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INDEX

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ELECTRICAL NEWS

AND

STEAM ENGINEERING JOURNAL.

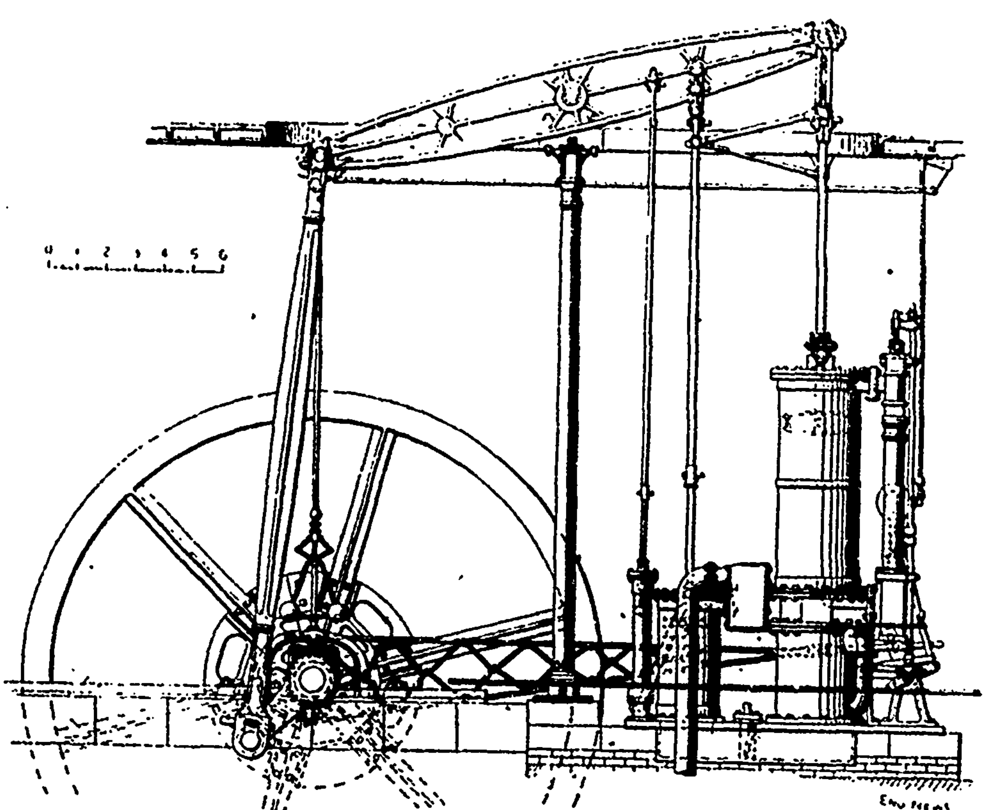
VOL. IV. JANUARY, 1894 No. 1.

THE OLDEST STEAM ENGINE IN THE UNITED STATES.

The steam engine shown in the accompanying drawing was built in 1815, by James Watt, of Lancashire, England, according to the information furnished us. This probably means that it was built by the firm of Boulton & Watt, formed by the sons of the great inventor and his partner to succeed the original and famous firm of Boulton & Watt, which terminated its existence in the first year of the present century. The engine illustrated was brought to Savannah in 1815, and was set up in the rice mill of Messrs. McAlpin & McInnis. It has been at work regularly ever since and is still doing daily duty, having been put in good repair two years ago by the Novelty Iron Works, of Savannah.

The engine runs at about 18 revs. per minute and develops about 90 H. P. Its cylinder is 31 ×72 ins. and it uses steam at 8 lbs. pressure. The air pump and boiler feed pump are each worked from the beam of the engine. The crank, the shaft and the connecting rod are made of cast iron.

There is good reason to believe that this engine is the oldest steam engine in the United States that is still doing regular service, and it is quite possible that it is as old as any of those which are still preserved as curiosities. In 1803 (see Jour. Franklin Inst., October, 1876), there were only five steam engines in the United States, of which two were at Philadelphia, two in New York and one in Boston. Three of these were pumping engines.



THE OLDEST STEAM ENGINE IN THE UNITED STATES.

Remembering that in 1815 manufacturing industries were still confined to the thirteen original States, and that in any of the Northern States an old machine would be much more likely to be replaced by a new one than in the South, it seems altogether likely the oldest engine at work in the United States, or, for that matter, anywhere in the world, save in Europe. If there be an older one in existence we shall be pleased to make record of it. We are indebted to Messrs. John Rourke & Son, proprietors of the Novelty Iron Works, of Savannah, for the drawing from which our illustration is made and information given above.—*Engineering News.*

QUESTIONS AND ANSWERS.

D. W. M., Drumbo, Ont., writes: 1. Where would you advise one to go in order to receive a thorough practical electrical education? 2. What would be the cost of such an education? 3. What time would be required, and what would be the necessary qualifications? 4. Do you know of any college in Canada where they have a special course in Electrical Engineerings?

Answer—1. We cannot undertake to advise you as to where you should go in order to receive such an education as you mention. That is a matter which you must decide for yourself. Some are of the opinion that such an education can be obtained apart altogether from scientific schools. Others believe that a scientific school education in electrical theory is what is required; and others, again, that such an education should combine a term in a scientific school with a year or two devoted to practical work in an electrical manufacturing establishment. We rather incline to agree with the latter opinion, and believe further, that an electrical education should be founded upon a thorough knowledge of engineering and mechanics. An eminent electrical authority recently made the somewhat startling statement that an electrical engineer should be one-tenth electrical and nine-tenths mechanical. We would advise our correspondent to read the paper read by Mr. Merrill before the Canadian Electrical Association at its last meeting, together with the discussion thereon. By this means he will learn the views of a number of persons prominently identified with the electrical business. 2. There is a course in Mechanical and Electrical Engineering at the School of Practical Science, Toronto, and at McGill University, Montreal. At Toronto the course extends over a period of three years, and the cost to the student, including the necessary books and instruments, is $250. 3. In order to enter upon this course students must have passed a University matriculation examination or a junior leaving examination at the High School. In case the student has had a year's experience at mechanical work in a manufactory, he will be admitted on passing a special examination in Mathematics and English.

MONTREAL ELECTRIC CLUB.

Dec. 4th.—At the regular meeting on this date, Mr. John Smillie read an entertaining paper on "Pioneer Electric Lighting in Montreal" for which he was given a vote of thanks. At the suggestion of a member, it was decided to have a question box in which the members could deposit questions which they desired to be answered.

Dec. 18th.—Mr. J. Gough delivered another of his series of papers on the "Philosophy, Application, Construction and Improvement of the Steam Engine," for which a vote of thanks was given him, debate was then held on "Alternate versus Continuous Current for Transmission for Power and Lighting a distance of Nine Miles." Messrs. H. W. Woodman and H. Ritchie supported the alternate current, and Messrs. W. B. Shaw and C. Legrand, continuous current. After an interesting debate in which the merits of each system were well set forth, the question was put to the meeting and was decided in favor of the alternate current by a small majority.

ON LIGHT AND OTHER HIGH FREQUENCY PHENOMENA.

By Nikola Tesla.

(Continued.)

ON ELECTRICAL RESONANCE.

The effects of resonance are being more and more noted by engineers, and are becoming of great importance in the practical operation of apparatus of all kinds with alternating currents. A few general remarks may therefore be made concerning these effects. It is clear, that if we succeed in employing the effects of resonance practically in the operation of electric devices, the return wire will, as a matter of course, become unnecessary, for the electric vibration may be conveyed with one wire just as well,

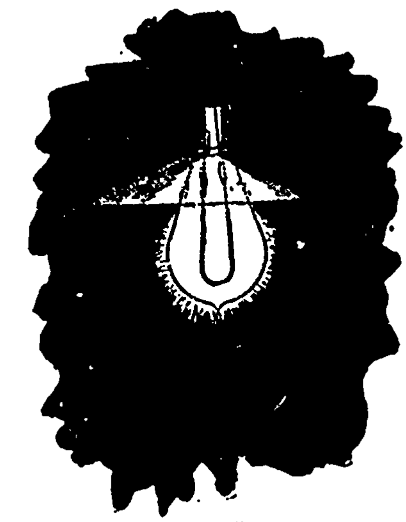


Fig. 22

Utilizing the Heating Effect of Conduction Current and Bombardment.

and sometimes even better, than with two. The question first to answer is, then, whether pure resonance effects are producible. Theory and experiment both show that such is impossible in Nature, for as the oscillation becomes more and more vigorous the losses in vibrating bodies and environing media rapidly increase, and necessarily check the vibration which otherwise would go on increasing forever. It is a fortunate circumstance that pure resonance is not producible, for if it were there is no telling what dangers might not lie in wait for the innocent experimenter. But to a certain degree resonance is producible, the magnitude of the effects being limited by the imperfect conductivity and imperfect elasticity of the media, or generally stated, by frictional losses. The smaller these losses, the more striking are the effects. The same is the case in mechanical vibration. A stout steel bar may be set in vibration by drops of water falling upon it at proper intervals; and with glass, which attributed, but are seldom due, to true resonance, for an error is quite easily made in this respect. This may be undoubtedly demonstrated by the following experiment. Take, for instance, two large insulated metallic plates or spheres, which I shall designate A and B, place them at a certain small distance apart, and charge them from a frictional or influence machine to a potential so high that just a slight increase of the difference of potential between them will cause the small air or insulating space to break down. This is easily reached by making a few preliminary trials. If, now, another plate—fastened on an insulating handle, and connected by a wire to one of the terminals of a high tension secondary of an induction coil, which is maintained in action by an alternator (preferably high frequency)—is approached to one of the charged bodies A or B, so as to be nearer to either one of them, the discharge will invariably occur between them; at least it will if the potential of the coil in connection with this plate is sufficiently high. But the explanation of this will soon be found in the fact that the approached plate acts inductively upon the bodies A and B, and causes a spark to pass between them. When this spark occurs, the charges which were previously imparted to these bodies from the influence machine must needs be lost, since the bodies are brought in electrical connection through the arc formed. Now, this arc is formed whether there be resonance or not. But even if the spark would not be produced, still there is an alternating E.M.F. set up between the bodies when the plate is brought near one of them; therefore, the approach of the plate, if it does not always, actually will, at any rate tend to break down the air space by inductive action. Instead of the spheres or plates A and B we may take the coatings of a Leyden jar with the same result, and in place of the machine, which is a high frequency alternator preferably, because it is more suitable for the experiment, and also for the argument, we may take another Leyden jar or battery of jars. When such jars are discharging through a circuit of low resistance the same is traversed by currents of very high frequency. The plate may now be connected to one of the coatings of the second jar, and when it is brought near to the first jar just previously charged to a high potential from an influence machine the result is the same as before, and the first jar will discharge through a small air space upon the second being caused to discharge. But both jars and their circuits need not be tuned any closer than a basso profundo is to the note produced by a mosquito, as small sparks will be produced through the air space, or at least the latter will be considerably more strained owing to the setting up of an alternating E.M.F. by induction, which takes place when one of the jars begins to discharge. Again, another error of similar nature is quite easily made. If the circuits of the two jars are run parallel and close together, and the experiment has been performed of discharging one by the other, and now a coil of wire be added to one of the circuits whereupon the experiment does not succeed, the conclusion that this is due to the fact that the circuits are now not tuned would be far from being safe. For the two circuits act as condenser coatings, and the addition of the coil to one of them is equivalent to bridging them, at the point where the coil is placed, by a small condenser, and the effect of the latter might

Fig. 26

Incandescence of a Solid.

