam, look to the feed pump, open cylinder cocks, turn the engine over the centre, and generally do the dozen little things which are required in starting an engine. With a motor all that is required is to turn on the switch when the power is wanted, and to turn it off again when the job is done. For domestic purposes again, nothing could be more handy and economical than electric power supplied from a central station. I have here a collection of appliances, for the loan of which I have to thank the Keys Electric Company, and I can show you how easy and convenient it is to apply electric power to small domestic machinery.

I have in the present lecture dealt with what may be termed general questions of engineering policy rather than with technical details, and I am afraid you will have found the financial parts of the lecture rather a dry subject. The question of cost is, however, of the utmost importance in engineering work, and it was, therefore, necessary to give it some consideration. In the remaining two lectures I shall be able to turn to the more interesting parts of our subject, and bring before you some of the scientific principles and technical details relating to the electric transmission of live power of long and short distances.

(To be Continued.)

DYNAMO ROOM TALKS.

I HAVE seen instruments called voltmeters of such low resistance as to materially change the potential difference of the circuit on which they were used. This will be the case where the supply of current is small and the resistance of the instrument low. The effect is always present to a more or less degree, and when making accurate laboratory tests is taken into account, but in practice, with the fall of potential due to the introduction of the voltmeter into circuit is too slight to be noticed or to be of any appreciable value.

A good dynamo room test for a voltmeter, where a galvanometer is not handy with which its exact resistance may be measured, is to connect in series with the voltmeter an ordinary 110 volt lamp. If the lamp colors the least in a dark room when in circuit with the voltmeter, the instrument is of too low resistance to be used. I do not mean by this that an instrument which will stand this test has sufficiently high resistance, but I mean that one which will not stand this should not be used at all.

A voltmeter is placed in circuit in such a way that it abstracts a small portion of the current, so that the higher the resistance of the voltmeter the smaller proportion of current will pass through it. With a very delicate, sensitive instrument only a small portion will be necessary to move the indicator hand. In practice I should say that not more than three to five watts should be allowed for any voltmeter or ampere meter.

An ampere meter is an instrument for measuring the current, and it is placed in circuit in series, so that the entire current it is desired to measure passes through it. It will therefore be readily understood that it should not form any considerable portion of the resistance of the circuit. An ampere multiplied by a volt equals one watt and it requires 746 watts to equal one horse power or 33,000 foot pounds.

You will understand that a current cannot pass through any conductor without losing a portion of its energy, just as water flowing though a pipe loses some of its energy by friction. This loss is easily ascertained in hydraulics, it is just as easily found in the case of electricity. There is no perfect conductors of electricity. There are no conductors over which a current passes but what offer some resistance, and to overcome this resistance we must lose a portion of our electrical energy. We must therefore make the resistance of our ampere meter as low as possible, so that our loss may be reduced to a minimum. The resistance of the ampere meter multiplied by the square of the current flowing through it equals the number of watts lost. An ammeter for station use should be provided with a short circuiting plug or switch, and occasionally it may be used to test the instruments. This is especially needed where your load is practically constant, as in some stations having approximately a definite number of lights on for a given time. Then the switch may be used to see that the pointer will always return to the same position. On railroad circuits, ammeters are usually kept busy and will not require this test. An ammeter in circuit with every feeder will enable you to quickly locate grounds, and an ammeter in circuit with the buss bars will show at all times the total current going to line, and it gives you a ready means for checking against feeder ammeters. In this way any derangement of any of the instruments may be quickly noticed.

Before leaving the subject of instruments, did you ever see a steam guage on a boiler that did not have an oil lamp, gas flame or incandescent lamp near it, so that the face of the gauge was always plainly in view? On the other hand, did you ever see an incandescent lamp properly placed in front of the instrument, or on an electric switchboard? In front and just above each instrument, secure a goose neck bracket, and let the lamp drop down so that it will fall just in front of the instrument, now get one of these mirror reflections and place it in front of the lamp so you may be able to see the instrument, without being blinded. A piece of tin foil pasted on one side of an ordinary lamp will answer. Take the cluster of lamps off of your switchboard, where they have so admirably shaded your instruments, and place them in the goose-neck holders before your instrument and do not stick lamps around on top of your dynamo, where they constantly shine in your eyes. Drop them down from the ceiling or put them on fixtures 8 to 10 inches above your eyes.

It is handy to have a lamp drop from the ceiling just above each dynamo, so that an extension cord may be connected into the socket. When it is necessary to examine or clean a dynamo, a lamp may in this manner be used to examine every portion of the machine.

Safety catches, plugs, fuses, or by the name of soft strips, they are all the same. It is an attempt to provide a safety valve for an electric circuit. The device is a small insignificant thing. It would be overlooked by a casual observer, and I am afraid does not receive enough attention from those whose duty it is to look after them. Without discussing the question here as to whether they are the *ne plus ultra* for the purpose intended, we must content ourselves with the fact that they are the most approved safety guard we have at the present time, and in order to get fairly good or reliable results from them, we must know something about them and must recognize them as one of the most essential factors to the operation of our plant.

I have just read a recent book treating on the subject of electric plants, apparatus, etc., and how to take care of them, and I find that it does not contain a single reference to safety catches. The author thought, probably, that they were so small and insignificant that they did not deserve attention. He evidently believes in "big things," however, for he has a picture in his book of every type of dynamo within the record of the Patent Office. Our thoughts are for those who are sufficiently well informed to distinguish the various types of dynamos, without the necessity of having the much worn electrotypes of them brought into requisition here, and having us say like Blenkarn, "this is a teapot." I have my own ideas about the best model and devices to be used for safety catches, but "that is another story."

A safety catch or fuse wire, as we find it in the market, is simply an alloy of lead and tin, but if we are to believe the makers, it is compounded in secret by a high priced man, who discovered the art after many, many years of careful study, and the secret is known only to the particular maker advertising the ware. But the truth of the matter is, that this difficult problem is solved in the following simple manner by the supply houses. The stockman discovers that his supply of the precious and very expensive metal is running low, he writes out an order on some prominent metallurgist or metal man which reads as follows. " . pounds assorted sizes half-and-half wire solder." The office boy then winds this solder on small fancy tin spools with gaudy printed labels pasted on the ends, it is graded by the use of a printed table, the author of which is not known, and probably would be regarded less if he were, and a rusty wire guage, it is then put on the shelf and is ready for the unwary, at prices 300 to 500 per cent. above cost.

So much for the commercial aspect, now let us see what we had better do with this delinquent. The best suggestion I can offer is, do not become one of the victims. How can it be avoided? I will tell you. Don't you buy half-and half solder nor other alloy. Instead, select a metal man in whom you have confidence, and next month we will tell you how to procure a fuse that you will find much more reliable than those to which you have been accustomed. Force Bain in *Electrical Industries.*

PUBLICATIONS.

We have received from the Waterous Engine Works Co., of Brantford, a catalogue and price list of their Friction Grip Pulleys, containing references from a number of well known firms who have these pulleys in use.

The publishers of the *Monetary Times*, Toronto, have issued a very neat and useful souvenir in the shape of a vest pocket slate. The *Monetary Times* has reached the 25th year of its publication and has our best wishes for a prolonged and increasingly useful career in the future.

The January *Arena* contains strong papers by Alfred Russel Wallace on "Human Progress: Past and Future"; Prof. A. N. Jannaris, Ph. D., of the University of Greece, Athens, on "Mohammedan Marriage and Life"; Henry Wood, on "The University of Law"; Ex-Gov. Lionel A. Sheldon, on "Louisiana and the Levees"; D. G. Watts, on "Walt Whitman"; Chas. Schroder, on "What is Buddhism?" and several other able papers. The *Arena* fully maintains its brilliant reputation and should be in the homes of all thoughtful people.

The Great Northwestern Telegraph Co. brought a suit against the Montreal Telegraph Co., whose lines it leased in 1881, for a loss of $80,000 per year alleged to have been sustained by reason of the competition from the Canadian Pacific Telegraph Company over exclusively Montreal Telegraph Company territory, which it claimed it was the duty of the Montreal Telegraph Company to prevent. The Supreme Court at Ottawa has just given its decision, which is in favor of the Montreal Telegraph Company.

STEAM BOILER FITTINGS.

SAFETY valves should be large enough to discharge all the steam the boiler can make without undue increase of pressure. Where pop safety valves are used, it is better to have two smaller ones rather than one large one. A good arrangement is to have one small pop valve and a larger valve of the ordinary kind loaded by a lever and weight. The large valve should be loaded to open only when the small pop valve proved insufficient to keep down the pressure.

Safety valves should be tried every day by slowly raising them a little from their seats. It is a good plan to try them occasionally by allowing the steam to raise them. If the valves are found to be fast to their seats, steam should be let down as soon as possible and the valves opened and taken out and cleaned and oiled. It is dangerous to attempt to relieve a valve that is stuck very fast while the pressure is on. Cases have occurred where the valve has suddenly left its seat and been blown with such violence as to break its chest and kill the man who was foolish enough to try to free it.

Safety valves that leak are sometimes made tight by hanging a chain or a poker on the end of the lever. This is a back woods method of saving steam that has been the true cause of many boiler explosions. If the safety valve cannot be made to fit its seat and keep tight when shut, and open at the proper pressure, there is something wrong with the valve. Frequently it is caused by the valve being made of too thin metal, and when the weight bears upon it, it yields and gets out of proper shape. The only remedy is to break it up and get a stronger one.

Sometimes pieces of grit or boiler scale will catch on the valve seat when steam is blowing off and cut the metal. In this case, the valve and seat should be ground together with a little fine emery powder and oil, until a good bearing is again obtained. Care should be taken to finish the grinding in such a way as to get all the powder worked out, and it is better to have the water in the boiler hot when it is being done, so that the valve and its seat may be as nearly as possible at the same temperature as they will be when steam is up.

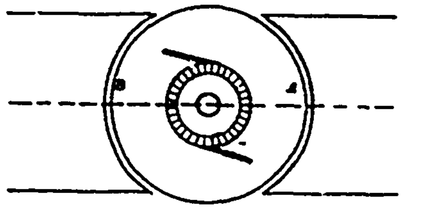
A SIMPLE METHOD OF LOCATING ARMATURE DEFECTS.

