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EXECUTIVE OFFICERS OF THE CANADIAN ELECTRICAL ASSOCIATION.

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FROM THE FAR WEST.

KAMLOOPS, January 8th, 1892.

Editor ELECTRICAL NEWS.

DEAR SIR,—I will send you the fee required to become a member of the Canadian Electrical Association in a couple of days. I send you by this mail one of my calendars, which please accept with my best wishes for your enterprise. I sold my electric light plant here to a company for $9,300, retaining $4,500 worth of shares. The institution is doing well, and expect to add a 500 light dynamo (1000 volt machine) very shortly.

Again wishing you success, I remain,

Yours truly,

J. E. SAUCIER.

"CANADA FOR THE CANADIANS."

Editor CANADIAN ELECTRICAL NEWS.

SIR,—The head line to this article should be the watch word for all persons engaged in any electrical industry in Canada, when any thought or consideration is given to joining an electrical association. It is hard to conceive how a person engaged electrically in Canada can become a member of a National Association—national in the United States only—in fact, that Association is a traitor to its very name in accepting members who are not "National" in their character, according to their standard, which we take it means "national" in the United States only -consequently there should be no hesitation as to which association Canadians should become members of: and there should be no holding back by any one interested in joining hands to make the Canadian Association shine just as brightly, and do just as much good in its way, as the National Association does on the other side of the line.

There seems to be an effort in some directions to discourage any one who contemplates becoming a member of the Association in Canada, and to favor their joining the U. S. Association. Surely no one who has Canadian interests at heart, nor any one who is operating an electric plant of any kind in Canada, can doubt but that it is his bounden duty to uphold the Canadian Association first, last, and all the time. There are, we know, quite a number of the knights of the screaming eagle among us who are doing good work in operating or managing electric companies in Canada; even they must see that the only proper path for them to tread is to become active members of the Canadian Association, for is not their entire interest centered in trying to make a Canadian company pay a dividend to its shareholders and thereby have their own conditions bettered? and is not their very living expenses paid by Canadian dollars? It therefore becomes to them purely a Canadian industry, and they become Canadians as it were in consequence, under which conditions one would have to stretch his imagination to a large degree to give even a thought to going into a national U. S. Association.

It is difficult to understand by what means the U.S. National Electric Light Association so far stretched their nationalism—if we may be allowed the expression—as to hold a convention outside of the nation, as they did their last one, simply because one of their "*Canadian-national*" members suggested it. No doubt they enjoyed themselves and had a good time generally, but they evidently must have been so much elated over the proposition as to be entirely blind to the fact that their convention could not be a national one in Montreal, under the Queen's flag, any more than if it had been convened in Asia or China. Now that they have so far digressed from their nationalism, would it not be a good scheme for them to hold their next convention, after the Buffalo one, say in London, Eng., or one of the large continental cities? What a glorious opportunity to take in some of the large electric plants in operation on the other side of the pond!

In conclusion, if any of your readers are thinking of becoming members of an electrical association, and are fitted therefor by connection with electrical industries in Canada in any shape or form, their interests must centre in the Canadian Association. It will welcome them and they are bound to profit by their connection with it. I feel sure that if they look before they leap, their leap will be into the new and well organized Canadian Electrical Association, the first yearly convention of which will be held on the second Tuesday in June of the present year, in the city of Hamilton, and which bids fair to be of two or three days duration with a running exhibition of electric apparatus of all kinds and a general display of electrical appliances.

Yours truly,

"CANADA."

A MODEL CENTRAL STATION AT NIAGARA FALLS.

NIAGARA FALLS, ONT., Jan. 14, 1891

Editor CANADIAN ELECTRICAL NEWS.

DEAR SIR,—As my business necessitates my travelling around the country a good deal, and having for several years been engaged in the electric light business, I concluded that the readers of your valuable journal might be interested in reading descriptions of some of the different installations of lighting plants throughout the province.

Last night I was looking through the central station of the Niagara Falls Electric Light Company. It is a limited stock company composed of citizens of the town. The officers are: Mr. J. Bampfield, President; Mr. J. Quillman, Secretary; Mr. Wm. Doran, Treasurer; Capt. Carter, Superintendent.

The station is a neat little building near the Clifton depot of the M. C. Railway. The streets of the town are lighted by 60 2,000 c. p. arc lamps, which are supplied by a 65 light 9·6 amp. Wood arc light dynamo, and I must say that the satisfaction expressed (by many prominent people of the town) with the street lighting must be pleasing to the Electric Light Company, and certainly is very creditable to the Edison General Electric Co., who supplied and installed the plant.

Mr. J. Foster, who has charge of the electrical department, and through whose kindness and courtesy the writer was allowed the privilege of going over the station, speaks very highly of the Wood arc dynamo. There are also two Edison incandescent dynamos, each having a capacity of 360 16 c. p. 110 volt incandescent lamps, run on the three wire system.

There is a fine switch board connected up on bus bars, with all the necessary ammeters, voltmeters, and ground testing instruments necessary to all first-class plants.

The power is transmitted from the engine to a counter shaft, from which the two incandescent machines are driven direct. The Wood arc machine is driven from countershaft by a Goldie & McCulloch friction grip pulley. This arrangement allows the arc machine to be started up or shut down at any time without interfering with the rest of the plant, and is very handy, as the incandescent machines have to be started up much earlier than the arc, and are also run until a later hour in the morning.

The power is furnished by an eighty-five h. p. Wheelock engine, running 96 revolutions per minute, supplied with steam by a 60" x 14', 98 3" tubes, steel Goldie & McCulloch boiler, which is fed by a Northey pump and Plunger pump, the latter being driven by belt from crank shaft of engine.

The position of engineer is filled by Mr. George Perrie, and they do not yet know what a "shut down" is.

This station (for a central), to use a vulgar phrase, "takes the cake" for cleanliness and good order in each department, and is a credit to the men in charge. In conclusion, I will say that there are many stations in the country that might, with profit to themselves and better satisfaction to their customers, take pattern from the central station of the Niagara Falls Electric Light Company.

Yours truly,

"TRAMP."

ELECTRIC MOTORS.

Motors may be classified as:—

1. Series motors, in which the field coils are connected in series with the armature.

2. Shunt motors, in which the field coils are connected in shunt or parallel with the armature.

3. Compound-wound motors, which have both the shunt and the series winding.

This latter class may again be subdivided into:

A. Differential motors, in which the series coil magnetizes the field magnets in opposite polarity to the shunt coil.

B. Cumulative motors, in which the series coil magnetizes the field magnets in the same polarity as the shunt coil.—*Electrical Age.*

There has recently been discovered near Kamloops, B. C., a deposit of mica of excellent quality.

LOSSES IN AUTOMATIC STEAM ENGINES—AND THEIR REMEDIES.*

ONE of the first conditions necessary to economy may be said to be high initial pressure in the cylinders. The higher the initial, the greater the economy that can be obtained in its use. Another condition is, that steam be cut off at such a point in the stroke that the expansion curve will, at the termination of the stroke, reach nearly to the back pressure line without touching it. Theoretically the higher the initial and the lower the terminal, the greater the economy (always provided that the terminal does not go below the back pressure line); but in ordinary practice this does not hold good owing to two very serious losses that occur in single unjacketed cylinders, viz., condensation and clearance. The first of these, viz., condensation, is due to the variation in the temperature of steam during expansion. For example, if steam at 80 lbs. gauge pressure or 95 lbs. absolute, be expanded to 20 volumes in a condensing engine, the initial temperature would be 324° Fah. and the terminal about 160° a change of 164° in temperature during each stroke.

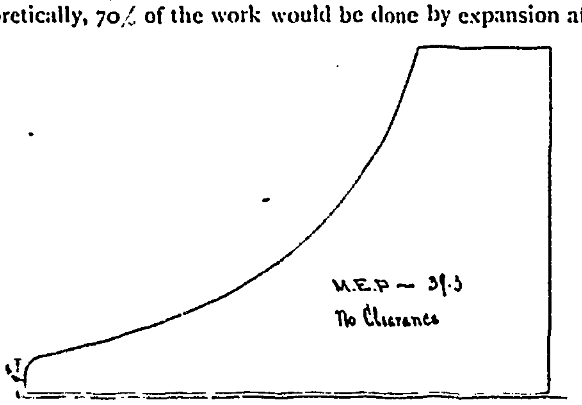
As the temperature of the steam falls during expansion, the temperature of the walls of the cylinder fall in like proportion, so that when the boiler pressure is again admitted to the cylinder, it takes a certain proportion of the steam admitted to raise the temperature of the surrounding metal to the initial steam temperature. The greater the ratio of expansion, the greater the variation in temperature between the initial and terminal, and also in the metal of the cylinder, and the greater the proportion of steam required to raise that temperature each stroke. The laws that govern the losses by condensation are, therefore, in direct opposition to those governing the theoretic gain by expansion. On the one hand the greater the ratio of expansion the greater the gain; and on the other hand, the greater the ratio of expansion, the greater the loss (by condensation). From experiments carried out, the losses "for unjacketed non condensing cylinders have been computed approximately as follows, with steam pressure at 80 lbs. expanded to:

VOLS.	POWER.	LOSS.
20	55	45
10	65	35
5	75	25
3	80	20
2	85	15

With 5% added for condensing engines. And the theoretic gain in condensing engines by expansion, "taking 80 lbs. gauge pressure without expansion as a basis," is as follows:

VOLS.	GAIN.
20	70%
10	65
5	60
3	50
2	40
1½	20

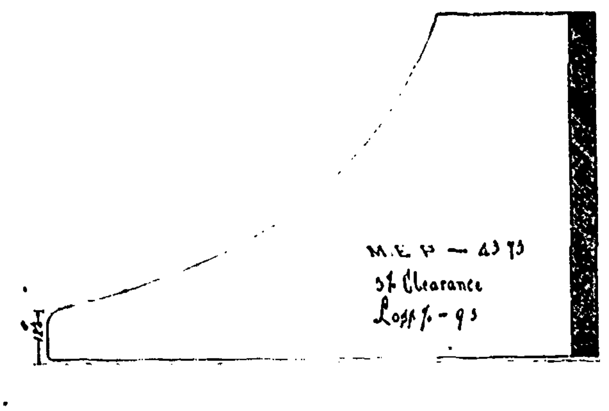
That is to say, in an engine expanding steam 20 volumes theoretically, 70% of the work would be done by expansion after



CARD NO. 1.

the admission valve is closed, and with 10 expansions 65% of the work is done by expansion after the admission valve is closed, and so on. Now as to the second loss, viz., "clearance loss." Clearance is the volume of space between the piston head and valve face "when an engine is on its centre, including ports, passages, etc., which have to be filled with steam each stroke before the piston moves forward on its stroke, and is computed by the percentage its volume bears to the piston displacement i. e., the area of the piston multiplied by the length of the stroke. This percentage varies from 3 to 5 in long stroke engines, and 15, and even 20, in short stroke, or high speed engines. The loss by clearance is quite a serious one when steam is used expansively, and also in short stroke engines when the clearance forms a large percentage of the volume of the cylinder.

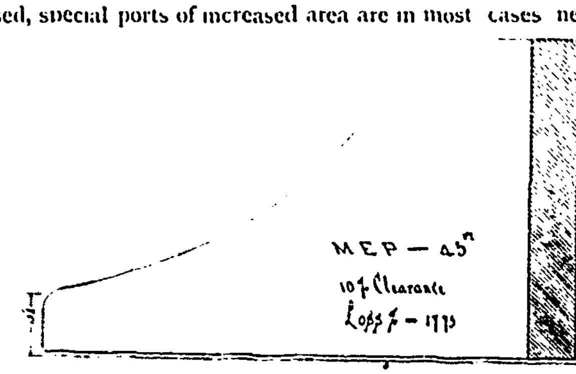
A certain amount of clearance is an absolute necessity in all engines, and cannot be reduced beyond a given point, for if the



CARD NO. 2.

port area be reduced another serious loss is incurred, viz., wire drawing or throttling. A certain amount of clearance is required also at each end of the cylinder to allow for wear of rods, adjustment, etc.

We will take a few examples to form an idea of its volume and effect in different classes of engines. For the first, viz., its volume, we will assume a cylinder of 12" in diam., 36" stroke, which is about the ordinary proportion for a long stroke engine. With well proportioned steam ports, passages and clearance we will find that the clearance area will be something between 3 and 5%, say 5%. Now if we reduce the stroke of this engine to 24" *instead of 36", but retain the same port area, etc., which cannot* be reduced no matter what the stroke may be, then the clearance volume will be increased from 5 to 7½%, and if the stroke is still further reduced to, say 12", which is not unusual in short stroke or high speed engines, the clearance volume is again increased to 15%, and this in most cases is still further increased owing to construction. A single valve only being used, special ports of increased area are in most cases necessi-



CARD NO. 3.

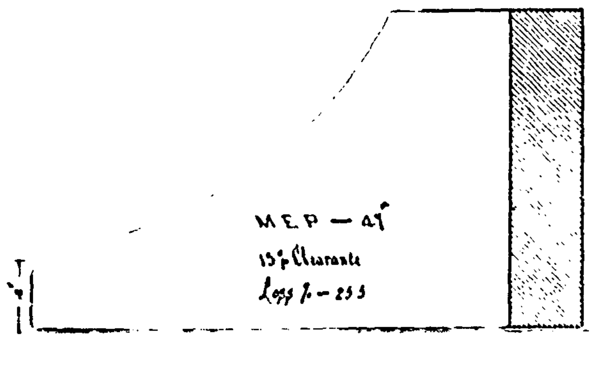
tated, so that we may safely assume 15% clearance as a fair *average* for short stroke engines, and 5% for long stroke engines.