Fig. 27

Phosphorescence.

Fig. 28

Incandescence or Phosphorescence or Rarefied Gas.

Fig. 29

Luminosity of Gas at Ordinary Pressure.

FOUR KINDS OF LIGHT EFFECTS BY HIGH FREQUENCY CURRENTS OF HIGH POTENTIAL.

is more perfectly elastic, the resonance effect is still more remarkable, for a goblet may be burst by singing into it a note of the proper pitch. The electrical resonance is the more perfectly attained, the smaller the resistance or the impedance of the conducting path, and the more perfect the dielectric. In a Leyden jar discharging through a short, stranded cable of thin wires these requirements are probably best fulfilled, and the resonance effects are, therefore, very prominent. Such is not the case with dynamo machines, transformers and their circuits, or with commercial apparatus in general in which the presence of iron cores complicates or renders impossible the action. In regard to Leyden jars with which resonance effects are frequently demonstrated, I would say that the effects observed are often be to prevent the spark from jumping through the discharge space by diminishing the alternating E. M. F. acting across the same. All these remarks, and many more which might be added but for fear of wandering too far from the subject, are made with the pardonable intention of cautioning the unsuspecting student, who might gain an entirely unwarranted opinion of his skill when seeing every experiment succeed; but they are in no way thrust upon the experienced as novel observations.

In order to make reliable observations of electric resonance effects it is very desirable, if not necessary, to employ an alternator giving currents which rise and fall harmonically, as in working with make and break currents the observations are not always trustworthy, since many phenomena, which depend on the rate of change, may be produced with frequencies widely different. Even when making such observations with an alternator one is apt to be mistaken. When a circuit is connected to an alternator there are an infinite number of values for capacity and self-induction which, in conjunction, will satisfy the condition of resonance. So there are in mechanics an infinite number of tuning forks which will respond to a note of a certain pitch, or loaded springs which have a definite period of vibration. But the resonance will be most perfectly attained in that case in which the motion is effected with the greatest freedom. Now in mechanics, considering the vibration in the common medium—that is, air—it is of comparatively little imporance whether one tuning fork be somewhat larger than another, because the losses in the air are not very considerable. One may, of course, inclose a tuning fork in an exhausted vessel, and by thus reducing the air resistance to a minimum obtain better resonant action. Still the difference would not be very great. But it would make a great difference if the tuning fork were immersed in mercury. In the electrical vibration it is of enormous importance to arrange the condition so that the vibration is effected with the greatest freedom. The magnitude of the resonance effect depends, under othewise equal conditions, on the quantity of electricity set in motion or on the strength of the current driven through the circuit. But the circuit opposes the passage of the currents by reason of its impedance, and, therefore, to secure the best action it is necessary to reduce the impedance to a minimun. It is impossible to overcome it entirely, but merely in part, for ohmic resistance cannot be overcome. But when the frequency of the impulses is very great, the flow of the current is practically determined by self-induction. Now self-induction can be overcome by combining it with capacity. If the relation between these is such that at the frequency used they annul each other, that is, have such values as to satisfy the condition of resonance, and the greatest quantity of electricity is made to flow through the external circuit, then the best result is obtained. It is simpler and safer to join the condenser in series with the self-induction. It is clear that in such combinations there will be, for a given frequency, and considering only the fundamental vibration, values which will give the best result, with the condenser in shunt to the self-induction coil; of course, more such values than with the condenser in series. But practical conditions determine the selection. In the latter case in performing the experiments one may take a small self-induction and a large capacity or a small capacity and a large self-induction, but the latter is preferable, because, it is convenient to adjust a large capacity by small steps. By taking a coil with a very large self-induction, the critical capacity is reduced to a very small value and the capacity of the coil itself may be sufficient. It is easy, especially by observing certain artifices to wind a coil through which the impedance will be reduced to the value of the ohmic resistance only, and for any coil there is, of course, a frequency at which the maximum current will be made to pass through the coil. The observation of the relation between self-induction, capacity and frequency is becoming important in the operation of alternate current apparatus, such as transformers or motors, because by a judicious determination of the elements the employment of an expensive condenser becomes unnecesary. Thus it is possible to pass through the coils of an alternating current motor under the normal working conditions the required current with a low E. M. F. and do away entirely with the false current, and the larger the motor the easier such a plan becomes practicable; but it is necessary for this to employ currents of very high potential or high frequency.

In Fig. 20 I is shown a plan which has been followed in the study of the resonance effects by means of a high frequency alternator. C is a coil of many turns, which is divided in small separate sections for the purposes of adjustment. The final adjustment was made sometimes with a few thin iron wires (though this is not always advisable), or with a closed secondary. The coil C is connected with one of its ends to the line L from the alternator G, and with the other end to one of the plates c of a condenser c c_1, the plate (c_1) of the latter being connected to a much larger plate P_1. In this manner both capacity and self-induction were adjusted to suit the dynamo frequency.

As regards the rise of potential through resonant action, of course, theoretically, it may amount to anything since it depends on self induction and resistance, and since these may have any value. But in practice one is limited in the selection of these values, and besides these, there are other limiting causes. One may start with, say, 1,000 volts, and raise the E. M. F. to 50 times that value, but one cannot start with 100,000 and raise it to 10 times that value, because of the losses in the media, which are great, especially if the frequency is high. It should be possible to start with, for instance, two volts from a high or low frequency circuit of a dynamo, and raise the E. M. F. to many hundred times that value. Thus coils of the proper dimensions might be connected each with only one of its ends to the mains from a machine of low E. M. F., and though the circuit of the machine would not be closed in the ordinary acceptance of the term, yet the machine might be burned out if a proper resonance effect would be obtained. I have not been able to produce nor have I observed with currents from the dynamo machine, such great rises of potential. It is possible, if not probable, that with currents obtained from apparatus containing iron, the disturbing influence of the latter is the cause that these theoretical possibilities cannot be realized. But if such is the case, I attribute it solely to the hysteresis and Foucault current losses in the core. Generally it was necessary to transform upward, when the E. M. F. was very low, and usually an ordinary form of induction coil was employed, but sometimes the arrangement illustrated in Fig. 20 II has been found to be convenient. In this case a coil C is made in a great many sections, a few of these being used as the primary. In this manner both primary and secondary are adjustable. One end of the coil is connected to the line L_1 from the alternator, and the other line, L, is connected to the intermediate point of the coil. Such a coil with adjustable primary and secondary will be found also convenient in experiments with the disruptive discharge. When true resonance is obtained, the top of the wave must, of course, be on the free end of the coil, as, for instance, at the terminal of the phosphorescence bulb B. This is easily recognized by observing the potential on a point on the wire w nearer to the coil.

In connection with resonance effects and the problem of transmission of energy over a single conductor, which was previously considered, I would say a few words on a subject which constantly fills my thoughts, and which concerns the welfare of all. I mean the transmission of intelligible signals, or perhaps even power, to any distance without the use of wires. I am becoming daily more convinced of the practicability of the scheme; and though I know full well that the great majority of scientific men will not believe that such results can be practically and immediately realized, yet I think that all consider the developments in recent years by a number of workers to have been such as to encourage thought and experiment in this direction. My conviction has grown so strong that I no longer look upon this plan of energy or intelligence transmission as a mere theoretical possibility, but as a serious problem in electrical engineering, which must be carried out some day. The idea of transmitting intelligence without wires is the natural outcome of the most

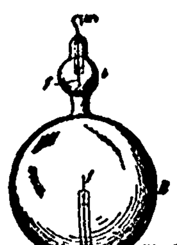


Fig. 30

Showing the Effect of Confining the Gas Around the Electrode.

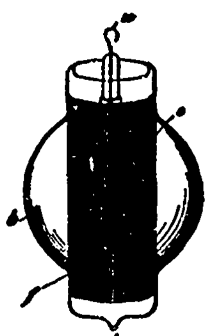


Fig. 31

Showing the Inefficiency of a Metal Screen.

Fig. 32

Electrostatic Action Between Primary and Secondary, with Extremely High Frequencies.

recent results of electrical investigations. Some enthusiasts have expressed their belief that telephony to any distance by induction through the air is possible. I cannot stretch my imagination so far, but I do firmly believe that it is practicable to disturb by means of powerful machines the electrostatic condition of the earth and thus transmit intelligible signals and perhaps power. In fact, what is there against the carrying out of such a scheme? We now know that electric vibration may be transmitted through a single conductor. Why then not try to avail ourselves of the earth for this purpose? We need not be frightened by the idea of distance. To the weary wanderer counting the mile posts the earth may appear very large, but to that happiest of all men, the astronomer, who gazes at the heavens and by their standard judges the magnitude of our globe it appears very small. And so I think it must seem to the electrician, for when he considers the speed with which an electric disturbance is propagated through the earth all his ideas of distance must completely vanish.

A point of great importance would be, first, to know what is the capacity of the earth and what charge does it contain if electrified? Though we have no positive evidence of a charged body existing in space without other oppositely electrified bodies being near, there is a fair probability that the earth is such a body, for by whatever process it was separated from other bodies—and this is the accepted view of its origin—it must have retained a charge, as occurs in all processes of mechanical separation. If it be a charged body insulated in space its capacity should be extremely small, less than one-thousandth of a farad. But the upper strata of the air are conducting, and so, perhaps, is the medium in free space beyond the atmosphere, and these may contain an opposite charge. Then the capacity might be incomparably greater. In any case it is of the greatest importance to get an idea of what quantity of electricity the earth contains. It is difficult to say whether we shall ever acquire this necessary knowledge, but there is hope that we may, and, that is, by means of electrical resonance. If ever we can ascertain at what period the earth's charge, when disturbed, oscillates with respect to an oppositely electrified system or known circuit, we shall know a fact possibly of the greatest importance to the welfare of the human race. I propose to seek for the period by means of an electric oscillator, or a source of electric alternating currents. One of the terminals of the source would be conected to earth as, for instance, to large surface.

(To be Continued.)

CANADIAN ASSOCIATION OF STATIONARY ENGINEERS.

Note.—Secretaries of the various Associations are requested to forward us matter for publication in this Department not later than the 25th of each month.

