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STEAM ENGINEERING JOURNAL.

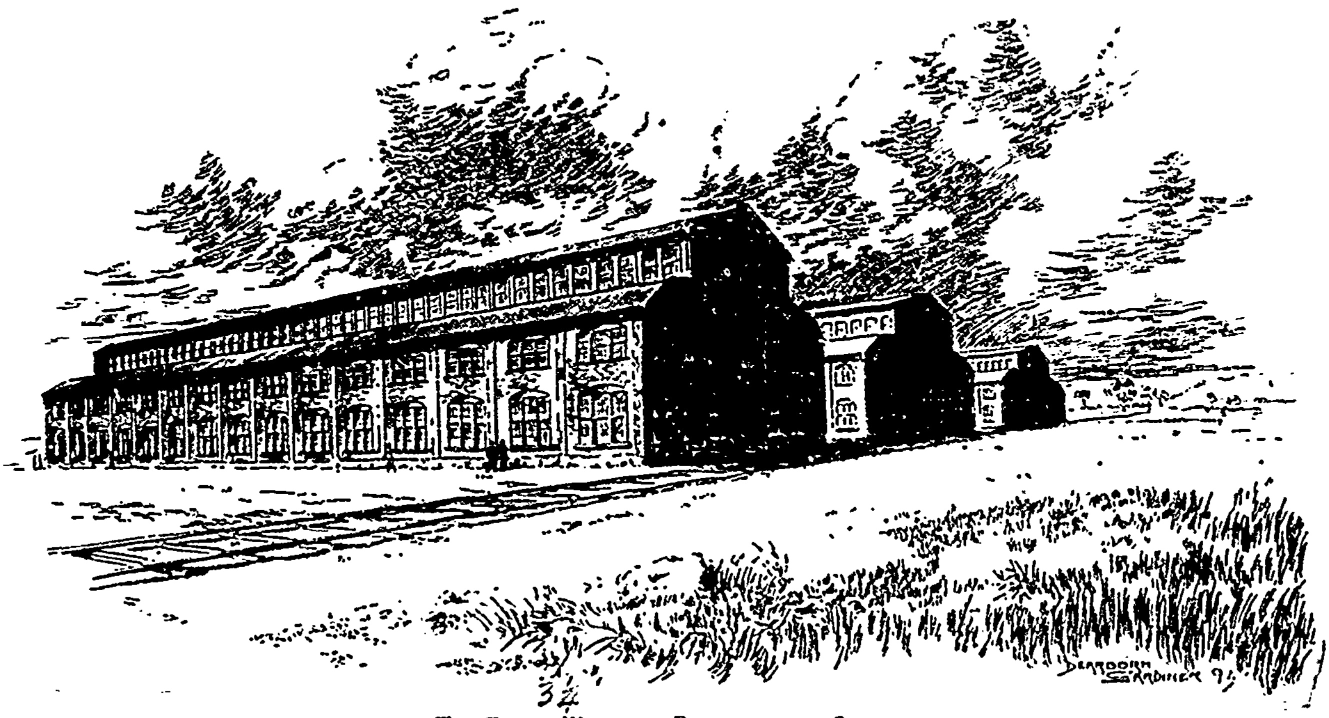
VOL. I. TORONTO AND MONTREAL, CANADA, OCTOBER, 1891. No. 10.

THE EDISON WORKS, PETERBOROUGH, ONT.

THE accompanying illustrations and description of the Edison General Electric Company's new manufactory at Peterborough, Ont., are reproduced from an article in the *Electrical Engineer*, of New York, descriptive of the various branches of the Company's extensive business:

"It is a well-known fact that Edison lamps and other electrical apparatus are now being made and used all over the world by various corporations, as the result of the exploitation of the patents secured. But in the growing Dominion of Canada, whose relationships with us are already so numerous, the Edison General Electric Co. is carrying on the business itself. From a very small beginning, with only a dozen men in February, 1888, the Company has already come to employ hundreds of skilled mechanics, and is now concentrating its productive energies in a huge new factory at Peterborough, Ont. These Canadian Works are in many ways a replica of the vast shops at Schenectady. The property consists of about thirty acres of level ground, and the main building is without a doubt the finest machine shop in the provinces. It is 110 feet wide, 272 feet long, with a gallery of 25 feet on each side, and a central height of 60 feet. In it are employed about 400 hands engaged in the manufacture of dynamos; motors for stationary power and electric railway purposes; mining locomotives; underground conductors; various small electrical instruments and appliances; electric cables and insulated wire. When the other buildings are finished, this will be used exclusively as a machine shop at once, and with that end in view it has already been equipped with a 10-ton travelling crane. Two other buildings, one 50 feet by 272, two stories high, and the other, 50 feet by 272, one storey, are in course of erection, and when finished will be occupied by the wire insulating and cable department. A power station is also in process of construction, with an ultimate engine and dynamo capacity of 1,000 h. p. In the distribution of power the same methods are followed at Peterborough as at Schenectady; namely, all the power is transmitted electrically by means of underground conductors, and each shop is provided with an Edison motor to drive each main line of shafting. This mode of distributing power is at once a great convenience and a great economy, since the motors are entirely automatic and require no attention.

But this does not exhaust the plans. Two new buildings for the lamp factory, two for the carpenter and pattern shops, two for underground conductors, a second machine shop, iron foundry, brass foundry, office and store house are already laid out, and will soon constitute an imposing suburb, with the others, to the prosperous little city of Peterborough. The works have, moreover, direct railway connections with the Canadian Pacific and Grand Trunk railroads. These connections are for the exclusive use of the company and unite with four tracks running parallel between the two rows of buildings throughout the entire length of the property 1,800 feet. Besides these steam railway connections there are railroad tracks connecting all the buildings, over which loaded hand cars may be run to any portion of the establishment. The Dominion may well be proud of this addition to its manufacturing industries.



THE EDISON WORKS AT PETERBOROUGH, ONT.

The recent catastrophe at Moenchenstein called attention to Riess's process for rapidly repairing ironwork by electric welding. The *Revue Industrielle* devotes some considerable space to showing how admirably this process works when applied to the repairing of various iron structures, rails, etc., that have become damaged by accident, and which, owing to the circumstances of such cases, required to be very rapidly repaired because of the traffic.

STEAM ADMISSION.

III.

IN the last paper the action of steam on the engine piston was considered from the point of view that when the exhaust valve opens to allow the steam to escape, the pressure in the cylinder should not be *below* that into which it is to discharge, and should be only a little above that pressure. From this way of looking at the matter, the size of engine required for any given horse power can be determined when the speed of engine and pressure of steam are also known.

There is, however, another aspect of the part of the working of the steam engine which should not be overlooked. In the ordinary crank engine, the piston as it moves back and forth in the cylinder, has a constantly varying rate of speed, and at each end of the cylinder the motion stops. The piston, piston-rod, cross head and part of the connecting rod, all partake in this rest, and change of direction and rate of speed. They are called the reciprocating parts, and their weight has much to do with the smooth working of the engine.

In order that an engine may work smoothly, the bearing sur faces must fit fairly, and be of such size that when the greatest pressure is on them, there may still be a film of oil between the metals. The crank pin is one of the most troublesome parts of the engine It should be fair to the bearing in the connecting rod at every part of the revolution, and all who have had to do with engines know how difficult it is to get this, especially when an engine is being used with steam of high pressure, as only a very little bending or yielding of the frame is enough to make the crank pin out of truth in its bearing.

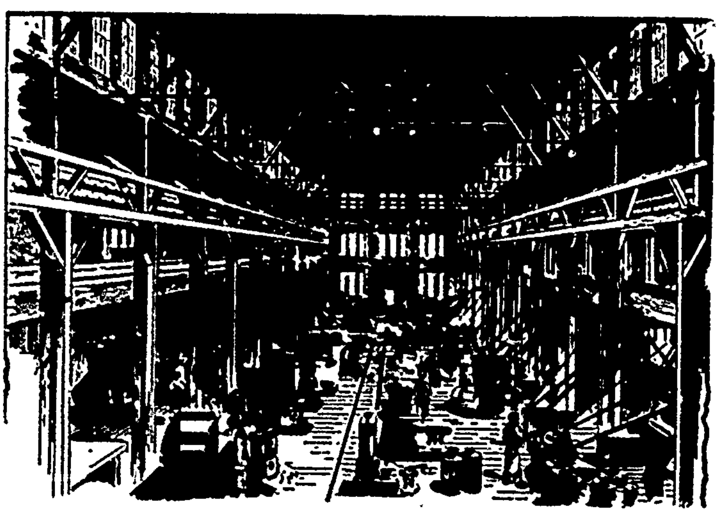
At the end of the stroke when steam is admitted and is at the highest pressure, the pressure passes straight through to the crank pin, and the pressure on the crank pin could be easily determined were the whole at rest, but, though the reciprocating parts are at rest, the crank pin is not, but is moving on in its course at its regular speed.

The pressure bears on the reciprocating parts and some of it is absorbed in producing motion in these parts, and the heavier they are the less the pressure in the crank pin during part of the stroke. The speed of the reciprocating parts gradually increases till at about half stroke, it is about the same as that of the crank pin. The power absorbed by the reciprocating parts during this time is equal to their weight lifted as many feet high as would be necessary in order to produce their velocity by falling. This can be calculated by the rules relating to the velocity of falling bodies.

So soon as the highest speed has been reached, it at once begins to slacken until it ceases at the end of the stroke. During this part of the stroke the reciprocating parts increase the pressure in the crank pin by the same amounts as they diminished it in the first part of the stroke, and the heavier they are, the more they increase this pressure.

By adjusting the weight of the parts for a known pressure and load, it is possible to have the engine working with an almost constant pressure on the crank pin.

It will be found a useful study to take an indicator diagram, and dividing it into about six parts, calculate the speed of the reciprocating parts at each point, and their effect on the pressure on the crank pin. If the reciprocating parts after half stroke are gradually losing speed, why keep up the steam pressure in the cylinder endeavoring to make them go faster, while the very construction of the engine compels them to go slow? Would it not be better to make the steam pressure so high and the reciprocating parts so heavy that the work could be done in the first half of the stroke and the exhaust opened almost immediately after half stroke?



MACHINE SHOP, EDISON WORKS, PETERBOROUGH, ONT.

DETERIORATION IN BOILERS.

"ONE very important cause of deterioration in boilers is due to their becoming too small to do the work without forcing, so that the pulsations of the engine cause a well marked succession of shocks on the boiler, which result in the weakening of the material."—*Journal of Commerce*, Aug. 28, 1890

The above statement, if true, would be a most alarming one. Boilers are made of steel or iron plates, and a "succession of shocks results in the weakening of material!"

Railway bridges are also made of steel and iron plates, and every time a train crosses a bridge there is a "succession of shocks," and the material ought also to be weakened and in a short time the bridge will fall!

Many buildings are now erected with steel girders carrying the floors, and every time a man walks across the floor there is a "succession of shocks," and if this weakens the material, the man has only to keep on walking and down will come the building.

When a metal beam or bar is subjected to a load or to a shock, there is a tendency to change the form or to bend the beam. When the load is removed or the shock is over, the beam will resume its original position unless the strain produced by the load or shock has been in excess of what is sometimes termed the elastic limit of strength of the beam. If the strain be within the elastic limit, it may be repeated an infinite number of times and yet there will be no evidence of any weakening of the material, but if it be in excess of the elastic limit, it has only to be repeated a sufficient number of times to break the beam.

However, there is another feature of the action of the metal which must not be overlooked. It is that the limit of elasticity is not constant throughout the succession of shocks required to break the beam. After the load has been several times applied and removed, it is found that a greater weight is required to produce the same amount of bending; that is, the limit of elasticity has been increased. It is, however, a question whether or not the safety of the beam has been increased.

In the case of a steam boiler, it will be more intelligible if a definite example be considered. Let the boiler be sixty inches in diameter and made of steel plates 5-16 inch thick, double rivetted in longitudinal seams, and carrying a steam pressure of 120 lbs. per sq. inch, what is the strain upon the metal? Is it below or above the elastic limit of the metal?

The weakest part of the shell is the rivetted joint, but at that point the limit of strength is not the tensile strength but the shearing strength of the rivets, and of the metal between the rivet holes. The strain produced on the metal of a shell sixty inches diameter and 5-16 inch thick, 120 lbs. pressure, will be equal to about 11,520 pounds per sq. inch. The strength of boiler steel may be taken at 60,000 pounds, and the elastic limit at certainly not less than 25,000 pounds, so that to produce a strain equal to the elastic limit, the steam pressure would require to be about 260 pounds per square inch. The ordinary working pressure is not in excess of 120 pounds, and it must be a very unusual and remarkable arrangement of engine the pulsations of which could possibly produce a "succession of shocks" of sufficient force to raise that pressure to the amount necessary to affect the strength of the metal.

Engineers in charge of steam boilers and engines have troubles enough to contend with in keeping things right, without giving their nerves a "succession of shocks" over the idea that every stroke of the engine is weakening the plates of the boiler.

Mann Bros., electricians, Montreal, suffered a slight loss by fire on the 27th inst.

Mr. Westhead, engineer of the McClary Mfg. Co.'s works at London, was severly injured a few days ago, by being struck by the fly wheel. He is recovering.

THE MONTREAL CONVENTION.

THE formal opening of the fourteenth semi-annual Convention of the National Electric Light Association of the United States took place at the Windsor Hotel, Montreal, at 3 o'clock on Monday, the 7th of Sept. The attendance, which included a number of ladies, is said to have been the largest which ever assembled under similar auspices.

The presiding officers chair was occupied by Mr. Huntley, of Buffalo, President of the Association.

A cordial welcome was extended to the delegates on behalf of the city of Montreal by Prof. Bovey, Chairman of the Citizens' Executive Committee, Mayor McShane, Sir Donald A. Smith, Sir J. W. Dawson, principal of McGill University, Alderman Wm. Clendenning, ex-Mayor Beaugrand and Alderman Cunningham.

Sir Donald Smith, in his remarks, said he was "one of those who believe that a meeting of the people of different countries, and especially those who are neighbors, as we are, and have such constant and such great relations with each other in trade and in every respect, cannot but clear away many of those cobwebs and many of those ideas which we have had each of the other and which were entirely erroneous."

President Huntley, in his reply said: "For the first time in its history the National Electric Light Association meets on other than its native soil. Yet even in so doing it but adds new evidence to the feeling in the breast of every electrician, that his art is foremost among the influences tending to promote human intercourse and break down the walls of separation," and he added, "If the earnest and practical quality of our dealings with the great questions of electricity shall in any wise stimulate electrical work in Canada, and lead to the electrical utilization of its great water powers and coal beds, in light, locomotion power and heating, we trust it will be accepted as at least some slight acknowledgement of the manner in which we have been so generously greeted."