It is owing to this high percentage of clearance that the short stroke or high speed engine has never, and never can, give as good results as the long stroke engine, from an economical standpoint. To form an idea of the effect of clearance under different circumstances, we will examine a few theoretical cards, and by computing the power, or M.E.P., draw our comparisons, and for that purpose we will just take up a few high pressure or non-condensing cards. For a standard, we will assume card No. 1 which is laid out without clearance. Cut off at ¼ stroke, with initial pressure of 80 lbs. In this case we obtain an E.M.P. of 29.5 lbs. with a steam consumption of 18.9 lbs. For card No. 2 we will assume same gauge pressure and same point of cut off, but with 5% clearance. In this case the volume of clearance is equal to a M.E.P. of 4 lbs., and the card gives 43.75 lbs. with steam consumption of 20.5 lbs.; thus the loss caused by clearance is equal to 9½%. For card No. 3 we will assume 10%

* Paper read by Mr. W. H. Laurie before the members of the Montreal Branch Canadian Association Stationary Engineers.

clearance, with all other conditions the same as before. In this case we have a M E P of 45 lbs with a steam consumption per H.P of 23.2 lbs, and a clearance M E P of 8 lbs., showing a loss in the card of 17.75 caused by clearance For card No. 4 we will assume 15 , with all the conditions as before In this card we get a M E.P of 47 lbs., a steam consumption of 25.40 lbs. per hour per H.P., and a clearance M.E.P. of 12 lbs., representing a clearance loss of 25.5 %.

Now if we apply the law governing the theoretic use of steam to these cards, *i.e.*, the greater the ratio of expansion the greater

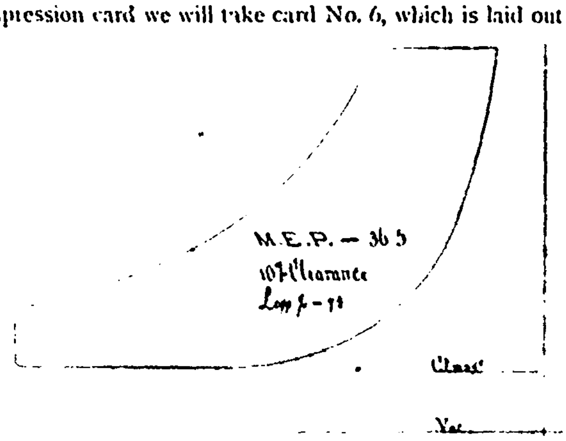


CARD No. 4.

the economy we will find that the increased loss by clearance will more than equal the theoretic gain by expansion in some cases. We will assume that each of the three cards are reduced in power by 50 . Then we have for card No. 2 a M.E.P. of 19.75 instead of 39.5, with a clearance loss increased from 9½ to 19 %. No. 3 card, trialed in the same way, will show a clearance loss of 35.5 instead of 17.75 ; and card No. 4 would show a loss of 51. instead of 25.5. Then on the other hand if we increase the M.E.P. or power developed, we reduce the clearance effect in exactly the same proportion.

While we are investigating the high pressure cards we will take a few examples to show the effect of compression in its relation to clearance. In single valve automatic engines compression cannot be obviated if it were so desired. There is quite a diversity of opinion among engineers as to the advantages of compression, some claiming that clearance loss may be entirely obviated by judicious compression ; others that compression is only a necessary evil.

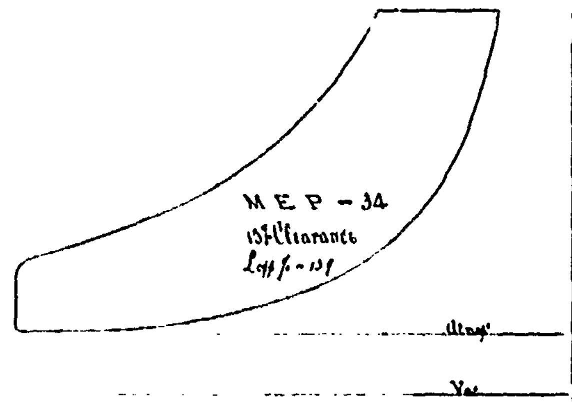
For our first example in compression we will take card No. 5 with 10 % clearance All conditions are identical with card No. 1, viz., steam pressure 80 lbs., cut-off at ¼ stroke, except that the exhaust has been closed at such a point in the stroke that the theoretic compression curve reaches to the initial pressure. The same quantity of steam has been admitted to the cylinder as in card No. 1, but the M.E.P. obtained is only 36.5 instead of 39.5 ; this is equal to a clearance loss of 7½ %. For our second compression card we will take card No. 6, which is laid out with



CARD No. 5.

15 clearance, and compression to initial pressure—all other conditions as before. In this case, although the same quantity of steam was admitted to the cylinder as in card No 1, the M E.P. has dropped from 39.5 to 34 lbs., or a loss of nearly 14 %, due to clearance.

For our third compression example we will assume a card with 20 %, clearance, and compression up to the initial pressure. In this case with same quantity of steam admitted to the cylinder, as in No. 1, the M.E.P. is reduced from 39.5 to 31 lbs., or a clearance loss of 21.5 . The loss through clearance in theoretic compression cards is caused by the large area that is deducted from the card by compression, necessitating the steam being cut off at a later point in the stroke than it would otherwise occur to

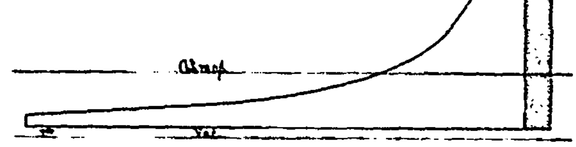


CARD No. 6.

develop the same power, and thus reducing the ratio of expansion and consequent economy to the percentage mentioned in cards 5 and 6.

In comparing cards with compression and those without compression, although the compression cards show much less loss in theory, in practice the difference is not so great owing to loss in the compression line and re-evaporation. If we examine condensing engine cards, we find the clearance loss still greater, owing to the effective pressure being so much higher. Taking card No. 8, first considered without clearance, with steam 80 lbs. gauge pressure, expanded 20 volumes, we obtain a M.E.P. of 15 lbs. Now if we expand the same volume of steam in a cylinder of the same area, but with 5 % clearance, we find that the card shows the steam to have been cut off when the engine was on the centre. We get the same terminal and the same expansion line as in the first case, but the effective area is minus the initial pressure, giving only a M E.P. of 10.5 lbs. instead of 15 lbs. as in the first case, showing a loss in power of 30 % caused by 5 clearance. If we expand the same pressure to 10 volumes instead of 20, then the clearance loss is reduced to 16.66 % ; if expanded 5 volumes, the loss is reduced to 9.55 % ; and if only expanded to 3 volumes the loss is 7 %. The foregoing gives a general idea of the losses incurred by condensation and clearance, and their causes.

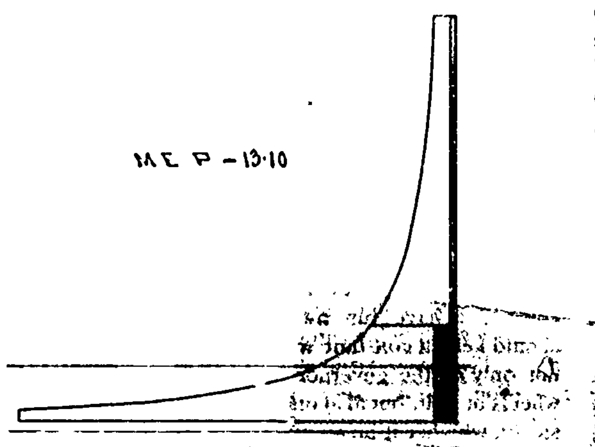
We will now devote a short time to the consideration of their remedies, commencing with condensation. This loss, as before stated, is caused by the fall in temperature of the metal of the



CARD No. 8.

cylinder, consequent upon the fall in temperature of the steam during expansion (each stroke). If this fall in the temperature of the metal can be obviated, then the loss is overcome. To attain this end, steam jacketing has been resorted to—usually done by fitting a bush in the cylinder, a forced fit at each end—and arranged with a space between the bush and cylinder, the whole length of cylinder, and spaces cored in both covers ; these spaces are usually filled with steam at initial pressure, thus retaining the walls of the cylinder at nearly that temperature, and reducing condensation to a very great extent. But to attain the very best results where high ratios of expansion obtain, the jackets should be supplied with super-heated steam, at a higher temperature than that of the initial pressure. Another fact that has been already mentioned in reference to loss by condensation is that the less the variation of temperature in a cylinder, or, in other words, the less the ratio of expansion, the less the loss. To this fact is very largely due the superiority of the compound or multiple cylinder engine over the single cylinder engine. For example, if we assume a case in which the low pressure is four times the area of the high pressure, we may obtain 16 expansions with only four expansions in each cylinder. In this way the high pressure cylinder works between limits of temperature, such as occasion comparatively small losses by condensation, and the low pressure cylinder works between the temperature of the exhaust from the high pressure cylinder and that of the condenser, these temperatures not varying very widely, the loss by condensation is correspondingly small. If the number of cylinders be increased, and the ratio of expansion in each reduced, then the condensation loss is still further reduced. Therefore, the loss by condensation may be almost entirely obviated by either steam jacketing or compounding, or both; and, at the same time, the economical advantages of high ratios of expansions obtained.

Referring to the second loss, viz., clearance, by analyzing its volume and effect we found, first, that the longer the stroke of the engine the lower the percentage of clearance volume for that



CARD NO. 9.

engine, and secondly, that the higher the M. E. P. developed in a given card the lower the percentage of loss by clearance in that card. It is an established fact that clearance is a source of loss; and also that the greater the percentage of clearance, the greater the loss, and, of course, the less the percentage of clearance, the less the percentage of loss; therefore the first point to be attained is to reduce the clearance volume to the lowest possible percentage; and the most successful way to do this is by adopting the long stroke engine.

To meet the second point, that is, to reduce the loss by clearance, we have found that the greater the M.E.P. of a given card, or the less the ratio of expansion, the less will be the percentage of clearance loss. If we attempt to reduce clearance loss in this way in a single cylinder, we are reducing one loss by reducing another gain, or trying to save steam by increasing the consumption of steam. But if we apply the same remedy that we have already applied to condensation, viz., compounding, we will find that it will have the desired effect. Although it may appear paradoxical to assert that by the employment of two or more cylinders (each having the average amount of clearance volume) to expand a given pressure, that the loss by clearance will be less than if the same ratio of expansion were carried out in a single cylinder, yet this is the fact, as I will endeavor to illustrate. For that purpose we will again refer to card No. 3, which represents steam at 80 lbs. gauge pressure, expanded to 20 volumes in a condensing engine, with 5% clearance. In this instance, the actual loss in power owing to clearance is 30% as compared to a theoretical card without clearance.

For purposes of comparison, we will assume card No. 9, in which the same volume of steam is expanded in a compound (or two cylinder engine), the low pressure cylinder of which is four times the area of the high pressure, and equal in area to the single cylinder referred to in card No. 8, each cylinder having 5 , clearance. In this case the steam is cut off at 1-5 of the stroke in the high pressure, instead of 1 20 as in the single cylinder. ¾ of the initial pressure is used up to the point of cut off, is utilized as effective pressure in the H.P. of cards, whereas in card No. 8 the expansion only of the clearance volume is obtained as effective pressure. In the compound the low pressure card shows the full percentage of clearance, viz., 5%, but the low pressure cylinder deals with such a short range of pressure that when it is averaged up with the total range it reduces the mean percentage very considerably. The high pressure cylinder being ¼ of the area of the low pressure, its clearance when referred to the low, becomes 1.25% instead of 5%, the total effective height of the card, *i.e.*, from initial pressure to the back pressure line is 92 lbs. and the high pressure by card in expanding the initial pressure 5 volumes, deals with a range of 71 lbs. out of the 92. Now we can find the proportion the high pressure clearance bears to the combined card by multiplying 1.25% by 71, and dividing by 92; this gives .95, or 5-100 less than 1 . To this we must now add the mean average clearance of the low pressure, which we find by the same rule, viz., 5 by 22, which is 4×92, which gives 1.14 as the average clearance. This, added to the high pressure, give us 2.09 as the percentage of clearance volume in the compound engine, as against 5 , in the single engine of the same area as the low pressure of the compound with same number of expansions in both cases, a reduction in clearance volume of 58%, in favor of the compound engine, or in the case under consideration, an increase in power of 24%. 5% clearance is high for a long stroke engine of large size. If we assume the clearance to be 2.5, which is quite possible, then the compound engine would reduce that to very little over 1%. When we give due weight to these several economical advantages of the compound engine, we are in a better position to arrive at a just appreciation of its superiority over any class of single cylinder engines, and to account for the increased economy that results from its introduction, when properly designed and proportioned to its work. Apart from its economical advantages, it has another great advantage over the single cylinder engine where economy is attempted with high ratios of expansion, in that the power is much more evenly distributed throughout the stroke. If, for example, we refer to card No. 8, we find that at the beginning of the stroke the piston was subjected to a pressure of 92 lbs. per sq. inch, and at the end of stroke 1¾ lbs. only, with a M.E.P. of 10½ lbs., and as the strength of an engine in all its working [illegible] tion to the greatest pressure to which [illegible] weight of the working parts must be en[illegible] the power actually developed, whereas in a [illegible] taking card No. 9 as referred to, the low pressure; on one end the initial pressure would be 21 lbs. and on the other end 18 lbs., reducing the initial thrust by about 78%, *or if considered as a* tandem compound, the initial thrust would be only 39 lbs. as against 92 lbs. in the single cylinder, a reduction of 58% in the initial thrust to develop 24% more power.

THEORETIC CONSUMPTION OF STEAM.

Pressure.	Volumes.	Consumption.
150	20	10
200	30	9.5
400	40	8
800	40	7.5

Increased cost in fuel and condensation due to the high temperature.

QUESTIONS AND ANSWERS.

"A. T." asks: What horse power may be obtained from an engine with a cylinder 10 inches diameter, 12 inches stroke, and making 250 revolutions per minute, steam supplied at 60 lbs. pressure, or at 90 lbs. pressure? The point of cut-off is not given. This cylinder is 78.54 inches in area, the piston speed is 500 per minute. Assuming that the cut off is at one-third of the stroke, with 60 lbs. pressure on the piston at the beginning of the stroke the mean pressure will probably be 37 lbs. per sq. inch. Then

$$\frac{78.54 \times 500 \times 37}{33000} = 44 \text{ horse power.}$$

With 90 lbs. on the piston at the beginning of the stroke and the same cut off, the mean pressure would be about 55 lbs. Then

$$\frac{78.54 \times 500 \times 55}{33000} = 65 \text{ horse power.}$$

If the cut off is earlier or if the back pressure be unusually high, the horse power w[illegible]ures show.

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

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EDITOR'S ANNOUNCEMENTS.