BY OSBORN P. LOOMIS.

ALL electricians are aware of the many trials of searching for an armature "short circuit." One method is to run the armature by the usual belting and excite the field, then by observing the heated parts some idea may be obtained where to commence searching for the trouble. It will be understood that the above will only apply to the short-circuiting of a few coils, for when the whole, or nearly the whole, armature is closed on itself by the two adjacent wires touching, running in an excited field will warm all the wires and, of course, no locating is possible. To add to the trouble, the machine must be belted up and run, which takes time, and repeated trials become very annoying.

I will now describe a method, devised by the writer, which at times has been very convenient. No arrangement for belting need be made; it is only necessary to fasten a monkey-wrench to the rim of the pulley, or, better still, a crank to the end of the shaft. Now excite the fields and, to make the effects more marked, connect the coils in parallel as the excessive current will only be used for a moment. When this has been done the strongest man will scarcely be able to rotate the armature, and then only with extreme slowness, except at one position. When this position has been found, mark the armature at points in the centre of the pole-pieces A, B, as shown in the accompanying diagram, and at both ends of the armature.

The explanation is that both halves of the armature oppose



one another at this position; but when not at these points a continuous circuit is formed and the resultant magnetic effect is enormous. As the "cross" will be found at one of these four marked points it becomes desirable to know in which one it is most likely to be found. Experience has shown that it is nearly always on the commutator end in the last half of the winding where the wires pass down through the first half terminals. In armatures where the windings are equal, I suppose it would be as liable to be at one point as at another.

With this method a defect can be found and remedied in a few moments, for it has always been a simple matter to repair it when discovered. These results can be observed in a perfect armature by connecting the opposite sections of the commutator. When only one coil is short-circuited, the magnetic effect is much less and the points must be marked 90° from the ones shown, but these cases are few and are soon discovered in other ways. The above will be understood to apply to armatures of the drum type with Siemens winding. N. Y. *Electrical Engineer.*

THE NEW "W. P." MOTOR.

VISITORS to the recent Street Railway Convention at Pittsburgh will recall a motor in the Thomson-Houston exhibits of apparatus called "W P." and described as designed for narrow guage service. Its history will prove particularly interesting to the street railway fraternity.

During the last spring the Thomson-Houston company, at their works in Lynn, began the development of a motor especially designed for narrow guage service. As the machine grew, there were incorporated into it many improvements suggested by experience with various types and the demands of railway service. The lessons of the preceding winter were particularly kept in mind and applied. The electrical parts of the new motor were so carefully protected from mechanical injury, snow and water, that the machine took its name from this feature and was called the "W P." or "water proof." The single reduction motor (known generally as "S.R.G.") that has been largely sold during the current year is also practically water proof, a separate casing being used to protect the condition.

When the "W. P." went into service on narrow guage roads its many improvements and its excellence created, to an extent, a demand for it on roads of standard guage. In response to this call a few machines were sent out and their record has been so satisfactory that the company have concluded to adopt and recommend the "W. P." as one of their regular single reduction motors for general railway service.

Among the railway companies that have tested the "W. P." motor is the West End Company, of Boston, and it is a striking evidence of the confidence which this motor has created that the Thomson-Houston company have received an order for 500 of these machines in further equipment of the West End system. The machine ordered by the West End company is very conservatively rated at twenty-five h. p. The other standard size at fifteen h. p.

The motor frame consists of two castings of steel clamped together by bolts at the back and front, the axle brasses being held between the two parts. The armature bearings are cast in one piece with the lower half of the frame, and are provided with caps so that the linings may be inspected or renewed without disturbing other parts of the machine. The lower half is shaped somewhat like a bowl, rounding up from a plough-shaped bottom, which will throw aside stones or other obstructions which may be on the track. The upper half meets the lower, except upon the armature bearings, where holes are left for access to bearings and commutator and for ventilation. Only one field spool is used, which surrounds the armature and upper pole piece, and is itself completely covered by the frame.

A remarkable feature of this machine is the fact that it is so proportioned that at its normal load the solenoidal pull of the field is sufficient to lift the armature and relieve the bearings of the weight. There will, therefore, under ordinary conditions be no tendency to hot bearings.

The motor can be run in water up to the axle in fact, can be left standing in it without damage; and water dripping on it from above is shed off without gaining the interior of the motor. It will then be seen that the armature, field spool, commutator and brushes are completely inclosed in the frame. The parts of the frame are hinged together at the axle end. By removing four bolts, therefore, the upper half may be swung upward, or the lower half downward through a trap in the car floor or into a pit under the track, as may be convenient. The armature or field spool may then be easily removed.

Not only is the motor, as a whole, ironclad, but the armature is also ironclad. The core is a ring with projecting teeth of a peculiar form. The coils are wound between the teeth and held firmly in place by wooden wedges. No binding wire is used, and to replace a coil it is only necessary to drive out a wedge and the coil can be rewound without disturbing the rest of the winding. The importance of this feature will be appreciated by those who have had to repair drum armatures. The winding is continuous, joints in the wire, where necessary, are electrically welded, no solder whatever being used. This construction protects the armature winding from mechanical injury as it is below the surface of the iron core. Electrically, a decided advantage is gained because the air gap can be made very small. This permits of comparatively few turns of wire being used to excite the field and consequently requires but a short magnetic circuit. Practically all the metal in the machine is used in the magnetic circuit, thus making the weight of both iron and copper small, while the efficiency of the motor is very high. The brush holders are mounted in a groove planed in the frame alongside of the armature bearing. By giving a quarter turn to a handle on the brush holder, it may be taken from the motor to examine or renew a brush. The convenience of such an arrangement is obvious, as it obviates the necessity of reaching down into the motor and handling a brush which possibly is hot. The armature shaft has been made short and heavy to avoid the possibility of springing, and is fitted with steel shells, thus ensuring a proper bearing at all times. In case of wear from long use or scoring from grit, these shells can be replaced. The linings of the boxes are of punched sheet metal just thick enough to stand the wear required of them, and when thrown away waste little metal. The gears are of steel and are run in a case filled with oil. This case is split in halves and has a hinged cover through which the gears may be inspected and oil introduced. By loosening the nuts on two hinged bolts a section of this case can be removed and the pinion on the armature shaft drawn off without taking apart the gear case proper. The small size of this motor permits two of them to be mounted on a truck of five feet wheel base and three feet guage.

These motors have not only been thoroughly tested at the works of the company, but have been in regular service on several roads. They have proved themselves to be highly efficient and able to stand the roughest usage without injury.

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VOLUME II.

THE CANADIAN ELECTRICAL NEWS celebrates its first anniversary. It has successfully passed the critical period of early infancy, and hopes to continue its development, side by side with the important interests which it seeks to serve, throughout many future years.

Thanks are hereby extended to every person who contributed in any degree to the success of the first year's effort. A continuance of their support would be much appreciated, while those who may not have lent their assistance are invited to do so in the future.

It is gratifying to observe that some subscribers are complying with the invitation to ask questions. It is the privilege of every subscriber to receive direct benefit to himself in this way, as well as to assist in making the paper increasingly valuable to every reader.

Suggestions from subscribers concerning means of making the paper better serve the wants of its readers, will always be welcomed and carefully considered.

It has been thought desirable to make a change in the cover of the paper, which it is hoped will meet with the approval of its readers and display to better advantage the announcements of advertisers.

With the kind assistance of its readers, the ELECTRICAL NEWS will doubtless be able to again report progress when it reaches its second anniversary.

May 1892 bring to all prosperity.

A MEMBER of a prominent Toronto firm who was recently visiting Canada after a residence of twelve years in England, said the general use of telephone and electric light in this country was a revelation to him. There are, he said, more telephones in use in Toronto than in London, England.

CARLETON Place, Ont., is the proud possessor of an "electric girl." Her name is Miss Abbott. If published accounts of her doings are to be relied on, her voltage is enormous. An angry bull which rushed at her she is said to have literally taken by the horns and tossed aside, notwithstanding his weight was 1,900 pounds. The animal evidently mistook Miss Abbot for the ordinary kind of girl, and has probably not yet recovered from his surprise. The Canadian girl has long been noted for her magnetism, and now that to this she has added electric power, she becomes simply irresistible.

THE Executive Committee of the Citizens Committee, under whose direction the members of the National Electric Light Association spent a week of huge enjoyment at the Montreal Convention in September, are not yet quit of the responsibilities of office. The settlement of accounts is now in order, and rumor has it that some of the bills rendered are regarded with more than a trifle of astonishment. This is not an unusual experience in connection with affairs of this kind. A good rule would be to recognize only such expenditures as were authorized by the Executive Committee. If any gentlemen, acting in their individual capacity, succeeded in winning widespread fame by their display of princely hospitality, they will no doubt consider it a privilege to pay the price of the honors out of their own pockets, and be especially grateful for the privilege when they consider how seldom opportunities for achieving sudden distinction present themselves.

The office of the Secretary of the Canadian Electrical Association is at No. 14 King St. West, Toronto, to which address applications for membership and all communications relating to the Association should be addressed.

AN amusing episode occurred in Mr. Justice Ferguson's court during a recent trial of an electric light case. It was probably the first time that electricity has played any part in a Canadian court of justice. After understanding that an "installation" had nothing to do with the officers of a secret society, his honor the judge set himself seriously to try and grasp the meaning of the many and varied technical terms in which the votaries of the science so much like to indulge. The word "voltage" caused a stay of proceedings, while it was explained to his satisfaction, and so much time was taken over it that he probably considered that was all there was to it. But the introduction of the rest of them one after another, such as "ohm," "ampere," "watt," "potential," "drop," and so forth, was a perfect paralyzer. A witness stated that a certain contract called for a seventeen candle power light, as that was considered to be the light given by a gas burner using five feet of gas per hour. "What" exclaimed his lordship, pointing to some extra miserable burners in the court room, "a Toronto gas jet equal to *seventeen* candles! Never!!" and a fine shade of contempt crossed his expressive features as he looked at the witness over his glasses, which said as plain as words: If you can do me up with your foreign languages and outlandish names, you can't fool me with any such yarn as that. Seventeen candles! No, sir!!!