General Knapp, U. S. consul, Judge Armstrong and Mr. Erastus Wiman, also responded. The latter, among other things, said. "I doubt if any system in the world is more perfect than the system of telephones in Montreal and Toronto. I doubt if any city in the United States has such a development of that marvelous instrument as those two cities have. As to the telegraph service, somewhat connected with it as I am, I believe I may say that there is a larger mileage of wire, a greater number of offices and a greater number of messages transmitted in proportion to the population in Canada than in any other country in the world taking distance into consideration; so that in telephony and telegraphy electricity has found, on this continent, in this Canada of ours, its greatest development. I would like to say to Canadians, though, that in certain things in the United States a greater progress has been made than here, and that is one idea I had in asking to speak to you to-day, namely, that I should draw your attention to the marvelous growth in the United States of the use of electricity in the street railway. It seems to me that no one thing has grown with such rapidity as the value of real estate wherever there has been an electric railway introduced. * * * I want to impress on my friends in Canada the advantage that the electric system has in the transmission of power. I was in Boston on Friday and stood in one station which has a capacity of 20,000 horse power. It seems to me I do my duty as a former citizen of this place and still somewhat interested in it, in drawing the attention of the residents here to the fact that they possess the potentials of power almost beyond any city in the world. In the great rapids, above them and below them, are forces which, if applied by electricity, would be of the greatest advantage. I know of no city that has such enormous facilities for the creation of electricity as this city has. I know of no place in which power can be transmitted so perfectly and completely as in this city, so that a delicate wire running over a house might work a fan in a sick room, and in the next block might lift a trip hammer; so that a sewing machine, or half a dozen of them, or fifty of them, or a factory, could be run from the St. Lawrence and Ottawa by the transmission of this power. An optician might grind the most delicate piece of glass in a small lathe before him, and even the running of a sewing machine and the rocking of a cradle might all be done by electricity. * * * So far as the city itself is concerned, I have the belief that your presence here will stimulate and draw attention to this question of not only having every street equipped with electric railroads, but making every ripple on the rapids contribute to the wealth of the city. I cannot but think that the great progress that electricity has made and your presence here will bring popular thought and popular opinion to bear on this question of the use of this tremendous force that lies now idle, so far as its transmission is concerned. If that should occur, it would all be attributable to the fact that the National Electric Light Association held its meeting in the city of Montreal. Montreal has facilities for manufacturing greater than any other city in the world. It has got raw material at its hands; it has got the cheapest and the best labor; it needs only the touch of electricity to make it the greatest city and this the greatest country under the sun."

President Huntley delivered the following address:

My predecessors in this chair have seen the association advance in strength and worth, outliving trials and vicissitudes, to emerge on a wider, larger field of usefulness and opportunity. I do not believe that there is another industry in the world which has passed through such quick stages of evolution as ours, and become so soon established in popular favor and general prosperity. But we must not assume that because electric lighting has set its feet upon the rock and laid its deep foundations, nothing more remains to be done save pursue the policy and practice of the past. On the contrary, I deem it necessary to say here that my own responsibilities as a central station manager compel me, as never before, to be watchful of the tendency of conditions and inventions in the art, so that I may in any degree profit from my own hard won experience. If, as central station men, we are to secure adequate return on the investment committed to our care, it becomes us in every way to study closely all the ideas that will give higher efficiency of plant and higher economy in operation. There was a time when some of us expected to grow rich out of abnormal prices. To-day there is not one of us who does not know that his hopes of dividends lie wholly in the skill with which the best business ability and the soundest engineering are applied to the work in hand.

I take it that it is now pretty well recognized among intelligent station managers that the day has passed when they can limit themselves to one class of services or apparatus to the exclusion of all others. To obtain the fullest measure of sucess and the largest return from the capital invested, they must be ready to supply any demand made upon them, as a result, the successful station, even to-day is gradually assuming a composite character. This compositeness is manifesting itself first in the variety of apparatus, as a result of the selection of the machines best adapted to a given class of work, and independent of any particular system. One cannot help seeing in this change from early practice a step toward increasing efficiency of station operation, as well as a good reactive effect upon the manufacturers of apparatus, who are thus all placed on a common basis of competition. But besides a compositeness in detail, signs are not wanting that no one method of distribution from a central station can, in the large majority of cases, be adequate to the demands that are made upon us, and that to meet them in a manner to insure a profitable business requires a flexibility and variety in methods of distribution, the full extent of which is to-day hardly recognized. To reach the full limit of usefulness the central station should avail itself of methods which, I believe, will finally resolve themselves into what may be called the "zone system" of distribution.

The idea embodied in this zone system can best be explained, perhaps, by taking a concrete, practical example, and for this purpose the present occasion makes the city of Montreal an interesting one. Setting aside for the moment the possibility and even the probability of the transmission of electrical energy to the city from the power obtained at the Lachine rapids, we will assume a station erected at the water front of the harbor. It will, I believe, be granted that up to within a distance of one-third mile radius, the three-wire low tension direct current system of distribution answers fully every requirement of simplicity and economy, and hence if, with the station as a centre, we draw a circle having a radius of one third mile, we shall have a "zone" supplied in the most economical manner for every class of light and power apparatus now familiar to us.

Coming to the districts beyond the first zone, we are necessarily obliged to have recourse to higher potentials for the feeders, and the selection of the proper potential is a matter of simple calculation. We may, for the sake of this argument, call it 500 volts. Continuing on in this way, in steps of 500 volts, successive zones, half a mile across, might extend, in the aggregate, to several miles without reaching the limit of potentials which have been found to be perfectly feasible in practice.

In the example no reference has been made to the nature of the current employed or to the method of local distribution. Evidently we may readily resort to the alternating system, employing converters to reduce or raise the potential. Perhaps some of our new school of electrical engineers will show us how to use the same circuits for both alternating and direct currents.

But, whatever system is employed, I deem it proper to record here my conviction that the most economical way to distribute the current to the consumers at the point of delivery is by low pressure conductors, in contradistinction to the plan now generally in vogue of giving each customer a converter of his own or, in the direct system, a separate motor dynamo. I need not here enlarge upon the train of reasoning which has led me to this conclusion, but I may remark that I am strengthened therein by my own experience in Buffalo, where we are now introducing gradually 200 light converters and replacing the smaller ones heretofore employed. Nor do we propose to stop there, but expect to install converters of still higher capacity, distributing the current to a number of customers by low pressure mains centering at the large converters. As addressing myself to practical men, I need not refer to the fact that it costs practically no more labor, &c., to put up a 200 light converter than it does a 10 light, while the initial cost per light is less in the case of the larger converter. In these conclusions I am only recommending for large American areas what, I believe, is recognized abroad by Ferranti and others, whose work, like our own, will eventually lead to the establishment of large converter sub-stations from which low tension wires will supply the surrounding districts.

The allusion made to the motor-dynamo system for converting the direct current from high to low potential may to some appear nothing more than the citing of a possible method in view of the existence of the alternating system, well tried and ready at hand. But without wishing in the least to detract from the merits of this system, which has probably done more to popularize electricity than any other, I cannot, as a practical man, conceal from myself the fact that, taking everything into consideration, the low tension direct current system of distribution is the most flexible within its area, and serves the greatest variety of purposes. I do not think that any one can successfully contradict the assertion that to say no other system can, with equal efficiency, take care of arc and incandescent lamps, motors, large and small, storage batteries, electric heaters, &c.

In making this statement I desire to be understood as referring to the present condition of the art, the only condition which, as practical men, we ought to consider in matters of this kind, but I hope the time will soon come when the same can be said of the alternating system. There are still other methods which suggest themselves, by which the "zone" system could be effectively carried out, but those indicated are sufficient to demonstrate the idea I have endeavored to convey.

After the intelligent station manager has decided upon the nature of his apparatus and the initial capacity of his station, his most important consideration is the allowance to be made for future growth. Look back, some of you, and recall the mistakes made, but which were brought about by the enormously rapid growth of the industry. I need not go out of my own experience for such an example. Less than two and a half years ago we erected in Buffalo a new station considered far too large for even the most extended future growth. Some of my colleagues shook their heads. Yet even to-day it is being worked to its fullest capacity, and provision will soon have to be made for more facilities.

What, then, may be asked, shall we determine upon as the unit time limit of growth for which provision should be made? Shall we build our stations sufficiently large to take care of the demands of five, or ten, or twenty years hence? This is a most serious question, and one to my mind as important as the selection of the proper station apparatus itself. I note the erection of several stations abroad, and some here, designed to supply the demands some 15 or 20 years hence. Without wishing in any way to detract from the laudable enterprise and faith exhibited by the promoters of these stations, a calm survey of the past, present and probably future condition of the art leads me to believe that the setting of so long a time limit as 15 or 20 years is inadvisable. I need not remind you in detail of the changes in methods and apparatus which have been effected during the last five years, by which the efficiency and output of our stations have been increased. And if to this we add the fact that already new methods, such as those pointed out by Mr. Tesla may at any time increase the present lamp capacity of our stations five and tenfold, I think we may be justified in placing five years as the limit of time, to make provision beyond which may involve expenditures, the benefit of which may not be realized.

These are matters we are endeavoring to settle for ourselves. It is to our interest to settle them. So too, with the underground question; but there we have gratuitous advice, assistance and abuse to such an extent that less progress is made than in any other part of the work. We all want to put our wires underground where the number is so great as to make them unsightly or unwieldly and not a few of us have been parties to experiments now written off to profit and loss. As soon as the time arrives when every house has its wiring as a matter of course, just as now it has piping for water and gas, it will be a comparatively easy matter to lay down comprehensive underground systems. But at the present time the customers for current are scattered and not continuous. The man with enterprise enough to take electric light and power soon moves into a larger store. His successor does not want the service, but gropes along with kerosene or spoils his goods with gas. Cutting out disused underground services is an added risk and expense and ten lights could be installed on overhead circuits for ten dollars, where with underground the cost would be fifty. It follows that in any city—Buffalo, for example—we shall not make one underground connection, where with overhead wires we shall have made twenty. Now, are the public or are we the greater losers? The public, I think. It is as unreasonable in most instances to demand underground wires as it is to expect every railroad to make every crossing above or below grade. But for our overhead wires, America would not be to-day the great land that it is of electrical triumphs; and, while I hail with delight every advance in the solution of the underground problem, I hope long to gladden my eyes with the sight of a pole well set and a wire well strung.

Another stirring question of the hour is that of municipal ownership. Now, it has been taken for granted that electric light men are against this plan, tooth and nail. How absurd that notion is! Because we represent the latest development of invention and industry, we certainly do not forfeit our pride as citizens, nor lose our interest in the advance of social science. It would, in fact, be difficult to find a more progressive, well known body of men in America to-day than they who have put their money and energies into electric lighting. They are neither crusty nor cranky. But when any movement has been started for the betterment of the communities in which they live, some of them have been at its head. Now, is it strange that such men should object to the confiscation of the properties they have built up and that are beginning to pay? Is it strange that they should ask for these new theories in social economy to be tried on something else first? Many of them have grave doubts as to the accuracy of the figures that are supposed to prove that municipal plants pay. Others of us have great objection to any taxation, the proceeds of which are to set the municipality up in a commercial business; others again believe that the best results are reached in an industry when it is freest from political influences and is left to the uplifting and perfecting impulses of individual enterprise.

I believe that the most conclusive answer we can make to the sophisticated arguments of an ill disguised socialism, presenting itself in this municipal ownership scheme, is to give the very best service possible at the lowest rates compatible with fair profit. Some of the prices we now obtain are so low as to exclude any profit at all, especially when repairs and reconstruction are considered. But here again we may help ourselves out by native wit. Every company in the ranks of this association ought to ascertain for itself at regular intervals just how it stands as an industry. A good deal of apparatus in use is decidedly inefficient. Overhaul it. If necessary, throw it out and put in better. Above all, adopt a good system of book-keeping. Electric light securities are to-day far from enjoying the esteem in financial circles that they deserve. This is due in a measure to speculative investment and to over capitalization in the past. But it is also attributable very often to the poor system of accounts employed, and I am glad to see the subject thus receiving attention. If we know what our current costs, we know what we can sell it for, and unless that information is obtainable from our office books, engineering will go for naught and capital required for new work will stand aloof.

In conclusion I would urge that the association determine upon meeting only once a year. Even if it were not impossible to recover in six months from such overwhelming hospitality as we are now the recipients of, I believe that the time has gone by when half yearly meetings were necessary. Once in twelve months is often enough for us to come together for the comparison of our experiences and the report of further refinements in the detail of the industry. The mere fact that frequent reunions are no longer necessary is in itself a hopeful sign for it tells of stable and settled conditions and of activities that now require our presence at home pretty much the year around.

Gentlemen, I thank you for your attention, and I trust that your deliberations in the coming week will be characterized by the same earnestness which has marked them in the past.

Invitations were received and accepted to visit the museum of McGill University, the Montreal Art Gallery, the works of the Quebec & Levis Electric Light Co., and take a trip down the Lachine Rapids. The Convention reassembled at 10 a.m. on Tuesday, and received a report from a Committee on the revision of the constitution, recommending that no changes be made in it.

A discussion followed on a motion by Mr. Weeks that the Committee on relations between parent and sub-companies be instructed to formulate a definite plan of procedure for the protection of central station companies, and to prepare the necessary articles of agreement, and report the same to the Association in executive session at its next Convention.

The Committee on data presented a partial report and asked permission to continue its labours, which was granted. The concluding paragraph of the partial report referred to, states: "One electric company has found it advantageous to make a thorough test of all the leading steam engines and boilers offered for this purpose. Our organization offers great advantages over individual or corporate enterprises in this direction. We have almost every type of equipment in use, and it only remains to record the performances to make the advantage of membership in this organization as apparent from a purely financial basis as it now is on the basis of education and social enjoyment."

Mr Hornsby, representing the World's Columbian Exposition, as Secretary of the Department of Electricity, reported what had been done and is proposed to be done to render that Department interesting and instructive.

Mr. Francisco read a report on underground conduits.

The business sessions on Wednesday and Thursday were devoted to the reading and discussion of papers.

The Secretary's report, presented on Friday, showed an increase in membership from 172 to 220. The report suggested that the Committee on data be increased in its membership and that the collection and distribution among members of important facts, figures and details relating to the furnishing of light, heat and power be carried out systematically and persistently throughout the year.