ONTARIO ASSOCIATION OF STATIONARY ENGINEERS.

A meeting of the Executive Board of the above Association was held a fortnight ago in Shaftesbury Hall, Toronto. There were present: A. E. Edkins and A. M. Wickens, Toronto; Robert Dickenson and R. Mackie, Hamilton; A. Ames, Brantford; James Devlin, Kingston; Fred. Mitchell, London, and S. Potter, Peterboro'. It was decided that in view of the feeling existing throughout the Province, an effort should be made to induce the Legislature at its next session to amend the present Engineers' License Act in such a way as to make it compulsory on all persons in charge of steam plants, other than farm engines or very small plants, to give proof of their ability to safely manage the same.

MONTREAL NO. 1.

At the last regular meeting of the above Association a resolution of condolence with the family of the late Mr. W. Wilson, a member of the Association, who was recently killed at the rolling mills, was passed.

Mr. Peter H. Cowper, mechanical superintendent of the Canadian Rubber Co., recently presented to Montreal Association No. 1 a model of a steam pumping engine made by himself, the cylinder of which has a small glass window through which the action of the water can be seen. Views of the engines of the Steamship Lucania were also presented to the Association by Mr. Hugh Vallance.

HAMILTON ASSOCIATION NO. 2.

The meetings of this Association of late have been of a particularly interesting and instructive character, especially the one held on the 15th of December, on which occasion Bro. Peter Stott read a valuable paper on "Centrifugal Force," illustrating the same in an able manner. The Association has appointed a committee to provide papers and subjects for discussion at the monthly open meetings throughout the winter, and I think other Associations would find it to their advantage to do the same.

WM. NORRIS, Rec.-Sec.

OTTAWA NO. 7.

A member of the above Association, under the *nom de plume* of "Progress," writes On December 12th Ottawa No. 7 held its regular meeting, with the President, Bro. J. H. Thompson, in the chair. Although a small number of engineers were present, it turned out to be one of the most interesting and instructive meetings since organization. The routine business is generally over in a short time, as every member is anxiously waiting for "Good of the Order," either to take part or get information from discussions on engineering.

The subject taken up was "The best methods of firing coal." At first the question did not receive much attention, but when some experienced hands stirred it up, it was clear to everyone to be of the most vital importance to engineers and steam users—for the employer should appreciate the services of the man that will run his plant the most economically—and as the fuel bill plays a prominent part in connection with the expenses of an engineer's department, it was elaborately demonstrated that every engineer should necessarily be thoroughly acquainted with different kinds of fuel and how to treat them during combustion.

Some veteran firemen drew attention to the large amount of fuel wasted in cleaning out a fire, when one made a suggestion to that effect. He said the general way is to shove the good coals off the clinkers to the back of the furnace, and rake the front out, and then pull the good coals from the back on the uncovered bars to the front. At this point he explained the advantage of having a layer of green coal on the front of the bars before drawing over the hot coals; it prevented a vast amount of combustible from dropping into the ash pit, to be afterwards thrown away as refuse.

After this question had been made as explicit as possible under the circumstances, Bro. Peters said he had experienced some difficulty in keeping up steam, and wanted to know if the cause should be attributed to some alterations made in the furnace. In answer to questions as to the grate and heating surfaces, and the construction of the bridge-wall, he said the latter was 7" or 8" from boiler, when it was suggested that he should put in another course of bricks to make it 4" or 5", which would keep the flames in closer contact with the boiler.

At this point Bro. Merrill went to the blackboard to make a rough sketch of boiler setting, showing the bridge wall, and that the flooring should be built parallel to the boiler or closed in towards the back end.

To this Bro. Robert took an opposite view, saying that from the bridge wall the floor should be sloping down to the back, so as to form a good combustion chamber, and more especially when soft coal is used; and the distance between bridge wall and boiler should in no case be less than ten inches. In his opinion a bridge wall was never intended to steer the gases against the boiler, but simply to form the back of the furnace, and retain the coal upon the grate. In support of his contention he quoted some good authorities.

Bro. Wensley endorsed this view, but as there is a wide difference of opinion, some thought it should be left open to a fair criticism by engineers of other Associations or by any one interested in engineering.

Before the meeting was closed the President gave notice of a special meeting on December 14th, at which Mr. Thomas Stewart, Chief Mechanical Engineer for Messrs. McLaughlin Bros., of Arnprior, was admitted to membership. Ottawa No. 7 feels proud to be able to boast of such an acquisition, as Mr. Stewart is widely known to be an indefatigable worker for the cause and welfare of engineers.

At our next and last meeting in December there will be two more initiations, and we will also elect our officers for 1894.

The London Association will in future hold its meetings on the first Thursday and last Friday of each month. Mr. William Meaden, 533 Richmond Street, has been elected secretary, *vice* Mr. George Taylor.

ENGINES FOR ELECTRICAL WORK.

Editor CANADIAN ELECTRICAL NEWS.

DEAR SIR —Mr. W. T. Brown's letter of the 15th November on the subject of engines gives one the impression that he considers the long stroke engine challenged, and feels called upon to defend it, as opposed to the short stroke engine. I am sorry if Mr. Brown or others of your readers have construed my letter, in your November number, as either condemning the long stroke engine in a general sense, or advocating the high speed engine as superior to it for all circumstances. I frankly stated that the long stroke engine will give somewhat better economy than the high speed engine under best conditions as to the amount and regularity of load, but you will remember that my letter was called forth by your article treating of engines for Electric Railway work, and I attempted to discuss the special features of the high speed engine, particularly with reference to this kind of work. In regard to the long stroke engine, I will go further, in order to leave no doubt as to my position in the matter, and say that I believe there are circumstances where, the work being steady and regular in amount, speed of the driven gearing slow and space unlimited, the slow speed engine may be better adapted to the work than the high speed engine, as at present constructed. But I think it is now pretty generally, if not universally conceded by the best authorities on steam engineering that the best high speed engines have reached a state of perfection where they may be selected for such circumstances as they are adapted to, without fear of failure either from excessive wear or breakage. In confirmation of this, I will make only one or two references, although a great many more could be given.

1st. I would refer your readers to a report, read at the Milwaukee Convention of the Street Railway Association, by a committee consisting of E. G. Connette, L. H. McIntyre, and F. S. Pearson, appointed to report on power house engines, an abstract of which may be found in the *Electrical World* of October 28th, 1893. These gentlemen have all had extensive experience in engines for electric work and are apparently unbiased, as their reports show. They say "for small plants to run from ten to fifteen cars, simple high speed engines, belted direct to generators, are unquestionably the proper choice. For twenty to fifty car plants, compound engines, with condensing apparatus where it is possible; with tandem compound engines for the smaller plants, and cross-compound engines for the larger ones, geared direct to generators, will probably be found most economical; while for the larger systems compound and triple expansion condensing engines, using steam at a high initial pressure, and either driving a countershaft or coupled direct to generator, whichever the conditions of the case will warrant, will be found a proper selection." It will be noted that while high speed engines are distinctly recommended for small plants, and for medium size plants, engines geared direct to generator, which must necessarily be either high speed or medium speed, and even for very large plants a choice is left open to engines either belted to countershaft, which presumably would be low speed, or direct connected to generator, which would be high or medium speed.

2nd. I would refer to a paper read by Mr. Charles H. Emery, Ph.D., before the seventy-fifth meeting of the American Institute of Electrical Engineers on "The Cost of Steam Power Produced with Engines of Different Types Under Practical Conditions," and a lecture by the same author before the Sibley College on "The Cost of Steam Power," an abstract of which may be found in the *Electrical World* of April 1st, 1893. This paper is a very complete estimate, based on practical experience, of producing 500 H. P. for one year with eleven different types of engines, embracing simple, compound, and triple expansion, condensing and non-condensing, both high speed and low speed, and includes the first cost of engines, boilers, and foundations, cost of fuel with various grades of coal, and repairs, insurance and interest. In regard to the item of repairs Dr. Emery makes the difference in cost between high and low speed engines 43 cents per horse power per year in favor of the low speed, or not quite 1 per cent on the total cost per horse power per year for 365 days, for electric railway plants, with coal at $3.00 per ton, and it may be that the results are not taken from the best high speed engines, as there are many inferior ones in use, probably more than of the low speed, owing to its earlier and more perfect development. The total cost of producing a horse power for one year to the various classes of engines, including first cost, wear and tear, fuel, attendance, and other items, while it shows that the low speed engine in each class will produce a horse power slightly cheaper than the high speed engine of the same class, also shows that a high speed non-condensing compound is cheaper in first cost and total cost per horse power, including wear and tear, fuel, etc., than a low speed simple engine; and a high speed compound condensing engine is cheaper in first cost and running expenses than a low speed simple condensing engine, and a high speed triple compound condensing is cheaper in first cost and total running expenses than a slow speed compound condensing engine, so I think it is safe to say that the choice of engines should be entirely regulated by the conditions of the case, as it is evident that under some circumstances it may be cheaper and better to use high speed engines, while under others it would be better to have slow speed ones.

Now just a few words in reference to some of the arguments used by Mr. Brown in criticism of my previous letter. He admits: "it is true that the high speed engine has more opportunities to correct the difference of speed caused by various loads," than the low speed engines, but he says, "it needs them all on account of the lightness of its parts." I am at a loss to understand just what he means by this. Does he mean that the piston, cross-head, connecting rod, or crank are lighter, and therefore have less balancing power? If so I would remind him that it is not simply the weight but the inertia of the reciprocating parts that affects the balancing or steadiness of an engine while in motion. Inertia is a result of both weight and speeds and as the high speed engine usually has greater inertia of moving parts, it has better balancing qualities than a slow speed engine. Does he mean the balance wheel? If so, the high speed engine has that in its favor too, because, while the wheel or wheels, of a high speed engine are much smaller and lighter than in a slow speed engine, their higher rate of speed gives them more balancing power. If he will take the trouble to make the calculation, he will find, that a wheel or wheels six feet in diameter, we ghing say 4000 lbs. running at 250 revolutions per minute, will have considerable more balancing power than a wheel thirteen feet in diameter, weighing say 9000 lbs., running 60 revolutions per minute.