WILL electricity as a source of power ever supersede the use of steam? Years ago some enthusiastic experimenters confidently predicted it would. At present it is being used instead of steam in many places, but the very electricity which is thus used is itself produced by steam engines. It is well known that steam power can be more economically produced in large quantities, in one large central engine house, than if divided up into a number of small plants. Using electricity as a means of carrying the power and distributing it in quantities right at the machines where it is needed, it is found that the power can be more conveniently and cheaply applied. This has the appearance of taking the place of steam, and in some of the daily papers it is so put that the ordinary reader is led to imagine that the problem of the economical production of electric power has been solved. Over thirty years ago, Prof. Rankine, of Glasgow University, writing of the electro-magnetic engine, pointed out that while it showed as an engine greater efficiency than any known form of heat engine, yet the cost of producing the magnetic current was so great that a horse power produced by zinc consumed in a battery cost as much as 200 horse power produced by a steam engine. He concluded that "electro-magnetic engines would never come into general use except in cases when the power required is so small that the cost of material consumed would be of no practical importance, and the situation of the machinery to be driven such as to make it very desirable to have a prime mover without a furnace.

AT intervals during the last three years the necessity of providing means of imparting technical instruction to artisans has occupied the attention of the City Council of Toronto. On each occasion the question, after having been to some extent considered, was on various pretexts "referred back. So frequently did it meet this fate, that its friends were almost ready to despair. It is therefore doubly gratifying to the friends of the movement to observe that definite action has at last been taken. An appropriation of $6,000 for the purpose of founding a technical school has been voted in Council, and a Board of Management appointed, comprising representatives of the City Council, the Architectural Guild, the Trades and Labor Council, the Association of Stationary Engineers and the Manufacturing interest. It has wisely been decided to establish at present but one school, to be located in the centre of the city. The course of instruction has not yet been outlined. The selection of subjects to be taught is a matter requiring the most careful consideration, and will, we trust, be approached with due deliberation and a proper knowledge of the requirements of the various classes of students. In view of the decadence of the apprenticeship system, it is from technical schools the coming generation must receive instruction of an elementary character pertaining to the various trades, a fact which should give additional interest to the present movement. Gratifying success has attended the classes for technical instruction conducted for several years past in the city of Montreal under the direction of the Council of Arts and Manufactures of the Province of Quebec, and if equal interest is manifested, the success of the Toronto school will be assured.

The Canadian Electrical Association aims to promote electrical interests in every part of the Dominion, and to include in its membership representatives of those interests in all the provinces. Therefore, wherever this paragraph meets your eye, please regard it as an invitation to become a member.

AN effort is being made by the Census Department at Ottawa to obtain the necessary data for a special schedule for the electrical industries of Canada. The information required will include the name and location of each company, amount of capital stock, date of incorporation, number of employés, amount of yearly wages, number of generators, number of lights (arc and incandescent), number of motors, miles of wire, kind of motor power, capacity of station in horse power, number of dwellings, public buildings and business places for which light is supplied, capacity of station in lights, name of system used, and in the case of electric railway companies, number of miles of track operated and cars used. The circular of the Dominion Statistician requesting companies to supply the above information, expresses the opinion that "the interests of a rapidly growing industry will be promoted by the preparation of a special schedule." In what way this result is to be achieved, those representing the electrical interests are not informed. The statement is made that all information given is to be strictly confidential, and as the returns will be published as a whole, the identification of any particular firm or company is impossible. It will, of course, be a matter of interest to know the extent of electrical interests in Canada, and the rate of their development, but whether the publication of these facts will be promotive of the interests of persons engaged in electrical industries, we have not the means of judging. We presume that the Government have in view some object not apparent from their circular, which to them justifies the importance of this step. It may be the information required is to enable them to judge whether or not the present tariff on imported electrical apparatus is suited to Canadian requirements. We can only speculate on this head. In any case we trust that the information sought to be obtained will be cheerfully supplied. There can be nothing gained by withholding it. We can only hope that wise use will be made of it, and that if the result does not tend to advance the progress of the electrical industries of Canada, it will at least not prove an obstacle in the way of progress. In connection with this subject it may be stated that the reports of the electric light inspectors of the Canadian Fire Underwriters' Association show that there are now in use 3,500 miles of electrical circuits; 400 dynamos; 200 motors; and that 12,000 arc lights and 33,000 incandescent lights are burning nightly in Ontario. There are in operation in Toronto electric motors representing a capacity of 500 horse power.

THE fact was recently mentioned in this paper that the City Council of Toronto had appointed the acting City Engineer and a provincial land surveyor a delegation to visit United States cities and the street railway convention at Pittsburgh and to report on the best motive power to be adopted in the operation of the Toronto street railway by electricity. The gentlemen, as previously stated, were not qualified by previous education or experience to estimate the merits of the various systems of electric street car propulsion, and form thereon their own opinions. Notwithstanding this fact, however, we are free to say that their report recommending the adoption of the overhead trolley system as the only one which can at present be depended on to give satisfactory results, is entirely justified by the circumstances. The information contained in the report might easily have been secured with the expenditure of a dollar or two for postage. Having secured it by the most costly method, it might reasonably be supposed that the aldermen would attach the greater value to it. The report was considered and approved by the Board of Works and Executive Committee, and its acceptance recommended to the Council. There its adoption was met by a protest from a company engaged in the manufacture of storage batteries, who wanted consideration of the question deferred for a period of three months to give them the opportunity of making a practical demonstration of the superiority of their system. This is the same company which took exception a year ago to some remarks in the ELECTRICAL NEWS concerning the merits of storage batteries for street railway work. They claimed that their battery was made on a new principle and that in its construction the objections commonly urged against storage batteries had been overcome. In order that these claims might be established, we offered to provide all the facilities necessary for a sixty days test of fifty plates, but were unable to induce the company to submit their apparatus to the test. Our offer to publish the results in full without charge, proved not to be a sufficient inducement to them to accede to our request. They stated that in March or April they would equip a street car, and on the tracks of the old Toronto street railway company would publicly demonstrate the practical utility of their system. It is to be regretted that March will soon have come the second time without witnessing the fulfilment of this promise. The statement was likewise made that the company would at the Montreal electrical convention give a practical demonstration of the adaptability of their system to street railway work. This promise also failed of fulfilment. In view of these facts the request which the company have preferred to the Toronto City Council deserves no consideration unless in the light of an attempt to obtain cheap advertising at the expense of a great public improvement. By reason of the representations of the company in question, and of certain aldermen regarding the undesirability of the trolley system, and on account of a provision in the agreement between the Council and the street railway company, that the company after having adopted a system, should not be required to change the same for a period of thirty years, the Council saw fit to refer back the report of the "experts" for further consideration. The provision referred to in the agreement may not be a wise one from the city's standpoint, but the agreement having been ratified, it is now rather late in the day to seek to have it altered. Certain it is that the company would not have been willing at any stage of the negotiations to agree to change its system whenever required by the city to do so, without asking from the city in return much more liberal terms than those under which it has agreed to operate the road. If the city decides that it will not adopt the trolley system, it may have to wait a considerable time for something better, and if it wants the right to compel the company to change its system when it may be thought desirable that it should do so, the re-opening of the whole question with attendant delay and perhaps litigation, is likely to be the price which must be paid.

NEW YEAR GREETING.

MR. R. A. LYONS, London, Ont., writes to the NEWS as follows: "Enclosed find $1. The NEWS is very interesting and instructive. I wish it success, and trust it will receive the support it so justly deserves."

Frank I. and Wm. K. L. Tinning, of Toronto, have been granted a patent on a telephone receiver.

CANADIAN ELECTRICAL ASSOCIATION.

ARE you a member of the above Association? If not, why not? Have you received a copy of the constitution and by-laws and form of application? If not, write to the Secretary, mentioning the fact, and he will be pleased to forward the same to you. Address, C. H. Mortimer, Secretary Canadian Electrical Association, office of the ELECTRICAL NEWS, 14 King street west, Toronto.

The Association has a career of usefulness before it, and should receive the hearty support of every person interested in the progress and welfare of the electrical industries of the country.

The membership is divided into two classes so as to enable students and those interested but not actively engaged in electrical work to receive the benefit of attending meetings of the Association and of receiving copies of the proceedings of such meetings on payment of the modest fee of $2 per year.

Those who are actively engaged in electrical enterprises would find it to be to their advantage to become active members. By doing so, they would be brought into contact with others in the same pursuit, and by comparing notes, would derive much valuable instruction.

The electrical industry has attained to its present importance within a very brief period. There has been a great deal to learn, little time in which to learn it, and few to whom to go for instruction.

There is much valuable information relating to the successful management of electric apparatus with which the owners and operators of such apparatus in Canada require to become acquainted.

In the Association are men who have witnessed the development of the industry from its earliest infancy in this country, who have been face to face with most of the difficulties, and whose experience, as has already been said, would be most helpful and valuable to every incoming member.

With the growth of the industry comes the need for organization on the part of those engaged in it for the purpose of protecting its interests against legislation of an unfavorable character. In this direction the Association is likely to prove, as the National Association of the United States has proved, of great advantage to its members.

We are pleased with the interest which has thus far been shown in the movement, but would like to awaken the enthusiasm of many others.

The travelling representative of a Toronto supply company called on the Secretary a few days ago and got copies of the constitution and by laws that he might make an effort to secure members for the Association. Representatives of other companies are requested to follow this worthy example, not forgetting at the same time to have their own names enrolled.

The Executive Committee will meet shortly, when steps will be taken to extend in every possible way the interests and influence of the Association, and make provision for a pleasant and profitable time in connection with the first annual meeting to be held in June in the city of Hamilton.