Dr. Mason offered the following resolutions, which were unanimously adopted by a rising vote:

The National Electric Light Association, assembled in Montreal, at the close of its session desires to put upon record its appreciation of the distinguished honor shown it by the Dominion of Canada in the presence of His Excellency, Lord Stanley of Preston, Governor-General of the Dominion,

Of the large-hearted hospitality of the city of Montreal, evidenced by many graceful acts, official and individual;

Of the tireless industry of the Citizens Executive Committee, whose efforts have carried to completion the most successful meeting in the history of this body;

Of the grand work done by the Committee on Exhibits, issuing in an exhibition of great educational value calculated to develop a larger appreciation of the flexibility of electricity, and its wide adaption to human needs;

Of the gracious liberality of McGill College, which has lent the great dignity of its name and the personal influence and labor of its officials to the success of our meetings;

To the press of the city, whose extensive and fair reports of our meetings have extended our influence;

To the railway companies for their liberal reduction in fares, and to the Windsor Hotel management, where as guests we have found a home.

Resolved, That the above minutes be placed on the records of the Association, and a certified copy thereof be sent to the various bodies mentioned.

The following resolution was also adopted:

Resolved, That a vote of thanks be tendered J. I. Gulick for the efficient and successful management of the exhibition now being held under the auspices of this Association, the largest ever held on this continent.

And that the Secretary be directed to have this resolution engrossed and presented to Mr. Gulick.

On motion of Mr. Seely, seconded by Dr. Mason, a vote of thanks was extended to Luther Stieringer and Allan R. Foote.

Frederic Nicholls, M. D. Law and A. M. Young were elected members of the executive committee of the third class.

Dr. Mason gave notice of the following amendment to the constitution—that in the first article the word "International" be substituted for the word National, so that the title of the Association would be the International Electric Light Association.

Buffalo was selected as the place for holding the February meeting of the Association.

The Convention then adjourned.

NOTES.

Messrs. Robt. Mitchell & Co., of Montreal, made an interesting display of artistic fixtures.

The Royal Electric Co. supplied power for a number of the exhibitors, but did not make a display of their goods.

The *menu* of the closing banquet was very much below the standard, and the same can be said of some of the waiters.

Messrs. Robin & Sadler's exhibit of leather belts manufactured for the Royal Electric Co., attracted considerable attention.

A miniature model of Dansereau's electric wire subway, recently illustrated in the ELECTRICAL NEWS, was exhibited by the inventor.

Mr. J. Fitzgerald, of Montreal, displayed combination gas and electric fixtures to which were attached the universal bracket joint, of which he is the inventor.

Prof. Bovey's little daughter pressed the magic button by which the electric current was switched on and the machinery and lamps in the exhibition set in operation.

The Toronto Construction and Electrical Supply Co. had a large and interesting exhibit, in charge of Mr. Nicholls, the manager, and his assistants Messrs. G. C. Stanuard and A. J. Christie.

T. W. Ness, of Montreal, displayed in attractive form a variety of electrical novelties and supplies, including telephones for attaching to office desks, and a sewing machine operated by an electric motor.

The most prominent subject of remark was the royal hospitality of the citizens of Montreal. Never in the history of the Association have the delegates to a convention been so elegantly entertained.—*Electrical Review.*

To General C. H. Barney, Manager of the exhibition, and

Mr. J. I. Gulick, Chairman of the Exhibit Committee, is due the credit of reducing the amount of "friction" in connection with the running of the exhibition to a minimum. There were few, if any, "hot boxes."

The Dominion Wire Mfg. Co., of Montreal, had an attractive exhibit to the left of the main entrance, consisting of galvanized telegraph and telephone wire, hard and soft drawn copper wires and stay wire, brass wire, iron and steel wire in bright, annealed, galvanized and tinned.

The Ball Electric Light Co. was a little late in arriving, but their exhibit under the skilful management of Mr. W. A. Johnston and his assistants was soon put in order. The exhibit embraced 4 ampere double armature arc light machines, Bernstein incandescent lamps, Wenstrom generators and motors, and a general line of supplies.

The word "Phillips," composed of 16 candle power incandescent lamps, surmounted the exhibit of wires and cables by the Eugene Phillips Electrical Works, of Montreal. Mr. John Carroll, manager of the Company, was one of the most active personages in connection with the exhibition and Convention.

The Canadian District of the Edison General Electric Co. occupied by far the greatest amount of space allotted to any exhibitor. It was conspicuously located in the centre of the building. Mr. Barr, district manager, assisted by Mr. W. W. Bremer, district engineer, and Mr. W. R. Rosenstengle, represented the Company's interests.

The Fort Wayne Electric Co. was represented by its Canadian agent, Mr. W. J. Morrison. The Company had a very handsome exhibit, consisting of a 750 light, compound wound alternator and a 15 light arc machine, operated by two Armington & Sims engines located in the Windsor Hotel. During the exhibition, Mr. Morrison booked an order for a 60 light plant.

The *Electrical Age* with becoming modesty asserts that "a greater number of those present took more interest in the daily edition of the *Electrical Age* than in any other one thing that brought them to Montreal." With not less becoming modesty it may be said that the Convention Number of the CANADIAN ELECTRICAL NEWS, of which several hundred copies were judiciously distributed at the Convention, met with a very favorable reception.

About fifty of the delegates paid a visit to the city of Quebec on Saturday, under the pilotage of Mr. A. J. Corriveau and Mr. Mohr, of the Quebec Electric Light Co. A very pleasant time was spent in viewing the many points of interest, including the wonderful falls of Montmorency, and the lighting station which receives its power from the falls. On behalf of his friends in the National Association, Messrs. W. J. Morrison, A. F. Mason and W. J. Hammer presented Mr. Corriveau with a gold-headed cane, accompanied by a letter expressive of appreciation of his efforts on behalf of the pleasure of the visitors.

HINTS TO ENGINEERS.

By "EXPERIENCE"

THERE are engineers who are engineers, and engineers who are not. Suppose, for instance, we take a walk around town a little to see some of the steam plants. We walk into an engine room, the floor of which is covered with oil and grease, with waste packing, wrenches, etc., lying all around the place.

Next we take stock of the engine, that is, what we can see of her, for steam is leaking out of every joint, and she is in such a filthy condition, that one cannot discern the (that once was) bright part of the motions from the frame. Along comes the engineer, and he will be in keeping with his surroundings, and will very likely launch out in something after this style. "Pretty dirty hole this, ain't it? Oh, well, it suits the boss, and you can bet your life it will suit me. If he don't care, I don't see why I should." And so this engineer goes on week in and week out; all he looks forward to is shutting-down time and pay night, and in too many cases, a plentiful supply of bad whiskey.

Now for the better side of things. We will suppose that for some reason or other the aforesaid engineer leaves this job and another man comes on to take charge. Now this man, being a go-ahead kind of fellow, takes stock of the place, and sees what a filthy state things are in, and makes up his mind to go to work and clean up. He goes to his employer and asks for an order on the supply man for some waste. Instead of receiving the order he gets something after this style: "What do you want waste for? The engineer who preceded you did not want any, and I don't see why you should."

Now just at this time is where this man scores a point. Instead of sulking around, and saying, "Oh, well, let her rip," he goes home and asks his wife for some old rags (some men have bought waste themselves; the writer himself has, and to-day does not think he lost a cent by so doing), and commences to clean up his machinery, boiler fronts, and the windows around the engine room, through which little light has penetrated for many a day, being excluded by a thick coat of dust and dirt on both sides.

After he has got so far, he turns his attention to the engine room floor, and scrapes up the dirt and grease and gives it a thorough scrubbing with water and soda or lye.

By this time, things are beginning to look somewhat improved. Bye and bye the boss comes along, and very often he will take in the situation at a glance and think to himself "So this is the kind of man he is. Well, now, that is an improvement, and I guess we will have to give him some encouragement!"

It is possible he may say something after this fashion. "Oh, by the way, engineer, you were speaking about getting some waste the other day. If you will call at the office, I will leave an order there for you to get some."

Of course I am aware that there are some steam users who do not care how their plants are run – whether they are kept clean or dirty--and this kind of employer never gives a thought as to whether his boiler is evaporating a fair amount of water in proportion to the quantity of fuel consumed. Such trifling affairs as these never bother him, because he is satisfied if he can keep his machinery running all day, and can manage to get a man to run his steam plant at a wage less than a common laborer. He has not common sense enough to see a goodly part of what should be his profits are going off up the smokestack, and through leaks, pistons and valves in the engine. But if we take particular notice, we shall, as a rule nowadays, find an employer of above stamp, and an engineer like the first mentioned in this article, in the same establishment, and it is right that it should be so. Thank goodness, this kind of employer and engineer are getting more scarce every year.

The coming successful engineer is the careful, thinking, studious man, who takes a pride in his engine and boiler room, and who makes the best use of his spare time in studying up electricity, for this is a subject that the engineer will have to tackle sooner or later. Even now, the dynamo has found its way into many engine rooms in our factories, and who but the engineer should be called upon to care for it.

Do not get disheartened because your employer does not appreciate your efforts to keep your plant clean and in good order, but rather strive all the more, because, if he does not appreciate your labor some one else will, and your plant will be talked about around town, and bye and bye some firm will be putting in a large and expensive plant, and a good many engineers will be after the situation. The first thing you know, you will be appointed, and all the other fellows will wonder how they got left. The fact was the firm were putting in an expensive plant, and they wanted a man to take charge of it who would take as much pride in it as if it was his own property. They had seen and heard from others how clean and nice you kept your plant, and what an interest you took in your work at Messrs. So and So's, and they decided to engage you and were willing to pay you good wages into the bargain.

Now who will contradict me when I say that in such an instance a man is well repaid for the extra interest he has taken in his work. Such instances are occurring all the time. The go-ahead engineer is at the top of the ladder every time, and will remain there, while the dirty, careless and intemperate engineer will go down from the fine, automatic cut-off to the small, hoisting and portable engine, and sometimes to the pick and shovel. On the other hand, the young engineer who starts on the small hoisting engine may by perseverance, good sense and "sand," obtain charge of the large plant and secure the largest salary.

The motto for every engineer should be "take an interest in your plant, be sober, steady and industrious; post yourself on all the latest improvements in your business, and your day will surely come; nothing can hinder it." The main thing is to be ready to take your chance when the time comes.

The Electric and Mining Co. has been organized at Ottawa, and is seeking incorporation from Parliament.

The Digby Electric Co. has recently been organized at Digby, Nova Scotia, with a capital stock of $7,000. Mr. H. A. P. Smith is superintendent and electrician. The capacity of the station is 600 incandescents. In use, 300 commercial incandescents, 20 public street incandescents. The company has two miles of street circuits. The plant will be in operation in a few days.

NOTES ON THE DESIGN OF MULTIPOLAR DYNAMOS.

(Continued from August Number.)

HAVING discussed the design of multipolar machines as influenced by both theory and practice, it remains to conclude this communication by calling attention to some of the ordinary forms of multipolar fields. The double wrought iron horseshoe (Fig. 4) is not very frequently used, being rather costly; but a similar machine with magnets of cast iron, was lately made by my firm for the National Line S.S. America. The armature core in this case was formed by winding square annealed iron wires on a gun-metal flanged cylinder. The winding was of the Gramme

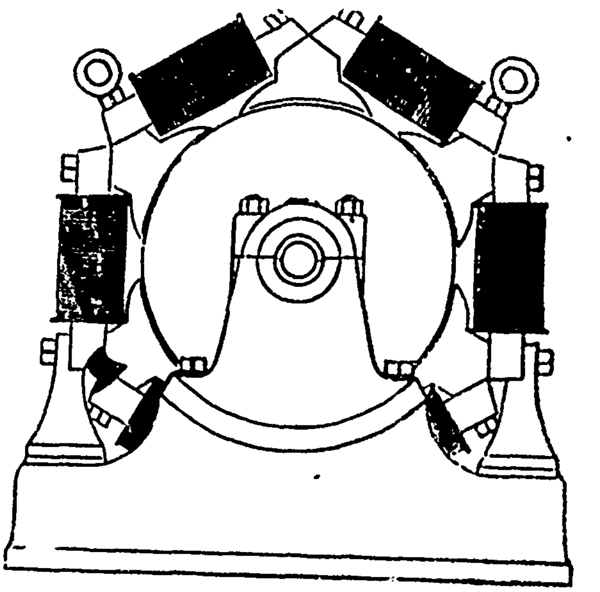


FIG. 7

type, and the machine was coupled direct to an inverted engine. This design, introduced by Gramme in 1869, generally gives place to the arrangement shown in Fig. 5, a form designed by the same inventor in 1885, and since adopted for cylinder-wound armatures by many makers, including Mr. Jasper, in Belgium, Mr. Brown, of the Œrlikon Works, in Switzerland, and Messrs. Patterson and Cooper, in England. Lately Mr. Knapp has used the same form for six and eight-pole machines with drum armatures. The magnets and octagonal yoke in Fig. 5 are of cast iron in two pieces, the lower limbs, the bottom half of the yoke ring and bed plate being one casting, and the top limbs and upper part of the yoke being another. Fig. 6 represents a similar field in which the magnet cores are of wrought iron, fitted with cast iron pole pieces, as used by Mr. Knapp in the

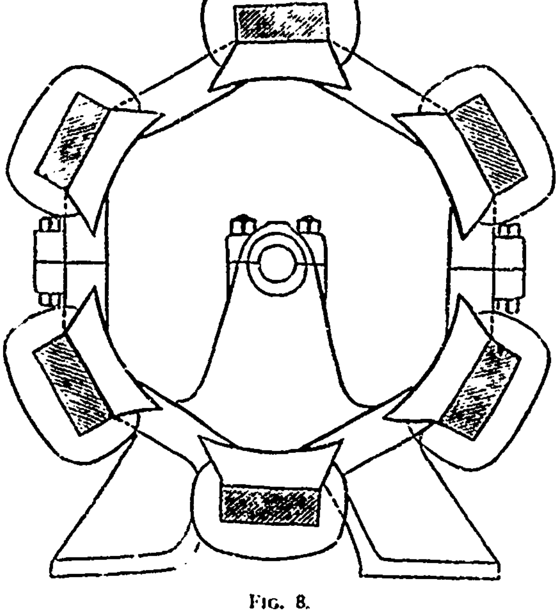


FIG. 8.

machines above mentioned. The decision as to whether cast iron or wrought iron should be used is arrived at in a very simple manner—by comparing the excess of copper required on one hand with the extra machining required on the other.

It will be observed that in the designs Figs. 5 and 6 the yokes are considerably longer than those shown in Fig. 4, and the weight of the former, if made of the same material, would be, roughly, twice that of the latter, though even then the complete magnet system would be but 75 per cent. of the weight of Fig. 3. The yokes being of cast iron, however, the system really comes about 20 per cent. heavier than Fig. 3, the less expensive character of the material compensating, of course, for the increased weight.