Mr. Brown next advises me to make proper enquiries and I "will find that there are slow speed engines which have very sensitive governor attachments, regulating very closely," etc. I am pleased to say I have seen a large number of long stroke engines with good governors, regulating as closely as long stroke engines are capable of regulating, but I have not yet seen any that, when called upon to run street railway generators, where the load varies from 100 to 500 per cent. in less than one revolution of the engine, as it frequently does in small plants, would regulate closely at all; and it is self-evident that an engine running say 60 to 80 revolutions per minute with trip cut-off cannot be made to do it. The writer next advises me to take a trip to the United States to find "that in a great many cases the high speed engines have been removed to make room for the low speed ones; it is not uncommon to find electric light and power stations where they removed two and even three high speed engines to put in one low speed, and by doing so have saved nearly one-half of their boiler capacity," and he concludes that the change is made that they may have better economy and fewer repairs. I think he is perfectly right in his conclusion, so far as economy is concerned, and I do not think it will be necessary to go to a foreign country to see examples of the same procedure, with the same result, because it is perfectly well known that one large engine, of either the high or slow speed type, will do better than a number of small engines, if the load is fairly uniform and suited to the larger engine, and there are many cases, not only in electric plants but for other purposes, where small engines have been replaced by larger engines, as the work increased and the requirements became better known, and it will continue to be so. This goes to support my contention that each class of engine has special advantages for certain cases. I have in my mind a case where a competent expert, after making careful tests of an electric plant, advised laying aside a long stroke engine and using two high speed ones, although this is perhaps exceptional, because when the change is made it is usually in the direction of using larger units of power under more uniform load.

Mr. Brown states that excessive clearance is the cause of considerable loss in the high speed engine, and he is probably correct in regard to many of the high speed engines in use, but it may not be out of place to say that this is overcome to a considerable extent by a higher compression than is possible in the slow speed engine, and the latter designers of high speed engines have managed to lessen the clearance to a very small amount without contracting the port area. I have in mind a high speed engine which has less than 5 per cent. of clearance, and the compression reaches very close to the initial pressure, so that the loss from this source cannot be very great.

Mr. Brown, in this connection, finds fault with the excessive compression necessary to insure quiet running in a high speed engine. Now 1st, I do not see how he makes out that high compression affects economy adversely. I think it is generally understood that high compression fills the clearance spaces with steam which otherwise would be wasted, and tends to equalize the temperature in the cylinder. In regard to its being necessary to insure quite running, I believe that is generally thought to be a good feature. It cushions the piston and reciprocating parts, lessens the strain on the crank pin bearings while turning the centres, and I believe has exactly the same effect in the long stroke engine as in the high speed one, and if, as Mr. Brown states farther on in his letter, the piston speed may be the same in both engines, the compression would require to be the same also, to balance the inertia of the reciprocating parts and to insure quiet running in both engines; but, as a matter of fact, the piston speed is usually greater in the high speed engine than in the long stroke, Corliss type, and consequently the compression may be higher, which is thought to be an advantage both in economy of steam, and wear and tear of engine, because it is possible to more nearly relieve the strain on the bearings while turning centres.

Mr. Brown next concludes that the fast motion of the high speed engine must of necessity cause more wear than there is on the same parts of the slow speed, and makes a short extract from Mr. Chas. T. Porter's paper on the "Limitations of Engine Speed," to back up his statement. Now I think a little consideration will convince any one that, as I stated and explained in my previous letter, high rotative speed is not in itself a cause of wear, and if Mr. Brown or any one else, will take the trouble to read Mr. Porter's paper throughout he will find that Mr. Porter states clearly in his first sentence that, "the practical limitation to high rotative speed in stationary reciprocating steam engines *is not found in the danger of heating or of excessive wear.*" The cause of both of these, he continues to say "it is now well understood are to be looked for in defects of design or construction, commonly both." Following the same line, Mr. Porter says "correct designs are now generally followed in both the fixed and moving parts of steam engines, and a higher degree of truth is readily attained in their construction; so that it has come to be a simple matter to make engines which can be run at very high speeds quite free from either of these difficulties." In regard to smooth running and high compression, Mr. Porter says, "again an objection to very high speed is not found in a tendency to knock on centers. In a properly designed and constructed engine, in which valves are correctly set, and which is run by steam, high speed tends to silent running." Mr. Porter takes pride in the fact that high speed has revealed defects in design and construction, and has wrought an entire change in engine construction not yet completed, and he says "even makers of slow speed engines have profited from them." I am sorry to say that the makers of high speed engines in Canada, with one or two exceptions, have not profited as largely by this experience as they might; I hope the low speed men have. Now since I have quoted so largely from Mr. Porter's excellent paper, which is quite in keeping with his past record, and is undoubtedly, as Mr. Brown says, "the matured opinion of one of the ablest consulting engineers of the present day." I suppose it will only be fair to state what he considers the limitation to engine speed to be, if it is not wear, heating, etc. Well, he thinks it is limited by excessive clearance, and while he holds that high speed engines may be run at very much higher speeds than they are, so far as wear or heating is concerned, advises makers not to exceed 600 feet per minute piston speed for ordinary sizes of engines, which, as he says, will give 300 revolutions per minute with 12 inch stroke, and which I may say is quite as fast as the best makers of high speed engines care to run them at present, and with which speed Mr. Porter thinks purchasers ought to be satisfied.

Now at the close we come to the sentence quoted by Mr. Brown to prove that the high speed engine is ruled out, and that even Mr. Porter, the unfortunate father of said engine, has disowned it. Mr. Brown quotes as follows: "I would ask builders in their own interest to resist the temptation to get the utmost out of a given engine and set their faces like flint against the demand for short stroke engines which will occupy but little room." How can this fit in after all that Mr. Porter has said in favor of high speed, so far as I have quoted? Well, Mr. Brown did not quote the whole sentence; I will finish it. It is as follows: "And from which the power can be got by speeding up beyond the limit here proposed." The limit here proposed, as you will observe from the quotation which I have given in a previous paragraph, is 300 revolutions for an engine with 12 inch stroke, which is the ordinary speed of a high speed engine of that size.

Yours truly, D. W. ROBB.

ENGINES FOR ELECTRICAL WORK.

Editor ELECTRICAL NEWS.

SIR:—I have read an article in your paper on the relative merits of high speed vs. slow speed engines, for electrical purposes. Although the article referred to appears to be a well reasoned one from the standpoint of those building and favoring high speed engines, I cannot agree with them, as my experience for some time past while following my business is the reverse of theirs. Having no interest in any engineering firm, and having no engine to dispose of, I might be expected to give an unbiassed opinion of what has come under my observation.

Some two weeks ago, Mr. St. John, late Marine Engineering Inspector to the Dominion Government, Mr. Smeaton, Chief Engineer of the Steamship "Modjeska", holding a first-class engineer's certificate, and the writer, conducted a test in the power house of the Hamilton Electric Street Railway, of a compound condensing tandem Corliss engine, built by John Inglis & Son, Toronto. The cylinders are H. P. 16"×36"; L. P. 30"×36"; revolutions, 88; pressure of steam, 100 lbs.; vacuum, 25" to 26"; (I may say that the Hamilton Street Railway is one of the best equipped on the continent the company having spared no expense to have it so throughout). The test of this engine extended over ten hours, 88 diagrams having been taken during its continuance, showing a large and immediate change in the power as the work came on and off it, varying from 80 to 230 H. P., yet not the slightest variation could be detected in its speed from a friction load with current switched off, or the whole load of say 230 I. H. P. The average load taken from the cars figured up to 190 H. P. The fuel burned in the ten hours of the test (equal quantities of hard and soft coal screenings) weighed 3,374 lbs. or rather less than 1¾ lbs. per I. H. P. per hour. Every care was taken in this test, considering the fluctuation of the load, to arrive at a fair result. It can not but be considered an excellent one; I know of nothing better, even with the best fuel.

There is another compound high pressure engine in this city running the Hamilton Colored Cotton Mills, and indicating 200 H. P. very nearly equally divided between each cylinder. This engine too has a very variable load, yet no difference can be detected in its motion. It also is fired with hard and soft coal screenings, burning 2½ lbs. per H. P. per hour; yet the exhaust from the engine heats the whole of the large mill, heats the water in the dye house to 180° Fr. and heats the large drying rooms also.

I could mention many others, perhaps not so economical of fuel but as regular in their motion. I do not know of any high speeds that will approach this compound condensing or otherwise. I know of several Armington & Sims engines taking 4½ lbs. per I H. P. per hour, and also of others of another make using up more than this; they also use up very much more oil than the long stroke engine and require to be much more carefully looked after. I know of several high speed engines that were taken out and replaced with long stroked automatic, but I never knew of the long stroke being superseded by the short stroke ones; in fact the whole tendency of electrical engineering at the present day is towards larger machines and slower speeds.

Yours respectfully, J. H. KILLEY.

PERSONAL.

Mr. J. C. Gough has just received the appointment of Mechanical Supt. for the Richelieu and Ontario Navigation Co., with headquarters at Sorel, P.Q.

Mr. Henry Goebel, whose name has of late figured prominently in the United States Courts as claiming to be the original inventor of the incandescent lamp, died at his residence in New York City on the 4th of December. Henry Goebel was born in the village of Springer, near Hanover, Germany, on the 20th of April, 1818, and arrived in New York in the early part of 1849.

The death is announced at Placentia, Newfoundland, of Mr. George M. Carson, manager and electrician of the cable borneat that place. Mr. Carson was in Pictou, August 16, 1847. At the age of 13 he entered the telegraph office in Pictou, later he worked in the Sackville office, Nova Scotia; thence he went to Heart's Content, Newfoundland, in 1867; to St. Pierre in 1870, and to Placentia in 1872, where he continued till his death.

Mr. F. E. Handy, who about a year ago was appointed superintendent of the New Westminster and Vancouver Tramway Company, is at present in Ontario, having been granted three months leave of absence to enable him to recuperate his health which has been affected by the dampness of the climate at Vancouver. We notice by the local press of Vancouver that Mr. Handy has been eminently successful in his management of the Westminster and Vancouver road, and it is the hope of his friends in British Columbia as well as in Ontario that he may speedily regain his health.

Mr. Benjamin B. Toye, Great North-Western Telegraph Superintendent, died at his residence in Toronto on the 6th of December. Mr. Toye was one of the oldest and best known telegraphers in America. More than forty years ago, in company with Messrs. H. P. Dwight, J. T. Townsend and R. Easson, he entered as a messenger boy the employ of the Montreal Telegraph Company., at Toronto, and continued his connection with the Company with which it afterwards amalgamated, during the long period mentioned. To him is given the credit of having been the first Canadian to practice the receiving of messages by sound. He was the inventor also of Toye's Automatic Repeater which found its way into use throughout Canada and the United States. Mr. Toye suffered a lingering illness due to pulmonary trouble, which eventually culminated in his death.

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

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VOL. IV.

THE ELECTRICAL NEWS enters with the present number, upon its fourth year. Its development, though not rapid, has been steady and substantial, which, after all, is the kind which is most satisfactory. We extend our thanks to all who have in any way assisted us in the past, and in our continued striving towards improvement in the future, we hope to have the co-operation of every reader. We take advantage also of the present opportunity to extend to all our best wishes for a Happy and Prosperous New Year.

THE runaway car on St. Denis st., Montreal, will probably result in a great outcry for brakes, and more than likely some bright genius will want an electric brake, possibly after some design of his own. Evidently something better is required than the usual hand-brake for extraordinary grades, but of what use would an electric brake be when the trolley is off.