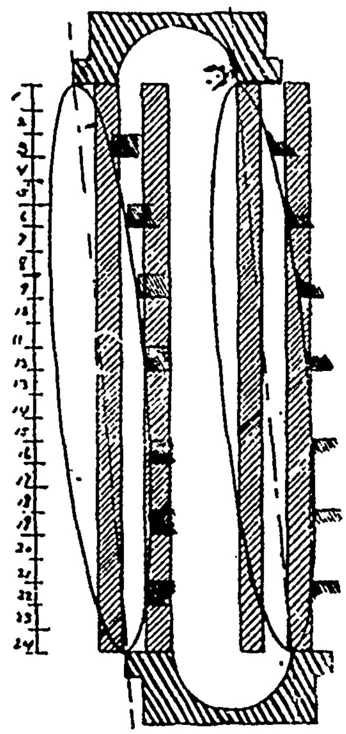
Forward immediately your application for membership, and take a hand in advancing the interests of the Association in conjunction with your own.

Do you find that owing to competition the capital and brains you have invested in the electrical business are not as profitable as they ought to be? Then you should become a member of the Canadian Electrical Association, when, in conjunction with your fellow-members, you would be in a position to work unitedly for the improvement of present conditions.

A CONVENIENT DIAGRAM FOR ENGINEERS.

BY H. F. COOK.

I HAVE been asked many times by engineers some plain, simple way of determining the position of the valve, the different points of stroke, etc., and for those who are not familiar with the Zuener diagram, which I consider one of the best, I will give below a simple way of telling the position of the valve at any point of the stroke. Any engineer with ordinary intelligence should be able to understand this with very little explanation. First, lay out the valve seat on any scale; that is, a section of the seat. Place the valve in the position you wish it at the beginning of the stroke, or in other words, with the desired amount of lead. Now, lay off the length of the stroke of the engine on the same scale by drawing the steam and exhaust lines down from valve seat, a distance equal to the length of the stroke of the engine. Then at the end of the stroke draw the valve seat, and draw the valve on this seat in the position it should be in when the piston is at the other end of the stroke; or, as stated before, place the valve with the desired amount of lead from this end of the stroke, it now having its opening or lead on the opposite port, as shown in the illustration. Now, draw an ellipse on a piece of cardboard, making the length of it equal to the stroke of the engine, and its breadth equal to the travel of the valve. Draw the line through it lengthwise and cut the ellipse out of the card, being careful to make it as accurate as possible. Now, place one end of the ellipse with its centre line at the edge of the valve as shown in the cut, and the other end at the position of the edge of the valve at the other end of the stroke. Draw the ellipse in this position and this will be the line the valve travels in the forward and backward stroke.



You can space off the stroke of the engine in inches, and from any number of inches on the end of the stroke, you can find the position of the edge of valve on ellipse line.

If you draw the same ellipse from edge to edge on the exhaust port you can get the opening of exhaust the same way.

I think that upon referring to the illustration it will be plain enough, and this explanation sufficient for any engineer after knowing the stroke of his engine, the travel of his valve and dimensions of seat, to lay out a diagram of his valve in this way. Of course, the angularity, of the connection rod will make some difference, but this is not taking that in consideration, and will do for nearly all practical purposes. —*Scientific Machinist.*

The Toronto Incandescent Electric Light Company (limited) announce that a cash discount of 20 per cent. will be allowed on all accounts rendered for incandescent electric light after January 1.

It is proposed to adopt the trolley system for a new line of electric railway to be constructed from the Bonaventure depot to St. Cunegonde and St. Henri, in the city of Montreal. Eight motor cars and about twelve trailers will be required.

A movement is on foot with the object of bringing about the amalgamation of the New Brunswick Electric Light Company, of St. John, N. B., with the Gas Company or the Eastern Company. The business to be done will not warrant the existence of three companies. A gentleman who was in St. John recently expresses the belief that the Gas Company will secure control of the New Brunswick Co.

Mr. Thos. Littlehales, of Hamilton, has been granted a patent for a process of making a heating and illuminating gas by the chief agency of pure or practically pure oxygen, in a simplified form, wherein the stream of oxygen itself generates the heat for continuous gas making, and forms a portion of the body or bulk of the gas itself, and at the same time generates sufficient continuous heat to decompose steam, the products of which also enters into and forms a portion of the body or bulk of the gas, or in other words, using a gas to make a gas.

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

BY WILLIAM BARNET LE VAN

(Continued from December number.)

THE experiments were made by David Rowan, with steam pressures from 5 to 45 pounds. The object was to ascertain the increase of pressure in a boiler when all the steam raised was allowed to pass away by the safety valves, unassisted at the different pressures. The following is the table of results:

Steam Pressure at which the Valve opened.	Steam Pressure rose to, in Pounds.	Percentage of Increase of steam Pressure	Lift of Valve in Inches.	Weight of Steam in pounds Discharged
5	13	160	0.325	3.39
10	19	90	0.255	3.223
15	25	66	0.18	2.68
20	30	50	0.16	2.676
25	36	44	0.1425	2.7
30	40	33	0.1262	2.58
35	44	25.7	0.1125	2.466
40	48½	21	0.103	2.437
45	52	15.5	0.097	2.41

With flat-faced valves, according to the English Board of Trade rule, half of one square inch of area per foot of fire grate:

$$\text{The weight of steam } w = \frac{3\,Ph}{2\,D}$$

But the valve sits being bevel to an angle of 45°

$$W = \frac{3\,Ph}{2.8\,D}$$ Weight of steam discharged per minute per square foot of fire grate.

The guides, or wings, of the valve would reduce the clear opening by full one ninth, for which no allowance has been made in the above.

James Brownlee, one of the committee of the Institution of Engineers and Ship Builders, in Scotland, in his experiments on safety-valve openings, found that with a square-edged entrance, the flow of steam was reduced from 12 to 14 per cent. The safety valve, as generally made, cannot be considered as presenting a much better entrance to the steam than a square edged orifice. In making this 14 per cent. allowance, the weight in pounds of steam discharged per minute per square inch of opening, with square-edged entrance, corresponds with very nearly three-fourths of the absolute pressure in the boiler, as long as that pressure is not less than 25.37 pounds. Examples of this are shown in the following table:

Absolute Pressure in Pounds per square inch.	Weight discharged per sq. inch of orifice, with rounded entrance, per minute.	Weight discharged per minute with square-edged orifice.	Three-fourths of absolute Pressure.
P+15	w_1	w_2	¾ p+15
25.37	22.81	19.6	19
30	28.84	23	22.5
40	35.48	30.5	30
45	39.78	34.2	33.8
50	44.06	37.9	37.5
60	52.59	45.2	45
70	61.07	52.5	52.5
75	65.30	56.1	56.2
90	77.94	67	67.5
100	86.34	74.3	75

The area of opening requisite to the discharge of any given constant weight of steam, it will be observed, is very nearly in the inverse ratio of the pressure. Thus, while 3 square inches of opening, with square-edged entrance, will discharge 3×23=69 pounds weight of 30 pounds pressure per minute, 1 square inch of opening will discharge 67 pounds per minute of 90 pounds pressure of steam.

The quantity of heat, however, requisite to generate (from water at 100°) 67 pounds weight of steam, at 90 pounds pressure, is only 1 per cent. less than is required to evaporate 69 pounds at 30 pounds pressure. The boiler which will generate 69 pounds of steam per minute at 30 pounds, cannot, therefore, possibly generate more than 67.7 pounds at a pressure of 90 pounds; but many experiments on record seem to indicate that the deficiency at the higher pressure is more than *ten per cent.*

In ordinary marine practice there is not often more than 20 pounds of coal consumed per hour per square foot of fire grate. Under these conditions, the area of the opening requisite to discharge all the steam a boiler can generate, corresponds to four times the square feet of fire grate, divided by the absolute pressure (p+15).

$$\text{or } A = \frac{4\,G}{p+15}$$

Rule. 1st. Multiply the square feet of the fire grate by the number 4

2d. To the steam pressure add the number 15.

3d. Divide the first by the second, and the quotient will be the area in square inches.

The English Board of Trade allowance is half of one square inch area of safety valve for each square foot of fire grate. Hence, the lift of valve is proportional to the diameter, and, inversely as the pressure. For a discharge of 3 pounds per minute per square foot of fire grate, the requisite lift in inches is twice the diameter of a (flat faced) valve, *divided by the absolute* pressure. This, however, does not apply to pressures less than 25 pounds (10 pounds per gauge, plus 15).

Take, for example, a safety valve 5 inches in diameter = 19.6 square inches in area, which corresponds to 2 × 19.6 = 39.2 square feet of fire grate, which would evaporate 39.2 × 3 = 117.6 pounds of water per minute. Then, since the area A in square inches requisite to discharge any weight w in pounds of steam per minute at the pressure p+15, is

$$A = \frac{4\,w}{3\,(p+15)}$$

We would have, by taking the pressure p=45, and the weight w=117.6, the area

$$A = \frac{4 \times 117.6}{3\,(45+15)} = 2.61 \text{ square inches}$$

which corresponds to the opening of a flat-faced valve, *5 inches in diameter*, when lifting.

$$\text{Lift } h = \frac{2 \times 5}{60} = 0.1667$$

The circumference of a 5-inch valve being 15.7 inches, and 15.07 × 0.1667 = 2.61 square inches of opening, as stated.

When the angle of sit of the valve is 45°, the lift required in inches is

$$\text{Lift } h = \frac{2.8\,D}{p+15}$$

When a boiler is regularly fired, and all the steam generated discharged through an ordinary safety valve, under a succession of different pressures, the lift of valve, multiplied by these absolute pressures, should be a constant quantity, provided the same quantity of heat is constantly entering the boiler, and provided, also, that the absolute pressure in the boiler, or the pipe below the valve, is not less than 1.726 *times the absolute pressure of* the steam in the chamber above the valve. In actual experiment a deficiency is generally manifested at the higher pressures. Hence, the suspicion of some considerable loss of heat at the higher temperatures. It has been suggested that this might be accounted for by the low pressure steam carrying water along with it—retarding its motion—and thereby requiring a larger opening; but this would only aggravate the case, since the same opening would permit of a much larger quantity of *heat* being discharged from the boiler with wet than with dry steam. This phenomenon may be suggested as one worthy of further investigation.