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

SEAMLESS steel boats are now being made in Wakefield, England. They are made from a single steel plate about one quarter inch thick, and are no heavier than a wooden boat.

THE fifteenth convention of the National Electric Light Association of the United States will convene at the Iroquois Hotel in the city of Buffalo, on the 23rd, 24th and 25th inst.

[illegible]r is well calculated to put the electrical [illegible]country to a thorough test. From Ottawa [illegible] the electric road in that city has demon[illegible] ability to run against the elements. The cars are said to have run as regularly and perfectly with the thermometer at zero, as they did during the months of summer. The electric road has come to stay.

FLY wheels are usually made of cast iron, and may be subject to very severe strains caused by the contraction of the metal while cooling. Allowing a factor of safety of 10, it is calculated that the highest safe speed for the rim of a fly wheel is about 130 feet per second. An engine making 240 revolutions per minute should have a wheel not more than eleven feet in diameter in order to be safe. The rim of such a wheel would travel about a mile and a half per minute.

AN excellent paper on "Losses in Automatic Steam Engines and Their Remedies," read by the author, Mr. Laurie, before the members of the Montreal branch of the Canadian Association of Stationary Engineers, is printed in full in this paper. It is understood that the Montreal Society have made arrangements for a series of papers on engineering subjects to be read at their meetings during the present winter. The readers of the ELECTRICAL NEWS will no doubt have the privilege of reading them. The enterprise of the Montreal society in this particular is deserving of emulation by branches of the Association in in other cities.

HERE and there will be found an engineer who gives as a reason for not becoming a subscriber of this journal, that considerable space is devoted to electricity and he is not interested in electricity. It may not be possible to convince these persons that they are mistaken in their views, but such is nevertheless the fact. We unhesitatingly make the statement that every engineer in Canada requires an acquaintance with the principles of electricity and the methods of its application. Not to recognize this fact means that some day positions to which he might have secured promotion, will be closed against him because of his lack of knowledge of electric appliances. The engineer who neglects now to fit himself for the changed conditions which electricity is bringing about in the manufacturing world, must expect to find himself relegated by and by to second and third rate positions with corresponding salaries.

A NEW invention in screw propellers for vessels is being experimented with at present in England. The object aimed at by the inventor is to produce a propeller which will always revolve in the one direction, and by means of which the motion of the vessel may be either forwards or backwards. With such a propeller the engine is much simplified, as it is unnecessary to have any reversing gear. The propeller is made with a centre hub, to which the projecting blades are so attached that they may be turned to form either a right hand screw or a left hand screw. The pitch of the screw may also be varied. Should this invention prove a success, it will make quite a change in the construction of marine engines, and will give the officer in charge of the ship as great control over the propeller as he now has over the helm. The engineer will only require to keep the engines going steadily, and by controlling apparatus, worked as the rudder now is, the propeller may be altered to change the speed or reverse the motion of the vessel.

ON January 7th, a little after 6 o'clock in the evening, a large new engine in a factory in Cincinnati became unmanageable and ran at such high speed that the fly wheel burst. The wheel is said to have been about thirteen tons weight, and one piece, about a ton weight, went up and came down again through the roof and three floors of the factory. Considerable damage was done, but fortunately no lives were lost. Something must have gone wrong with the governing apparatus, else the engine could not have run away beyond control. Every engineer should keep a constant watch on all the governing apparatus not only on the governor itself and the driving gear, whether wheels or belt, but also on the valve which has to throttle off the steam, whether it be an automatic cut-off or not. Sometimes a separate valve is used to throttle the steam, and cases have occurred where this valve became loose on its spindle and was forced wide open by the steam, and of course in such a case the most perfect governor could do nothing. Such throttle valves should be made so that the pressure of steam will tend to shut them, and then if the governor fails to hold the valve open, the engine is stopped.

A DECISION of great importance to telegraph companies and operators and of much interest to the public, was pronounced a few days ago by the Court of Appeal in Montreal. The case was that of Laurance v. the Great Northwestern Telegraph Co. While Mr. Lionel Laurance was in New York, one of his employees sent him a despatch saying, "Writing you to-night." The sentence was made to read, "Waiting you to-night." Consequently Mr. Laurance made an unnecessary trip from New York to Montreal and he sued the telegraph company for $200 damages. The court in the first instance awarded $30, the actual cost of the trip from New York. The company appealed from this decision. The fact was established that the error was due to the negligence of the employees of the company, but the appellant set up the plea that despatches were sent under a contract which declared that it would not be liable for damages resulting from errors unless the despatch was repeated, and then only to the amount of fifty times the amount paid for the message. Such a contract the court declared to be contrary to public policy, and any contract by which a party sought to fix the punishment for his faults was illegal. The judgment was confirmed.

AN amusing, and at the same time instructive incident, occurred quite recently in one of our neighboring cities, the like of which, it seems, may often be the cause of trouble, yet one would scarcely look for it in that direction. The meter inspector of the electric light company in making his usual rounds to take the readings for the monthly accounts, reported one of the meters (Shellenberger) as not having registered, although previous months had always shown up in good shape (for the company. A repairer being sent to break the seal and remove the cover, found woven round the thin aluminium blades of the retarding mechanism, spider webs in all directions, but apparently not satisfied with spinning them from blade to blade, the spider had cast several hawsers from the blade to the back of the meter, thereby preventing it from being set in motion when the current was turned on. When they were removed, the meter started off in good shape again with but one lamp burning. The natural conclusion in such a case is that the spider had crawled into the meter when very small, and had made it his permanent abode until too large to crawl out again, but the problem is, what did he feed on? surely not some of the current! Moral if you want your meter bills to bring you in a proper return for the current supplied, have the covers removed from them every six months. In the case referred to, the meter had been undisturbed for more than a year.

HAMILTON, the "Ambitious City," who will be expected to wear her holiday attire during the convention of the Canadian Electrical Association there the coming June, will, we feel sure, be glad to welcome its advent, and be only too pleased to know that she is giving a good send-off to what may become one of the most influential institutions in the Dominion. Doubtless she will have her mountain all trimmed up in green, her bay wearing its best and cleanest apparel, and the weather the most propitious. *Apropos* of this, and for the benefit of those who have never paid a visit to this well known city, we take great pleasure in saying it has many attractions that few other cities enjoy. Especially is this the case during the summer months. Among these attractions may be mentioned the mountain, the various drives, the glorious Hamilton (formerly Burlington) bay, the well-known Hamilton (formerly Burlington) beach, her beautiful, straight, block paved streets, arched over with shade trees, her comfortable, cozy homes, her congenial people, and above all, the thorough manner in which she tries to make all strangers within her gates enjoy themselves and have a good time generally. Other attractions will be the Electric Light and Power Company's new station, one of the most complete and best planned in the Dominion, the new City Hall and other public buildings, and the manufactories, the principal ones of which, we feel sure, will be thrown open for the inspection of the visitors. Apart from the above, Hamilton is one of the coolest and most home-like cities in the Province, in fact, just the sort of place to take the family along to spend a few days. We feel safe in asserting that all who attend the first annual convention of the Canadian Electrical Association in Hamilton, will have a right royal good time, and a brotherly welcome from her citizens generally.

To those who have the care and running of dynamos of any description in their charge, we would say that dynamos and dirt can never be made to assimilate, no matter how hard one may try. Provided one expects his dynamos to do good service and cause little or no trouble, they should be looked after in this respect as particularly, if not more so, than is a steam engine by a good engineer, who knows what he may expect if he neglects this one matter in the handling of a steam engine. In fact, a dynamo room, from the switch board to the drip pans, should have no place for dirt in any form whatever. Particularly is this the case with the commutators and brushes of any class of dynamos, but more so with those that have open or removable segments. The writer has known of cases where arc dynamos of the T. & H. pattern were allowed to run for weeks at a time without the removal of the commutator segments, and when removed, the wonder was how they managed to hold out and give good results. It is almost criminal to have things in such a shape. The segments of which we speak should have been removed and thoroughly cleaned of their copper dust and oil at least every second day, which if properly attended to will reduce the liability of the current to jump through or perforate the insulations of the commutators to almost a nullity. Not only should dirt around the commutator be particularly guarded against, but a scrupulous cleanliness should be maintained over the entire apparatus. It will pay in every way to see that apparatus is not being loaded down with dirt. See to it that belts are kept clean both inside and outside; have them gone over at regular intervals by your belt maker, and have him remove all foreign matter from their pulley side with his thin steel scraper We say have your belt man do it, because we feel sure that he will know just what to scrape off and leave your belt with a good hugging face for the pulleys. Also see to it that the pulleys on your line shafting are not whirling around nightly pound upon pound of grease and dust. In this connection it can be stated for a fact that recently a large friction grip pulley being used nightly to drive a large alternating machine, when ordered by a new manager to be cleaned, produced a full carbon box of filth, the rest of the pulleys also gave up their muck in proportion to their size. In view of such incidents it becomes not only a necessity, but an absolute charge on those operating electric light machinery, if they would have their plant in prime order, to see that dirt becomes no part of it. You can count on the loss of at least a pound of coal per hour for every pound of dirt that has to be whirled around by your engines. Another point that might be mentioned in this connection is, that none but the best lubricants should be used; they are the cheapest in the long run, and with the oil saving devices of the present day, you cannot afford to use poor ones; make it a point if you are not already fitted out with one, to procure an oil filter at once; be sure that it is a good one, and one that has stood the test; you can then afford to use none but the best quality of oils.

To those interested in, or who contemplate purchasing an electric light plant, or making additions to an existing one, we would say, beware of the cheap trashy material and apparatus that is being landed at your door without more than a suggestion that you think of purchasing. By cheap, we do not mean those which are sometimes bought from a reliable manufactory at a very low price on account of keen competition for any of the reliable manufacturing companies in existence to day will sell the best they can produce, and will install it in a proper manner, even if they find that on account of the low price obtained they are *sometimes unable to make but little profit thereby* but those which from the start are offered at a ridiculously low price, so low that the contemplative purchaser must know that it is away down, causing him sometimes to wonder if there has not been a mistake in quoting figures. Yet, when the seller assures him that the price is all right, he imagines he is getting as good as has been offered at perhaps twice the figure by a rival bidder for his contract, and not until he has the work all finished, the wiring all completed, the engines and dynamos in running order, does the trouble begin to show itself, nor does he realize that the expense of keeping the thing in running order is going far beyond his expectations, until later on, when, after one or two incipient fires, he is notified by the Underwriters' inspector that to run the plant as it is installed will mean that he must run it at his own risk, without insurance. Then, and not until then, does he fully comprehend that he has been penny wise and pound foolish, and that it would have been better had he bought the more expensive plant at the outset. To make matters worse in cases of this kind, the concerns who do this low class work are generally so low down in their financial standing that it is worse than useless trying to make them do it over again and in a proper manner. The upshot of it is that the plant either has to be entirely removed and sold for little or nothing, or more money spent on it to put it in apple pie order than would have been required in the first place had an A1 plant been purchased. It would be an easy thing, and not over expensive, for would be purchasers to find out for themselves before placing their orders, what is good and what is not. Instances have come under our observation where the entire wiring, &c., has been condemned by the insurance companies' inspector. One of the installations was done by a company who know how to do good work, but a cheap job was what was supposed to be wanted, and they filled the requirements; the other was done by a concern who do not know any better who sell apparatus and do wiring without ever having had a day's instruction in such work, they do make a sale occasionally, but at what figures! There is another feature of the subject that it is far from our wish to encourage, that is, the excessively high prices and large profits which some of the larger electric manufacturing companies have been exacting from their patrons right along. In this direction, however, we are pleased to note a decided change for the better. They seem now to be aware of the fact that even 50 per cent. profit on such articles as they turn out is far too much, and they are reducing their figures accordingly, in doing which they are assisting in the removal of the incompetents in the business in a way which is bound to result in an increase of their business and output. In conclusion we wish to say to those who are doing a manufacturing business, and who have the installation of a plant under their direction, see that everything is done in a proper and careful manner, and the best that can possibly be done. Have every large or small wire, be it for 1 lamp or 100, of the best material and put up in the proper way in other words, do everything in your power to raise the standard of electrical work of all kinds, and nothing to lower it. Let money considerations be the last to think about when good work is placed on one side of the scale and bad on the other, for as sure as the sun rises and sets the bad will hit back every time.

MR. A. J. Corriveau, of Montreal, cut a prominent figure in connection with the recent National Electric Light Association convention at Montreal. Incidentally it might be mentioned that his prominence was not so much due to the value of his public services on that occasion as to the numerous articles inspired by himself which appeared in the American electrical journals, all tending to show that to him belonged the credit not only of securing the holding of the convention in Montreal, but also of the successful carrying out of the entire undertaking. In short, Mr. Corriveau got all the free advertising that it was possible for him to obtain out of his connection with the affair, and while with a liberal hand he assisted in the expenditure of public money subscribed for the entertainment of the visitors, he appears to have carefully refrained from drawing on his personal resources for that object. Therefore, if any person has special reason to regard with satisfaction the late convention that person is Mr. Corriveau. It was on this account that we read with less surprise than otherwise we would have done the announcement that at the recent street railway convention in Pittsburgh, Mr. Corriveau extended an invitation to the Street Railway Association to hold its next convention in Montreal. The invitation was not accepted, and for this Mr. Corriveau doubtless has reason to be thankful, inasmuch as the people of Montreal, whose hospitality cannot be doubted, might nevertheless have declined to allow him another opportunity of self-glorification at their expense. It may almost with certainty be said, that in thus professing to speak on behalf of the city of Montreal, Mr. Corriveau in reality represented no other person or interest than himself. If he would contribute handsomely to a settlement of the liabilities accruing from the late convention he would stand in a better position to advocate a repetition of the event.