All these are examples of single magnetic circuits, where the lines of force from each pole remain undivided in their paths

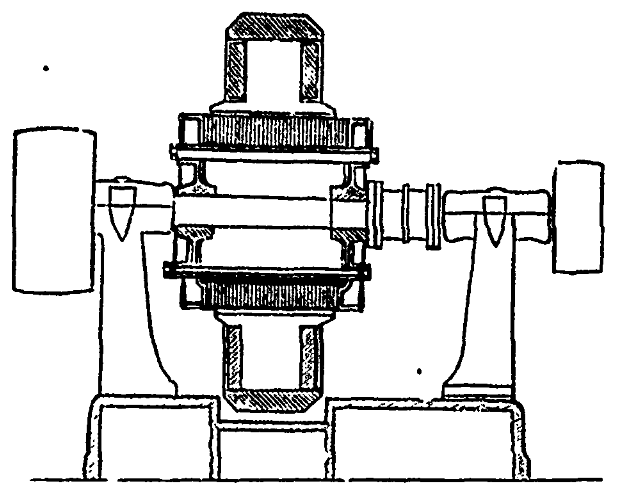


FIG. 9.

through the magnetizing coils; but in Figs. 7 and 8 are shown examples of double magnetic circuits, in which the lines from each pole take two paths through separate coils. Fig. 7 is a type of magnet used by Sautter-Lemmonier, of Paris, for Gramme-wound armatures, and by Cuenod-Sautter, of Geneve, for armatures having a Siemens winding as modified by Thury. The magnetizing coils are wound upon the parts of the system constituting in Fig. 6 the yokes, and a greater amount of copper is in consequence required. It looks at first sight as if the weight of copper was not very different in the two types, but in this respect appearances are deceptive, for, as a matter of fact, the field of a four-pole machine made according to Fig. 7 would require about 125 per cent. more copper than if made according to Fig. 6. It will be observed, however, that the magnet cores and pole pieces, which are made throughout of the softest wrought iron, are very light. In Fig. 8 the magnets are a series

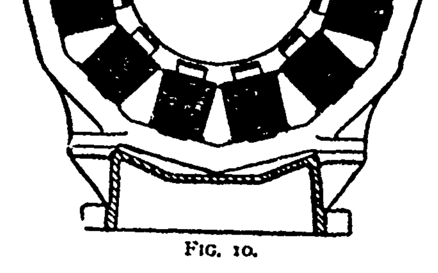


FIG. 10.

of wrought iron bars lying parallel to the armature, each fitted with a cast pole piece in the middle of its length, and having two magnetizing coils, one on each side of this piece. It is a structure which may be frequently met with, though not precisely in the form shown, and the observations regarding the copper made with reference to Fig. 7 apply equally here.

The cost of a four-pole machine is approximately represented by the cost of a couple of two-pole machines of the same efficiency, which give each half the output at twice the speed; the cost of a six-pole by that of three two-pole machines which give one-third of the output at three times the speed, and so on. For comparison, the fields must be in both the multipolar machines and two-pole machines of the same character that is, with single or double magnetic circuits.

The fields of alternators may be similarly divided into those having single and those having double magnetic circuits, the former requiring, as in the fields of direct current machines, much less copper than the latter. Among those having single-magnetic circuits are the machines of Siemens, Ferranti, Elwell, Mordey, Westinghouse, Parker, Paterson and Cooper. Mr. Knapp possesses the distinction of having the only alternator with double magnetic circuits. The "Phœnix" alternator, shown in Figs. 9 and 10, possesses some features which may be of interest, as illustrating the way in which the commercial aspect of designing has to be considered. The yoke-ring is of cast iron, but the magnets are of tooled wrought iron, shaped as shown. If the magnets had a breadth equal all the way up to the length of the armature core, they might as well have been of cast iron, for the little advantage consequent on the reduction of copper obtained by narrowing them would not have paid for the extra work in tooling wrought iron. But when we reduce the breadth where the magnetizing coils are, as shown, we at once diminish the copper on the fields by 60 per cent., greatly reduce the leakage area, and get a good balance after paying for extra tooling. The machine, as will be seen, has 12 radial magnets, and there are on the armature six flat coils, each equal to three times the width of the magnet cores, and laid on the periphery with a space equal to the core between them.

The length of the paper prohibits me from dealing with many special types of machines, to which, however, all the reasoning here used may be applied without difficulty.

ANNUAL CONVENTION OF THE C. A. S. E.

THE second annual Convention of the Canadian Association of Stationary Engineers assembled in Shaftesbury Hall, Toronto, on Sept. 15th, the president, A. M. Wickens, in the chair. There were present, vice-president, Mackie; secretary, G. C. Mooring; treasurer, Wm. Sutton; conductor, A. Ames.

The following delegates were in attendance: Bros. Heal and Edkins, Toronto; Bro. Thos. Ryan, Montreal, (2 votes); Bros. Nash and Langdon, Hamilton; Bro. Bate, Stratford; Bro. Geo. Mooring, Brandon. The minutes of the last Convention having been read and confirmed, the president's annual message followed.

Reports of the secretary and treasurer were read and referred to the Auditing Committee.

Bros. Ames and Dickinson reported, recommending that the property of the Association, consisting of charters, stereotype plates, etc., valued at $76.35, be paid for by a special pro rata levy. The report was adopted.

The following Committees were appointed: On "Constitution," Bros. Ryan, Heal and Mackie; on "Good of the Order," Bros. Ames, Nash and Sutton; on "Ways and Means and Auditors," Bros. Oathwaite, Langdon and Mosely.

The meeting adjourned for Committee work, resuming at 8 p.m.

The Committee on "Constitution" reported, recommending a form of constitution, which was adopted clause by clause.

The Committee on the "Good of the Order" recommended the appointment as soon as circumstances will permit, of an organizer, a liberal amount of whose time should be given to the interests of the Association in extending the branches to districts where the required number can be brought together; also the appointment by each Association of an instructor, with the object of establishing a means of obtaining correct decisions with reference to disputed subjects pretaining to questions and answers, and of results obtained under various working conditions of steam plants. The Committee also recommended the filling of situations by Association members, and that any Association not having a member to fill a position should communicate with the other Associations and obtain a man with the necessary qualifications, so that the steam user might appreciate the endeavors of the C. A. S. E. to place competent men in charge of steam plants. The report urged that the instructor and President of each Association likewise assist in preparing the members and qualifying them to take out certificates under the Ontario Act, passed April 30th last, and that it is advisable to adopt a pin, button or badge, for purposes of recognition, and that a Committee be appointed to procure a suitable design, also that all Associations be notified of any expulsions of members or rejection of candidates.

On motion, the report was adopted.

The secretary's report was audited and adopted. It showed the total number of members initiated to be 389, total amount of money received, $3,239.92, total expenses, $2,493.25, total paid out for sick benefits, $386.75. The report was adopted.

The election of officers resulted in the appointment of A. M. Wickens, as president, Thos. Ryan, past president, Robt. Mackie, vice-president; A. E. Edkins, secretary; Wm. Sutton, treasurer; Chas. Heal, conductor; Geo. C. Mooring, door keeper.

Bros. Ames, Sutton and Ryan were appointed a committee to procure a suitable badge or button to be worn by members.

The meeting adjourned until 10 a.m. Wednesday morning.

On resuming, the Committee on Constitution having furnished its report, it was adopted.

The place of next meeting was settled in favor of Hamilton, and the date chosen is the last Tuesday in August, 1892.

The Convention closed at noon.

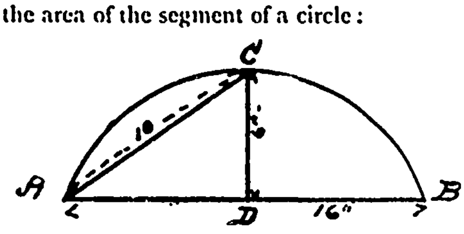
On Tuesday from 2 until 6 p.m., the delegates were under the care of the Reception Committee of Toronto No. 1. Carriages were procured and the visitors driven to the reservoir, Metropolitan Street Railroad power house, High Level Pumping Station, and School of Practical Science.

All the delegates expressed satisfaction at the work accomplished, and look forward to a prosperous year.

QUESTIONS AND ANSWERS.

Editor CANADIAN ELECTRICAL NEWS.

I NOTICE in the September number of the NEWS an enquiry from E. J. Phillips, of Toronto, as to the method of calculating the area of a segment of a circle. The following rule, which may be found in many works on engineering, and which can be easily worked out by anyone who understands decimal fractions, will give the area of the segment of a circle:



Let A C B D in the above figure represent a segment of a circle, the area of which it is required to ascertain. The curved line, or portion of the circumference, A C B, is called the arc. The straight line A B, connecting the extremities of the arc, is called the chord. The straight line C D, perpendicular to A B, and dividing the segment into two equal parts, is called the versed sine; while the straight line A C, is the chord of one half the arc A C B. The rule is:—To the chord of the arc add the chord of one-half the arc, and to this again, add the chord of one-half the arc, divided by 3; multiply the sum of these numbers by the versed sine, and this again by decimal ·4; the result is the area of the segment. To put this in the form of an equation:

Let C = the chord of the arc.

V S = the versed sine.

c = the chord of one-half the arc, then $(C + c + \frac{c}{3}) \times V\,S \times {\cdot}4$ = area of segment of circle.

To illustrate this, we will assume that the length of the chord of the arc (A B) in the above diagram is 16 inches, the versed sine (C D) = 6 inches, and the chord of one-half the arc (A C) = 10 inches—then $(16+10+\frac{10}{3}) \times 6 \times {\cdot}4 = 70{\cdot}4$ square inches = *area of segment of circle.*

To find the chord of half the arc, when chord of arc and versed sine are given: To the square of the versed sine add the square of one-half of the chord of the arc; the square root of this sum will be the chord of one-half the arc. Example—In the foregoing figure the versed sine is 6 inches: 6×6=36"; to this add the square of one-half the chord, which is 16"; one-half of this would be 8", and 8"×8"=64"; then 36"+63"=100"; the square root of this is 10", which is the length of the chord of one-half the arc.

O. P. ST. JOHN.

Vancouver, B. C., 12th Sept., 1891.

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Advertising rates sent promptly on application. Orders for advertising should reach the office of publication not later than the 25th day of the month immediately preceding date of issue. Changes in advertisements will be made whenever desired, without cost to the advertiser, but to insure proper compliance with the instructions of the advertiser, requests for change should reach the office as early as the 22nd day of the month.

SUBSCRIPTIONS.

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

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

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

EDITOR'S ANNOUNCEMENTS.

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

NOTICE TO SUBSCRIBERS.

SEVERAL subscribers to the ELECTRICAL NEWS have changed their addresses of late without notifying us of the fact. In one or two instances it has been found impossible to discover their new locations. To avoid difficulty in this line, subscribers will oblige by notifying the publisher whenever they may change their address.

THE National Association of Stationary Engineers of the United States assembled in annual convention at Omaha, Neb., the first week in September. No better evidence that the Association is prospering is needed than the fact that 2,519 initiations took place during the year. The total membership is now 7,680. The proposition to amalgamate the American and Canadian Associations was disapproved of.

OUR genial friend, Mr. "Dan" Thomson, the recently appointed general manager of the Hamilton Electric Light Co., has a great scheme in his head. He says it will make that ambitious city the biggest on earth and the chief manufacturing centre on the continent. We believe the MOUNTAIN is "in it" somehow, but are not sure. We suggest that the scheme be unfolded at the first meeting of the Canadian Electrical Association, and can promise on behalf of the Toronto contingent some most interested listeners. This is a really serious scheme too, and not to be confounded with the irreverent suggestion of a member at the inaugural to wind some wire round the mountain as an armature and rub it on the north pole.

OUR contention that it is not advisable for a municipality to engage in commercial enterprises has received a strong confirmation in view of the present condition of electric light matters at Toronto Junction. It is considerably over a year ago that the council started in to purchase an electric light plant. The usual "deputations" to the United States were indulged in, with the result of mixing up the "deputies" in a worse manner than they were before. Part of them returned wedded to arc lights and the other part as determined for incandescent. The result is a lamentable mixture of the two systems with "deputations" of citizens to the council as determined to stick to gas. Work has commenced, and considerable objection is taken to the quality of some of the material by a part of the council while the other part are just as determined that it is all right. The chances are that the illumination will be an expensive business, but in any case, whoever gets the fun of dancing, the patient citizen will be expected to foot the bill for the piper.

SOME dissatisfaction appears to exist among the engineers that the position of chief at the Toronto waterworks was not thrown open to competitive examination. There is no doubt, however, that, provided the necessary qualifications are there, the plan of promotion adopted by Superintendent Hamilton was the proper one. Men who have handled the engines for years should know more about their practical working than any outsider, no matter how near his finger ends he may have the correct theory of steam, or be able to paralyze an examiner by his knowledge of algebraical equations. While we do not for a moment wish to underrate the possession of such knowledge which may be, and indeed is, indispensable to the designer and constructor, it is certain that a thorough, practical acquaintance with the particular machine in use and how to handle it and humor its idiosyncracies, would be decidedly more useful and to the point. It is reasonable to suppose that the machinists and engineers who have handled and repaired the engines for years should be competent to take a step higher when the chief difference in their duties consists in drawing a somewhat larger salary. Theory is all very well, but in the simple matter of driving a steam engine, practice also counts for a good deal. A scholar could probably demonstrate to the Italian navvy working on a drain just how the law of leverage applied to his spadeful of clay, and that the nearer the fulcrum to the load the less the weight would be, and what he gained in power he lost in time, and so forth ; but without solving this theory, the navvy in question had already solved the problem of throwing out the earth with the least trouble to himself. A test on book learning would disqualify many good engineers we know of, but its possession will no doubt enable a man to graduate from the coal shovel to a superior position in the profession.

THE question as to the cause of boiler explosions is often the subject of considerable argument and various theories are advanced in explanation of it. Some are very fine spun and involve intricate problems regarding the decomposition of water, the absorption of oxygen by the red hot plates and the liberation of hydrogen and so forth. Our idea is that a boiler explodes simply because it is unable to withstand the pressure inside it at the time. The apparent simplicity of this reason may cause a smile, but there is nothing more in it. A boiler by neglect and corrosion is gradually but surely weakened, until perhaps after hovering for weeks around the bursting point, it lets go, and disaster is the result. It is not alone in old boilers that trouble is to be feared. Some new boilers are so carelessly and unskillfully made that when the angles or flanges of the sheets are not broken by the flange turners they are cracked out by the drift pin of the rivetting gang. When the holes come out of line with each other this drift pin is inserted, and the sheets are literally stretched until the rivet can be got in. It is possible that in this manner there is strain enough to severely weaken a boiler before a pound of steam is raised. Faulty design in a boiler is a prolific cause of trouble. Due attention is not paid to the liability of expansion and contraction, and this is the reason why it is impossible to keep some boilers tight. The careful and conscientious engineer will pay particular attention to his boiler He should examine the braces and the work required of them ; take off the manhole and get in the boiler and sound the braces with a hammer. Some may ring like a bell and others have the sound of a loosened cord; the latter should be shortened up. The jaws should be examined to see that they are not split or cracked. If there is scale forming on the crown sheet or flues, it should be removed. If stay or socket bolts leak they should be taken out and replaced. The flues should be clean and swept every week. Ashes should be kept away from the back ends and water legs of boilers, and if leaks occur, they should be caulked at once. It has been asserted that fibrous and flocculent material placed inside boilers will stop them from leaking, but as a leak is an evidence of weakness, it is not policy to conceal it but to strengthen it by caulking or renewing with another sheet. While the organ of weakness leading to boiler explosions may be often obscure, it is evident that certain causes produce certain effects, and that neglect and carelessness have no place around steam boilers. They should be clean inside and out, and strong as well. It is no use to put on dabs of putty to hide leaks, or fill a boiler half full of horse manure for the same purpose. The bad part should be taken out and a new one put in to make a radical cure. Take care of the safety-valve; try it every day, and don't have it sticking fast. If these simple rules were more attended to, there would be far less occasion to invent obscure reasons for the explosion of a steam boiler.