A SUIT was lately brought against the Bell Telephone Co. in Toronto by the proprietor of a livery stable, who claimed damages on the ground that his name and telephone number had been omitted by the defendants from one issue of their telephone book. In his evidence the plaintiff made the somewhat remarkable statement that the omission of his name and telephone number had resulted in a falling off of 50 per cent. in his business. In the light of such testimony as this, and of the enhanced appreciation of the value of the telephone by the company's subscribers since the efficiency of its system was impaired by the recent storm, the present would seem to be an opportune time to increase rates.

THE experiment tried on the Erie Canal, near Rochester, of towing by means of an electrically-propelled boat connected with a double trolley, is one which might be repeated with profit on several of our Canadian canals. Take for instance the Lachine Canal near Montreal; an extension from the Street Railway Company's trolley wire at 500 volts could readily be carried up there. Kingston again would probably give service at the mouth of the Rideau; the same would apply to Ottawa. This trolley wire could also be used together with "step down" motor dynamos to charge the storage batteries of electric skiffs, launches, &c. The great drawback to anyone putting such a boat on our present cruising waters is the trouble of getting the cells recharged.

PERHAPS no more startling proof of the rapid strides made by electricity can be found than taking a city directory of to-day and comparing it with one of a few years ago; in the latter the term "Electrician" is not to be found, whereas to-day their name appears to be legion. This suggests the enquiry, "What is an Electrician?" On making an analysis of the aspirants who glibly dub themselves with this designation, we are of opinion that many of them are about as much entitled to do so as a man who ties up an injured finger is to style himself "M.D." Let those who would be electricians study and study hard, that they may so qualify themselves as to be known as such, not only nominally, but in reality.

Referring to our former remarks re varying candle powers on arc lamps, keeping the watts constant, as found by Prof. Cahart during his experiments, Crompton does not agree with him, but states that in his experiments he finds 42 volts give the best effect. He uses a larger carbon for the upper than for the lower, also has the upper one soft cored. Crompton states that probably Prof. Cahart's carbons were to blame. There is one thing certain, viz., that if anyone who uses an arc lamp on a constant potential circuit will try the effect of soft cored carbons in comparison with the usual hard variety he will simply be astonished at the result. This is especially the case in 52 volt alternating current arc lamps, which, with soft cored carbons, give a steady, pure white light.

WE publish elsewhere in this issue a report of a meeting of Ottawa Association No. 7, C. A. S. E., kindly sent to us by one of its members. This report is a model of what we would like to receive regularly from the Secretary or some member of every association. It indicates what subjects came up for discussion and what were the views which were expressed upon them, thus showing to the officers and members of other associations what matters are engaging the attention of engineers in Ottawa, and possibly suggesting to them subjects for discussion. There is also a hint given that the members of the Ottawa Association would be pleased to read the opinions of their fellow engineers in other places on the question which they have been considering. We have on one or two former ocassions pointed out that the columns of this journal might with advantage be used for the interchange of reports of the proceedings of the various associations, as well as the individual opinions of their members on points of interest to engineers.

IN the present issue is printed further correspondence on the subject of the relative values of high versus slow speed engines for electrical work. The preponderance of opinion expressed thus far seems to be in favor of the slow speed engine but no doubt the arguments on the opposite side are not all exhausted. The high speed engine is not without its friends. Only a few days ago we heard its praises being sounded by an engineer in charge of a street railway power plant, who, pointing with pride to the high speed engine by which the power was furnished, stated that it had been in constant operation 19 hours per day for nearly two years, and that during this period there had never been a break down, while the repair bill had not amounted to $5.00. This must certainly be considered a good record. It may be mentioned that on this road there are some heavy grades, thus imposing upon the engine great fluctuations of load. We shall be pleased to publish all further information obtainable on this interesting subject.

IT would seem that there is a great lack of information on the part of the public with regard to the amount of profit to be derived from the operation of electric lighting plants. It is only on this supposition that we are able to understand the action of business men in investing their money in lighting plant and entering into competition in small towns with those already in the business. In some of the towns in Eastern Ontario this competition has been carried to the extreme limit, especially as regards incandescent lighting, which in some localities is being furnished at or below cost of production. The citizens in these towns are congratulating themselves, as well they may, upon the existing condition of affairs, while the rate at which light is being supplied to them is being used as the means of forcing down prices in adjoining municipalities. The state of things is affecting so seriously the owners of electric machinery that meetings of those interested have lately been held to consider what steps should be taken to place the business on a more satisfactory and equitable basis. It is to be hoped that the statement of facts above set forth will suffice to deter others from entering into competition with existing lighting companies in localities where there is barely sufficient business to warrant the existence of a single plant.

The paper by Mr. G. C. Mooring on the value of different kinds of fuel for steam purposes, which we publish in the present number of the ELECTRICAL NEWS, opens up a subject of much interest both to engineers and owners of steam plants. Its importance, we believe, has not been as fully appreciated as it is desirable that it should be. While every effort has been made by engine makers to produce machines which can be operated with the greatest economy, and while high prices are being paid by steam users for machinery of this character, with the object of reducing the expense for power, it frequently is the case that firemen and engineers are employed who do not understand how to manage economically the plants entrusted to their care, and thus the advantages derived from the purchase of high class machinery, are offset by lack of skill on the part of firemen and engineers. "The best fireman I ever saw," said one of the ablest engineers in Canada to the writer recently, "was a man in charge of a battery of boilers who, instead of loading up his furnaces at long intervals with a coal shovel, went constantly from one furnace door to another and threw in upon the grate a small quantity of coal with a hand shovel. He seemed to know exactly where the fresh coal was needed, and had the ability to place it exactly on the right spot. By this method he secured the highest efficiency of which the boilers were capable with the least consumption of fuel." The fact is too little appreciated by steam users that it is economy to pay a man of this class a much higher salary than the one who does his work unthinkingly and at the expense of hundreds of dollars per year in wasted fuel.

A STRANGER, riding on a Montreal Street Railway car on one of the hill routes, would be apt to notice an individual standing beside the motor man, holding in his hands a massive weapon closely resembling a sledge hammer, the only difference being that the head is of wood. If he were of an enquiring turn of mind and ventured to ask the use of the aforesaid instrument he would be surprised to learn that it is the only safety appliance at present used by the street railway company in the leading city of Canada, in the event of the hand brakes refusing to work, as has occasionally happened. In emergencies where it has been called upon, the result has proven that as regards efficiency it is comparatively useless, the heavy car either pushing it aside or crushing it to matchwood. The effect on the nerves of the passengers sitting in a car over which the brakes have lost control, descending at an increasingly rapid rate, on suddenly coming into contact with this block of wood, may be more easily imagined than described; and the effect on one of the unfortunates handling it was such that he was not likely to repeat the experiment. There seems no reason why the Westinghouse or similar air brake system as used by steam railways could not and should not be used as an emergency brake on electric cars. The only question would be that of expense, and considering the danger to cars, to say nothing of lives, this should not stand in the way of the improvement. To equip an electric car with such brakes it would be necessary for each station to be provided with an air compresser and each car to carry a cylinder of sufficient capacity. As they would only be used in case of emergency the expense of charging would be infinitesimal, and the first cost would really represent the whole outlay. If a trolley wheel could be had which would stay on the wire, or rather climb back on to it should it get off, a suitable electric brake might be found.

As we go to press two very important matters are engaging the attention of the County Judge at Toronto. These relate to the attempt which is being made by the Assessment Commissioner of Toronto to fasten an assessment upon the personal property of the electric light and telephone companies, as well as upon the mains, retorts, etc., of the Consumer's Gas Co. In the case of the latter an assessment of half a million dollars is sought to be imposed. The gas and electric companies have carried the matter to the only source of appeal, the County Judge, before whom the question is being argued, and whose decision may be looked for very shortly. The Gas Company's property, is to be assessed not as personalty, as in the case of the electric companies, but as realty, on the ground that the mains, retorts, etc., are attached to the earth. As the decision in these cases will establish a precedent, and may effect very seriously the electric and gas interests of Canada, the outcome of the arguments now being presented will be looked for with unusual interest.

WE publish in the present issue a description and illustration of what is believed to be the oldest steam engine at present in operation in the United States. We would like to obtain a description of the oldest engine at work in this country. A comparison of the old engine which we publish with the latest improved types being manufactured in Canada affords an instructive lesson to those who feel an interest in the improvements which have taken place in steam engineering during the last half century. Will our readers, who may be expected to be interested in this subject, kindly send us any information which they may possess along the line indicated?

The stockholders and managers of electric companies may well hope that storms of the character of the one which caused such havoc to their property a week or two ago, may not be of frequent occurrence. It is to be hoped also that the public will now be able to realize that a fair margin of profit is necessary in lines of business which are thus subject to their property being suddenly and seriously damaged. Neither should the lesson be lost upon the managers of electric lighting companies, some of whom, as elsewhere stated, have been engaged in a ruinous competition. In Toronto and Montreal the inability of the street railway companies to grapple with a storm of this character was clearly demonstrated, but no doubt the experience gained will lead them to make preparations which will enable them to cope more successfully with such conditions in the future. In Toronto lack of sufficient power and a failure to make an early attempt to keep the wires free of ice, appear to have been the defeating causes. In storms of a less severe character the advantages of first-class construction have been manifest, but in this case the tremendous weight of ice upon the wires was sufficient to break down construction work of the best character, and the Great North-Western Telegraph Company's system, which suffered but slightly from the severe wind storms of last autumn, has been badly shattered in all parts of the country. The heavy loss which the various companies have sustained is not to be wondered at in view of the estimate which has been made that on a pole carrying one hundred wires the weight of ice during the recent storm would be about five tons.

NOTES FOR ENGINEERS.

It is sometimes necessary to test the truth of the fitting of an engine by lining it up and every engineer ought to know how to do it. In order that an engine shall run truly, it is necessary that the guides shall be exactly parallel with the cylinder, and that the crank pin shaft be exactly square to cylinder, and that the crank pin when revolving shall remain exactly in the plane of the centre line of the cylinder. By way of a simple example, take the case of an ordinary horizontal engine, in a mill, and consider how it may be proved that above conditions are complied with. First, have cylinder opened up, and piston and connecting rod removed. Fix securely a stick across back end of cylinder, and another in the gland for the piston rod. Find centre of cylinder and of gland, and stretch a cord through these centres and produce it, beyond crank shaft. If engine is right, this cord will be parallel to sides of cylinder and to guides, and will pass exactly in line with centre of crank shaft. Then turn crank over till crank pin touches the line on one side, and the cord should be in centre of width of crank pin and exactly square to it. Then turn crank over to the other side, and if shaft and crank are true, the pin will still be square to the line, and the line will be in middle of the length of pin. If all these conditions are complied with, then one may conclude that engine is fair and true. A large Corliss condensing engine of five feet stroke was found to be very hard on the packing used for the piston rod, and to require frequent tightening up to prevent the vacuum from being spoiled by air passing in at the sides of the rod. On lining it up, it was found that the guides were in the five feet, over ¼ of an inch out of parallel with the sides of the cylinder, and as the piston travelled back and forth the rod rose and fell over one eighth of an inch, or bent, and so destroyed the packing. The cylinder was re-bored, so as to make it parallel with the guide frame, and the trouble was cured.