According to the Prussian law, and allowing 36 square feet of heating surface per square foot of fire grate, the area A *of safety valve is*

$$A = \frac{36\,G}{p+15}$$

A valve of this size, when full open, is capable of carrying away *nine* times the quantity of steam generated at the pressure p+15, and therefore will, at the designated pressure p+15, be able to discharge all the steam by lifting 1-36 part of its diameter.

At absolute pressure of (57+15) 72 pounds, the British and Prussian laws prescribe precisely the same area of valve. Take, for example, 20.36 square feet of fire grate, which requires, by British rule, a valve 10.18 square inches in area, equal to 3.6 inches diameter, and which, if flat-faced, would, at a pressure of 72 pounds, require to lift

$$h = \frac{2 \times 3.6}{72} = \text{1-10 of an inch}$$

Then, by the Prussian rule, the area of valve is, for 20.36 square feet of grate and 72 pounds absolute pressure,

$$A = \frac{36 \times 20.36}{72} = 10.18 \text{ square inches,}$$

equal to 3.6 inches diameter; and the requisite lift is (diameter 3.6) as before:

$$h = \frac{3.6}{36} = \text{1-16 of an inch.}$$

The circumference of this valve being 11.31 inches, would (if flat-faced), by lifting h=1-10 of an inch, give a clear opening of 1.131 square inches, which would, at 72 pounds absolute pressure, discharge ¾ × 72 × 1.131 = 61.07 pounds of steam per minute, and which corresponds to 3 pounds per square foot of fire grate—as 20.36 × 3 = 61.08.

At absolute pressures of 36 pounds, the Prussian law prescribes double, and at 144 pounds only half the area of the British.

At all pressures above 1.726 atmospheres, the area of valve, when full open, by Prussian rule, is nine times that requisite to discharge all the steam generated, while by the British rule it is four and a *half* times at 36 pounds pressure, and eighteen times more than is required at 144 pounds absolute pressure; and this is after allowing for an evaporation of 3 pounds of water per minute per square foot of fire grate, which is considerably more than is usually realized in marine practice.

Before the ordinary valves rise and give sufficient opening, the pressure of steam frequently greatly exceeds the load under which the valve begins to rise. Hence the requirement of large areas. *With a properly constructed* valve, however, such as many now in use, which rise one fourth of their diameter by an increment of 1 to 5 pounds above the load, there is no necessity for the area being much (if any) more than one-ninth of that prescribed by the Prussian rule.

$$\text{Say, area } A = \frac{4\,G}{p+15} \text{ plus the area of wings of valves.}$$

The valves here referred to are so very small that the stems, or wings, occupy a considerable proportion of the area, and must, in the above equation, be allowed for. These small valves give much more prompt relief to the boiler, and never permit the pressure to rise much beyond the load.

PRIZE FOR SAFETY VALVE COMPETITION.

The editor of the *Nautical Magazine*, London, England, in March, 1872, offered a reward of £100 ($500) for the best 3 inch spring safety valve suitable for high pressure marine boilers. There were five safety valves entered for trial. The boiler upon which they were all tested, under the conditions of the trial, was 33 feet long, 7 feet 2 inches in diameter, of the Lancashire

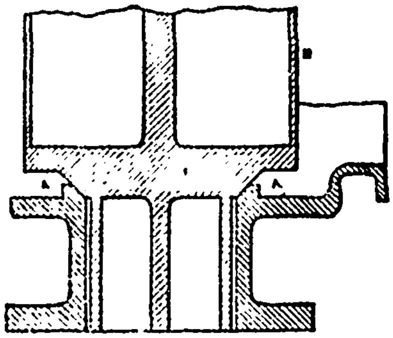


FIG. 19.—THE ROCHFORD SAFETY VALVE.

type, having two internal flues about 32 inches diameter each, inside, in which the fire grate was placed, as in marine boilers, the total area of grate surface was about 30 square feet.

The Rochford safety valve (Fig. 19) was awarded the prize. It will be seen that it has a projecting lip A, and the spring is enclosed in a case B, which can be filled with oil, if desired, for the preservation of the spring.

The editor, commenting on the trials, says, notwithstanding its absence of novelty, it would appear that an ordinary simple valve, well made, with true and narrow seating, and *long feathered wings*, moving freely in a long, truly-bored guide, meets the practical requirements so far as the valve and its setting are concerned.

For the loading of a spring valve, it would appear that a light, direct spring, with great range of elasticity, no friction, and a minimum amount of inertia, are the best means. These essential and sufficient conditions imply no novelty, and no delusive ingenuity.

In the trials, the valves were set to blow at 60 pounds per square inch, and the result was in favor of the Rochford safety valve. The umpires say, in their general remarks "We could not raise steam above 63½ pounds

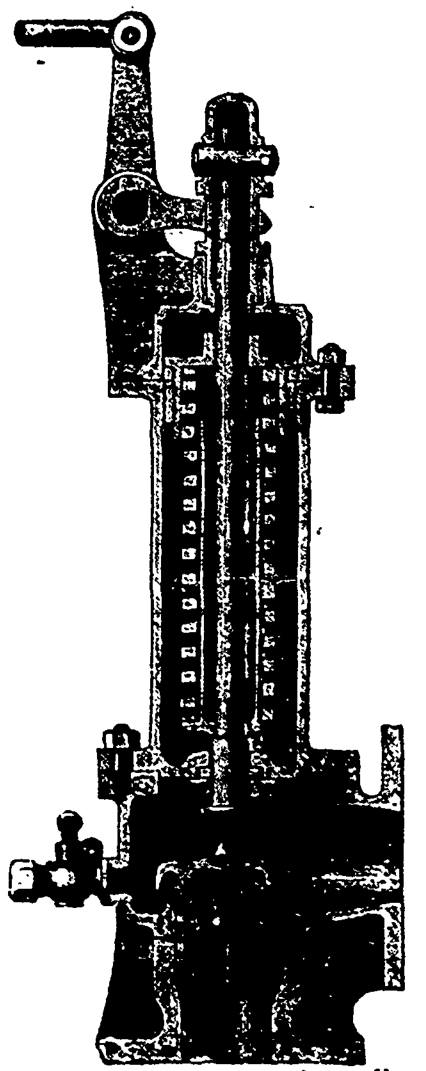


FIG. 20.—THE VENA CONTRACTA SAFETY VALVE.

pressure by this valve. Reduced boiler pressure; stopped blowing off at 60 pounds exactly."

One of the umpires remarked that he thought the Board of Trade were right enough in not adopting any of the spring safety valves yet put forward; but he could not agree in any condemnation of the spring principle, though he did not himself, as at present minded, like it as well as the dead weight; and he added, that if a more reasonable area of valve were asked than half an inch to the square foot, it would be hard (while lock-up valves are asked) to beat the old dead-weight system. The steam that is wasted in rolling, is, he said, nothing to that wasted in the continual leakage, rolling or quiet, from the huge valves which he appears to think are required by the Board of Trade.

It would appear, from the remarks of this umpire, that efficient, small, dead-weight safety valves are required, rather than ordinary valves spring-loaded.

The results of these trials seem to confirm the convictions of the arbitrators that a safety valve can hardly be too simple and direct in its action and arrangement.

During the year 1874, the Glasgow engineers appointed a committee to investigate the subject of safety valves. In January, 1875, they came to an agreement on certain recommendations. A difference of opinion on a certain "pop" valve had delayed an earlier acquiescence.

The editor of the *Nautical Magazine*, seeing that his efforts in 1872-74 were attended with very successful results in calling into existence and competition many useful safety valves, and seeing that by the exertions of the Board of Trade officers very much useful information and accurate knowledge has since been disseminated and fully confirmed by the experiments afterwards made by the Glasgow engineers, and elsewhere, it has occurred to the present editor that he may be successful in calling forth further latent talent, and stimulating invention, by offering a further prize.

Eight safety valves entered for the editor's prize of £100 ($500), and Fig. 20 shows the safety valve, Vena Contracta, for which the prize has been awarded. Owing to the sad death of the secretary of the Committee of Umpires, the details of the test cannot be given, but the following details concerning the performance of the successful valves are stated.

Conditions of the Test.

Diagram of valve in inches	3
Diagram of waste pipe in inches	3
Area of fire grate in square feet	14
Rate of combustion per square foot of grate per hour in pounds	20
Rate of evaporation per pound of coal	8.75
Temperature of feed water (constant) in degrees	100
Temperature of waste gases in smoke box	670
Steam pressure at which the valve was loaded, in pounds	4
Steam pressure in waste pipe 4 feet above the valve, in pounds	3
Duration of test, in hours	1

The whole of the steam generated had to pass through the valve, and the following is the result. One gauge, showing 60 pounds per square inch, the valve went off. The gauge instantly started to go gradually back to 59.4 pounds, when the valve closed tight, the time occupied being 13 seconds, and the mean difference between the greatest and least steam pressure being 0.6 of a pound (there being no accumulation whatever). The valve repeated this cycle of operation, during the hour's test, with unvarying regularity of pressure and time. The time was taken simultaneously by all the arbitrators from a 15-inch diameter dial clock, fixed on the wall, having a second hand moving around its periphery, and they were unanimous in awarding the prize to Vena Contracta, which has since been claimed as the valve of Thomas Adams, of Manchester.

A trial of safety valves was also made in 1874, before the chief surveyor of the Board of Trade and the chief of the Marine Department, of England, to test the proper area to relieve boiler pressure. The first trial was on a marine tubular boiler of the following dimensions: Diameter, 9 feet 9 inches; length, 19 feet 3 inches, with four furnaces 7 feet 3 inches long by 2 feet 10½ inches in diameter, with a total grate surface of 75 square feet, and 2,300 square feet of heating surface.