WE are pleased to be able to record the auspicious beginning of what we believe will be a most successful organization. We allude to the inaugural meeting of electricians and electric light men which took place during the recent Industrial Exhibition. It was in every sense a representative gathering, as it included not only those interested more directly in electric lighting and power, but also the kindred branches of electric telegraphy and telephony. It was abundantly demonstrated that there was the nucleus of a most successful Association which, in the hands of the Committee appointed, will no doubt take practical working shape. It will have the advantage of being distinctively Canadian, and will be able to handle the many problems of both the scientific and commercial application of electricity from a Canadian standpoint. The National Electric Light Association of the United States is a growing and powerful organization, but it is first and foremost, as its name implies, "National," and as the nation to which it belongs is striving to accentuate the line of demarcation between the two countries in a commercial point of view, the time appears to be opportune for Canadians to form an alliance of electrical interests on a similar plane, but which shall also be national in fact as well as name. Montreal was a "surprise party" to a number of American visitors to its Convention, who had an idea that Canada was a veritable backwoods as to its development electrically—in fact, a rich mine only waiting to be explored and developed by the American manufacturer. As a matter of fact, however, taking the number of population as a basis of comparison, there are more electric light plants than there are in the United States, and manufacturing interests on as large a scale. In the protection of these varied industries, the maintenance of a profitable method of business, and the elimination of undesirable and unfair competitive depreciators of values, there is a wide field of usefulness for an Association comprising the business element and the backbone of the industry in Canada. With these men, whose capital is necessary to extend and develop electrical discoveries, may well be associated the scientific man and the electrician—a combination that would be invincible—and thus everything newest and best in the electrical field would be brought within available reach. Apart from purely business considerations, also, the meeting together with the object in view of mutual advantage, will have a tendency to round off some of the sharp corners and arperities that have developed from undue competition, and we may hope that a better understanding will arise with the increase of friendly feeling, which will redound to the advantage of all. From a purely technical standpoint also, the formation of an Association of the electrical interests will be of great advantage to its members. An interchange of ideas: the discussion of different methods of attaining a desired end; the introduction of new and novel inventions; essays and papers on subjects of interest to the craft, would tend to make its meetings both interesting and instructive to the members. It is to be hoped that the enthusiasm of the inaugural meeting will be maintained by the Committee, to whom has been entrusted the details of organization, and that a perfect and comprehensive scheme will be formulated for adoption by the general meeting which is fixed for the 26th of November next.

LOOKING forward a month ago to the approaching visit of the members of the National Electric Light Association of the United States to Canada, it was our pleasure and privilege to bid them a hearty welcome, and to express the hope that their brief stay amongst us might become so pleasureable as to incline them to repeat the visit on a future occasion. Looking back upon the Convention, it seems as though the most sanguine anticipations concerning it have been realized. Montreal has on other occasions extended her hospitality to a larger number of visitors, but it can safely be declared that never did her citizens exert themselves more energetically or successfully for this object than on behalf of the delegates to this Convention. Entertainments of a public and private character were so numerous as to leave not the ghost of a chance for a feeling of *ennui* to creep in. Indeed, those who sought to take part in all the events of a social and business character in this most eventful week were obliged to place themselves on short allowance in the matter of sleep. If, however, the citizens of Montreal left undone nothing which would ensure the pleasure of their guests, it should also be stated that they were amply rewarded by the most hearty appreciation of their efforts on the part of the visitors. Fortunately the weather was delightfully bright and warm, revealing the city and its surroundings to advantage, and tending in a most important degree to enhance the pleasure of the occasion.

Notwithstanding the busy round of social engagements, the special object of the Convention, viz., the promotion of electrical interests in the United States, was not overlooked. At the business session held each day during the week, instructive papers were read and discussions held on a variety of subjects, and important action was taken in a number of directions on behalf of the welfare of the industry. The discussion on the relations of manufacturing and central station companies, revealed the existence of a deep and widespread feeling of dissatisfaction with the conduct of many manufacturing concerns in seeking to increase their profits at the expense of their original customers by forcing competition upon them as they were beginning to realize some return from their investments. Mr. Weeks, in speaking on this subject, said: "Parent companies are selling to the gas interests—and they have the effrontery in their advertisements to boast of their success—apparatus that employs the very devices whose exclusive control has been guaranteed to the interests that the new purchasers are straining every nerve to kill." A few instances of this reprehensible practice have recently come to light in Canada, but thus far we believe they have been confined to the operations of a single concern. The feeling among members of the National Electric Light Association concerning this matter seems to be in favor of discontinuing to purchase from companies known to be guilty of a breach of faith in this particular. Meanwhile, the Association has appointed a Committee to formulate a definite plan of procedure for the protection of the central station companies.

Among other subjects to which consideration was given, may be mentioned:—Comparison of economy in the generation of power; electrical arrangements connected with the World's Columbian Exposition, including the holding of an International Electrical Congress; data on the prices charged for electric lighting in various cities of the United States—it being pointed out in this connection that comparisons were made showing that some municipalities were being supplied with electric light at much lower rates than others, without mention being made of the difference in the conditions under which the electric plants were operated, and which are responsible for the variations in the prices. It was a matter of regret that the Committee on Underground Conduits had not sufficient time at their disposal in which to secure the necessary data for a comprehensive report. The result of their labors will be eagerly looked for at the next Convention. An interesting discussion took place on the paper read by Mr. T. Carpenter Smith at the Providence Convention, on "The Distribution and Care of Alternating Currents." The Convention in executive session reported a series of tabulating, wiring and insurance rules, which are printed in full in this paper. Papers were read as follows: "Central Stations Operated by Water Power," by Geo. A. Redman; "A Central Station, Combining the Advantages of both the Continuous and Alternating Systems," by H. Ward Leonard; "Uniformity in Method of Keeping Central Station Accounts," by J. J. Burleigh; "Three Years Development of Electric Railways," by Eugene Griffin; "Electric Railroad Construction and Operation, and a Consideration of Their Connection with Central Station Interests," by C. J. Field; "Some Details of the Care and Management of an Arc Light System, as Practiced by the Municipal Company of St. Louis," by J. I. Ayer; "Different Forms of Carbons Used in Arc Lighting," by E. P. Warner. The banquet with which the proceedings closed afforded the opportunity for an exchange of the kindly sentiments which the intercourse of the week had engendered. One could discern in these expressions the ring of something deeper than the compliments of polite society—the tones of honest admiration and sympathy. Lord Stanley fittingly expressed it when he said that "blood is thicker than water." The Convention throughout was well calculated to deepen the mutual respect existing between the people of the United States and Canada. As a proof of this it is observed that Dr Mason has given notice of motion to amend the constitution by substituting "International" for the word "National" in the title of the Association. Notwithstanding, the resolution comes too late to check the movement in favor of a Canadian "National" Association.

The visit of the Association to Canada has served to bring before the notice of its members and of our own people the natural advantages in the way of water power, etc., which exist in this country for the profitable utilization of electric apparatus. Contact with men of such bright minds and great energy as the members of the National Electric Light Association should also benefit us by stimulating us to the accomplishment of greater things on our own behalf and that of the country to which we belong. It is to be regretted that a greater number of persons connected as owners and managers with electric plants in Canada, were not present. The electrical exhibition was a perfect success, and served as a valuable object to demonstrate to the thousands who daily visited it the almost infinite number of practical uses to which electricity is being adapted. We have only to add that the visit of our American friends has done us good, and we cherish the hope of seing them with us again if not in the immediate, at least in the not distant future.

ELECTRIC AND MAGNETIC THEORIES.*

THE medium surrounding a wire that is a part of an electric circuit is the seat of a double set of actions. Its electrical potential varies from point to point, the medium being in a state of electro-static disturbance. It is also in a state of magnetic disturbance, and its magnetic potential varies from point to point, but in a wholly different manner. For the sake of simplicity let us consider an indefinite long straight wire, through which a "current" is passing. For the sake of numerical precision, suppose the wire to have a resistance of $\frac{1}{100}$ ohm per inch, and a current of an ampére to be passing through it. Then points distant an inch apart along the wire will differ by $\frac{1}{100}$ of a volt. Select one of these points where the potential has the value, say, of 0·50 volt. Through this point consider a plane drawn so that the wire is normal to it. All points in this plane will be at the same potential, the plane will be a surface

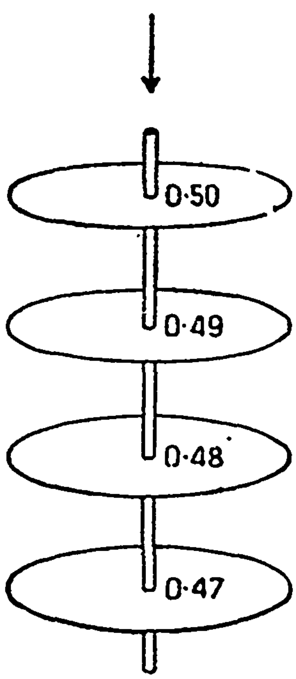

FIG. 1.

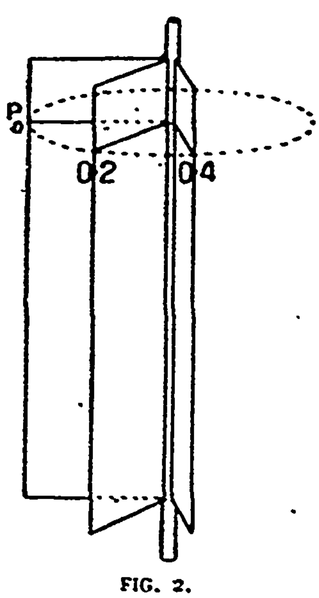

FIG. 2.

of equipotential No energy need be spent in moving a unit of electricity from any point in this plane to any other point in it. At other points along the wire let similar equipotential surfaces be drawn, as in Fig 1 The lines of electrostatic force will be straight lines drawn parallel to the wire, and will cross the equipotential surfaces normally. But surrounding the wire will be another system of lines and surfaces mapping out the magnetic properties. Consider any point P near the wire. On a unit magnetic pole, at a distance of r centimetres, the force due to the one-ampere current will be equal to $0.2 \div r$ dynes, and will tend to move it (as viewed in Fig. 2) clock-wise around the wire. If we push it the opposite way around we shall do work upon the unit, and when we have pushed it once completely round the wire we shall have done $2\pi \times 0.2$ ergs of work; or to move it through an angle of one radian ($= \frac{1}{2}\pi$ of a circumference) will require an expenditure of 0.2 ergs of energy. A plane drawn through P and the wire will be a plane in which all points are at the same magnetic potential. A system of such magnetic equipotential surfaces may be drawn around the wire; they will be set radially, at equal angles apart, reckoning from the zero position. For the current of 1 ampere the angle between surfaces that differ by $\frac{1}{10}$ of a unit of magnetic potential will be equal to $\frac{1}{4}\pi$. Now, imagine these two systems of surfaces to be superposed. The intersections of the electrostatic

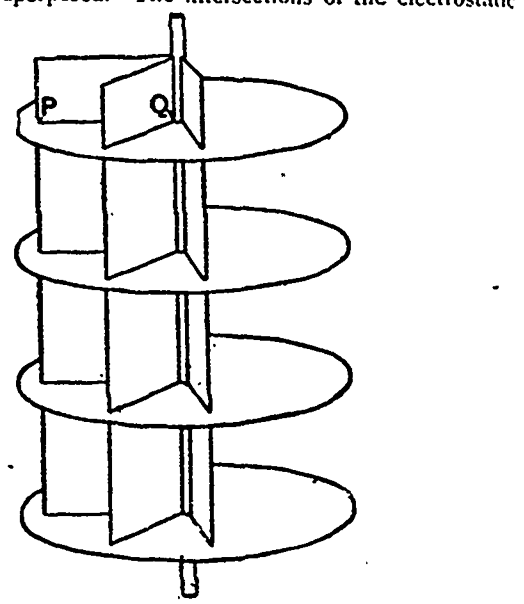

FIG. 3.

equipotential surfaces with the magnetic equipotential surfaces will be a set of radial *lines* (Fig. 3). Now consider what would happen if we had to move either a unit of electricity or a unit magnetic pole along one of these lines, such as P Q. Because the line is in a surface of electrostatic equipotential, no work would be done along the line in question in moving a unit of electricity along it and because it lies in a surface of magnetic potential, no work would be done in moving a magnetic pole along it. Now, according to Poynting's view, it is precisely along such lines as these—the intersection of the static and magnetic equipotential surfaces—that the electro-magnetic energy flows. It is the only path compatible with the condition that the energy in crossing the medium shall not either add anything or take anything away from the energy already existing in the medium. If it were to leave this line and pass either to a point of higher or lower potential in the medium, this would alter the state of the medium and change the configuration of the electrostatic and electro-magnetic stresses in it. That is, of course, exactly what happens during the time when an electric current is starting, during the variable period, while energy is being poured out into the medium to throw it into the peculiar state at the beginning. But we have been dealing here with the question of steady flow.

Again, in the case of alternating currents setting up alternating electromotive forces across the medium in another circuit, during part of the oscillation some energy is being thrown outwards into the medium simply to set up stresses and some more energy is actually crossing by the paths so set up into the second circuit, and during another part of the oscillation the energy that was momentarily resident in the medium is re-entering the source to be again thrown out. Doubtless the energy paths are of somewhat complex form in all these cases; that is no reason why their real existence should be held doubtful. Take a single case. Consider a system of circuits with two interposed transformers; one transforming from a primary circuit into a secondary, the other transforming from the secondary circuit into a tertiary. How complex must be the paths here along which the energy flows, even if one confines one's attention solely to those parts of the circuits where the transformations are taking place.

*Abstract of a paper read by Silvanus P. Thompson, London.