* * *

When a crank shaft is heating something must be done at once in order to carry off the extra heat produced and prevent the babbit from melting. Sometimes slackening the bearing a little to let oil run more freely through it is sufficient. Adding flowers of sulphur to the oil is sometimes successful, but in other cases it is necessary to get a stream of water to play on it. It is better to stop engine at first chance and examine bearing to find out the cause and remove it.

Some are puzzled to understand why a steam pump driven by steam at 60 lbs. pressure can force water into the boiler from which the steam is taken. If the steam cylinder were of the same diameter and stroke as the water cylinder, it would not be able to do it, but by making the steam cylinder larger in diameter or longer in the stroke, sufficient power may be got to overcome all the friction, and force the water into the boiler. If the steam cylinder be six inches in diameter and the steam 60 lbs. pressure, then the steam has a force of nearly 1700 pounds to move it. If the water cylinder be four inches diameter then the resistance to be overcome is 750 pounds, leaving about 900 pounds to overcome friction and to produce motion and give the water velocity.

* * *

Readers of these Notes who are advanced in experience and knowledge, please remember the day when you did not know as much as you do now, and think of others who are younger, and who know now no more than you did long ago. Help the younger and less experienced to avoid the dangers and difficulties you had to fight your way through. Encourage the young fellows to tell out their difficulties and to ask questions. What a wonderful word "why" is when it has a big ? after it, and is followed by "because," spelt with a "B." What is a horse power? Why is the power of an engine measured by horse power? Because the first steam engines made for general sale were made to do work that had been done by horses, and the makers of the engine said that it would do as much work as ten horses, or twelve horses as the case might be. Later on some began to think the engine builders meant very small horses, when they sold an engine as of twelve horse power. James Watt went to London and got the biggest horses to be had, and tested what amount of work they could do, and concluded that 33000 pounds raised one foot high, in one minute of time, was a horse power. Then he made his engines to do that amount of work for each horse power he called them, and to do it without getting tired out as the horses did. In our day the term has not the sharp, definite meaning it ought to have even when applied to steam engines, and many are deceived thereby. To make matters worse, the same term "horse power" is applied to boilers. All the boiler can do is to produce steam, and an engine is needed to use that steam and produce power. Why, then, should horse power be applied to boilers? It originally meant, the size of boiler that should be used to make steam for an engine of that horse power. A horse power of boiler meant that the boiler could make into steam one cubic foot of water in an hour for each horse power it was called, that is, a ten horse power boiler was one that used ten cubic feet of water in an hour, or about 62½ gallons. This standard was fixed, because it was observed that the engine required about sixty pounds weight of steam in an hour for each horse power. As engines were improved, less steam was required, and now 30 lbs. of water per hour made into steam, is a boiler horse power. Some specify the temperature of the water, and the pressure of steam into which it is to be made, but all are not agreed on these points.

PIONEER ELECTRIC LIGHTING IN MONTREAL.*

By JOHN SMILLIE.

MR. CHAIRMAN AND GENTLEMEN:—The paper I have the honor of bringing before you to-night, is not of the class you have been accustomed to receive, judging by those I have listened to at your meetings and read in the printed reports in the CANADIAN ELECTRICAL NEWS.

Knowing as I do from the above sources of information the advanced knowledge this association has in all matters relating to electricity and magnetism, and that anything which tends to increase that store of knowledge is received with respectful attention, all due allowance will, I am sure, be made for the shortcomings of anyone who undertakes to bring any matter before this body in the form of a paper.

This, gentlemen, is an apology for carrying you back to the dark ages of electric lighting in this city, for when one considers the development of electricity, I think I am quite in order in speaking thus of the beginning of a period of 13 years in the history of electric arc and incandescent lighting in the city of Montreal.

In the year 1881 electric arc lighting was creating quite an agitation among those who were interested in the betterment of street lighting and the lighting of large halls for public assemblies all over the northern part of the continent of America. The city of Montreal was not behind the rest of the country in watching for the success of the new light, and no wonder, for it would have been hard to have found a city that was worse served with gas, than the city of Montreal at that time.

I cannot say whether the Brush arc machine placed in the Custom House to light up the wharves, or the crude attempts of the Craig people, who had one going at the Exhibition, and also on one or more of the Richelieu and Ontario Navigation Company's boats at that time, were the first to go into operation here, but the successful plant was the Brush, which went very well from the start.

The next plant to be put in was at the Quebec, Montreal and

* Paper read before the Montreal Electric Club.

Occidental Railway Works at Hochelaga, and the St. Lawrence Hall, by the United States Electric Light Co., for a local company of which the late Mr. Senecal was president. The plants at Hocehlaga and at St. Lawrence Hall were being put up at the same time, but the one at Hochelaga was in advance of the one at the Hall, and was therefore finished first; and it was at that station the first public exhibition of electric incandescent lighting was made in Canada. I believe it was in July, 1881, when the formal starting of the incandescent plant took place, and it was made the occasion of a grand luncheon given at the Hochelaga works, at which no less a personage was present than his Grace the late Duke of Sutherland, who upon that occasion predicted a great future for incandescent lighting. Who would be bold enough to say that his prediction had not been fulfilled at the present time? and further, who would be rash enough to say we had reached the limit of improvement in incandescent lighting? none at least I am sure of those at this meeting.

I will now try to give you an idea of the machines we used at the St. Lawrence Hall. The incandescent machine was a 65 lighter, the arc machine a 5 lighter.

The arc machine was a five light Maxum supplied by the United States Electric Light Co The armature was on the Gramme ring principle. There were 14 sections in the armature with four layers of No. 14 imperial gauge wire to each. The wire was double cotton covered. The core was made of sheet iron plates, one sixteenth of an inch thick. There were 114 of these pieces in the armature; they were placed together in pairs with spaces of one sixteenth of an inch between each pair; these plates had raised points at intervals for the layers of wire to lay in, forming 14 spaces in the armature.

The one sixteenth of an inch space, I need not say to you, was for the air to have free access to the coils to keep them cool, and I can assure you, it was all required, for after running five or six hours it would get so hot you could hardly lay your hand upon it.

The diameter of the armature was 8¼ inches; length 12 inches; the length of armature shaft between bearings was 16 inches, and the diameter one and one quarter inches. This was one of the troubles we suffered from; the spring of shaft was sometimes so great, that it would graze the field, thereby stripping the insulation off the armature wire, with a consequent short circuit.

The commutator had 60 strips in it, one of which I have now before you. There was a saw drift cut into it for about a ¼ of an inch, and the ends of the two wires soldered into it, thus to make the connection between the armature coil.

Those strips were fastened by two brass collars, one with a centre hollow piece for fitting on the shaft, and screwed on one end, two vulcanite bushes slipped on, and the commutator strips placed around resting on the pieces of vulcanite, with thin strips of leather board put between for insulation. When this was done I had a thin iron band with two knees rivetted thereto, and a bolt for drawing them tight together for turning the outsides; when this was done, the flanges were screwed together, and the commutator was turned and wires soldered in their places.

But I need not tell you that leather board made a very poor commutator insulation; short circuiting between the segments of the commutator was no uncommon event; sparking soon carbonized the leather board, and then my troubles began.

About this time Mr. Fred. Thomson came to Montreal to take charge of the Royal Electric Light Co., then in its infancy. One day I was telling him of my troubles with the commutator insulation, and he suggested asbestos paper. I tried it, but my troubles were not much lessened, for the fine particles of copper would get into the soft paper and in a short time make contact between the segments; then my work was to scratch out all the copper dust from the asbestos.

The line wire is about five and one-half imperial wire gauge. This was a naked wire; we stapled it to the woodwork and when we came into contact with gas, water or steam pipes, we would put a piece of rubber tube over the wire at those points.

When we wired this machine first, we grounded the return wire upon the main gas pipe, but it ran very unsatisfactorily, and later we returned to the machine.

The lamps were very good, and indeed the lamps in use in the city to-day are not much in advance of those we used then, except in mechanical detail and insulation. The body of our lamps was not insulated; the clutch for lifting the carbon rod was worked on the same principle as at present with fine wound magnets for regulating the lift of carbon, and I must say the candle power of them was very much in excess of the lamps now in use in this city, although they were designated 2000 candle power, as the ones in use are at present.

The carbons used were the Wallace diamond carbon; the cost of them was about ten cents each.

The bearings of this machine were at times very hard to keep cool; sometimes we had to keep ice on the journals for two and three hours at a time. As to measuring current, we had no means of doing so: if a machine gave current enough for a given number of lamps without burning or overheating that was enough for us, and the only means we had of ascertaining its load; the number of revolutions this machine turned per minute was 1200.

The incandescent machine, as I have already stated, was a 65 light machine, also a Maxum type. This machine had a commutator on each side of the armature. Each commutator had 60 segments, and they were insulated with leather-board. The iron core of the armature was made in same manner as arc machines, with this difference that there were 30 sections, and in each section there were two coils connected with four segments of commutator, and each alternate coil was connected to opposite commutator.

The length of armature was 18 inches; diameter 13½ inches. The wire used in armature was No. 10 imperial gauge, with four layers of wire in each coil. Field coils were 18 inches long by 7½ inches high, with eight layers of wire on each, of No. 5½ imperial gauge.

The length of shaft inside bearing to inside bearing was 30 inches; diameter of shaft 1¾ inches: the bearings were of the sleeve form, and were adjusted with set screws from sides, much as an adjustable hanger for shafting.

The diameter of line wire was No. 1½ imperial wire gauge, and the branch wires to lamps were 16½ imperial wire gauge, run on the multiple principle: we had the lamps screwed upon the gas fixtures, and used the gas pipes for our return wire.

You will see by the lamp and switch before you, the method we adopted for connection; it was no uncommon thing for a wire to short circuit by making contact with the gas lamp, and in a moment we had the covering on fire for as much as 30 feet at times. This wire was double covered cotton, dipped in paraffine, and when it caught fire it made quite a blaze and smell. Indeed it required the closest watching, and even then we had two or three insipid fires which vigilance alone prevented from being of a dangerous character.