Another matter on which Mr. Corriveau has recently been expressing his opinion in the American electrical journals, is the attitude which those representing the electrical interests of Canada should assume towards the recently organized Canadian Electrical Association. He is a strong advocate of Canadians joining the American association. He thinks that thereby their interests would be better served. He is especially confirmed in this view since it was decided to change the name of the "National" to the "International" association. What advantages are to be conferred upon Canadians by this change in the name of the American organization he omits to mention. Of course the American papers are only too willing to publish Mr. Corriveau's opinions in this direction, while Mr. Corriveau is not slow to put his opinions on this or any other subject on record for the sake of the cheap notoriety which is thus afforded him. Mr Corriveau is, of course, entitled to his opinions, but we submit that he has long enough posed as the representative of Canadian electrical interests, and hence, in vulgar parlance, is "called down." Mr. Corriveau never was and is not now entitled to speak on behalf of those interests. Touching the change of name of the American association, the opinion prevails on this side of the boundary that its object was to head off the movement for a purely Canadian organization. So far as the benefit to be derived by Canadians from membership in the respective associations is concerned, there is something to be said on both sides, but there is no doubt at all where the preponderance of advantage lies. Canadians for a time might derive more instruction from attendance on the meetings of the American society, but that is all that can be said. How many of such meetings, held say at one time in Boston, and at another time in Atlanta, Georgia, would Canadians be able to attend? What influence would the representatives of Canada be able to exert as members of the American association on behalf of the electrical business in Canada? To what extent would the American association have the power to influence legislation in Canada affecting the electrical interests of this country? Mr. Corriveau is kind enough to admit that "Canadian electrical interests are large enough to support an organization." So far he represents the feeling on the subject in this country. While it cannot be denied that in the United States there is, generally speaking, a more perfect development of electrical knowledge, we are nevertheless prepared to dispute the assertion of a New York contemporary that "all of the experience is on this side of the border." There are in Canada a few persons at least whose knowledge of the science is contemporaneous with its first application to commercial uses. As to the Canadian Electrical Association, it is daily gaining strength, and unquestionably has before it a career of usefulness. While preferring to exist as a distinctively Canadian organization, it has none but the kindliest feelings for the greater organization in the United States. Each of these associations has its own work to perform, and may each perform that work with the greatest possible efficiency and advantage to the interests represented. Meanwhile will Mr. Corriveau kindly refrain for a time from obtruding himself upon the notice of a forbearing public?

CANADIAN ELECTRICAL ASSOCIATION.

THE front page of this number of the ELECTRICAL NEWS is embellished with the portraits of the executive officers of the recently organized Canadian Electrical Association.

In future years, when the Association shall have become a large and influential body, as we believe it is bound to do, it may be a matter of some interest for its members to refer to the number of the ELECTRICAL NEWS containing the physiognomies of its original promoters.

It is with pleasure that we are in a position to state that interest in the Association is steadily extending. In another column is printed a letter from a resident of British Columbia who desires to becomes a member. In the possession of the Secretary is another letter of similar character from Edmonton, N. W. T., while a number of applications for membership from prominent representatives of the industry in Montreal and elsewhere are awaiting the action of the Executive Committee.

VALUE OF TRADE JOURNALS TO ADVERTISERS.

THE circulation of a trade paper concentrated among a special class entitles it to a higher advertising rate than the medium of general circulation. It is not worth more to every advertiser, but to those who wish to address the special class it reaches it is worth much more. The man who has an article to sell to druggists can afford to pay the best drug journal a rate higher than that charged by a paper circulating among all classes. The drug journal has practically sifted the community down to possible customers, and he pays for no waste circulation, as would be the case with any other medium. An inspection of the rate cards of the best trade papers shows that they uniformly charge rather high rates, and an inspection of their columns shows that they secure a much larger proportion of advertising than the mediums of general circulation. The conclusion is irresistible that advertisers find them to be worth what they charge.—*Printers' Ink.*

Wagg—We had a terrible thunderstorm as I came up in the train this afternoon.

Wooden—Weren't you afraid of the lightning?

Wagg—No: I got behind a brakeman.

Wooden—Behind a brakeman? What earthly good did that do?

Wagg—Why, he was not a conductor.—*Philadelphia Item.*

"Our old friend, Mrs. Ramsbotham, was reading the other day a letter in the *Times* about 'Electrical Tramways,' when she came upon a line stating that 'two naked conductors' would be used. Much shocked, she was about to look at something else in the paper when she noticed that 'one of the conductors was to be carried on poles and another to be 'laid rigid between the rails.' Horrified at this apparent brutality, the worthy lady has been writing letters (in draft) to the commissioner of police ever since." —London *Punch.*

THE ELECTRIC TRANSMISSION OF POWER.

By Gisbert Kapp.

(Continued from January Number.)

LECTURE II.—FUNDAMENTAL PRINCIPLES.

The fundamental principle on which the electric transmission of power depends is that peculiar, and, I might almost say, mysterious interaction between magnets and currents, which we comprise under the name electro-magnetic induction; but more particularly two special cases of electro-magnetic induction, the one discovered by Oersted and the other by Faraday. Oersted discovered that, under certain conditions, a compass needle is deflected by an electric current, and Faraday discovered that relative motion between a magnet and a closed conductor will, under certain conditions, produce a current of short duration in the conductor. Oersted's effect is a permanent one; the needle remains deflected as long as the current flows. Faraday's effect is transient; the current flows, not as long as the magnet is present, but only during the time that it takes to change the relative position of magnet and closed conductor.

It is clear that in Oersted's experiment the movement of the needle is due to the action of a mechanical force between the magnet and the coil. In Faraday's experiment the transient current must be caused by a transient electromotive force, and this, in its turn, is caused by the relative movement between the coil and magnet. The modern method of explaining these things is based on the conception of magnetic lines of force, and the looping of these lines with the wire coil through which the current flows. The whole subject has been so admirably laid before this Society in the Cantor Lectures on the Dynamo, which Prof. S. P. Thompson delivered here in 1882, that I need not occupy time by going over the same ground again, but may take it for granted that you are familiar with the lines of force theory. In modern language, we may therefore explain the two fundamental phenomena somewhat as follows:—

1. The looping of a current with magnetic lines of force sets up a mechanical force between the conductor and magnet (or its equivalent).

2. Relative movement between a magnet (or its equivalent) and a wire coil sets up in the latter an electromotive force.

It follows immediately from these two propositions that looping and movement combined will require the expenditure of power, or yield power, accordingly as the movement is opposed to, or in the direction of, the mechanical force produced by the looping. In other words, that we can, by these simple means, convert mechanical into electrical power, or electrical into mechanical power. If we carry out both processes at the same time, that is, if we combine Faraday's with Oersted's experiment, we require, of course, a pair of wires between the two converting instruments. In Faraday's experiment, if we thrust the steel magnet into the wire coil, we expend mechanical power, which

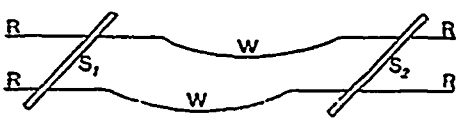

Fig. 1

is converted into the electrical power represented by a current flowing under a certain, though in this case very small, potential difference. The power represented by this current is again reconverted in Oersted's experiment into mechanical power, which is used to produce the deflection of the magnet. The total amount of power thus transmitted from one place to another is, of course, exceedingly small, but the same principle, applied on a larger scale, effects the transmission of many horse-powers, and it will be my task to show you how this is done in practice.

Before entering upon this subject, I must explain an expression used in stating the fundamental principles on which the electric transmission of power is based. I said that we require a coil and a magnet "or its equivalent." The equivalent of a magnet is, as you know, a coil through which a current flows, and the experiments ought, therefore, also to succeed if instead of a magnet we use such a coil. In practical work we use neither a steel magnet nor a coil alone, but a combination of a coil with an iron core, constituting what is known as an electromagnet.

You know that, according to our modern conception of magnetic fields, there emanates from each pole of a magnet a certain flow of lines of force; and when we thrust a magnet into a coil we cause the individual wires of the coil to cut through the lines of force. The quicker the movement, that is to say, the more lines of force are cut by each wire in unit time, the greater is the E.M.F. produced; and the more wires are contained in the coil, the greater is the E. M. F. produced, since the E. M. F. impulses of the different convolutions are added. It is also

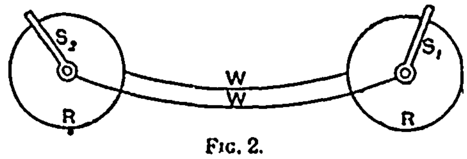

Fig. 2.

easily seen by experiment that the stronger the magnet the greater will be the E.M.F.; so that we find that the E.M.F. is proportional to the product of strength of field, speed of cutting, and length of conductor. Denoting these quantities respectively by H, v, and l, the E.M.F. produced is in C.G.S. units $H\,v\,l$, and remembering that a hundred million C.G.S. units of E.M.F are equivalent to one volt, we have the E.M.F. in volts given by the expression

$$\text{Volts} = H\,v\,l\;10^{-8}.$$

In this formula the strength of field is given in lines per square centimetre, and speed and length are given in centimetres.

The mechanical force experienced by a conductor in the neighborhood of a magnet pole is, according to our modern views, due to the fact that the conductor is laid across the lines of force emanating from the magnet pole. The force in dynes is given by the product, $H\,c\,l$, c being the current. Since there are 981,000 dynes required to represent the force of one kilogramme, and since the C.-G.-S. unit of current is 10 amperes, we have the force produced by a current of c amperes—

$$\text{Kilogrammes} = \frac{H\,c\,l}{9,810,000}.$$

These are the two fundamental equations required in the design of plant for the electric transmission of power. Now let us see what is the most simple kind of plant we could possibly employ. At the generating station we require a conductor cutting lines of force; this conductor must be joined by wires with a similar conductor at the receiving station. The second conductor is also laid across lines of force, so that when a current passes it will be acted upon by a mechanical force displacing it parallel to itself and doing work. The arrangement here described is shown in Fig. 1, where the lines R represent fixed, horizontal, parallel rails, across which are laid sliding rails or sliders, S^1, S . Imagine the magnetic lines of force passing vertically between the fixed rails, then, if we displace the slider S^1, an electromotive force will be set up in it, causing a current to flow through the connecting wires, W, and the slider S_2 at the receiving station. The slider S_2 is supposed to be laid across lines of force, and will, therefore, be acted upon by a mechanical force. Thus, power may be electrically transmitted from the slider S_1, to the slider S^2. It will immediately occur to you that the experiment I have here illustrated could easily be tried by means of any railway. The fixed conductors and connecting wires would be the rails; the generating slider would be a crowbar thrown across them, and hauled along by a train, and the lines of force would be supplied by the vertical component of terrestrial magnetism. At another part of the railway—possibly miles away—another crowbar thrown across the rails should then be set in motion, by the current passing through it. Theoretically, such an arrangement represents correctly enough the electric transmission of power; but I need hardly tell you that it would not work in practice. If you apply the E.M.F. formula I have given to this case, you will find that, even if the slider is hauled along at the speed of an express train, there will only be generated about the one-thousandth part of a volt, the reason being that the magnetic field provided for us by nature is so extremely weak. If we could apply an artificial magnetic field of the strength generally employed in dynamo machines—that is, about 10,000 times as strong as the vertical component of terrestrial magnetism—then we could get about 10 volts in our slider. Now, it is obvious that we cannot spread so strong a field over miles of railway, and we must, therefore, alter our arrangement. This may be done as indicated in Fig. 2, where one of the rails has been replaced by a centre contact, and the other by a circular conductor. The slider, instead of being moved parallel to itself, must now revolve round the centre contact, which can easily be done by a belt and pulley. We have thus arrived at was is known as a non-polar dynamo. But even this arrangement, although very much better than the progressive slider, is not of practical value for power transmission, because the E.M.F. of non-polar dynamos is still too low. It is only a few volts, whereas we require hundreds, or even thousands, of volts to carry the current to any distance. The obvious remedy is to use a large number of revolving sliders, so connected that the E.M.F. generated in each shall be added, in other words, instead of a non-polar dynamo, we must use an ordinary continuous current dynamo, wound for high E.M.F. This arrangement is shown in Fig. 3,

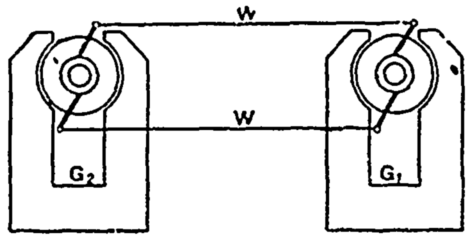

FIG. 3.

where G_1 is the generator and G_2 the motor or receiving dynamo. If you connect their brushes, as shown in the diagram, and rotate the armature of the generator, a current flows through it, the line wires W, and through the armature of the motor, and exerts upon the latter a mechanical force, tending to produce rotation and give off mechanical power. I am able to show you this experimentally, by means of two dynamos connected, as shown in Fig. 3.

The Machines Employed in Power Transmission.

This experiment has shown how power may be transmitted electrically. Let us now consider somewhat more in detail the different parts of the transmitting plant. At one end of the line of transmission we have the generating dynamo, at the other we have the motor dynamo, and then we have the line itself, consisting of two wires insulated from each other and from earth. You will readily see that although for the convenience of experimental illustration I have placed the generator and motor close together, this proximity was not an essential condition of the experiment. The motor might have been placed in another room, or in a different part of London, and still the experiment would have succeeded, provided I had used sufficiently stout and well-insulated connecting wires. But then you could not have had ocular demonstration of the fact that movement of the generator armature is closely followed by a corresponding movement of the motor armature.

A full treatment of my subject would, of course, include a complete investigation of the dynamo, but this I shall not attempt. In the first place there is no time for it, and in the second place it is hardly necessary, since you are all more or less acquainted with these machines. I shall, therefore, not occupy time by giving mathematical proofs for the few formulæ I shall have to use, but assume they are familiar to you. They are as follows:—

$$\text{Volts} \ldots\ldots\ldots = H\,v\,l\,10^{-8}$$

$$\text{Kilogrammes} \ldots = \frac{H\,c\,l}{9{,}810{,}000}$$

C Total current through armature; c, current through single armature conductor.

e E.M.F. in armature in volts.

r Number of active conductors counted all round armature.

p Number of pairs of poles ($p = 1$ in a two-pole machine).

n Speed in revolutions per minute.

F Total induction in C.-G.-S. lines.

Z " " English lines.