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

At the last regular meeting of the above branch, held on Friday evening, 25th inst., a very profitable time was spent. After routine business, considerable discussion took place on the different methods and formulas as given in the text books for computing the height of columns of water which would be equal to given pressures per sq. in. at the base. Bro. C. Heale, Chief Engineer at the High Level Pumping Station, gave some valuable "pointers" on the blackboard.

A pleasant event in the evening's proceedings was the presentation of three books on Mechanical Engineering to Bro. Walter Blackgrove, as a slight token of appreciation of his energetic work as Secretary for the past three years. The presentation, accompanied by a few deservedly eulogistic remarks, was made by President A. E. Edkins. Bro. Blackgrove, in response, thanked his brother engineers for their kindness, and assured them that as long as he was blessed with health he would gladly serve the Association in any capacity.

One new member was admitted, and three propositions received.

A committee was appointed, consisting of Bro. W. Sutton, W. Lewis, S. Thompson, A. M. Wickens and W. Oathwaite, to make necessary arrangements for the annual dinner, which will take place in November.

CANADIAN ELECTRICAL ASSOCIATION.

PURSUANT to the announcement published in the ELECTRICAL NEWS for September, a meeting was held in the offices of the Industrial Exhibition Association, Toronto, on Thursday afternoon, Sept. 17th, to informally discuss the desirability of organizing an association which should be representative of the electrical interests of the country.

The following gentlemen were in attendance:

J. J. Wright, manager of the Toronto Electric Light Co.; George Black, manager G.N.W. Telegraph Co., Hamilton; John Yule, manager Guelph Gas Co.; I. C. McLachlan, Hamilton, representing Edison Co.; J. D. McDiarmid, Aylmer, Ont.; S. Douglas, Kay Electric Works, Hamilton; A. T. Anderson, 75 Adelaide St. east, Toronto; Richard Mitchell, vice-president of the Guelph Gas & Electric Light Co.; H. H. Powell, secretary Woodstock Electric Light Co.; W. A. Tower, superintendent underground work, Bell Telephone Co., Toronto; J. A. Baylis, electrician, Bell Telephone Co., Toronto; J. Norman Smith, electrician, Ball Electric Light Co.; W. A. Johnston, general manager Ball Electric Light Co.; D. Thomson, general manager Hamilton Electric Light & Power Co.; J. W. Taylor, Brooks Manufacturing Co.; J. Braden, traveller for the Brooks Manufacturing Co., Peterboro'; J. Telfer, Blenheim, Ont.; C. A. Phillips, Midland, Ont.; H. Brown, St. Thomas Gas & Electric Light Co.; C. H. Mortimer, publisher The ELECTRICAL NEWS; A. B. Smith, Inspector of Electric Lighting Board of Underwriters.

On motion of Mr. Yule, Mr. J. J. Wright was asked to preside over the proceedings, Mr. C. H. Mortimer being chosen to act as secretary.

The Secretary read the following letter:

611 & 612 ELECTRICAL EXCHANGE.
NEW YORK, Sept. 9th, 1891.

To the "~~Canadian Institute of~~ Electrical ~~Engineers~~" Greeting

On 15th April, 1884, pursuant to a call issued a few days previous a few gentlemen met, by the courtesy of the American Society of Civil Engineers, in their rooms "for the organization of a National Electric Society." This association became the American Institute of Electrical Engineers, with a membership at the end of its eighth year (May 19, '91) of five hundred and forty-one (541). The Institute, as you know, stands to-day as the representative of our profession in the United States. You, gentlemen, are assembled to form just such another association for the great Dominion of Canada, the sister of the United States, although there are many of us who hope she may some day relent and cease to be a "sister to us," only that our mutual interests may be made the closer thereby.

While Canadians chiefly are gathered at this time, your call has sounded "afar off," and there are many friends with you in spirit who would have been glad to be with you in person at this time, and to whom the prosperity of the new society will be of deep concern. As one of such, permit me, with congratulation that the advances of electrical engineering have brought you thus into a nearer bond of fellowship to the mutual advantage of all concerned, to salute you, one and all, severally and unitedly, and may "God speed" the good work you have undertaken.

Cordially and fraternally yours,
J. STANFORD BROWN.

Letters of regret at inability to attend the meeting and expressive of best wishes for the successful formation of a Canadian Electrical Association, were read from Mr. Frederic Nicholls, manager Toronto Construction & Electrical Supply Co., and from Mr. E. F. Clements, of Yarmouth, Nova Scotia.

The Chairman invited an expression of opinion as to the lines upon which the proposed Association should be organized.

Mr. Taylor thought the Association should embrace all branches of the electrical industries.

Mr. Johnston concurred in this view.

Mr. McLachlan thought the Association should conserve the commercial interests of the electrical industries.

Mr. Thomson moved, seconded by Mr. Douglas, that a committee be appointed, consisting of Messrs. Wright, Nicholls, Thomson, Johnston, Smith, Dunstan and Yule, to formulate a scheme of organization, and report at a future meeting. Carried.

Mr. Thomson moved, seconded by Mr. McLachlan, that the meeting to receive the report of this committee be held on Thursday, November 26th, at a time and place to be fixed by the committee, and of which due notice shall be given. Carried.

It was decided that a meeting of the Committee on Organization should be held, in the offices of the Toronto Electric Light Co., on Monday, Sept. 28th.

The following letter came to hand after the date of the above meeting:

646 CRAIG STREET,
MONTREAL, Sept. 9th, 1891.

Editor ELECTRICAL NEWS.

DEAR SIR,—Re formation of a Canadian Electrical Association, I note Mr. M. D. Barr's letter in regard to former society of that name existing in Montreal. As late secretary of said society I may state, that for various causes it no longer exists, and the monthly meetings were discontinued some time ago. Although lack of time does not permit my being present at the formation of the new Association, yet I should be happy to forward its interests.

Yours very truly,
WM. B. SHAW,
Electrician with T. W. Ness.

The Committee on organization met at the appointed time and place.

There were present Messrs. J. J. Wright, D. Thomson, W. A. Johnston, —— Dunstan, John Yule, A. B. Smith and the Secretary, C. H. Mortimer. Mr. J. J. Wright was requested to preside.

After full discussion, it was decided that the organization should be named the Canadian Electrical Association, and that its object should be to foster and encourage the science of electricity, and promote the interests of those engaged in any electrical enterprise.

The Committee will recommend that the membership consist of active and associate members—the former to include all persons actively engaged in electrical business, who shall be entitled to vote at all meetings of the Association; and the latter, all those interested or actively engaged, who shall be entitled to attend all meetings, except those of the Executive, and take part in all discussions, but shall not be entitled to vote. It is recommended that honorary members may be elected by a two-thirds vote of the Association.

There will, of course, be a difference in the membership fee, as between active and associate members, corresponding to the value of their respective privileges.

In the judgment of the Committee the officers should consist of: President, two Vice-Presidents, a Secretary and Treasurer, who may be one person, and an Executive Committee consisting of nine members, together with the President and two Vice-Presidents, five of whom should form a quorum.

The suggestion was made that a Legislation Committee would be a valuable adjunct to the Association. Its appointment will devolve upon the Executive Committee.

The Secretary was instructed to issue a circular to persons in charge of electric light, power, telephone and telegraph stations throughout the Dominion, setting forth what is proposed to be done, and inviting their active co-operation in behalf of the enterprise.

The meeting was a most enthusiastic one. In fact, the more the undertaking is discussed, the greater appears the need for such an organization as the one proposed, and the deeper becomes the interest of those who have thus far lent their assistance.

It is earnestly hoped that representatives of the electrical industries in all parts of Canada will give the undertaking a helping hand.

ENGINEERS AT THE MONTREAL CONVENTION.

Editor ELECTRICAL NEWS.

THE recent convention of the National Electric Light Association in Montreal has come and gone, but remaining are many pleasant reminiscences for those of us who were fortunate enough to be present. It goes without saying that our American cousins were agreeably disappointed. Many of them had the haziest of ideas concerning our Canadian people, our salubrious climate, our beautiful scenery, and last, but not least, the perfection and substantial character of our electrical establishments.

The newspaper man from over the border was there galore. From all appearances Canadian air has a very good effect on him, and if he would bide with us a little, he would return home with his ideas so refashioned that he would deride McKinley and his little bill as much as is done on this side of the line. Canadian institutions can and do thrive well on a McKinley freeze out.

Among others whom I had the pleasure of meeting in Montreal was P. G. Monroe, of the *Stationary Engineer*, and Wm. Swetland, of *Steam Power*. What they were fooling around with electricity for, passes all understanding. However, the Montreal members of the C.A.S.E. called a special meeting and engaged carriages in order that the visitors might see and meet some of the Canadian engineers.

The chair was taken by Bro. Hunt, of Montreal No. 1, and kind words of welcome expressed.

Mr. Swetland, being in a hurry to have a share in the festivities at the Windsor banquet, spoke first, expressing his surprise at our Canadian institutions, and his desire for the fullest and freest possible intercourse between the two nations.

P. G. Monroe was then called upon, but declined to say anything until after Bro. Wickens, of Toronto, had spoken.

Bro. Wickens gave an outline of the work of the C.A.S.E. from its inception, and also explained the position of the C.A.S.E. in regard to the recent amalgamation scheme. This was apparently what Mr. Monroe was waiting for, as he at once started to "rip us up the back." Fortunately for us, however, his good nature had dulled the knife, so that it did not cut very deeply.

Montreal No. 1 then made honorary members of the visitors. Bro. Monroe, after having thanked them for the honor conferred, gave a good common-sense talk on the subject of the good to be derived from such societies as the N.A.S.E. and C.A.S.E.

After adjournment, the members repaired to a neighboring restaurant and spent a social hour.

N. GINERE.

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

BY WILLIAM BARNET LE VAN.

(Continued from August number.)

Example 10.—A safety valve of the following dimensions, to find the weight W in pounds?

L=length of long lever in inches 40
l=length of short lever in inches 4
A=area of valve in square inches 5
p=the steam pressure in pounds per square inch 100

Then by formula 11: $W = \frac{A\,p\,l}{L}$.

Weight $W = \frac{5 \times 100 \times 4}{40} = 50$ pounds.

Example 11.—A safety valve of the following dimensions, at what pressure p per square inch will it blow off?

W=the weight in pounds 10
L=the long lever in inches 24
l=the short lever in inches 2
A=the area of the valve v in square inches 3

Formula 12: $p = \frac{W\,L}{A\,l}$

Pressure $p = \frac{10 \times 24}{2 \times 3} = 40$ pounds per square inch.

Example 12—A safety valve of the following dimensions, how long must the long lever L be to blow off at 80 pounds?

A=the area of the valve v in square inches 4
W=the weight in pounds 30
l=the short lever in inches 3
p=steam pressure in pounds per square inch 80

Formula 13: $L = \frac{A\,p\,l}{W}$

Long lever $L = \frac{80 \times 4 \times 3}{30} = 32$ inches.

Lever safety valves, as generally made, are easily altered, and thus prevented from operating correctly. The lever arm a of a safety valve should always be of a length suitable for the maximum pressure the boiler is to carry; or the weight secured to the lever arm a at the proper working distance, and to prevent overloading only *one weight* shou'd be allowed on the lever arm a, and this placed at the end of the same.

EFFECTIVE AREA OF SAFETY VALVES.

The *effective area* is the opening for the flow of steam, due to the height of lift of the valve. It is an annular opening, the area of which may be found by the following rules:

Valve-Sit Notations.

Æ represents the effective area of the annular opening through which the steam escapes.
h represents vertical height in inches equal to the lift of the valve.
D represents the inner diameter of the valve sit in inches.
d represents the depth of the valve sit in inches.
v represents the angle of the valve sit to the plane of the valve.
π represents the circumference of a circle whose diameter D=1, and stands for 3.14159265.
Cos represents the cosine or the sine of the completement of the angle of the valve sit.
Sine represents the sine of the angle of inclination.
Tan represents the tangent of the angle or bevel of the valve sit.

For safety valves with flat sit, Fig. 14 gives an opening, when lifted, equal

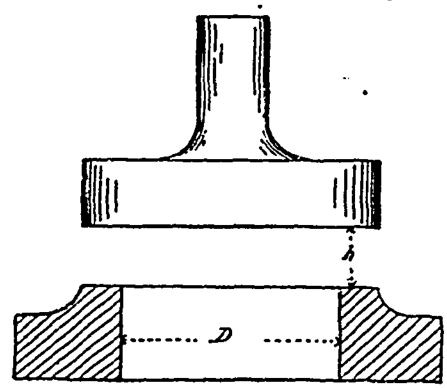

FIG. 14.

Lift of valve one-quarter of the diameter. Flat sit.

to the surface of a cylinder having the same diameter D, as that of the valve, and a height equal to the lift h.

The effective area Æ of the annular opening, when there is no bevel to the valve, will be

Æ $= h\,\pi$ 14

Rule.—The effective area equals the vertical lift h, multiplied by the circumference π, when there is no angle, or

Æ $= D\,h\,3.1416$ 15

Rule.—The effective area equals the diameter D, multiplied by 3.1416, and this product by the vertical lift h.

Example 13.—A flat valve sit (Fig. 14) without bevel, with D=2 inches, and lift h=1-16 or 0.0625 of an inch. What is the effective area Æ of the opening?

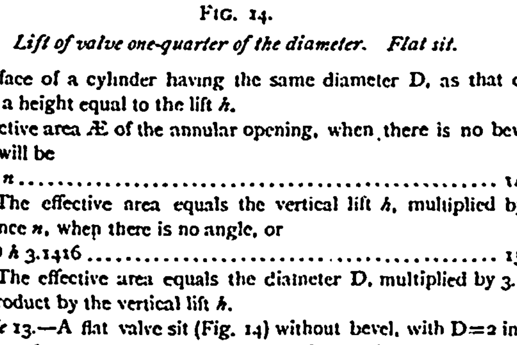

FIG. 15.

Lift of valve, half the depth of sit. Angle of sit, 45 degrees.

Formula 14: Æ $= h\,\pi$

Effective area Æ $= 0.0625 \times 6.283 = 0.3927$ square inches.

Formula 15: Æ $= D\,h\,3.1416$.

Effective area Æ $= 2 \times 3.1416 \times 0.0625 = 0.3927$ square inches.

In the case of a valve sit with an angle or bevel v, Fig. 15, it is clear that the effective area Æ of the annular steam passage will be equal to the surface of a frustrum of a cone, and is the perpendicular distance $d\,c$, multiplied by the mean circumference of the diameter $a\,b$.

The distance $a\,b = D + \frac{1}{2}\,h$, which, multiplied by π, gives the circumference; or, $\pi\,(D + \frac{1}{2}\,h)$, when the angle v is 45 degrees.