One of those fires, I will describe, which will be enough to show to you what troubles were in store for the unfortunate who had to look after an electric plant in those early days of electric lighting. In the refreshment room of the St. Lawrence Hall hotel we fitted up an old lamp; its form was a stem with three rings, one very large and the other two below, each about 12 inches smaller than the one above; on those rings we hung about 25 lamps, and the wire came through the ceiling and down the stem, and branches were taken to lamps of the small size wire, the return wires being clustered and carried up between the floors, then a large size wire carried down to main gas pipe and grounded. One of those small return wires made contact with positive wire and short circuited, aud when it got very hot, it bent down, unable when hot to support its own weight; unfortunately lying directly under it was a ¾ inch composition lead pipe (gas); the heat very soon melted it, and you know what would follow. I was in the refreshment room at the time, and the lights gave a bad flicker. The room above had been left with carpet loose, also part of flooring, so that we might easily get at the wire. When the room was reached and flooring lifted there was a ¾ inch gas pipe burning and lead melting, and the wire at almost a white heat. It was quite a long distance to where the engine was; the gas main was in another building, and the joists and flooring on fire. Gentlemen, it was one of those dilemmas that a man does not want to be placed in very often in his lifetime. I had the gas shut off as quickly as possible, then the belt off the incandescent machine, then fire in the woodwork put out. The damage done amounted to very little, but it would have been bad enough had we not caught it in time.

As a matter of fact all our pipes were charged more or less with electricity. The drinking fountain in the office at times was so charged that when you took hold of the pull to draw water, you would get such a shock that you felt disinclined to try it any more. The surprise to me to-day is, that we did not succeed in burning down the hotel.

We had this plant going for two years, and the incandescent machine is in good working order yet. I had no trouble with this machine; it ran smoothly and had no repairs done to it whatever; it had a separate machine for exciting its magnets. The workmanship on this machine was first-class. The mechanism for increasing or diminishing the current was of a complex character; this I will not attempt to explain at this time.

At the junior conservative ball held in St. Lawrence Hall in 1882, at which Lady Macdonald was Lady Patroness, we had placed upon the banquet tables a number of fish bowls, some with different coloured waters in them, and others with clear water, and gold and silver fish therein. We had incandescent lamps placed in them, and when the guests sat down to the tables, we switched in the current, and I can assure you it had a very beautiful effect. We had to keep ice constantly in the water to keep it from over-heating. I mention this circumstance because it was considered quite novel at that time.

The engine we used was an old slide valve, with cut-off valve; it was 11 inches by 22 inches; we carried 60 lbs. steam pressure. We allowed four incandescent lamps per h. p., this gave us 14¼ h.p. for incandescent machine, and about 6¼ h.p. for arc machine, or 20½ h. p., not speaking of friction of engine or shafting. Our average run per day was 5 hours and the consumption was 925 lbs. of Scotch coal, or in other words 8·6 lbs. per hour per h. p.

This, gentlemen was what we did in the year 1881.

The Dodge Wood Split Pulley Company, of Toronto, recently shipped a split pulley 14 feet in diameter and having a circumference of 42 feet. This is believed to be the largest split pulley yet manufactured in Canada.

A FEW POINTS ON THE CALORIFIC VALUE OF FUEL.*

By G. C. Mooring.

Mr. President, Brethren and Friends: When the Educational Committee was appointed, each one promised to do his best to get up a paper; this is my excuse for standing before you to-night. The figures I may quote are from books and mechanical papers in my possession, and I shall endeavor to give the proper authorities due credit. I will, however, leave out most of the university terms, for the very good reason that I do not understand one-half of them myself.

Economy in fuel is of vital importance to our employers here in Toronto, the price being high and competition in manufactured goods very close. It is calculated that there are four hundred million tons of coal burned every year, and more than half of this is used to generate steam for power purposes. There is imported into Toronto five hundred thousand tons, including all grades, and thousands of cords of wood, besides all the refuse from our planing mills. Fully one-half of this is used to generate steam. Now, if we as working engineers can combine a little theory with our daily practice and thereby save a little of this vast coal pile, I consider it no more than our duty to do so, and this can best be done by talking over and discussing the matter here in our association meetings, for there is none of us that knows it all.

To determine the quantity of heat that may be obtained from various combustibles is an important branch of Applied Chemistry. Before heat can be measured, however, it is essential to establish some unit standard of measurement. The British thermal unit commonly used in England and this country is that quantity of heat necessary to raise the temperature of one pound of water from sixty to sixty-one degrees Fahrenheit. Each British thermal unit, or, as we will call it, heat unit, has the mechanical energy equal to raising one pound seven hundred and seventy-two feet. Water was selected as the standard for thermal comparisons because it can be readily and easily obtained in a state of purity, and because its capacity for absorbing heat is greater than that of any other known substance. This capacity to absorb heat as its temperature rises is technically called specific heat, consequently the specific heat of other bodies can readily be obtained with water as a standard.

CALORIFIC POWER.

The amount of heat to be obtained by the combustion of a definite weight of any fuel is called calorific power. The earliest and perhaps most extensive researches to determine the calorific power of combustibles were undertaken by Favre and Silberman. Their method of operation consisted in burning a very carefully weighed quantity of the substance in question enclosed in a small metallic vessel which could be immersed in a receptacle containing a weighed quantity of water, which was protected against radiation by a jacket of non-conducting material. The inner vessel containing the substance under test was provided with an inlet tube for supplying a sufficient amount of pure oxygen, and an outlet pipe coiled back and forth through the water, which formed an outlet for the products of combustion. By thus burning in the inner chamber a weighed quantity of fuel and ascertaining by means of a thermometer the rise of temperature of the water, the calorific power of the substance was immediately determined. The instrument thus used to determine calorific power is denominated a calorimeter. Other forms of calorimeters have been invented, but nearly all agree on the calorific power assigned to carbon, hydrogen and such of their compounds as form the great bulk of combustibles. When the gas hydrogen is burnt in pure oxygen the same authorities found by direct experiment that sixty-two thousand five hundred heat units were evolved for every pound of hydrogen consumed. They also found that for every pound of carbon consumed fourteen thousand five hundred heat units were obtained. The calorific power of a fuel or the quantity of heat developed during the burning of a definite amount of any combustible is always the same, and is entirely independent of the rate at which combustion takes place. Every pound of carbon consumed with the proper amount of air yields fourteen thousand five hundred heat units. Whether combustion occurs as in the discharge of a gun, or whether it occupies years, as in the decay of a tree trunk, signifies little in the total amount manifested.

Now, according to the thirteenth edition of Reed's Engineers' Hand-Book—a book of very reliable and practical information for engineers, and which is authorized by the British Board of Trade—we find that in practice every pound of coal we burn requires three hundred cubic feet of air, or one pound of carbon requires twelve pounds of air; and to one pound of hydrogen we require thirty-six pounds of air. Now, we have already seen that hydrogen is about four and a quarter times the value of carbon, but we have very much more carbon in the fuel than hydrogen.

After looking into the method of testing fuel and finding the principal components for giving heat to be carbon and hydrogen when properly mixed with the oxygen of the atmosphere, we will now look into the calorific value of the different fuels. Commercial fuels may be classed as natural and artificial. Natural fuels are wood, coal, mineral oil and natural gas. Artificial fuels are obtained from natural fuels by certain processes of manufacture; for example, from wood we get charcoal, and from coal coke is manufactured.

Dr. Percy classes the natural fuels as follows: Wood, peat, lignite, bituminous or soft coal, anthracite or hard coal, petroleum oil and natural gas; but no doubt the first fuel used by man was dried sticks gathered in the wilderness, kindled by rubbing two sticks together in the old Indian style, and to this day I believe wood is the most widely used fuel, owing to its almost universal distribution. Taking the average wood when fresh cut, it contains about fifty per cent. of moisture, but when thoroughly air dried this falls to about twenty per cent. According to C. Williams Siemens, D.C.L., the average calorific value of wood as far as its heating quality goes, is: carbon, fifty per cent.; hydrogen, six per cent.; oxygen, forty per cent.

Next comes peat, which is found in swampy, or what may have been swampy places; the largest bed I have read of in America is near South Bend, Indiana, which is three miles wide, sixty miles long, and from five to fifty feet deep. I have also heard that there are large beds in our own country. Peat is not much used in this country, but in Ireland, Germany and Sweden it is used extensively. Peat is totally unfit for use as a fuel until dried; according to Sir Robert Kane the average calorific value of Irish peat is: carbon, fifty per cent.; hydrogen, six per cent.; oxygen, thirty-one per cent.

By far the most important fuel is coal. The first variety is lignite, which is generally brown in color; sometimes looks very much like true coal, but is not worth as much as the poorest kind of coal. In America it is only used in the localities where it is found, namely, Kentucky, Colorado, and west of the Mississippi river. Its calorific value according to Arthur V. Abbott, C.E., is: carbon, forty per cent.; volatile combustible matter, twenty-three per cent.

Next comes bituminous or soft coal, which is used most in this city for steam purposes. There are many kinds of soft coal imported into Toronto, but for my part I much prefer the Renellsville Soldier Run; I believe that almost as much steam can be generated from a ton of this coal as from a ton of the best hard coal. There is coking and con-coking soft coal. From the coking coal a great deal of coke is made in the mining regions and is used extensively, being light to transport. This coal is also valuable for gas manufacture. Did you ever make gas in a small way? Get a long clay pipe, fill the bowl with powdered soft coal, cover over with blue clay, place it in the fire with the stem projecting out, and in a few minutes the gas will come out of the stem; then light and it will burn for some time. I have always understood that illuminating gas was invented in this way.

The difficulty with soft coal is that it is dirty to handle and blocks up the tubes of a boiler with soot and emits a black smoke. There are over three hundred patent smoke consumers, so called, some of which may assist to burn the smoke, but I have yet to see a perfect one, and even in Chicago, where a smoke by-law is in force, one cannot see beyond a few blocks from the roof of any high building for the dense smoke, soft coal being used for steam purposes. I believe that most of our grate bars are set too close to the boilers for burning soft coal, there not being room enough for combustion. I think this is one of the reasons why a water tube boiler gives better duty than the tubular boiler, there being more room for the mechanical combinations of the different gases of the coal with the oxygen of the atmosphere. Then again, the tubes must be hotter than the shell of a boiler on account of the very rapid circulation which must be going on in a water tube boiler, for it is a well known fact that the hotter the surfaces with which the gases come into contact, the better the combustion. But these water tube boilers do not evaporate as much water per pound of coal as is sometimes claimed. One of the professors of the Engineering Department of McGill University, Montreal, told us this summer that nine to one was the best they could ever reach under test. The calorific value of soft coal averages eighty per cent. carbon and five per cent. hydrogen.

Anthracite or hard coal is the oldest of the coal family, and is generally the lowest of the coal strata. It is very hard, which makes it the best of all coals for transportation. It is hard to ignite, but when kindled burns with a high temperature and steady glow, emitting no flame or smoke and does not coke. In density hard coal is superior to all other fuels. It is used in all our government buildings—Dominion, Local and Municipal—and even in our water works pumping stations, I suppose for the reason that it is cleaner to handle and that there is considerably less work attached to it; certainly not because it is the cheapest. With the present prices of coal at least twenty per cent. could be saved at our main pumping station by using a good soft coal instead of hard. The average composition of Pennsylvania hard coal according to the same author, C. William Siemens, D.C.L., is: carbon, ninety per cent.; volatile matter, five per cent.