Electromotive force
$$\left.\begin{aligned} e &= F\,r\,\frac{n}{60}\,10^{-8} \\ e &= Z\,r\,n\,10^{-6} \end{aligned}\right\}\ \text{for two pole-machines.}$$
$$\left.\begin{aligned} e &= p\,F\,r\,\frac{n}{60}\,10^{-8} \\ e &= p\,Z\,r\,n\,10^{-6} \end{aligned}\right\}\ \text{for multipolar machines with series-wound armature.}$$

Torque ....
$$\left.\begin{aligned} \text{Kilogramme-metres} &= 1{\cdot}615\,F\,r\,C\,10^{-10} \\ \text{Foot-pounds} \ldots\ldots &= 7{\cdot}05\,Z\,r\,C\,10^{-6} \end{aligned}\right\}\ \text{for two-pole machines.}$$
$$\left.\begin{aligned} \text{Kilogramme-metres} &= 3{\cdot}23\,F\,r\,c\,p\,10^{-10} \\ \text{Foot-pounds} \ldots &= 14.10\,Z\,r\,c\,p\,10^{-6} \end{aligned}\right\}\ \text{for multipolar machines.}$$

In analyzing these formulæ you will observe a curious parallelism. The symbols for field strength and total number of active armature wires occur in either group, but the current occurs only in the group giving torque, or mechanical turning effort, and the speed occurs only in the group giving E.M.F. Now, if you multiply any of the torque formulæ with the speed you get on the left mechanical power; and on the right the product of electromotive force, multiplied with current and a constant, or, in other words, electrical power; by working this out in figures, you will find that mechanical energy expressed in horse-power is equal to watts divided by 746, the well-known equation for converting mechanical into electric power.

The formulæ are equally applicable to cylinder armatures wound gramme fashion and to drum armatures, provided we count not turns of wire but active conductors over the whole circumference of the armature. As regards two-pole machines, the formulæ are the same as found in every text-book on dynamos, but as regards multipolar machines, a little explanation is required, both as to the winding and as to the advantage or otherwise of using more than one pair of poles. To make the explanation clear, I must refer for a moment to the ordinary method of drum winding for two-pole armatures. When such a winding is illustrated in a text book, the author takes care to show only very few conductors, for the simple reason that the diagram would be one unintelligible maze of line if it were drawn so as to represent an armature as really made. To get over this difficulty I employ, instead of a diagram, a tabular statement of the winding such as you see on the wall. This particular table represents the winding of a drum armature having 100 active conductors.

Drum Winding.

F	B	F	B	F	B	F	B	F	B	F

D	U	D	U	D	U	D	U	D	U
100	49	− 98	47	96	45	94	43	92	41
90	39	88	37	86	35	84	33	82	31
80	29	78	27	76	25	74	23	72	21
70	19	68	17	66	15	64	13	62	11
60	9	58	7	56	5	54	3	52	1
50	99	+ 48	97	46	95	44	93	42	91
40	89	38	87	36	85	34	83	32	81
30	79	28	77	26	75	24	73	22	71
20	69	18	67	16	55	14	63	12	61
10	59	8	57	6	55	4	53	2	51
100	49	− 98							

The figures at the top of the vertical columns indicate the direction of winding, supposing the winder looks at the armature end on. The letter D signifies a wire, wound down or away from him; and the letter U a wire wound up or towards him. The letters F and B, placed between the others, denote the front and back connections respectively. In modern machines these connections are not made of flexible wire, but are separate pieces, specially made to shape, and are generally of larger section than the conductor, so as to reduce the resistance of the armature as much as possible. One form of connector is on the table, both in pieces and built up. By referring to the winding-table, you will see that every wire is numbered; and thus we can see at a glance how the ends of each wire are connected. The table on the wall refers to a two-pole machine, that on the slip in your hands to an eight-pole machine, wound so as to obtain the E.M.F. of the four pairs of poles in series. The printed table, giving the eight pole winding, is almost self-explanatory; but, to assist you in understanding the winding of these multipolar machines generally, I had this model prepared, showing a few of the conductors of a six-pole armature. This method of winding has been invented by Messrs. Scott and Paris, patents 4,683 and 6,261 of 1874. There are no internal cross-connections, the ends of the conductors being joined simply by connecting segments of the kind I have just shown you; but with this difference, that each segment, instead of embracing half a circle, embraces only one-sixth of a circle. The winding goes in zig-zag, so to speak, round the armature.

returning to the second wire in front or behind the previous starting-point. There are thus only two brushes required. The winding tables show, also, very clearly how the E.M.F. increases from wire to wire, and that the greatest difference of potential occurs between neighboring wires at the diameter of commutation. The difference of potential between neighboring connector segments, is, however, limited to the E.M.F. due to the two conductors. The winding is used for machines intended to give high-pressure currents, such as are required in power transmission. Where low-pressure and large currents are required, the winding is altered, so as to form overlapping loops on the armature, and for intermediate electromotive forces a combination of both methods can be used. But as these windings have no immediate importance for power transmission, I shall not detain you with a description of them.

Table of Winding for 8-pole Drum Armature; 202 Conductors; Series Winding; Brushes (+) 135 apart.

F B F B F B F B F

D	U	D	U	D	U	D	U
202	25	50	75	100	125	150	175
200	23	48	73	98	123	148	173
198	21	46	71	96	121	146	171
196	19	44	69	94	119	144	169
194	17	42	67	92	117	142	167
192	15	40	65	90	115	140	165
190	13	38	63	88	113	138	163
188	11	36	61	86	111	136	161
186	9	34	59	84	109	134	159
184	7	32	57	82	107	132	157
182	5	30	55	80	105	130	155
180	3	28	53	78	103	128	153
178	1	26	51	76	101	126	151
176	201	24	49	74	99	124	149
174	199	22	47	72	97	122	147
172	197	20	45	70	95 +	120	145
170	195	18	43	68	93	118	143
168	193	16	41	66	91	116	141
166	191	14	39	64	89	114	139
164	189	12	37	62	87	112	137
162	187	10	35	60	85	110	135
160	185	8	33	58	83	108	133
158	183	6	31	56	81	106	131
156	181	4	29	54	79	104	129
154	179	2	27	52	77	102	127
152	177	202					

Now, as to the advantage of multipolar machines, such as the one which I illustrated on the screen. The field magnets are arranged perfectly symmetrical round the armature; and thus the one-sided magnetic pull, consequent upon the employment of a single pair of horse-shoe magnets, is avoided. There is very little magnetic leakage, the machine being what is known as iron-clad; and, as I have already shown, the E. M. F. is equivalent to that of several smaller machines, coupled in series. The internal diameter of the armature is very large, affording plenty of space for the ingress and egress of air; and the weight of the machine is less than that of an equivalent two-pole machine. The most important advantage, however, is the small armature reaction. Experience with large two-pole machines has shown that there is a limit to the size above which such machines are satisfactory. This limit depends, of course, on the speed and voltage, as well as on the output, but, roughly speaking, we may take it that, for moderately high voltage, and an output above 100 H.P., the multipolar machine is preferable; and we find, accordingly, that, for the transmission of large powers, multipolar machines are, as a rule, employed.

I have hitherto not made any distinction between motors and generators, because the difference between them is almost negligible. There are certain secondary effects which may be a little greater in one machine than in the other, but these are of so little importance that it will not be worth while to devote any time to their consideration. As a rule, a good generator makes a good motor. All we require to do is to set the brushes a little forward of the neutral line in the former, and a little back from that line in the latter. Now let us see what it is we must naturally aim at in putting up a transmission plant. At the generating end of the line we want as high an E.M.F. as we can get, because a high E.M.F. means large power and small percentage loss due to line resistance. At the motor end we want as large a torque or statical effort as possible, combined with a certain speed. But a glance at the formulæ will show that it is impossible to get speed without also getting E.M.F., which, in the case of the motor, must oppose the current, and thus the current actually flowing through the motor is that due to the difference between the E.M.F. of the generator and the counter E.M.F. of the motor. This difference, divided by the total resistance of the circuit, gives the current.

The electrical power developed in the generator is the product of this current, and the E.M.F. in its armature. The electrical power converted by the motor is the product of the same current and the counter E.M.F. of its armature. It therefore follows that the electrical efficiency of the whole system is given by the ratio between the generator and motor E.M.F. The more *nearly alike these two are, that is to say, the less E.M.F. lost in* resistance, the greater will be the electric efficiency. Now, the smaller the current the less E.M.F. is lost in resistance; but to get power with a small current we must work at high pressure, and we thus find that, from the point of view of electrical efficiency only, the higher the voltage the better. There are, however, other things to be considered besides electrical efficiency, and if we take due account of these we find that for every case there is one particular voltage at which it is best to work.

Upon this subject I shall enter presently, but, before doing so, I must place before you some points in connection with the regulation of speed and power in transmission plants. Unless we can *control the speed, and regulate the power given out* at the receiving end of the line, the most perfect motor or the most efficient system is useless. Fortunately, however, electricity is not only a powerful transmitting agent, but also one that can be easily controlled, and my next task is to show you how this control is effected.

(To be Continued.)

PERSONAL.

Mr. A. A. Dion recently resigned his position as chief electrician of the Intercolonial railway at Moncton, N. B., to accept the management of Messrs. Ahearn & Soper's establishment and the secretary-treasureship of the Chaudiere Electric Light and Power Co., at Ottawa.

Mr. H. Q. Moysey, assistant electrician of the Toronto fire alarm system, died of pneumonia, superinduced by an attack of la grippe, on Sunday, Jan. 17th. Mr. Moysey was born in Devonshire, England, 52 years ago, and came to Canada about 1871. He was first employed by the old Montreal Telegraph Co., but had been in the city's employ for some years.

In recognition of the valuable service he has rendered on behalf of the Commercial Cable Co., in which many Canadians are interested, a banquet and a solid silver service valued at $3,000 were recently tendered to Mr. Chas. R. Hosmer, general manager of the C.P.R. Telegraph Co., and a vice-president of the Commercial Cable Co., at the St. James Club, Montreal.

PUBLICATIONS.

We have received with the compliments of the American Electrical Works, Providence, R I., a souvenir of the recent N.E.L.A convention in Montreal in the form of a large photograph showing a group of the leading spirits both American and Canadian in connection with that event.

The February *Arena* will be read with interest by thoughtful people. Its papers are all readable, many of them very strong. Briefly, the contents are as follows: Frontispiece, Herbert Spencer, a very fine portrait of the great philosopher. *Herbert Spencer's Life and Work, by W. H. Hudson,* for many years Mr. Spencer's private secretary, Danger Ahead, a thoughtful discussion of the electoral college problem, by Robert S. Taylor, The Railroad Problem, by Ex Gov Lionel A. Sheldon, The Solidarity of the Race, by Henry Wood, Hypnotism and its relation to Psychical Research, by B. O. Flower; *Inspiration and Heresy, by P. Cameron, B.C.L.; The* Sub-Treasury Plan, by C. C. Post, author of "Driven from Sea to Sea"; The Atonement, by Rev. Burt Estes Howard, The Last American Monarch, by James Realf, Jr. A Spoil of Office, part second of Mr. Hamlin Garland's great novel of the modern west.

The British Columbia District Telegraph and Messenger Service Co., of Vancouver, will establish services in Nanaimo and New Westminster

The plans adopted for lighting the buildings and grounds of the World's Columbian Exposition provide for 138,218 electric lamps, of which 6,766 are to be arc lamps of 2,000 candle power each, and 131,452 incandescent, 16 candle power each. The electric lighting will cost something like $1,500,000, and will be ten times as extensive as was employed at the Paris Exposition. The light and motive plant at the Exposition, it is estimated, will require 26,000 horse power, of which 22,000 will be required for the electric plant.

ANNUAL DINNER OF MONTREAL BRANCH, C. A. S. E.

THE Reindeau Hotel, Montreal, was the scene of rare good fellowship on the evening of Saturday, Jan. 23rd, when the members of the Canadian Association of Stationary Engineers of that city and invited guests assembled around the festive board to celebrate their annual reunion.

The attendance outnumbered that of previous years, about one hundred being present. The management of the hotel exerted themselves most successfully on behalf of the enjoyment of their guests.

The Committee of Management, Messrs. T. Naden, President of the Society T. Ryan F H Thompson, H. Nuttall, R. Doran, Jas. Elliott, and Jos G. Robertson the efficient secretary of the Association, left nothing undone which might contribute to the happiness of the occasion. The "regulation," "lubrication" and "adjustment" were so perfect that while "noiselessness" was not altogether secured, "hot boxes," "pounding," or anything tending to disturb harmony were conspicuously absent.

Mr Geo. Hunt occupied the chair, and proved himself to be well-versed in the duties of a "governor"—more especially a governor of a feast.

Letters of regret at inability to attend were read from Professors Bovey and McLeod Messrs. H Valance, H. M. Sweetland (New York), Mayor McShane E. O Champagne, Fred Thomson and C. E. Robertson.

After due attention had been paid to the many delicacies with which the tables were loaded the usual patriotic toasts were honored.

In response to the toast "Mechanical and Steam Engineering, Capt. Wright spoke as follows:—

"It is with great pleasure that I have the honor of meeting you at your second annual dinner. I believe in such things. The civil engineers have theirs, why not the stationary engineers? For a few hours once a year you can cast aside care. Low water in the boiler or steam down makes no difference for the time being. I was amused a year ago at overhearing a conversation between two members of this society. The first annual dinner was close at hand. "Are you going?" said one to the other. "No," was the reply. "Why not?" "Because I never attended such a thing, and don't know how to behave." I felt humiliated. But by this acknowledgement, the speaker at least proved himself capable of learning. I was sorry that such feelings existed. The behaviour at a public dinner—whether we feed ourselves with the fork or the knife, whether we put the spoon to the mouth sideways or pointways, or whether the tea spoon should remain in the cup or be put in the saucer—we engineers must leave these highly important momentous and abstruse questions to the cultivated and high toned society gentleman, who alone is able intellectually to grasp the situation. We engineers will content ourselves with the rule of the engine room that the most direct and simple method is the best, at table or elsewhere. A few days ago circumstances brought your society in a forcible manner to my mind. A free public lecture was given under your auspices by Mr. Laurie, on "Improvements on the Steam Engine." It was duly advertised in the papers, and a large representative gathering was present. An able paper was read on the subject, which was appreciated by all present. The following day I saw a notice in two of the English dailies that such a thing had taken place—all done up in space of four or five lines—while in the same papers whole columns were dished out to us about contests at billiards, "An Angle in an Ulster," pugilism and dogs. It is said, and I believe it with truth, that the moral and intellectual standing of a community can be correctly estimated from their newspapers. What would intelligent strangers or foreigners think of us in view of such a showing? In defence it might be said that a paper is run to please its patrons. Granted: but I have no doubt that fifty copies of the daily papers are sold to the engineers and mechanics of this city for every one sold to the slugging, plugging and gambling fraternity, and I will include the owners of St Bernard dogs, which were honored on that occasion with a column and a half.