Rule.—Multiply 3.1416 by the sum of the diameter D, added to one-half the vertical height h, when the angle, or bevel v, is 45 degrees.

For any other angle use formula 16.

The distance $d\,c = h$ cosine v. That is to say, that the distance $d\,c$ equals the vertical height h, multiplied by the cosine of angle v.

Æ $= \pi\,h \cos v\,(D + \frac{1}{2}\,h \text{ sine } 2\,v)$ 16

Rule.—First, to the diameter D of the valve, add one-half the vertical lif

h, and multiply this sum by the sine of twice the angle v; second, multiply the circumference n of the valve by the vertical lift h, and by the cosine of the angle v; third, multiply the first product by that of the second, and the result will be the effective area Æ of the annular opening in square inches.

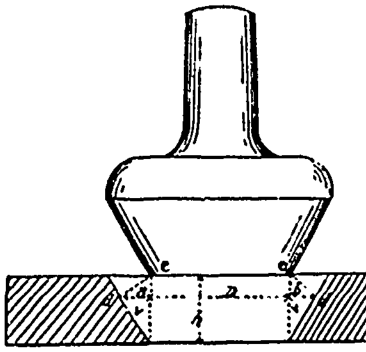

FIG. 16.

Lift of valve, the depth of sit. Angle of valve sit, 60 degrees.

Example 14.—A safety valve having a diameter D=2 inches, and the valve sit has an angle $v=25$ degrees. What will be the effective area of the annular opening for a vertical lift $h=\frac{1}{4}$, or 0.25 of an inch?

Formula 16: $\AE = n\ h \cos v\ (D + \frac{1}{2}h \text{ sine } 2\ v)$

$$\text{Effective area } \AE = 3.1416 \times 0.25 \times 0.906\ (2 + \frac{0.25}{2} \times 0.766) = 1.157$$

square inches; or,

First, $2 \times \frac{0.25}{2} \times 0.766 \quad = 1.627.$

Second, $3.1416 \times 0.25 \times 0.906 = 0.7115$

Third, $1.627 \times 0.7115 \quad = 1.157$ square inches.

Care must be taken in not confusing $2\ v$, or double the angle v, with 2 sine or double sines.

It will be seen in the above example that the angle $v=25$ degrees, $25 \times 2 = 50$ degrees, and the sine of which equals 0.766 (see table). The following is a simple formula for a valve sit of an angle of 45 degrees, and lift h, less than depth of sit.

$\AE = 2.22\ h\ (D + \frac{1}{2}\ h)$ 17

Rule.—Multiply the number 2.22 by the lift h, and by one-half the lift h added to the diameter D, the product will be the effective area Æ, in square inches.

Example 15.—What will be the effective area Æ of the annular opening of a valve having a diameter $D=2\frac{1}{2}$ inches, for a lift $h=\frac{1}{2}$ or 0.5 of an inch, the angle v of valve sit being 45 degrees?

Formula 17: $\AE = 2.22\ h\ (D + \frac{1}{2}\ h)$

$$\AE = 2.22 \times 0.5 \left\{ 2.5 + \frac{0.5}{2} \right\} = 3.05 \text{ square inches.}$$

or, number 2.22
multiplied by vertical hight h 0.5

and this product multiplied by 1.110

the diameter $D = 2.5$ plus $\frac{0.5}{2}$ = ... 2.75

Total square inches 3.0525

The following simple formula will also answer for angles of 30 degrees, *with a lift less than the depth of the sit:*

$\AE = 1.57\ D\ h + 0.68\ h^2$ 18

Rule.—First, multiply the diameter of the valve D by the vertical lift h,

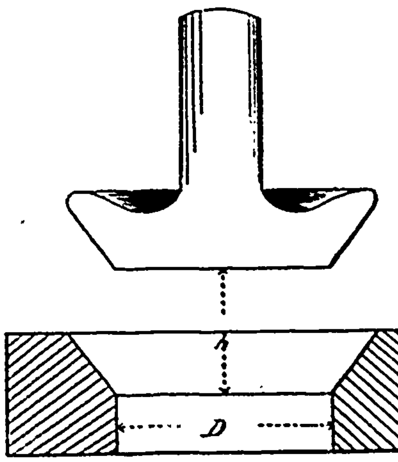

FIG. 17.

Lift of valve exceeding depth of sit. Angle of valve sit, 45 degrees.

and by the number 1.57; second, multiply the square of the vertical lift h by the number 0.68, and add the two products together.

Example 16.—What will be the effective area of a safety-valve diameter D=2 inches, having an angle $v=30$ degrees, and the vertical lift $h=\frac{1}{4}$ or 0.0125 of an inch? What will be the effective area of the annular opening for a lift h=1-16, or 0.0625 of an inch?

Formula 18: $\AE = 1.57\ D\ h + 0.68\ h^2$

Effective area $\AE = 1.57 \times 2 \times 0.0625 + 0.68 \times 0.0625 \times 0.0625 = 0.199$ sq. in.,
or $1.57 \times 2 \times 0.0625 =$ 0.196250
and $0.0625 \times 0.0625 \times 0.68 =$ 0.003656

Effective area in square inches 0.199912

The Special Committee of the Board of Supervising Inspectors of Steam Vessels of the United States on safety valve tests at the Washington navy yard, in September, 1875, made use of the following formula. All the safety valves on trial had valve sits at an angle of 45 degrees.

$\AE = D + \frac{1}{2}\ h\ 3.1416\ h \times 0.71$ 19

Rule.—First, to the diameter D of the valve add one-half the vertical lift h; second, multiply this sum by 3.1416, and this multiplied by the product of lift h, multiplied by the number 0.71, gives the effective area.

Example 17.—A safety valve has a valve diameter D=2 inches, and a lift $h\ \frac{1}{2}$ or 0.5 inch, the angle $v=45$ degrees, what will be the effective area of the annular opening?

Formula 19: $\AE = D + \frac{1}{2}\ h\ 3.1416\ h \times 0.71$

$$\text{Effective area } \AE = 2 \frac{0.5}{2} \times 3.1416 \times 0.5 \times 0.71 = 2.5 \text{ square inches.}$$

In case the lift h of the valve exceeds the depth of its sit, the area of excess of lift h is obtained as follows: Multiply the diameter D by the additional lift h, and by the circumference $n=3.1416$; this will be the area opening due to lift h above the valve sit, in square inches. Add this area to that due to the depth of the valve sit, and it will give the total effective area Æ, in square inches.

Example 18.—The diameter of a safety valve D=4 inches, and the angle $v=45$ degrees, and the depth of sit $\frac{1}{8}$ or 0.125 inches, what is the area of the annular opening for a lift of $\frac{1}{4}$ or 0.25 of an inch?

First, calculate the area of opening for a valve $v=45$ degrees, for a lift $h = \frac{1}{8}$ or 0.125.

Formula 17: $\AE = 2.22\ h\ (D + \frac{1}{2}\ h)$

$$\text{Effective area } \AE = 2.22 \times 0.125 \left\{ 4 + \frac{0.125}{2} \right\} = 1.124 \text{ square inches.}$$

Second, calculate the amount of opening due to the lift h above the sit, which, in this example, is h 1-8 or 0.125 of an inch.

Formula 20: $\AE = D\ h\ 3.1416$

Effective area $\AE = 4 \times 0.125 \times 3.1416 = 1.570$

Third, add these values together:

Effective area due to lift above valve sit 1.570
Effective area due to lift to top of valve sit 1.124

Total effective area in square inches due to $\frac{1}{4}$ inch lift = ... 2.694

THE VALUE OF THE SINES, COSINES AND TANGENT ANGLES, FROM 20 TO 60 DEGREES.

Angle.	Sine.	Cosine.	Tangent.	Angle.	Sine.	Cosine.	Tangent.
20°	.342	.940	.364	41°	.656	.755	.869
21°	.358	.934	.384	42°	.669	.743	.900
22°	.375	.927	.404	43°	.682	.731	.933
23°	.391	.921	.424	44°	.693	.719	.966
24°	.407	.914	.445	45°	.707	.707	1.000
25°	.423	.906	.466	46°	.719	.695	1.036
26°	.438	.899	.488	47°	.731	.682	1.072
27°	.454	.891	.510	48°	.743	.669	1.111
28°	.469	.883	.532	49°	.755	.656	1.150
29°	.485	.875	.554	50°	.766	643	1.192
30°	.500	.866	.577	51°	.777	.629	1.234
31°	.515	.857	.601	52°	.788	.615	1.279
32°	.530	.848	.625	53°	.798	.607	1.327
33°	.545	.839	.649	54°	.809	.588	1.376
34°	.559	.829	.675	55°	.819	.573	1.428
35°	.574	.819	.700	56°	.829	.550	1.482
36°	.588	.809	.727	57°	.838	.544	1.540
37°	.602	.799	.754	58°	.848	.530	1.600
38°	.616	.788	.781	59°	.857	.515	1.664
39°	.629	.777	.810	60°	.866	.500	1.732
40°	.634	.766	.839				

DIAMETER OF SAFETY VALVES.

The effective area Æ of the valve being known, and the height or lift h, the diameter can be calculated as follows: For a valve sit without bevel

$$D = \frac{\AE}{h\ 3.1416} \quad \text{.................................... 20}$$

Rule.—Multiply the lift h of the valve by the number 3.1416, and divide the area of opening by the product.

Example 19.—A safety valve having an effective area Æ=0.3927 when the valve lifts h—1-16th or 0.0625 of an inch. What should be its diameter:

By formula 20:

$$\text{Diameter } D = \frac{0.3927}{0.0625 \times 3.1416} = 2 \text{ inches.}$$

or,

Number 3.1416
Multiplied by lift 0.0625

0.19635

$$\frac{0.3927}{0.19635} = 2 \textit{ inches.}$$

Having given, the effective area Æ, formula 16, and the height h lifted, the diameter D is found from the above formula as follows:

$$\frac{\AE}{n\ h \cos.\ v} - D + \frac{1}{2}\ h \sin.\ 2\ v; \text{ of which the}$$

$$\text{diameter } D = \frac{\AE}{n\ h \cos.\ v} = \frac{1}{2}\ h \sin.\ 2\ v \text{ .... 21}$$

(To be Continued.)

A HANDY WIRING TABLE.

BY H. R. LEYDEN.

THIS table is arranged to show the size of wire for all the various low potentials and percentages of loss used in practical electric lighting and for 500-volt motor and electric railway circuits. It is calculated on the assumption that the conductivity of commercial copper wire is .97 of the conductivity of pure copper, according to the Matthiessen standard. It is also assumed that the cross section of wire doubles with every three sizes of Brown & Sharpe gauge, which, though not absolutely correct, is sufficiently accurate for practical work. The safe carrying capacity is taken as four-tenths of the current required to heat underwriter's insulated wire to 212° Fahrenheit in air, or the column headed "1.8 per cent. loss" at "110 volts," and we have No. 11 B. & S.

Or, suppose we wish to carry 60 amperes 100 feet at 220 volts and 2 per cent. less loss. From "62" in the column for "100 feet" cross to the column headed "1.8 per cent." at "220 volts," and we have No. 5 B. & S.

For 500 volts the table does not indicate above 2 per cent. loss, but higher losses and greater distances can readily be estimated by remembering that the cross-section varies inversely with the loss, and directly with the distance. In taking the size of wire from the table, care should always be taken not to exceed the safe-carrying capacity of the conductor.—*Electrical Engineer, N. Y.*

	.2	.4	.5	.63	.8	1.	1.3	1.6	2.	% LOSS AT 500 VOLTS.
	.45	.9	1.13	1.43	1.8	2.27	2.86	3.6	4.54	% LOSS AT 220 VOLTS.
.25	.5	1.	1.25	1.57	2.	2.5	3.15	4.	5.	% LOSS AT 200 VOLTS.
.45	.9	1.8	2.27	2.86	3.6	4.54	5.7	7.3	9.1	% LOSS AT 110 VOLTS.
.5	1.	2.	2.5	3.15	4.	5.	6.3	8.	10.	% LOSS AT 100 VOLTS.
1.	2.	4.	5.	6.3	8.	10.	12.6	16.	20.	% LOSS AT 50 VOLTS.

FIGURES AT TOP OF COLUMN: DISTANCE IN FEET FROM CENTRE OF DISTRIBUTION CURRENT IN AMPERES GIVEN BELOW.

										25	50	75	100	150	200	300	400	500	600	700	800	900	1000 FEET.
10	13	16								9	5	3	2	1									
9	12	15	16			Siz	e of	Wir	e	12	6	4	3	2	1								
8	11	14	15	16		B.	& S.	Gau	ge	15	8	5	4	3	2								
7	10	13	14	15	16					19	10	6	5	3	2	1							
6	9	12	13	14	15	16				24	12	8	6	4	3	2	1						
5	8	11	12	13	14	15	16			31	15	10	8	5	4	2	2	1					
4	7	10	11	12	13	14	15	16		38	19	13	10	6	5	3	2	2	1				
3	6	9	10	11	12	13	14	15	16	49	24	16	12	8	6	4	3	2	2	1	1		
2	5	8	9	10	11	12	13	14	15	62	31	20	15	10	8	5	4	3	2	2	2	1	1
1	4	7	8	9	10	11	12	13	14	77	38	26	19	13	10	6	5	4	3	2	2	2	2
0	3	6	7	8	9	10	11	12	13	97	49	32	24	16	12	8	6	5	4	3	3	3	2
00	2	5	6	7	8	9	10	11	12	123	62	40	31	20	15	10	8	7	5	4	4	3	3
000	1	4	5	6	7	8	9	10	11	154	77	52	38	26	19	13	10	8	6	5	5	4	4
0000	0	3	4	5	6	7	8	9	10	195	97	65	49	32	24	16	12	10	8	7	6	6	5
	00	2	3	4	5	6	7	8	9		123	82	62	40	31	20	15	14	10	9	8	7	6
	000	1	2	3	4	5	6	7	8		154	104	77	52	38	26	19	16	13	11	10	8	8
	0000	0	1	2	3	4	5	6	7		195	130	97	65	49	32	24	20	16	14	12	11	10
		00	0	1	2	3	4	5	6			164	123	82	62	40	31	25	20	18	15	14	12
		000	00	0	1	2	3	4	5			208	154	104	77	52	38	31	26	22	19	17	15
		0000	000	00	0	1	2	3	4			220	195	130	97	65	49	39	32	28	24	22	19
			0000	000	00	0	1	2	3				220	164	123	82	62	49	40	35	31	27	24
				0000	000	00	0	1	2					208	154	104	77	62	52	44	38	34	31
					0000	000	00	0	1					220	195	130	97	78	65	56	49	43	39
						0000	000	00	0						220	164	123	98	82	70	62	54	49
							0000	000	00							208	154	123	104	88	77	69	62
								0000	000							220	195	155	130	112	97	87	77
									0000								220	195	164	140	123	109	98

CURRENT IN AMPERES.