This boiler was fitted with two ordinary safety valves, 5 inches in diameter, having a total area of about 39 square inches, and loaded to 60 pounds per square inch pressure by direct weight—in the aggregate 2,340 pounds

An improved valve was placed on this boiler, having a diameter of 2¼ inches, with an area under four inches, and loaded by direct weight to 50 pounds per square inch. The total weight on this valve was under 200 pounds, and the valve relieved the boiler of all the steam that could be generated, as the following will show: At the commencement of the trial the height of the water was 5 inches in the gauge glass, the pressure of steam was 48 pounds, the fires very strong, and forced in a similar manner to steaming at full speed. When the steam had risen to 50 pounds, the valve began to rise and steam to escape, three minutes after the pressure was 51 pounds, and the valve was full open—namely 9-16 of an inch. After another period of two minutes, the height of the water in the glass was 3½ inches, and the pressure of steam 52½ pounds, after another period of five minutes, the height of the water was 2 inches in the glass, and the pressure of the steam 56 pounds per square inch; after another period of five minutes, the height of the water was one inch in the glass, and the pressure of steam still at 56 pounds, after another period of one minute, the engines having been moved, the pressure was reduced to 51 pounds, and the valve began to close, and as the ship was obliged to move, the steam was let into the engines, when at 49½ pounds the valve closed. The fires were forced during the whole period of the trial with the boiler feeds, and all connections shut off; the water was steady in the glass gauge, and no water escaping by the waste steam pipe.

The next experiment was on the same boilers with the ordinary valves, being two of five inches diameter each, equaling a total area of 39.26 square inches, loaded by dead weights of 2,355 pounds to a pressure of 60 pounds per square inch. The steam rose until these valves began to blow at 60 pounds; the fires were then forced, to get as much steam as possible, and at the end of 11 minutes (at which time the engines commenced to move again) the steam had risen to 68 pounds.

From the above two experiments, it would appear that a 2½-inch valve is hardly large enough to discharge all the steam that this large boiler was capable of generating, at a pressure of 50 pounds, but at 60 pounds it possibly would, for, during the last five minutes, the fires were, if anything, better than at first, and the steam remained at 50 pounds *for five minutes.* The small range of pressure between that at which the valve lifted *full open*, and that at which it closed altogether, is worthy of remark.

A further trial of the same 2¼-inch valve was made on another marine tubular boiler, 12 feet 6 inches in diameter, 10 feet 3 inches in length, with three furnaces 6½ feet long by 34 inches in diameter, having a total grate surface of 46¾ square feet. This boiler was fitted with two ordinary safety valves of 3⅞ inches in diameter each, having a total area of about 23½ square inches, and loaded to 70 pounds pressure by levers and weights.

The improved valve was loaded, by direct weights, to 60 pounds per square inch, and relieved the boiler, as the following table will show.

	P. M.	Pressure in pounds.
Trial commenced..................	2.35	
Valve began to lift..............	2.37	58½
	2 38	59
Valve blowing freely	2.40	60
Full open	2.45	61
	2 50	62
	2.55	62
	2.30	63

The fires were in proper order during the trial, clear steam and no water escaping from the waste steam pipe; but the height of the water was not taken on this trial, as it was not steady in the glass, doubtless caused by the boiler having been filled with dirty water from the dock. The lift of the valve during this trial was regulated to 7-16 of an inch, previously to the commencement of the trial. It will be observed that, on the previous trial, the lift was regulated to 9-16 of an inch.

A third trial, on the same boiler, at a reduced pressure of 50 pounds, was made to test its rising and falling properties, when it was found that the valve had risen to the regulated lift of 7-16, at a pressure of 52¼ pounds, and when the pressure was reduced to 47¾ pounds the valve had closed.

These trials were witnessed by Mr. Traill, chief surveyor to the Board of Trade, and Mr. Bisset, assistant principal surveyor for Liverpool.

The editor of the *Nautical Magazine* says that the trials of safety valves for the prize of $500, show conclusively that a long spring, which is nobody's patent, is the best sort of spring if a spring is to be used at all; and the trials of the improved safety valve, as before stated, go far towards proving that a single 2¼-inch safety valve is almost sufficient, when properly constructed, to relieve a hundred horse power boiler of four furnaces, with hard firing. The valve may be loaded with anybody's spring, or with dead weights, as the fancy of the ship-owner may elect. We cannot, of course, expect the Board of Trade to allow at once a solitary 2¼-inch valve to take the place of two 5-inch valves on a large marine boiler, as such a proceeding would be in direct violation of established engineering practice; but we venture to suggest to ship-owners that they might reasonably ask the Board to allow, by way of experiment, *two* 2¼-inch improved valves on boilers of 100 horse power and upwards, in order that the experiments we have been at the pains to witness and record may be repeated and verified.

From the examination of the improved valve (Samson and Parker's), and the results of the trials, it would appear that this valve has done its work sufficiently well to warrant us in expressing a belief that two valves would be ample to relieve a boiler of 100 horse power. We should remark, that this valve has no rubbing or bearing surfaces beyond what is necessary for a common valve, and appears to be as simple, and as easily kept in repair, as a valve of the common kind of the same diameter, and certainly much easier than the 6 or 8-inch common safety valves now in use on some high pressure boilers.

If this improved valve can—as we say it can—do the whole work with such a remarkably-diminished area, then it is doubtful whether dead weights will not be better than springs.

SAFETY-VALVE LIFTS.

The height of the lift of a safety-valve governs the diameter of the valve. To find the lift, we must know the weight of steam (water) in pounds which will escape through an orifice in the boiler having an area of one square inch. This in ordinary practice, is very nearly fifty times the pressure of the steam measured from the absolute zero pressure. The area of opening, therefore, for any boiler must be, in square inches, the weight of water evaporated per hour as a maximum, divided by fifty times the absolute pressure.

The absolute steam pressure above vacuum is the steam pressure as shown by a steam gauge, plus (+) the pressure of the atmosphere, which is on an average 15 pounds (14.7 pounds exact) per square inch. The formula will be as follows:

$$Æ = \frac{\text{lbs.}}{50(p+15)}$$

Where Æ = the effective area of outlet.

p = steam pressure as shown on steam gauge.

lbs. = pounds of water (maximum) evaporated per hour.

15 = pounds average atmospheric pressure.

Rule. 1st. To the steam gauge pressure add 15, multiply this sum by 50.

2d. Divide the number of pounds of water evaporated per hour by the product of the first, and the quotient will be the effective area (Æ) in square inches.

Example. – A boiler evaporating 600 pounds of water per hour, what area of opening should the safety valve have, so that the steam pressure shall not exceed 80 pounds per square inch on the steam gauge?

By formula $Æ = \frac{\text{lbs.}}{50(p+15)}$.

$$Æ = \frac{600}{50(80+15)} = 0.126 \text{ square inches.}$$

or, Pressure per steam gauge $80 + 15 \times 50 = 4{,}750$.

$$\frac{600}{4{,}750} = 0.126 \text{ square inches area.}$$

United States Rule.

Board of Supervising Inspectors of Steam Vessels.

$Æ = D + l \div 2 \times 3.1416 \times l - 0.29.$

l = lift of valve, in hundredths of an inch.

D = diameter of valve in inches.

Rule.—1st. To the diameter of the valve add one-half the lift.

2d. Multiply this number by 3.1416, and the last product by 0.71 of the lift, for the effective area.

The conditions incident to this rule are: Diameter and lift are given; angle of inclination of valve sit must be 45° to the centre line of its axis, valve must not rise out of its sit, or above a line perpendicular to its angle of inclination, and meeting the upper edge of the sit and the lower edge of the valve. When a valve rises above a line perpendicular to its angle of inclination, the amount of area so obtained is found by the following rule.

Rule 2.—Multiply the diameter of the valve by the additional lift, and by 3.1416. Add this last product to the first, for the whole effective area.

In case the sit of the valve is flat, at an angle of inclination of 90° to the center line of axis, the effective area is found by Rule 2, leaving out the word "*additional*" *and the last clause of the rule.*

Rule 1 based upon the formula applied to finding the surface of a frustrum of a cone, the upper base of which is equal to the diameter of the valve, the lower base equal to the diameter plus (+) the lift of the valve, and the slant height equal to 0.71 of the lift.

In the trials made at the Washington navy yard, September, 1875, it was found: That the diameter of a safety valve is not an infallible test of its efficiency; that the lift which can be obtained on a safety valve, other conditions being equal, is a test of its efficiency; that the lift of a safety valve depends upon the velocity and weight of the escaping steam; that two-tenths of one inch is the maximum lift to be obtained on a common lever safety valve.

In these trials, it was found that two-tenths of an inch was all that any of the valves could be forced from their seats without a considerable increase in the pressure, equaling, in the case of a valve with an area of 5 square inches, at 10 pounds pressure, 110 per cent. excess. To get any considerable increase in the lift, it is necessary to increase the pressure in a greater ratio than that of the lift. This ' but reasonable to suppose, when we consider that as soon as a valve begins to leave its sit new conditions are introduced. The high velocity with which the steam escapes reduces the pressure at and near the orifice of escape, and its dynamical effect upon the increased area of the valve is not that due the pressure when acting upon the valve at rest.

(To be Continued.)

ELECTRICAL DEFINITIONS.

In answer to a correspondent the New York *Electrical Review* gives the following definitions:

A kilowatt is 1,000 watts. A watt is the unit of electric work. A current having an electromotive force of one volt flowing through a resistance of one ohm, consumes one watt in one second; 746 watts represent an electric horse-power. A kilowatt is, therefore, about 1¼ horse-power.

A milliampere is $\frac{1}{1000}$ of an ampere, an ampere being the unit of current strength. When a current of one volt flows against a resistance of one ohm, the current will be one ampere in strength. In the formula $C = \frac{E}{R}$ (Ohm's law), C represents amperes, E represents volts and R represents ohms. The term milliampere is confined to delicate apparatus or measurements. A polarized telegraphic relay will operate with a current of from, say, three milliamperes.

A microhm is $\frac{1}{1000000}$ *of an ohm, an ohm being the unit of* electrical resistance. There have been several standards of measurement, but the legal ohm is the one endorsed by the International Electrical Congress of 1884. According to their standard it is the resistance of a column of mercury one square millimetre in cross-section and 106 centimetres in length at 32 degrees Fahrenheit.