Mr Chairman and gentlemen, the engineer is one of the most important factors of the present time. There are several meanings to the term "Engineer," or more properly speaking several branches in the department of engineering. I confine myself to the word as used in the name of your society. One doctor may have the lives of a dozen persons in his hands. An engineer may have a thousand. Put all of our lawyers, notaries, brokers, shavers, boodlers aldermen etc., etc., that ever have, or ever will exist, in a bag, shake them up and riddle them in a riddle—what have they done for the benefit of their fellowmen or the country in comparison with the work of one engineer known as James Watt? He has revolutionized the world and changed its geography in a peaceable manner by giving us "power." As a consequence, the wages of the workingman have doubled and trebled since his time, and the necessaries of life are much lower in price since 1792; we are better fed and better clothed, live longer and enjoy ourselves more. The child born this year, if he lives to be 60 years of age, will live more, see more and do more, than if he had lived 960 years in the time of Methuselah. The railroad and the steamship are the great christianizers and civilizers of the day. Should thousands of missionaries be sent to Africa, they would not civilize the nation as fast as would a railroad through the country. What are the results following engineering in our own country? I can get a suit of clothes of English or Canadian material in Ontario for the same or less money than here in this city, depending upon municipal or other taxes. The farmer 500 miles from here gets within a few cents per bushel of the price for his grain alongside of the ship in Montreal. These are some of the doings of the engineer and his engine. What will take place in the next fifty years it is impossible to forsee. The engineer can work, but he can not prophesy."

"The Manufacturing Interests" were responded to in suitable terms by Messrs. Laurie and Darling.

Messrs. Smellie and Naden did likewise on behalf of the toast to "Electrical Engineering."

Mr Grandberg replied on behalf of the toast "License Law and Inspection"

"The Brotherhood of Locomotive Engineers" found an able representative in Mr. Clark.

Messrs Gormley and Mitchell replied on behalf of "Our Guests," and Mr J B Mortimer of the ELECTRICAL NEWS, on behalf of "The Press."

Several recitations and songs were creditably rendered by Messrs. Hunt, Nuttall and Naden

An invitation was extended to the members of the society by Prof. Bovey, on behalf of McGill University to pay a visit to that institution, when Prof. Nicholson has kindly promised to explain to them all the latest improvements in apparatus employed in teaching applied science. It has been decided that in response to the invitation so kindly extended the Association will visit the University on Saturday next, the 6th inst.

Capt. Wright also promised to read a paper on "Power" at the next regular meeting of the Association, on Feb. 11th.

An evening of unusual enjoyment was brought to a close shortly after midnight.

TRADE NOTES.

The Toronto Electrical Works report business extraordinarily good for the season. They have been making a large number of repairs to armatures, converters, &c., having special facilities for this class of work. They are also Canadian agents for the justly celebrated Stanley converters. The "tried and true" Clark rubber covered wire is a specialty of theirs of which they handle large quantities. In the general supply line they have been and are very busy. In the construction and expert department they have been pushed to meet demands. They are making a specialty of reconstruction or extension of present plants and of expert inspection.

Within the last three months the Royal Electric Company, of Montreal, have manufactured and installed the following electric lighting and power plants: Quebec & Levis Electric Light Co., 1500 light alternating dynamo, The Prince Albert Electric Light & Power Co., 500 light alternating plant complete, with transformers, lamps, meters, &c., Corporation of New Westminster, B.C., 50 light arc dynamo complete, with lamps, etc., and 1500 light alternating incendescent plant, with transformers, lamps, meters, etc.; School of Practical Science, Toronto, 25 light direct current dynamo; Standard Electric Co, Ottawa, two 1500 light alternating dynamos, three 75 h. p. power generators, 75 h. p. motor, two 15 h. p. motors, two 10 h.p. motors, 7½ h.p. motor and two 5 h.p. motors; Messrs. J. C. Wilson & Co., Montreal, 250 light direct current incandescent plant, complete; Messrs. Wells, Richardson & Co., Montreal, 7½ h. p. motor, Canadian Pacific Railway Co.'s new shops at Hochelaga, 35 light arc plant, complete, Grand Trunk Co.'s new rolling mills, 15 light arc plant, complant, complete; Messrs. G. A. Mooney & Co., 100 light direct current incandescent plant; Henry Owen, Montreal, 2½ h. p. motor; J. B. Robert, Beauharnois, Que., 150 light direct current dynamo; Alex. Buntin, paper mill, Valleyfield, Que., 150 light direct current plant; Lachute Electric Light Co, Lachute, Que., 350 light alternating plant, complete; Canadian Bridge & Iron Co., Montreal, 15 light arc plant, Royal Pulp & Paper Co, East Angus, Que., 350 light alternating plant, complete; Geo Hilliard, mills, Peterborough, Ont., 150 light direct current plant, complete; Edmonton Electric Co., Edmonton, N.W.T., 500 light alternating plant and the necessary steam plant complete; Coaticooke Electric Co., Coaticooke, Que., 350 light alternating plant; Wm. Ewing, grain warehouse, 5 h p. motor; The Granite Mills, St. Hyacinthe, Que., 35 light arc plant, complete; Dominion Wire Mfg. Co., Montreal, 300 light direct current dynamo, and the P. E. Island Electric Co., Charlottetown, P.E.I. 500 light alternating plant, complete. This, for a purely Canadian institution speaks volumes for the enterprise and push of the management, and especially so when the heavy competition from every large American institution is taken into consideration. A number of these plants have been increased, principally the Quebec & Levis Electric Light Co., the corporation of New Westminster, the Standard Electric Co., the Dominion Wire Mfg Co the P. E. I Electric Co., the Granite Mills and the C. P. R. Besides the above the Royal Electric Co. have installed some 8000 lights with corresponding engine and dynamo capacity in their own lighting station in the city of Montreal The Polson Iron Works Co. are now building for them in Toronto, two large engines, one of which is a 750 h. p. double compound engine and the other a 500 h.p. They are installing four batteries of Babcock & Wilcox boilers, each of a capacity of 300 h.p., and are building a large factory and lighting station, thereby doubling their present output.

ASSOCIATION OF MARINE ENGINEERS.

AT the last regular meeting of the above Association the following officers were elected for the ensuing year: President, F. E. Smith, by acclamation; 1st vice-president, E. W. Fox, 2nd vice-president, P. J. Kennedy; council, R Hughes, S. Gillespie, D. L. Foley, J. J. Kennedy, P. Quinn; treasurer, J. H. Ellis, by acclamation; secretary, S. A. Mills, by acclamation; inside guard, J. Adams, auditors, J. Harrington and J. D. Banks.

Winnipeg, Manitoba, possesses a telephone exchange which has over 750 subscribers—one to every thirty-six of the population. Such facility of communication, *Practical Electricity* thinks, "must tend greatly to the increase of family gossip, and it would be interesting to know how far this conpition tends to cordial relations in the community. If the difficulties of obtaining the ear of "Central" and completing an interview over the wire without interruption are anything near what they are in most telephone exchanges, there must be great self-control practised, or a canvasser for a vocabulary of objurgatory phrases would be favorably received. In London, England, where telephone service has recently been reduced to ten pound a year, the attendants at the central stations wear sounders on their heads and no bell is rung—the taking of the phone by the user producing a sound that is faint, indeed, but sufficient to call the girl's attention. In consequence, the room is less noisy than by the methods which have hitherto prevailed, with, probably, less confusion of sounds over the wire than is usually met with."

STEAM TURBINE TESTS.*

OUR cable dispatch this week contains what to electrical engineers will appear a most remarkable and sensational experiment. It is the result of a careful test made by Prof. Ewing on a steam turbine and dynamo combination of 100-kilowatt capacity. The Parsons turbine has been known for some years, and has been given a considerable trial on a small scale. The excellence of the result of this last test, however, was hardly to be anticipated, even by the most visionary friends of the steam turbine. It was found that at full output an electrical horse-power hour could be obtained by the consumption of only 27.6 pounds of steam, while at half load but 29 pounds were required. If his result is confirmed, and there is reason to expect that it will be on account of the well-known skill of the engineer who made the tests, its effect may prove to be very far-reaching. Nearly a year ago in discussing an American invention of a similar character -the Dow steam turbine*—we called attention to the wide field of usefulness that would be opened to such an apparatus if it should be found reasonably economical of steam. The present facts show not only reasonable but extraordinary economy, for 27.6 pounds of steam per horse-power is a figure that, it is safe to say, has never been reached by any simple high speed engine of the type of which there are thousands in use in electric light and power stations to-day, and is barely within reach even of compound engines when they are used non-condensing. And still more remarkable is the half-load efficiency. If either the Parsons turbine or its American compeer can give such results as this with the regularity that it is fair to anticipate in view of such favorable tests, the simple engine has found a competitor more formidable than even the most sanguine of engineers has felt justified in expecting. For not only is the steam turbine economical but it is cheap to build, occupies an exceedingly small amount of space, and is unusually free from mechanical complications. Furthermore, the high speed desirable in its use tends to the production of an extremely economical type of dynamo. High speed is the most efficient way of getting high voltages, so that the very conditions which have given such good results in the prime mover are most favorable to the dynamo itself. A 100-kilowatt steam dynamo of the type we are considering is a much smaller and cheaper machine than any similar combination which has as yet been devised, and quite capable of playing a most important part in central station equipment. The enormous output in proportion to the weight will render it desirable for marine use, while the immense economy of space gained at the same time will tell in its favor everywhere. It is hard now to estimate the importance which this new development in prime movers may assume. It certainly means active rebellion against small high speed engines, and may extend to open revolution against our present methods of central station practice.—*Electrical World.*

NOTES.

The maximum safe velocity of solid cast-iron fly wheels should not exceed a rim speed of 100 feet per second.

The largest engine in England is the product of the Heirschen works of Munich. It weighs 84 tons, and moves a load of 200 tons.

It is reported that a large steel company is experimenting with a process to render steel sufficiently tenacious to supplant copper for the manufacture of rods and wire.

One square foot of heating surface in a boiler will receive and transmit 20,002 to 30,000 heat units per hour, while radiation from the same surface is limited to about 300 heat units in the same length of time. -*Stationary Engineer.*

When an agent comes around and talks about saving fifty to seventy-five per cent. of your fuel bills by some attachment or other, politely show him the door. If he talks only five to ten per cent., listen to him.—Robert Grimshaw's Hints to Power Users.

When heating water by a steam jet it is best to put an elbow and nozzle on the end of the steam pipe inside the tank so as to produce a circulation of the water while heating it, as by this means the heat is applied to better advantage and a larger portion of it is utilized. - *Stationary Engineer.*

From many experiments made on the condensation of steam in wrought iron pipes, when exposed to the open air, it is found that one pound and six ounces of steam per square foot of pipe's surface is condensed per hour when the difference in temperature between the steam and air is 200 degrees.

Bearings constructed of compressed wool pulp are the outcome of some ingenious mechanic. Combined with graphite they require no lubrication, and greatly reduce the friction. The compound can be cut or dried like metal, and is almost as hard. A dynamo is stated to have been fitted with these bearings with satisfactory results.—*Invention.*

To cleanse an engine, dissolve a pound of concentrated lye in about two gallons of water, and with a mop saturate the engine with the liquid, being careful that it does not get into the oil holes of the journals and bearings. After the lye has eaten all the grease and gum from surfaces, clean perfectly by scraping and brushing, and apply, after the iron is dry and free from grease, a thin coat of lead paint.

A number of engineers lately have asked us, says the Boston *Journal of Commerce*, concerning the tensile strength of boiler plate, what was meant by 'a tensile strength of 60,000 pounds.' Several evidently had the idea that that was the strength of an inch-wide strip of that particular plate. The idea is not correct. The 60,000 pounds, or the tensile strength marked, is the strength of that plate an inch thick as well as an inch wide. If the plate is one-quarter of an inch its strength will be one-quarter of 60,000 = 15,000 pounds, if it is three-eights of an inch thick it will be three-eights of 60,000 = 22,500 pounds, and so on.

Too many engineers behind the times still use tallow as a cylinder lubricant, says an exchange, and by so doing run a great risk of eventually destroying the engine, as the several fatty acids, stearic, oleic, margaric, etc., of which tallow is composed, are almost sure to eat out the valve seat, piston rings and other parts of the cylinder. Some good mineral oil should be used, which is known to have a reputation. - *Invention.*

The interesting announcement is made in Philadelphia that a device has been invented to guard against the burning out of armatures in electric railway motors. This is done by means of a clutch, which permits the motor to start up gradually, by allowing one-fourth of the current to enter the motor at once. By this method the inventor claims that the burning out of an armature is impossible.—*Boston Journal of Commerce.*

SPARKS.

A Welsh newspaper, on the ground that the present lamps are neither suitable nor safe for the purpose to which they are put, advocates the adoption of an electric safety lamp for miners.

Bentley—"How did Larkin meet his death? When we left him last night he seemed unusually jolly. Vosburgh—"He tried to blow out the electric light in his room and burst a blood vessel." —*Brooklyn Life.*

The Terrebonne Electric Light Company has been organized at Terrebonne, Que., with a capital of $12,000. Incorporators, Hon. Louis R. Masson, R. H. Buchanan, E. S. Mathieu, C. Gauvreau, W. Joubert, A. Piche, M. Moody, L. H. Desjardins, A. H. Masson, Matthew Moody, A. Masson, C. Chapleau, Mrs. C. Archambault.

The Great Indian Peninsula is utilising old rails as telegraph posts, and they are cheap and durable, as well as strong and inflexible. An extra piece of rail is bolted to the rail at its lower extremity, generally from 4 feet to 6 feet long for an ordinary telegraph post. This end is then buried in the ground, and the pole is ready for its fixings. The cost is about from eight to ten rupees.

One of the attractions of the new Queen's Theater in Montreal is the incandescent illumination which keeps the hall much cooler and the air much purer than they otherwise would be with gas. The foot lights consist of three rows of lamps, red, green, and white respectively, and striking effects can be produced by turning on the red or green alone. These lights may also be turned down as gas.