Size of Wire B. & S.	0000	000	00	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Safe Current, Amp.	220	190	165	140	120	102	87	73	62	54	47	40	34	28	25	21	17	14	11	8

THE LEYDEN HANDY WIRING TABLE.

seven-tenths of the current required to bring it to the same temperature when placed in moulding.

The manipulation of the table is very simple; for example, suppose we wish to carry 40 amperes 300 feet from the centre of distribution at 100 volts and 5 per cent. loss. From "40" in the column for "300 feet" cross laterally to the column headed "5 per cent. loss" at "100 volts," and we have the size of conductor as No. 3 B. & S. gauge.

The table is calculated for even percentages of loss at 100 volts. For 110 and 220 volts the percentages are fractional, but, by taking the nearest fractional percentage below the required one, the error is always on the safe side. For example, suppose we wish to carry 10 amperes 75 feet at 110 volts and 2 per cent. loss. From "10" in the column for "75 feet" cross to

PERSONAL.

Mr. Geo. Mooring, engineer at Messrs. Alexander & Kelly's mills at Brandon, Man., and a member of the C. A. S. E., paid a flying visit to Toronto a few days ago, remaining long enough, however, to make the final arrangements in connection with a life-partnership agreement entered into with one of the fair daughter's of the Queen city. Mr. Mooring and his bride carry with them to their Northwest home the best wishes of numerous friends in Ontario.

We publish elsewhere a letter from Mr. O. P. St. John, of Vancouver, late of Toronto, in reply to an enquiry by one of our subscribers. In a letter to the editor; Mr. St. John states that he is much pleased with British Columbia, is prospering and in good health, and desires to be kindly remembered to his friends among the engineers of Ontario. There are many of our readers who carry about with them kindly recollections of Mr. St. John, and who will join in reciprocating his kindly greetings.

RECENT CANADIAN PATENTS.

No. 37118. Geo. L. Foote, Electric Signal.
No. 37127. Wm. W. Savage, Holder for Electric Lamp.
No. 37135. Chas. W Hazeltine, Arc Lamp.
No. 37137. W. F. Wellman, Antifriction Bearing.
No. 37152. D. G. Weems, Electric Railway.
No. 37162. P. Decker, Electrical Insulator.
No. 37166. Jas. Jos. Bush, Steam Generator.
No. 37186. T. D. Bottome, Incandescent Electric Lamp.
No. 37188. W. C. Bryant, Incandescent Lamp Socket.
No. 37198. T. L. Kay, Storage Batteries.
No. 37219. Scotch Yoke for Steam Engine.
No. 37229. E. Howland, Portable Steam Boiler.
No. 37,230. E. Howland, Boiler and Engine.
No. 37,249. Ed. Mather, Furnace Grate.

SPARKS.

Mr. Fred. Stark, late of Listowel, has been appointed assistant engineer of the electric light station at Mitchell.

The Edison General Electric Company will establish an arc and incandescent lighting plant in the town of Lindsay, Ont.

Prof. Galbraith has received his first instalment of electrical instruments for the electrical engineering department of the School of Practical Science, and hopes to have his department fully equipped in a few weeks.

The city of Chicago has introduced in its telephone exchange a very useful "busy call," which enables a caller-up of a "busy" line to have his call placed on record, so that it will have attention as soon as the line is clear.

The Montreal Exhibition Association, as well as the citizens of that city, are to be congratulated upon the success which crowned their efforts in connection with the recent exhibition. The total receipts amounted to upwards of $50,000.

The Hamilton Light and Power Company is going to spend $30,000 or $40,000 in improving its system. Work has been commenced on a new power station at the corner of Main and Catharine streets. New dynamos, two new twin engines of 600 horse power each and other new plant will be added.

The agreement between the Bell Telephone Co. and the city of Toronto, which provides for a reduction in rates to $45 per year for business premises and $25 per year for residences, and the payment into the city treasury of 5 per cent. of the gross earnings of the company in the city, has been consummated. The city grants the company an exclusive franchise for five years.

Isaac Newton is said to have carried in his ring a magnet weighing but 3 grains, which could raise 746 grains or 250 times its own weight. This magnet naturally excited much admiration, but is surpassed in power by that formerly belonging to Sir John Leslie, and now in the Physical Collection at Edinburgh, weighing 3½ grains, and having a carrying power of 1,560 grains.

Prof. Elihu Thomson has recently devised a method of case-hardening iron or steel by means of the heat produced by the passage of an electric current. His process consists essentially in heating the object electrically, and then applying to the metal so heated a surrounding envelope—either gaseous, fluid or solid—for the purpose of changing or preventing change in the quality of the material, according to the special end to be attained.

Mr. B. J. Throop, who has been local manager for ten years past of the Bell Telephone Co.'s business at London, Ont., has been appointed to fill a similar position at Hamilton. Mr. S. J. T. Brown, of Hamilton, replaces Mr. Throop at London. The staff of the London office presented Mr. Throop on the eve of his departure with a kindly worded address, a couple of easy chairs, and a marble clock, in token of their appreciation of his character.

Mr. A. A. Cross, in a brief note to the *American Machinist*, thus describes a form of commutator smoother which he has found to answer the purpose. It is simply a block of maple, with a handle like a square chisel mallet, with a semi-circle cut in outer end of block, the circle to fit the commutator. Lay a piece of fine emery cloth in the semi-circle, fasten it with a tack on the side of the block, and grind away, running the dynamo about half speed. With this arrangement, and a little judgment, commutators can be kept smooth and round at little expense.

The Machinery Hall at the Industrial Exhibition presented but few exhibits in the electrical line this year. The honors were divided between the Ball Co., the Toronto Electric Light Co. and the Kay Electric Works, Hamilton. The lighting of the various buildings was done jointly by the Toronto E. L. Co. and the Ball Co. Not only was Machinery Hall less interesting from an electrical standpoint than on some former occasions, but a great falling off was observed as compared with former machinery exhibits of all kinds. The management of the Exhibition must give more attention to the requirements of machinery exhibitors if the retograde movement which has already set in in this important department is to be checked.

NOTES.

Dilute muriatic acid will take the muddy deposits out of gauge glasses.

Foaming in a boiler is most frequently caused by impurities in the water supply.

It is estimated that 20,000 horse power will be required for the electric lighting plant of the Columbian Exposition.

The *Northwestern Mechanic* says:—Vertical engines seem to be coming more and more into favor in this country for electric lighting, both for slow and high speeds. They have long been popular in England, and now quite a number of American engine builders are selling vertical high-speed compounds, and so far they appear to have been very successful.

A gentleman, well known as a maker of recording gauges, has a little son of an inquiring turn of mind. The other evening the boy said to his father: "Papa, where is Atoms?" Father—"Athens, you mean; don't you, my dear?" Inquiring son—No, Atoms, the place where people go to when the boiler explodes; because it always says they were blown to Atoms."—*Electrical Review.*

In the discussion at Providence of the topical question: "How many times per minute can a dashpot apparatus be lifted, such as used with Corliss' valve gear?" the case of an engine running at the Trenton Iron Works was cited by two or three members. It has worked successfully for several years, at 160 revolutions per minute. Another case where 150 revolutions is attained was mentioned.

That it is almost impossible for a steam engineer to secure a situation to-day unless he has sufficient knowledge to operate an electric plant, is well known, and it would seem axiomatic to state the converse proposition, and say that no electrician should be held competent to superintend a central station, or even an isolated plant, whether for railway power distribution or isolated lighting, who does not know whether or not the steam plant which drives his dynamos is being worked not only with safety to the neighborhood, but also with reasonable efficiency and economy. The weakest part of central station work has been and still is more frequently found to-day in the boiler room than elsewhere.—*Electrical Age.*

A shaft that is crooked, and is run in bearings that are in line, consumes power equal to the amount of strain it requires to bring it into line, and this strain is constant in any position that the shaft may be in, but as it revolves it shifts the strain to the bearing, and has a tendency to wear and loosen it. If the shaft is straight, and the bearings are out of line or level, the result is similar as to the constant strain of bending the shaft as it revolves, but the strain on the bearing will be one way all the time, and the tendency will be to wear the bearing in a direction that will allow the shaft to straighten itself. If a shaft is crooked and the bearings are out of line to the same amount, there will be one point in each revolution where there will be no strain, but opposite to that will be a point where it will be double, and the result will be a jerky motion, worse than if one or the other was right.

NOTES.

An excellent way to discover the whereabouts of pound about an engine, is to place the end of a piece of rubber hose to one ear and the other at different parts of the engine. Sometimes it may be necessary to stop up the other ear, as sound travels in a very deceptive way. Some engineers put the end of a thin pine stick between the teeth, and let the other end touch the suspected part of the engine. We have always found the hose quicker and more reliable.—*Boston Journal of Commerce.*

A pneumatic telephone has been patented in Canada by Mr. George Noreau, of Quebec, Que., on the 23rd of May, 1891, (No. 36,667.) This telephone consists of a box at each end of a speaking tube, this box contains mechanism for operating the call bells. A bulb of elastic material, when squeezed, causes the bell to ring. The speaking tube has a branch at each end that may be held to the ear, thus an uninterrupted conversation may be carried on in the same manner as the electric telephone.

Says the *Locomotive*. "It should be remarked that water may be heated above 212° Fah. without passing into steam, and while it is under ordinary atmospheric pressure, provided it is kept perfectly quiescent, but let the slightest motion be communicated to it—even the tremor produced by a footstep—and behold! the water which was calm and quiet suddenly flashes into steam. This is the mysterious cause of so many steam-boiler explosions, which take place when the valves have been closed for some time, and the boiler quiescent."

Perhaps readers will be interested in a kink in the engine which came to my notice recently, writes a correspondent of the *Scientific Machinist*. I have been troubled with the boxes on my crank pin getting warm and cutting away very rapidly I could not locate the cause for some time. I had put my engine in perfect line, and still the trouble kept on. I was on the point of using some strong engineer's language, when I thought perhaps the trouble was in the strap of the crank pin boxes. So I took it off and again filled up my boxes and put them back, but instead of screwing the nuts tight before driving the key in, I inserted the bolt and drove the key down hard, and then tightened up the nuts. Then, loosening up the key, I drove it to the proper place. I have not been troubled with hot boxes since. This way you put your boxes in perfect condition before you have made your strap fast.

NOTES.

The Jenckes Machine Co., at Sherbrooke, Que., has just completed a very large colliery winding engine, 60 tons in weight, ordered by the Intercolonial Mining Co., for work at their mines at Westmill, Nova Scotia. The engine is a double one with cylinders 28 x 60 inches, fitted with Cornish valve gear, and is 500 horse power. The drums are ten feet in diameter, and will wind over 5,000 feet of rope each, and it is intended to hoist seventeen boxes of coal at each lift from the slope of the mines, which are at present about 4,000 feet in depth.

Professor Wiggins, the inspired prophet of weather, has evolved a new idea from the Torricellian Vacuum in his maintop. According to this euphoniously named seer, we are to have a dry summer on account of the increased use of electric wires. The analogy is as *apropos* as if one should say, Baby McKee will take the croup because the Prince of Wales plays baccarat. The official weather prognosticator is enough for one country to be afflicted with. We can abide, with at least a simulation of patience, the mistakes of Greeley, but spare us from the Tices and the Wigginses.—*Electric Enterprise.*

It may be strange to engineers, but it is stated to be a fact, that in high pressure hot water heating the water frequently becomes red hot, pressures of 1,000 to 1,200 pounds per square inch being reached, and when the circulation of the system is defective the pipes become visibly red in the dark. One of the main obstacles in the way of using steam of very high pressures and correspondingly high temperatures, is the difficulty in properly lubricating the cylinders and keeping the stuffing boxes properly packed. With this difficulty overcome, pressures of 400 or 500 pounds to the square inch would be as common as 125 pounds to-day.

The employées on the Victoria Electric Tramway, numbering 33, recently struck for a reduction in the hours of labor from 12 to 9. The president of the company states that he can get plenty of men to fill the places of the strikers.

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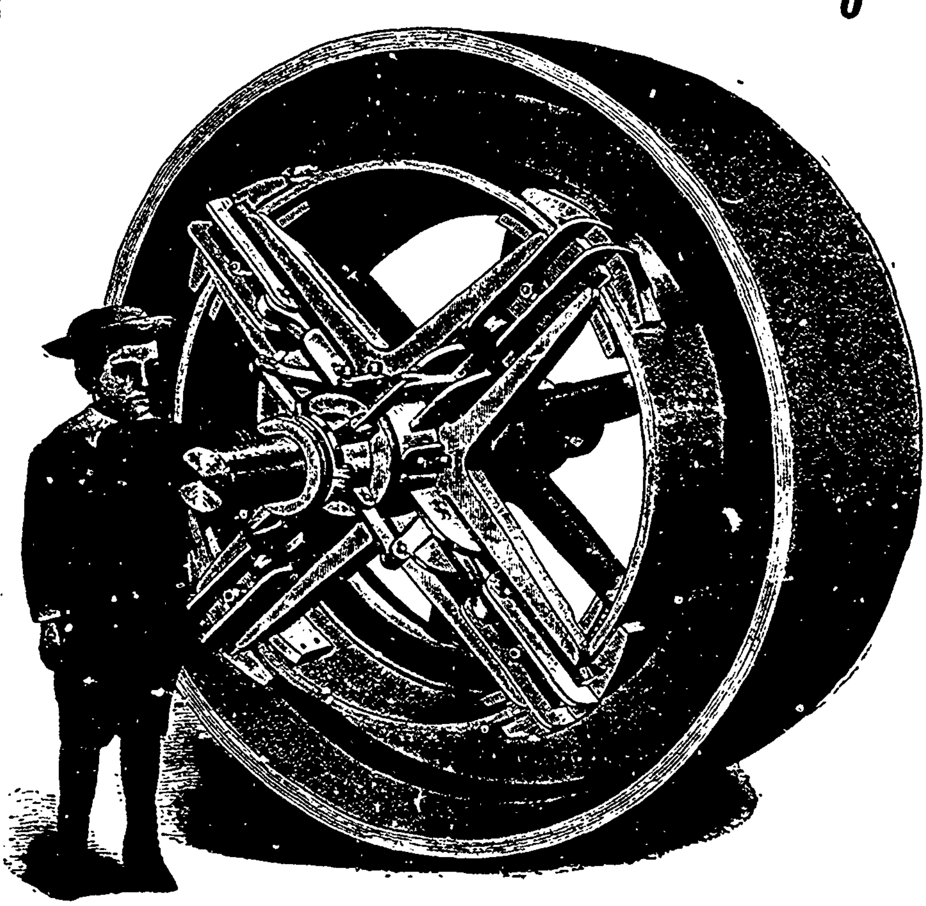

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