A megohm = 100,000 ohms.

RUNNING AN ISOLATED LIGHTING PLANT.

By Fred H. Colvin.

It is just "starting up" time, and the engineer, at the signal, gets ready to set the plant running. He is not interested in the subject, and only does this and that because he was told, does not know why nor does he care to learn. Instead of a waterproof cover for the dynamo, as all good practice and the insurance companies direct, we see him unwrap the old piece of bagging and reveal a dynamo that would probably look fairly well if it was where we could see it, instead of being hid in this dark corner of the room.

He puts the belt on, and, as the lights begin to glow, we see that the driving pulley is directly over the dynamo ; so the belt runs in its worst possible position. The dynamo has a six inch pulley, and the driver is about thirty ; so we see that the arc of contact on the small pulley is sadly insufficient for the best performance of its work. It is a peculiar fact that many men who have a good general idea of mechanics on other subjects, seem to think that as soon as you begin to deal with electricity you can drop all other mechanical ideas and make belts or bearings, or, in fact anything, without regard to the mechanics of the question. In other words any thing will do, if it is for electricity. We see this idea at every step : this man would not think of running his lathes or other machinery under such unfavorable conditions ; yet it is all right as "it's only the dynamo."

There are many strange features in this installation ; there is not a switch in the whole building; there is not a rheostat or adjustable resistance, nor is the dynamo compounded for regulation. In fact, there is no means of regulation. The brushes have had little, if any, attention since they were new, and, of course, spark quite badly ; but that is considered part of the system, and everything goes here.

Instead of examining the brushes, commutator and binding posts every day before starting up for the night's run, the engineer considers this an unnecessary performance, or knows nothing of it ; not the best man to have charge of even a small plant, but a class we very often find in this position. Of course this plant does not run all night ; but the principal parts mentioned should have attention just the same, the brushes, especially, if they are to be subjected to the treatment of having the bagging hauled over them every day. The machine is rarely cleaned, and save for the cover we have seen removed, it has no protection from the sweepings of the room and the occasional bath from steam when the safety valves "pop."

A pair of bellows and a paint brush will free the commutator, armature, and fields from the particles of copper and other dust that are continually floating in the air ; and all shafting in the vicinity should be carefully guarded, lest it deposit oil from its bearings on the dynamo—especially upon the commutator, where it would be the cause of serious trouble. Some advise removing the brushes every day ; but where this is not done they should be carefully raised and wiped with a clean cloth, to remove all dust ; and the brush holder should receive attention also.

But we will leave the dynamo, and take a look over the lines, to see if we can find any poor connection or leaks, though they will be hard to find by sight, as they may be in the joints, which are, or should be, taped.

Here is something that demands attention, however. The lead wires are run up beside the wall, and there is a belt here that rubs the insulation whenever it becomes a little slack. If this was some mechanical connection of importance it would never be allowed, but it's only the electric wire, so it is all right, and it is never thought of as being of any importance. Should it make connection between the two some of these days, it may be of considerable consequence, however. We find cleats off, and the wires twisted together and hung as are easiest—by cords or wires, and now and then a nail driven into the wall to hang over. Hardly the best kind of wiring for the place, either for the safety of the building or the efficiency of the lighting plant, yet whenever a fire takes place, it is attributed to the wires, as a matter of course. This looks like a new fixture, and by a little investigation we find it is ; and we also find that the change was made by a man who knows nothing about the business ; so we are not surprised to learn that the joint was not soldered, but just twisted together and taped ; for tape, like charity, covers a multitude of sins.

We are told by some of the workmen that they sometimes see fire run along the wires ; and they also tell us that it is no unusual thing for a fuse to blow from poor contact, probably. This state of affairs is partly due to the agents of the different companies, who tell prospective purchasers that any one can run it—no experience required, etc. Under these circumstances it is little wonder that some installations are declared a nuisance, or even worse ; for in hands that are ignorant of its properties and the laws that govern its control, electricity can become a dangerous element. What mode of transmission can not ?

The financial feature of the question is also of importance ; the loss in the wires of a poorly constructed or poorly attended plant means money gone to waste, just as a leak in the steam pipe means wasted coal energy ; in one case you can see it, and in the other you don't, though it is sometimes felt quite forcibly.

It will not take long to test the lines in a small plant, and it will discover a leak and locate it, saving power as well as removing a source of danger from fire. Any man with average intelligence can learn to test for faults in a short time ; and the time spent in learning will more than repay him as well as his employer ; he can then test the lines—say once a week ; and can keep them in good order, to the advantage of all concerned.

We hear men say that the lamps do not give satisfaction, take more power than formerly, and much more than the agents claimed for them. And it is often the case—but as elsewhere there is a cause for all things, and the cause can often be found in the fact that the lines are not kept in good order.

A maker or dealer naturally gives the best figures he can for his wares, and sometimes I fear even goes beyond the actual figures in order to make a sale ; but he is not always to be blamed when the plants are not all that is represented after they have been installed for some time. Would anyone think of expecting the best results from an expensive machine, unless reasonable care was taken of it ? Yet this case is too often found, and will be until the mechanics generally know more about the laws and actions of the electric current. The time is coming when this will form part of the every-day knowledge of the progressive mechanic ; and when this comes, the isolated plants will give much better satisfaction to all concerned.

It may be extravagnat to suggest a volt-meter for a plant of fifty lamps ; but it would have been a profitable investment in at least one case in the writer's knowledge, where about fifty lamps were burned out in short order—due to running too high voltage. A volt-meter will act as a safety valve for the lamps, by showing the attendant when the voltage rises above the normal.

The fuses are not to protect the lamps—though this is the prevailing impression among the uninitiated—but to protect the wiring from heating to a dangerous extent when the current for any reason is abnormal.

Although safety plugs or fuses are marked in lamps, it simply expresses their capacity in 16 candle-power lamps, instead of amperes. They blow when the current becomes too great for the carrying capacity of the wires they protect. *Power.*

TRADE NOTES.

The Windsor and Sandwich Electric Railway, a description of which appeared in the Electrical News for December, use three friction grip pulleys manufactured by the Waterous Co., Brantford. One of these pulleys was examined with much interest at the recent meeting to form a Canadian Electrical Association. One of the delegates pointed out that this pulley differs from others in being capable of being adjusted without stopping the shaft or interfering with other pulleys, the grips being always motionless when out of clutch.

To the Toronto Construction and Electrical Supply Co., Toronto, belongs the credit of being the first wholesale electrical supply house in Canada to canvass the entire Dominion by means of capable travelling representatives who each carry with them several sample trunks filled with samples of the latest and best novelties for electrical uses. At the present time one representative is in British Columbia, another in Halifax, N. S., and four others at various points between the two first mentioned, which are nearly 4,000 miles apart, and as a result of such a progressive policy, the business of the company has increased with great rapidity. All purchases made by the Toronto company are for prompt cash, and consequently they buy to the best advantage.

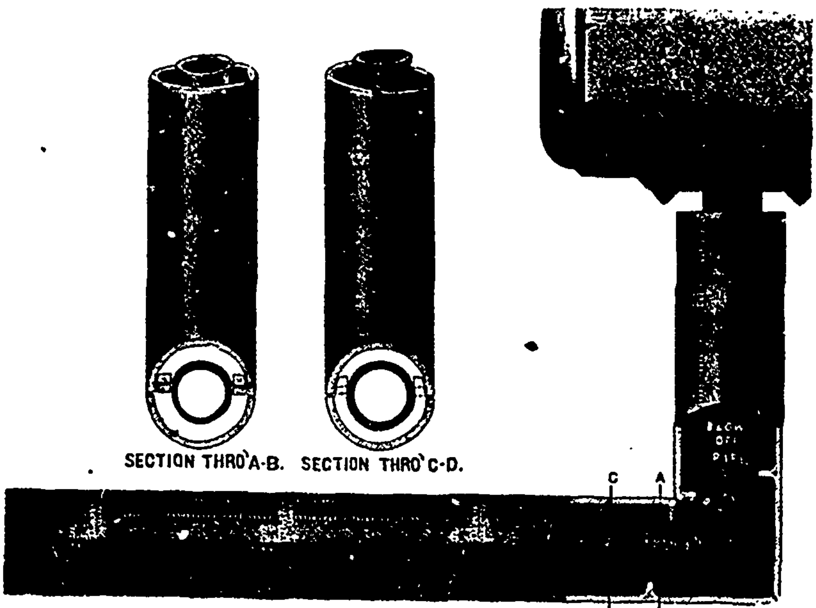
We note the issue of letters in New Brunswick incorporating the Kingsley Steam Boiler Company, limited, and the McNaughton Gold Company, limited.

BLOW-OFF PIPES.

Among the defects reported by our inspectors many defective blow-off pipes occur, and accidents often arise from this source. The defects are usually due to the burning of the pipes. When sediment is present in the feed water, the pipe becomes partially filled with it, and overheating is the result; and even when the water is pure, the high temperature to which the blow-off pipe is exposed seems to cause the water to attack the iron, and deterioration may be quite rapid.

Much of this trouble seems to be due to the flame striking directly against the pipe, and to overcome it, it is customary to slip a cast iron sleeve over the pipe to protect it. A piece of soil pipe is the usual thing for this purpose. This in turn becomes burned away, and to replace it, it is necessary to disconnect the blow-pipe and run it through the new sleeve. To avoid this trouble, half sleeves with lugs or flanges, fastened together with bolts, have been used, but these have not proved perfectly satisfactory, as the projecting lugs are apt to burn away after a little while.