Rockaby expert
On a pole top;
When the wind blows,
The cross arms will rock:
When the pole breaks,
The cross arms will fall,
And down tumbles expert, cross arms and all.

—*Electrical Enterprise.*

A method of repairing broken filaments economically has been discovered by a French engineer. A hole is made in the bulb and the broken filament taken out, excepting a small piece which is left attached to the platinum supports. The bulb is now filled with some liquid hydrocarbon, and a new filament is placed within it, in such a position that its ends just touch the remaining ends of the old filament. An electric current is now passed through the lamp, this has the effect of decomposing the hydrocarbon, liberating hydrogen gas, whilst solid carbon is deposited at the free ends of the filament in such a way that the old and the new portions are cemented together. Finally, the bulb is cleaned, exhausted of air and the hole sealed up.

The American Bell Telephone Co. of Boston has under way 50 long-distance telephone lines from Chicago to New York. Each of these lines takes two wires, making 100 lines of single wire, and as the distance from New York to Chicago is about 980 miles, the length of wire used in connecting these two points would be 98,000 miles. The size of the copper wire used in the construction of the long-distance telephone weighs 174 lbs. to the mile, making the total weight of the copper turned into wire for this one undertaking 17,052,000 lbs., or 8,526 tons, or 3,000,000 lbs. more than the total production of the Tamarack for the last year, or within about 1,800,000 lbs. of the combined output of the Quincy, Osceola and Franklin; or, omitting the Calumet, Hecla, Tamarack and Quincy, more copper than the remaining combined Lake Superior copper mines produced in 1890.

Herr E. Koeffler, in a paper read before the Vienna Electrotechnical Society, discussed the subject of the employment of dynamos and accumulators for telegraph purposes. The use of dynamos in any except large offices was uneconomical, he said. Their great first cost and the cost of maintenance and superintendence only permitted of their economical employment where, as in the United States, comparatively strong currents are used. The author admitted, however, that the substitution of dynamos for batteries at the Central Telegraph Office at Paris had effected a saving. The examples of the London and Berlin telegraph offices were cited in support of the economy of accumulators. By employing 12 ampere hour cells on open-circuit lines, and 50 ampere-hour cells on closed-circuit lines at the Vienna Central Telegraph Office, Herr Koeffler makes out a saving of 38 per cent. over Daniell cells in the case of busy wires. He also alluded to the new departure now being made in Germany, where, at the numerous translating stations between overhead and underground lines which exist in that country, accumulators are substituted for primary batteries.

*The *Electrical World*, Feb. 28, 1891.

SAFETY VALVES THEIR HISTORY, ANTECEDENTS, INVENTION AND CALCULATION.

By William Barnet le Van.

(Continued from January number.)

Thomas Adams, of Scotland, constructs a valve with a projecting lip A, as shown in Fig. 21. By applying steam gauges at the points shown on the sketch, he observed that they gave the indicated readings at the time the valve opened, and that then the pressure began to lower, around the valve *first, and lastly in the boiler when the valve suddenly closed.*

In the navy yard trials, six safety valves were experimented on, and all of them, with the exception of the one with 5 square inches, at the pressure of 10 and 20 pounds, afforded sufficient effective areas to discharge the weight of steam generated, and by the following comparison it will be found that

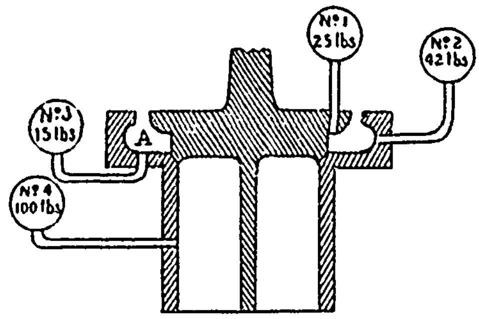

Fig. 21.—Adams Experimental Safety Valve.

the lifts and areas of the several valves *decreased from the lowest to the highest pressure* in nearly an exact proportion, the difference being less than one per cent., viz.

Decrease of lift from

5-inch,	10 to 100 lbs.,	75	– of areas 76	– per cent.
10-inch,	10 to 100 lbs.,	70	" 71	"
15-inch,	10 to 100 lbs.,	82+	" 83	"
20-inch,	10 to 80 lbs.,	82+	" 83–	"
25-inch,	10 to 80 lbs.,	73+	" 74	"
30-inch,	10 to 80 lbs.,	88	88	

The committee found that when very large valves of the common form were used, their action was not satisfactory, as at high pressures the lift is scarcely noticeable. It was found that no practical results could be obtained on the experimental boiler by going above 80 pounds pressure with the larger valves. On a trial of the valve with 30 square inches area at 100 pounds pressure, it hardly rose at all from its sit, but appeared to *tilt* alternately from one side to the other, sufficient to allow all the steam to escape that the valve was capable of generating. It was also found that the lift of the valve of 30 square inch area, at a steam pressure of 80 pounds, was only 0.02 of an inch.

Fig. 22 represents the lever safety valve used in these experiments. This safety valve was carefully constructed, with knife-edges for the fulcrum and valve stem, as shown in the figure. It was found, in experimenting with

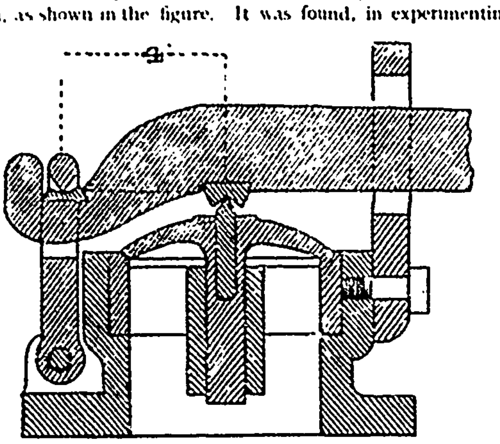

Fig. 22.—Common Lever Safety Valve Used on the Trials.

these safety valves, that the lift decreased as the steam pressure at which the valve was loaded was increased, and by taking these areas of opening, the committee arrived at the following rule for calculating the area of opening, in square inches, required to discharge a given weight of steam per hour.

Let Æ = effective area in square inches.

lbs. = pounds of water evaporated in one hour.

Then, at a steam pressure of

10 pounds per square inch,	Æ = lbs. 0.0011
20	Æ = lbs. 0.0010
30	Æ = lbs. 0.0009
40	Æ = lbs. 0.0008
50	Æ = lbs. 0.0007
60	Æ = lbs. 0.0006
70	Æ = lbs. 0.0005
80	Æ = lbs. 0.0004
90	Æ = lbs. 0.0003
100	Æ = lbs. 0.0002

The committee say that in the arrangement of safety valves for any boiler, or set of boilers, that a number of safety valves are preferable to one with a large area; and they do not believe it advisable to employ a common lever safety valve, with either a bevelled or flat sit, of more than 10 square inches area (say, 3.5 inches diameter). According to their experiments, the lifts of the lever safety valve, when discharging at different pressures, two 3.5 inches diameter valves will discharge *four thousand* pounds of steam (water) in one hour, at all steam pressures from 20 to 100 pounds per square inch; and from which the committee derived the following rule for calculating the area of valve that will give the required area of opening for any particular case.

Multiply the number of pounds of water evaporated per hour by the number 0.005, the product will be the area (A) of the valve in square inches.

The Scotch committee recommend that the lift of the valve in all cases will be equal to their diameter divided by the constant number 36.

THE BEST FORM FOR A SAFETY VALVE.

A safety valve, when raised, presents a greater area to the steam pressure than when closed. Hence, it would be expected that it would open wide, due to the action of the steam pressure on this increased area. But in practice this is found not to be the case; all experiments show that the common lever safety valve lift is very small when the pressure for which it is loaded is reached. At the Washington navy yard experiments, it was found, as before stated, that two-tenths of an inch was the maximum lift on the common lever safety valve.

The committee made trial of twenty-two safety valves sent to be tested; but twelve of them passed a full trial, with two common lever safety valves furnished by the committee. From the experiments made, it was found that the patent safety valves with larger areas of openings than the common lever valves allowed the pressure to increase full as much as the latter. This was, no doubt, due to the complicated forms by which the excessive lift was accomplished, and made it more difficult for the escape of the steam, rendering it necessary to have larger openings for the same weight of steam. The results with the same valve showed great variation in some of the trials. The excessive difference was due to a proper adjustment, and when properly adjusted the best results were obtained. This was the case with both the special and common lever forms.

During these experiments, it was noted that with the common lever form of valves, when the valve opened, the pressure gradually increased to the maximum when the boiler was forced; and when the pressure began to fall, they closed at the points indicated. In the case of all the special form of valves, after the valve opened, the pressure fell below the opening point, the valve sometimes closing several times, and the pressure falling below the opening point several times during the duration of the trial, and sometimes the pressure immediately fell and the valve blew off at a pressure less than that at which it was set during the whole trial.

The following table gives the results of the different valves which passed a full trial—12 in number. Each safety valve was in turn attached to the boiler, and was loaded to blow off at 30 pounds steam pressure, and was operated for ten minutes, with a strong fire in the boiler. The steam pressure was then increased to 70 pounds per square inch, and the experiment repeated.

LOADED TO OPEN AT 30 POUNDS.

Name of Valve.	Area of Valve in sq. inches.	Lift of Valve in inches.	Effective area of Valve in square inches.	Commenced to blow at pounds pressure per square inch.	Open wide in pounds pressure per sq. in.	Seated at pounds pres. per sq. inch.	Kind of Valve on Trial.
Borden	7	0.19	1.11	29	30	26	Combination.
Cockburn	5	0.23	1.82	29	30	27	Disk.
Crosby ..	5	0.12	1 257	29	30	28	Reactionary.
Clemens	5	0.2	1.171	28	30	28	Combination.
Chamberlain ..	5	0.25	1.58	29	30	28	Reactionary.
Hodgin	5	0.37	2 934	25	30	26	
Lynde .	5	0 14	1 11	29	30	27	Disk
Morse. ...	5	0.10	1.42	29	30	27	Annular.
Orme........	5	0.08	0.457	29	30	30	Reactionary.
Richardson.....	5	0.25	1.455	29	30	29½	"
Rochow.......	5	0.21	1 231	28	30	28	Piston.
Common lever.	5	0.16	0.929	29½	30	29½	Disk
" "	10	0.18	1.469	29½	30	30	"

LOADED TO OPEN AT 70 POUNDS.

Name of Valve.	Area of Valve in sq. inches.	Lift of Valve in inches.	Effective area of Valve in square inches.	Commenced to blow at pounds pressure per square inch.	Open wide in pounds pressure per sq. in.	Seated at pounds pres. per sq. inch.	Kind of Valve on Trial.
Borden.......	7	0.10	0.574	60	70	67½	Combination.
Cockburn.....	5	0.15	1.18	69	70½	68½	Disk.
Crosby.	5	0 65	0 729	69	70½	66	Reactionary.
Clemens	5	0.20	1.171	65	70	65	Combination.
Chamberlain ..	5	0.13	0.920	68	70	67½	Reactionary.
Hodgin	5	0.18	1.427	65	70	56	"
Lynde	5	0.07	0.555	69	70	67	Disk.
Morse	5	0.6	0.84	69	70	59½	Annular.
Orme	5	0.05	0.284	69	70	61	Reactionary.
Richardson....	5	0.12	0.691	69½	70	67	"
Rochow.	5	0 21	1 231	69	70	64	Piston.
Common lever.	5	0.11	0 633	69	70	68	Disk.
" "	10	0.09	0.725	69	70	68¾	"

It will be seen from the above table that the patent safety valves, with larger areas of openings than the common lever valves, allowed the pressure to increase fully as much as the latter. This was, no doubt, due to the complicated forms by which the excessive lift was accomplished, and made it more difficult for the escape of the steam, rendering it necessary to have larger openings for the same weight of steam. With the same valve, where the table shows considerable difference, the results where due to a want of proper adjustment of the valve, which, when remedied, the best results were obtained.

With the common lever safety valves, when the valve opened, the pressure gradually increased to the maximum when the boiler was forced, and when the pressure was allowed to fall, it closed at the points indicated. With nearly all the other valves, however, after the valve opened, the pressure fell below the opening point, the valve sometimes closing several times, and the pressure falling below the opening point several times in the course of a ten minutes trial; and sometimes the pressure fell at once, and the valve blew off at a less pressure than at which it was set during the whole trial. This peculiarity is important and not a desirable feature in a safety valve, and the records of these trials fully confirm the opinion of engineers generally that the common lever safety valve, when properly made, is not excelled for the relief of the excess of steam pressure in a boiler.

It is a paradox, that a safety valve at a high steam pressure will lift less in height than at a lower pressure. This is due to the well-known fact that the greater the pressure the greater the velocity at which the steam will flow through an orifice of given size; the high velocity of the steam immediately under the valve will, by the temporary reduction of the volume there, and the consequent reduction of local pressure, cause the valve to sink lower before finding a position of equilibrium. (See tables of the experiments at the Washington navy yard.) The area of opening of the Crosby safety valve, at 30 pounds steam pressure, was 1.257 square inches, and at 70 pounds, 0.729 of a square inch, being 0.528 of a square inch difference. With the common safety valve at 30 pounds pressure, the area was 0.929 of a square inch, and at 70 pounds pressure, 0.633 of a square inch, being 0.296 of a square inch difference.

In the report on safety valve tests, made in 1875 at the United States navy yard, Washington, D. C., by a special committee of the Board of Supervising Inspectors of Steam Vessels, it is stated that an ordinary disk valve with a bevelled sit, having an area of *ten* square inches, will discharge *two thousand* pounds of steam in an hour at all pressures from 20 to 100 pounds per square inch.

The following rule for determining the size of safety valves is deduced from these experiments:

Multiply the weight of water, in pounds evaporated in one hour, by 0.005; the result is the area of the valve disk in square inches.

It is likewise recommended that the area of safety valves should not exceed 10 square inches, and that several valves be employed when a larger area is required for a boiler.

These experiments proved that the ordinary disk valve is not only the simplest in construction, but the most reliable in its action and least liable to derangement. Disk valves are made either with a conical or with a flat sit. It is claimed for the latter, that they are less liable to stick, and that they present a larger opening, with the same lift, than the former. On the other hand, it is objected that it is more difficult to keep them tight, and that the steam escapes with greater difficulty through their opening, since it has to make two abrupt changes in direction. When a wide bearing surface is given to flat-faced valves, they are apt to have a trembling, vibratory motion when they are discharging steam.

Conical valves are most usually employed, the bevel of their seat forming an angle of 45°. With a narrow face, the valve is more easily kept tight and the steam escapes with greater ease than with a wide face. Some authorities claim that a width of one-sixteenth of an inch is sufficient for the sit of a conical valve 4 inches in diameter. The valve and sit are generally made of composition metal. In some of the patent valves the bearing surfaces are formed by nickel rings let into the valve and sit.

The valve is guided either by wings attached to the disk below its sit, or by a central spindle working in a sleeve. The opinions of competent engineers differ as to which of these two devices for guiding the valve is preferable; both are liable to cause the valve to stick when they are fitted too close, in consequence of the lodgement of dirt or scale, or of unequal expansion when steam is raised quickly.

To prevent the canting of the valve in consequence of the oblique thrust thrown upon it by the lever as it lifts, the central spindle upon which the lever rests is often detached from the valve disk; the latter is hollowed out on the top, so that the point where the spindle rests upon the valve lies below the valve sit (see Fig. 23). When the spindle is rigidly attached to the valve disk, it is connected with the lever by means of a short link. The pins or bolts of the articulated joints of the lever and link are often made of composition, to lessen the liability of their becoming fast by rusting, or by getting clogged with grease and dirt. To reduce the friction as much as possible, it is best to make the lever turn on knife edges, case-hardened.

(To be Continued.)

The recent consolidation of the Western and New Brunswick Electric Companies at St. John, N. B., is expected to result in an improved and cheaper service. It is said to be the intention of the new concern to carry out in the spring extensive improvements by which additional power will be secured to operate street cars, and perform any other service which may be required.

Mr. John Galt, C. E., Toronto, has patented a steam or water heating furnace consisting of sections, with means for uniting them and providing circulation of water or steam from section to section, said sections being provided with a fire-chamber in the upper part thereof, with a stratum of water above and around the same, and flues situated beneath said chambers for conducting heated products of combustion therefrom through said section to the outlet.

SPARKS.

The Belleville Gas Co. has added a Thomson-Houston incandescent dynamo.

The Palmerston, Ont., Electric Light Co. has added a 100 light Ball dynamo.

The Welland Electric Light Co. has added to its plant a 750 light Slattery machine.

The Hutton Electric Light Co., of Brampton, Ont., is reported to be in financial difficulties.

The Walkerton Electric Light Co. has recently added two dynamos, a new water wheel and 300 sixteen candle power lamps.

A French inventor named Picard has achieved successful results with simultaneous telephony and telegraphy along the same wire.

The paid up stock of the Vancouver Electric Railroad and Lighting Co. is to be doubled. It is the company's intention to introduce electric heating in residences.

Judge—Well, officer, who is this person, and what is she charged with?

Officer—Sure, it's the "Magnetic Girl," your honor, and she's charged with electricity.—*Puck.*

A local company, of which Mr. Hall is President, and Mr. John Murray Secretary, has recently put in operation a plant to light the streets of the town of Springhill, Nova Scotia.

An arc lighting plant has recently been installed by Mr. Alex Shaw, at Nanaimo, B.C. The city has contracted for 40 lights, and contracts have also been made with twenty-five business firms.

The Ball Electric Light Company are making preparations for an incandescent lighting and power installation at London, Ont., and are receiving good encouragement from the business men of the city.

The electric car service lately opened between Vancouver and New Westminster, B. C., is said to have proved such a success that the Canadian Pacific Railway Company has been compelled to discontinue its trains.

An amusing episode occurred on the electric railway on Thursday. An old lady hailed a car at a crossing and told the conductor she wanted to cure her rheumatism by having an electric ride. She got on board, sat down and proceeded a block. She then stopped the car declaring she was cured and expressed her gratitude to the conductor as she left the car. Ottawa *Free Press.*

Our contemporary, *Electrical Plant*, states that for small stations it has no doubt that the gas engine would be vastly more economical than the steam engine. Prof. Kennedy recently gave it as his opinion that the best unit for a central station should not exceed 200 H.P., for the reason that with engines of larger power it was extremely difficult to keep them fully loaded, while the efficiency of a steam engine of 2,000 H.P. is but little better than one of 200 H.P.

The total number of miles of street railways in the United States and Canada is 11,029, of which 5,442 are operated by animal power, 3,000 by electric power; 1,918 by steam power; and 660 by cable. The total number of cars on these lines are 36,732, of which 25,344 are operated by animal power, 6,332 by electric power, 3,317 by cable power, 1,044 by steam power. It is interesting to note that since November, 1890, the number of horses employed on street railway lines has fallen from 118,795 to 88,114, that is, 28,681 in one year.

The Ottawa *Patent Review* says: If our own experience in the use of the telephone is at all in accordance with that of the general public, the telephone is now practically useless at night. Induction causes a perfect roar with hardly any intermission. The metallic circuit seems to be only a partial cure for it, and at least one patent, having for its object the overcoming of the difficulty, appears to be a decided failure. It is high time that the telephone experts should devote their serious attention to this evil. Would not metallic circuits in well insulated cables laid in underground conduits be the most natural and at the same time the most successful remedy?

The theory of the nature of electricity is now this. Electricity is a wave motion of an assumed ether. When electricity does work, the form of its energy is changed. It is then no longer motion of ether, but motion of ordinary matter. Likewise, heat and light, as we receive them from the sun, are ether vibrations, and when they do work, their forms are changed in one way or another from the motion of the ether to motion of ordinary matter. When electricity is generated, the ether is distorted in such a way as to produce the electric wave, and energy is thus transformed from ordinary matter to ether, and we have electric waves or vibrations which we call the "electric current" or "electric fluid."

The consolidation of the Bell and Federal telephone companies in Montreal has resulted in the raising of the price of that useful instrument, and now instead of its being twenty-five dollars *per annum* it is fifty dollars. A great deal was said at the time of the lowering of the price, and indignation was shown over the fact that the people had been paying much more than was necessary. If these people would stop for one moment and think of the remarkable cheapness of the telephone at fifty dollars, they would cease to be indignant. The price makes it a little less than one dollar per week, and in a store where the telephone is in constant use this is remarkably reasonable. What office boy could be got to do the work in carrying and receiving messages for the same price? Compare the rate of our telephone service with that of any other city and it will be seen that we are favored with a good efficient service at a very moderate cost.—*Canadian Magazine of Science.*

THE RESISTANCE OF THE ARMATURE.

By Fred. H. Colvin.

There seems to be a common mistake among many electrical students, amateur and otherwise, regarding the resistance of the armature of a dynamo or motor.

At first glance the mistake is natural enough, but when the subject is carefully studied it seems incredible that such an authority as Power could announce in a note by the editor, that the resistance was half that of the entire resistance of the wire *wound on the armature.*

We will suppose the armature to be of the usual type with the winding in multiple arc—or parallel as it is often called.

Supposing the whole length of wire to be 2,000 feet, and taking the wire as No. 20. the resistance of the whole wire, if it was in series, would be a little over 21 ohms—call it 20 ohms for convenience of illustration.

As the winding is in multiple the 2,000 feet would be cut in two, making the resistance of *each half* of the winding equal to *10 ohms.*

This is one-half the entire resistance, and here is where too many make the error of stopping all calculations and considering the problem as finished—let it be continued and the true result will soon be apparent.

Each half of the armature winding has a resistance of 10 ohms, and when we connect them in multiple arc we present two paths for the passage of the current.

This is doubling the cross section of the conductor which, it is plain to see, will reduce the resistance offered to the passage of current by one-half, thus making the resistance of the *two* wires, *half* the resistance of the single wire for the same distance

We now have our solution, we cut the wire in two parts and thus halve the resistance, then we place the wires in multiple and again halve the resistance, making it one-quarter of that of the entire winding.

Just diagram the wires on paper and the solution becomes even more apparent. Let the two lines represent the two halves of the armature windings. Connect them in series by connecting either A C or B D, and it is easily seen that the resistance would be doubled, i. e., 20 ohms. As it is in multiple, the length of wire to be traversed by the current is one-half of the whole, or 1,000 feet.

ARMATURE CONDUCTORS.

A	1,000 feet	10 ohms	B
C	1,000 feet	10 ohms	D

We have now reduced the resistance to 10 ohms for each half of the winding, and remembering that the winding is in multiple and that the current divides and flows through each half of the winding, we see that this equivalent to making a two-strand conductor which has twice the cross section that a single strand of the same size has. Now as it has twice the cross section it must be apparent to all that the resistance is reduced to one half.

I have dwelt on this a little longer than necessary perhaps in order to have a clear understanding of this principle which is necessary in order to thoroughly study the action of the machines.—*Northwest Mechanic.*

ADAPTING THE TELEPHONE TO THE POSTAL SERVICE.

Postmaster General Wanamaker of the United States in his annual report says. "A year from next March the telephone patent expires, and unless Congress acts promptly to authorize its adoption for communication among the people, it requires no stretch of the imagination to believe that in the next two years' one immense syndicate will unite and control all the hundreds of telephone plants of the country as the telegraph is now controlled, or the two will be united, and then for the next twenty years the most astute attorneys will be legitimately earning large salaries in indignantly opposing the so called attacks of future Postmasters-General upon defenceless vested rights.

One-cent letter postage, 3 cent telephone messages, and 10-cent telegraph messages are all near possibilities under an enlightened and compact postal system, using the newest telegraphic inventions. The advantage of tying the rural post-office by a telephone wire requiring no operator to the railroad station must be obvious. The benefits arising from telephonic connections with the post-offices will easily suggest themselves in a hundred ways to those who want the entire people to share in common privileges. The rural population would be the greatest gainer. A telephone message from the post-office to the railroad station miles away to ascertain if expected freight had come, would save the farmer many a needless wagon trip over bad roads; news of approaching frosts could be promptly spread over country districts and fruit growing regions, and many a valuable crop saved.

The day's market prices for cattle and grain and wool and produce may be obtained by the farmers direct by inquiry from others than the buyer who drives up to the farm in his buggy. All these may seem homely purposes to dwellers in cities, but country life would lose some of its drawbacks by the extension of such facilities to those who bear their full share of the burdens of the government, and receive, in postal respects at least, less than their share of its benefits."

CENTRAL STATION FIRE PROTECTION.

An insurance company that makes a specialty of writing risks on electric light and power stations has recently issued, in pamphlet form, specifications for an inside hose system and water supply to protect such stations against fire. It has been a generally accepted notion that about the worst thing that could be applied to a fire in a dynamo room was water, but this notion will be quickly dispelled by the requirement of hose and apparatus by the insurance companies. A number of central stations are already thus equipped, but the practice has not been general as it promises to be in the future.

The requirement, as laid down in the pamphlet mentioned, is for a small hose system to be under constant pressure and ready for instant use at all times. *It is recommended that in steam power stations,* with dynamo rooms covering 5,000 feet or less in area, there be two connections in the dynamo room as remote from each other as possible, but in all cases near a door or window. An additional connection should also be put in boiler room for the first 2,500 feet of area, and additional connections each in boiler or dynamo room for each additional 2,500 feet of area in that room. Basements and second stories should be protected in like manner. In water power stations there should be a connection for each 2,500 feet of area, but not less than two in any event.

An important recommendation is that the hose should be kept in laps on swinging racks, instead of reeled. An unimportant recommendation, and, it seems to us, an unfair one, is that endorsing a certain make of hose, when there are a number of firms making as good an article as the brand specified. Central station owners will, doubtless, cheerfully comply with the requirements for hose, but they will insist on buying it where they please.—*Whipple's Reports.*

An Edison Athletic Club has been organized at Peterborough, Ont.

The London *Electrical Engineer* relates the following instance of quick work in telephony between towns. "A public call-room has recently been opened in Tewkesbury by the Western Counties and South Wales Telephone Company. The *Tewkesbury Record* representative was, at the occasion of the opening, put into communication with Cheltenham and a report which we have before us was transmitted for press. It was spoken from Tewkesbury to Cheltenham, in the limit of time allowed to users of the telephone for communication between towns, and is, we think, one of the smartest pieces of telephone work which has ever taken place. There are 700 words in the report, and to communicate that number of words in three minutes indicates a great deal of smartness on the part of the sender and receiver."

SPARKS.

A factory lately started at Trenton, N. J., proposes to use seamless rubber as an insulating material.

The town of Annapolis, Nova Scotia, is to be lighted by an Edison plant owned by Messrs. Fraser & O'Dell.

Now that electrical men have become so ambitious in their schemes for the transmission of energy over long distances by means of electricity, the *India Rubber World* thinks the manufacturers of insulated conductors will have to bestir themselves in order to meet the demand for insulating materials capable of withstanding very high pressures.

For a cash consideration of $5,000 the Reliance Electric Light Company transfers to the Stratford Gas Company their contract with the city, and two miles of wire, poles, and lamps—the remaining fifteen or sixteen miles of wire, poles, lamps, and dynamos to remain the property of the Reliance Company and be removed from the city. Gas Company assumes the city contract on the terms specified therein, relieves the Reliance Company of their contract for power with the North American Mill Building Company, and withdraws the legal proceedings entered to set aside the contract.

According to the New York *Electrical Review*, Chief Barrett, of the electrical department of the World's Fair, is confronted by what appears a unique predicament. He states that owing to the many and rapid improvements being made in electrical machines, most manufacturers are afraid to prepare an exhibit until the last minute. By the time the fair opens two years hence, the fixtures they now have in hand may be, according to Chief Barrett, the most antiquated of "chestnuts."

In an interesting experiment in long-distance telephoning made in Australia during October last, when the postmasters-general of Victoria and South Australia, with their principal executive officers, succeeded in conversing by wire between Melbourne and Adelaide, a distance of 500 miles the instruments of Hunnings and Berthon are said to have been more effective than those of Berliner and Blake. Animated conversation was carried on for over an hour,—during which the chimes of the post office clock in Melbourne were distinctly heard in Adelaide, the chimes in the latter post-office as distinctly answering back. The governments of the two colonies have just completed the suspension of a No. 12 copper wire, over which these experiments were made.—*Practical Electricity.*

Dodge Wood Split Pulley Co.