Steam users have often asked our inspectors for something not expensive, which could be put on without disconnecting the blow-off pipe, and some years ago we made drawings for a sleeve having supporting rings with lugs so arranged that the two halves could be securely fastened together without bolts or nuts. The details of the sleeves will be seen from the cuts. Inside of the sleeve half rings are cast, the internal radius of which is slightly larger than the blow-off pipe. At the ends of these half rings hook-like lugs are cast, which serve to fasten the parts of the sleeve together. In putting this covering on, one-half of it is first laid against the pipe, and the other part is brought down upon it with one end hanging half or three-quarters of an inch over the end of the first half. The two are then slid together until the hooks or lugs inside lock together. The dimensions of the sleeve may be altered at will, but we have recommended the following for a two-inch blow-pipe: Diameter of cast iron sleeve internally, 3⅞ inches; thickness of casting, ⅜ inch; distance from one supporting ring to the next, 8 inches. The ends of the horizontal and vertical lengths are, of course, beveled so as to fit together, and care must be taken that the lugs or hooks that secure the parts together do not come within, say, an eighth of an inch of the blow-off pipe or the sleeve itself, as otherwise the parts will be likely to become iron-bound under the intense heat to which they are exposed. If the brick-work is so arranged that a small amount of air can enter the sleeve, a circulation can be maintained through it that will give further protection to both sleeve and blow-off. The rings in the sleeve will prevent the air from drawing freely through, but it will be found that enough will pass by them to be of benefit.



SIDE ELEVATION.

CAST-IRON COVERING FOR BLOW-OFF PIPES.

We believe this arrangement has proved satisfactory, and any one wishing to use it can make a pattern, one pattern being sufficient if it is made long enough, since shorter pieces may be cast by simply cutting off in the sand mould to the length desired.—*The Locomotive.*

Two additional Brill cars have been ordered for the Spring Ridge, Pandora Street and Beacon Hill Park extension of the Victoria, B. C., Tramway Company's line.

The Erie Glass Co. is being organized at Port Colborne, Ont., by Mr. James Lydiatt, of Toronto. The works, in which natural gas will be used as fuel, are intended to produce gas goods for electric lighting. It is said that the importations of flint glass goods into Canada last year amounted to half a million dollars.

A REALISM.

"At last we are alone!"

It was the man who spoke.

The woman trembled and lifted her eyes to his face.

They were beautiful eyes, but they were tremulous eyes—eyes which look out from a heart which is irresolute, fearful.

He stamped with his heavy foot upon the floor of the room.

The echoes brought back in their invisible arms the sound, and let it ripple out again until it struck the walls once more and fell into the vast void of silence.

A bat, disturbed by the unusual activity, darted from a corner and blindly dashed in eccentric convolutions about the dusty building.

Great ropes of cobwebs hung down from the ceiling, and across the corner of the room dead flies swung lightly in the hammocks the spiders had fastened there.

The dust rose in listless clouds from the shock of the heavy footfall, and sank again, overcome by its own inertia.

Even the air was resting.

The spirit of the desolation seemed to pervade the place.

The woman looked furtively around upon her dim surroundings and shivered.

The man laughed harshly.

"Alone, I said," he growled.

"Yes," she murmured.

A faint light struggled in through the great windows in front, thick with dust.

"Where are we?" she whispered and shivered as the bat dashed into her hair.

"Listen," he replied hoarsely, "we are in a store which does not advertise."—Detroit *Free Press.*

EXPERIMENTS UPON THE VELOCITY OF STEAM.*

A SERIES of observations upon the peculiar shapes assumed by a jet of steam upon issuing from orifices of different forms, led the writer to the supposition that a discharging nozzle could be so proportioned as to give the maximum efficiency of expansion under given conditions, and numerous experiments were therefore made to determine the internal pressure and velocity of the steam at different sections of tubes of various shape. The results obtained at 30, 60, 90, and 120 lbs. initial gauge pressure are shown by diagrams and tables accompanying the paper, and indicate very interesting results, while the characteristics of some of the tubes are quite marked. As might be expected, a cylindrical nozzle is shown to be the least efficient, and the terminal velocity of the steam in this tube is found to be the same as at the initial section of the tubes with divergent taper. In the latter style of tube, the steam has more opportunity for expansion, and the terminal velocity approaches more closely the theoretical value.

A peculiar circumstance is noted in the text and made very apparent by the diagrams, viz: that in a well proportioned nozzle or thin diaphragm, the actual velocity of discharge at the minimum section is very nearly constant for all the pressure of steam used in the tests, and for any other section of the tube, the same condition obtains as long as the expansion is continued. This qualification seems to be necessary, as several instances are given where the expansion within the nozzle falls far below the atmospheric pressure, and subsequent contraction causes a loss of velocity.

This fact of constant velocity of discharge under certain conditions is commented upon at some length and shown to give good grounds for the use of Napier's formula for discharge of weight of steam, with the suggestion that the use of the initial density of steam instead of the absolute pressure might give even more accurate results.

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* Abstract of a paper by Strickland L. Kneass, in *The Proceedings of the Engineers' Club of Philadelphia*, Vol. VIII, No. 7.

NOTES.

If you put green coal close to the furnace doors and then press it away as it cokes, you will burn out the gases and dispel a nuisance that shows itself in several forms.—*The Safety Valve.*

The mechanic who does not possess a rudimentary knowledge of electrical matters, writes James F. Hobart in the *Northwestern Mechanic*, is out of place and there is little demand for his services at the present time. As the uses of electricity increase, the engineer must add to his knowledge of matters electrical, and this can only be done by study and by practical experience among electrical machinery.

It seems only a question of time, and not a very long time either, when electricity will play a most important part in every-day work in mill and factory. It does not require any great stretching of one's imagination to see a mill operated by electricity, each machine with its own motor, stopped and started independently of any other machine, and giving trade papers little chance for long articles on the proper methods of erecting and caring for shafting, hangers, belting, etc. *Wood-Worker.*

An exchange informs us that the method of making an electrical connection to a governor of an engine in such a way that the engine could be instantaneously stopped on the pressure of a push button which was devised some time ago, has been found to work so well and to provide such a valuable addition to the provisions against accident, which are necessary where light bodies of machinery are constantly in motion, that in many factories these push buttons have been placed in convenient positions all over the floor in which machinery is working. In case of accident from any cause whatever, any person who happens to be nearest to one of the push buttons by pressing it can instantly bring the engine to a standstill. This device has already been the means of saving life where persons have become entangled in moving machinery.

SPARKS.

A new electric light company is projected at Moncton, N. B.

The Miramichi Telephone Company is being incorporated at Chatham, N. B.

An incandescent plant is being installed by the Galt, Ont., Electric Light Company.

The Chatham Electric Light Company, Chatham, N. B., is being incorporated with a capital stock of $20,000, for the purpose of establishing an electric light plant in that city.

Mr. Charles Myles, of Hamilton, who is endeavoring to form a company to build an electric railway from the eastern terminus of the Hamilton and Dundas Railway to Grimsby, touching at Bartonville, Stony Creek, and Winona, has secured subscriptions to the amount of $75,000. The city of Hamilton will be asked for a bonus of $25,000. The cost of the road will be $175,000. The trolley system will be used. The intention is to locate the generating plant on the Welland Canal. Considerable revenue is expected from the carriage of fruit for the Hamilton and Toronto markets.

NOTES.

Paint your boiler fronts white; black radiates more heat than any other color.

How much ash does your coal give? If you don't know this, you should lose no time in getting the information.

The power absorbed by the reciprocating parts of an engine during each stroke is equal to their weight lifted as many feet high as would be necessary in order to produce their velocity by falling. This can be calculated by the rules relating to the velocity of falling bodies.—*Stationary Engineer.*

Phonographs are to be used in Mexican post offices for the benefit of those who cannot read or write. The illiterate Mexican will go to the post office, talk his message into the receiver of the phonograph, and when the cylinder reaches its destination the persons addressed will be sent for and the message will be repeated to him from another machine.

Inexpensive but handsome incandescent lamps are now being made in various colors. The bulbs are made of white glass and then dipped in colored varnish, which is as durable as the lamp itself and is transparent. Sandblasting a lamp first and then dipping it in red vranish is said to produce a fine rose-colored effect, and even lettering on the bulb may be produced in this way.

The practice of expressing the economy of a steam engine in so many pounds of coal per horse power has been almost universal in the past, and though some few engine builders are using a different standard, the former may still be considered the prevailing method. Certainly nothing could be more fallacious than to speak of the consumption of fuel by the engine, which consumes steam only, or should if proper conditions exist. An improved automatic cut-off engine is sold under a guaranty of, say, three pounds of coal per horse power per hour. How does the maker arrive at this figure, not knowing the economy of the steam generator? With an average boiler performance, the quantity of steam supplied to the engine on the above rating will be that due to the evaporation of about seven pounds of water evaporated per pound, or 21 pounds of water per three pounds, from and at 212 degrees Fahr. Therefore the economy of the engine should be rated at 21 pounds of water per horse power per hour, instead of three pounds of coal.—*Iron Age.*

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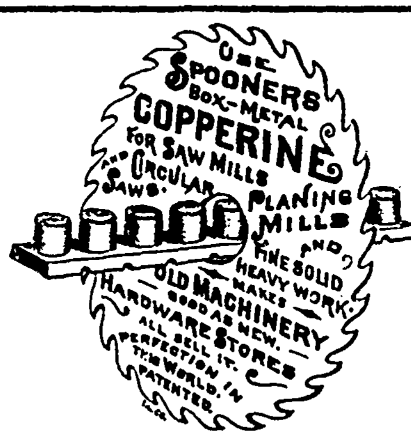

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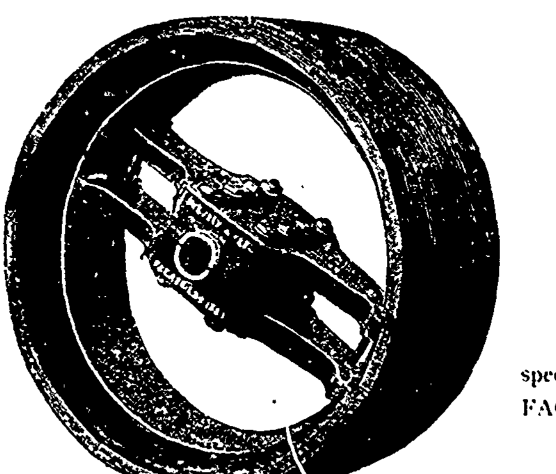

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