Probably no discovery of the present century has brought a more widely extended change in manufacturing operations than that of natural gas. Already in Pittsburgh there are thousands of miles of pipe lines, and it is fast taking the place of coal in the favored localities. Natural gas is found in many places in Canada, and has been put to practical use in the county of Welland and at the new asylum near Toronto, but the quantity appears to be limited; it is also found that manufactured gas can be used to advantage for steam purposes, but not in Toronto, chiefly owing to the high cost of coal.

The only natural liquid fuel is crude petroleum, which is found in the United States, Russia and Canada. Since its discovery many attempts have been made to use it for power purposes, but it is only of late years that the attempts have proved successful. One great point in its favor is that it has nineteen to twenty-one thousand heat units, against thirteen to fourteen thousand for coal, and it only requires the price to come down a little when it would become a dangerous competitor of coal. While our President, Bro. Wilson Phillips, and I were in Chicago visiting the Fair, we had an opportunity of seeing oil used in a practical way for power purposes, as the main battery of boilers in the World's Fair buildings, consisting of twenty-seven thousand h. p., all water tube boilers and of many different makes, were all fired with oil fuel. We also visited three of the main cable road power stations; they also used oil fuel. At the North Clark

* Paper read before Toronto Association No. 1, C.A.S.E.

Street Station the chief engineer, Mr. O'Connor, who is an old Toronto boy, told us that oil fuel was not much, if any, cheaper than coal, and certainly not as cheap with a small power plant, but it is by a long way the cleanest—the boilers and everything about them being easily kept clean and in good order.

Perhaps a word or two on the latest method of burning oil to generate steam would not be out of place. There are two forms of very similar apparatus, one using compressed air, the other steam. The object seems to be to spray or atomize the oil as finely as possible. The apparatus for oil firing is first a large tank or reservoir at a safe distance, either sunk into the ground or bricked around to protect it as far as possible from fire. In the case of the steam system, the oil is conducted to a smaller tank, near the furnace. The oil from the main tank is allowed to flow by gravity, but at the Fair it was pumped by large duplex pumps. From this smaller tank, which is only supposed to hold enough oil for a few hours' run, the oil flows to the burner, which is practically a steam siphon. The oil jets are within the large pipe containing the air, so that by the force of the steam and air the oil enters the furnace in a very fine spray. The oil, air and steam can be separately regulated, and when properly adjusted almost perfect combustion is obtained. It makes a roaring noise, and on looking into the furnace nothing but a mass of white flame can be seen. The ash pit doors and all other inlets are closed, and no smoke comes from the stack. The only drawback about this system is that an auxiliary boiler is necessary, or steam must be raised with other fuel, as it cannot be started without steam. Crude oil contains 84 per cent. carbon and fourteen per cent. hydrogen.

From an average of thirteen experiments with good soft coal, Dr. Brunt found out of a possible fourteen thousand four hundred and thirteen heat units, only eight thousand four hundred and thirteen were inducted into the water in the boiler—so it is quite likely that we very seldom get more than one-half of the heat of our fuel; and the engine is still more wasteful, as never more than twenty-five per cent., and not very often more than ten per cent., of the heat units are taken out of the steam; but in this country for about seven months of the year we make good use of this waste steam by warming our buildings with it. Look from the top of any of our buildings on a cold morning and you will not see very much exhaust steam going to waste—with one exception, and that is, the Terauley Street Electric Light and Power Station; there clouds of steam from a very large exhaust pipe may be seen any time. Now, I am satisfied that had this station been situated among some of our large buildings, every pound of that steam could have been sold for heating purposes, for at least seven months of the year, and the revenue from this source would have paid at least half the coal bill. One electrical manager said in convention—I think it was in Philadelphia—that the revenue from the sale of their exhaust steam almost paid their coal bill during the winter months, and they never carried more than three pounds back pressure on their engines.

There is a fortune awaiting the man who can give us power straight from the fuel. I lately read of a man in Germany who is working with this object in view. He grinds the coal to a very fine powder and explodes it in the end of the cylinder, after the style of the gas engine, but he could not get rid of the ashes and soot. I think there is a great field for inventors along the line of the internal combustion engine. An efficiency of twenty per cent. has been realized, with bright prospects of doing better.

Just a word now on patent fuel. The earliest patent we have mention of was granted by the British patent office in April, 1773, and there have been hundreds of patents granted since then; nearly all of them have been directed towards utilizing the mine waste, which is calculated to be fifty million tons per annum for the whole world. This field for inventors still exists. Surely some way can be found to save this annual waste of energy!

The sawdust of our saw mills used to be a burden to the owners, and I have known them to move the mill rather than the piles of sawdust around it, but all that has changed now; their power is generated with the sawdust automatically fed to the furnaces, and they now sell the slabs which they used to burn. Have you seen anything of the patent coal compound agent? I think him a pretty good agent who will go to any intelligent engineer and try to make him believe that he can save twenty-five per cent. by mixing a few pounds of rock salt, or whatever it is, with the coal. There are seven million heat units in five hundred pounds of coal—I am sure there is not in five pounds of compound—neither can we get any more out of the coal than there is in it, and to wet the coal the very best authorities agree is detrimental.

Then as working engineers it is our duty to keep our boilers clean both inside and out, watch our fires closely and keep the grate and bars covered, for I believe with the coal we get, which is coking, the danger is in admitting too much air instead of not enough. We should make the best use of the appliances given in our charge, whatever they may be.

Toronto is situated so that we might save a large amount of our coal bill by utilizing the vast water power which nature has placed at our service. Thirty-eight miles north of us we have Lake Simcoe, three hundred square miles in extent, with a head of four hundred and seventy feet, and with a thousand square miles of water shed. If that would not be enough, we have Georgian Bay, an arm of the great lakes, with three hundred and fifty feet head, and if we were to draw five hundred million gallons per day the people of Niagara Falls would never miss it.

Messrs. O. Kartzmark & Bro., of Hamilton, have assumed control of the business of the late Mr. Geiss, and will engage in all kinds of mechanical and electrical work.

DESCRIPTION OF THE KINGSTON LIGHT, HEAT AND POWER COMPANY'S PLANT.

(By a Correspondent.)

A short time ago I had the pleasure of looking over the plant of the Kingston Light, Heat and Power Co., a description of which I have much pleasure in forwarding to you for publication.

The officials of the company are as follows: Mr. B. W. Folger, Superintendent; Mr. J Campbell, Electrician; Mr. Robt. King, Chief Engineer; Messrs. S. Donnelly and J. Gallavin, Assistant Engineers. The station itself is a substantial stone building on Queen street, near the water front. The plant consists of three horizontal cylinder tubular boilers, 66" × 14' × 3/8" steel plate, built to carry 125 pounds pressure pr. square inch. These boilers are fed by a Northey Improved Compound Plunger Pump, 6"x11"x10"x5, the cylinders of which are nicely lagged, making it a very handsome pump. There are two tandem Compound Corliss Engines, built by Messrs. J. Inglis & Sons, of the following dimensions: 16" and 30" × 42".

These engines run at 85 revolutions per minute and have fly wheels 16' diameter and 36" face. The engines run "under" and belt back from fly wheel to a counter shaft, which is fitted with Waterous Patent Grip Pulleys.

The engines are condensing; a Northey independent condenser and air pump being in use. These engines are a credit to the builders, Messrs. J. Inglis & Sons and also to the Chief Engineer, Mr. Robert King, who erected them. They are substantially built and the finish and workmanship leave nothing for the most fastidious engineer in the country to desire.

The electrical part of the plant consists of two No. 20 1000 light 16 c. p. 220 volt Edison Generators on the 3 wire system used for incandescent lighting; one T. & H. 35 light 2000 volt arc dynamos; two Wood 50 light 2000 volt arc dynamos; one T. & H. 1,500 light 2,080 volt alternator, with an Edison exciter for long distance lighting; one T. & H. power generator for street railway work.

The above machines were wired to one of the finest switchboards in Canada, which is elaborately fitted with all the necessary recording instruments to be found in any first-class station. I was shown some indicator cards taken from the engines which proved beyond a doubt that they were running economically. I was also informed that during a test made a few weeks ago, these engines developed a h. p. per 2⅛ lbs. of hard and soft screenings, with a proportion of 3 of hard to 1 of soft.

A distinguishing feature about this plant is its cleanliness. There is apparently a place for everything and everything is kept in its place. Taking it all in all, it is one of the best kept plants which it has been my fortune to visit, and is a credit to Chief Engineer King and his assistants. If any engineer should be visiting Kingston, I would advise him to call in and see this plant, and he will receive a hearty welcome from those in charge, and will see something to interest him.

THREE TERRIBLE BOILER EXPLOSIONS.

ON the 2nd of November there appeared in the daily papers accounts of three boiler explosions, attended by great loss of life and property.

The most serious of these took place in the stables of the Dry Dock, East Broadway and Battery Surface Railroad Company, at Fourteenth street and Avenue E, New York City, and tore out the building, causing death and destruction. The section of the building in which the boiler was located collapsed. The boiler flew across the street and struck the double tenement No. 534 East Fourteenth street, just below the first story. The side of the building was crushed in. Three men were instantly killed and nearly a score were injured, several of whom have since died.

The second explosion took place on the steamer City of Alexandria, while on her way from Matanzas for Havana and New York. As a result the vessel took fire and was destroyed, and a number of persons on board were drowned.

The third explosion took place in a flour mill at Windfall, Ind., and occasioned the death of the fireman and the serious injury of some other persons.

In the light of such terrible occurrences as these, the action of the Quebec Legislature in incorporating into the new Factory Act of that province a clause making compulsory the proper inspection of boilers in manufactories, is well-timed.

ELECTRIC RAILWAY DEPARTMENT.

LONDON STREET RAILWAY CO. VS. CORPORATION OF CITY OF LONDON, ONT.

In July, 1892 the London Street Railway Company commenced to build their tracks on Dundas street west, in accordance with the provisions of their agreement with the City, when the City applied for an injunction to restrain them from building the said tracks on the grounds that the Company forfeited its rights to the use of the street by not constructing the railway sooner.

The case was tried at London on Oct. 7th, 1892, before Hon. Mr. Justice Rose, who gave judgment as follows.:

"I find that there is no time limit by implication, that there is no express limit fixed by the by-law; that there was a right given to the London Street Railway Co. with respect to the streets named; that the Company had the right to exercise its franchise with reference to those streets subject to the provisions of clause 33 giving the ten days notice; that the laying of a proposition before the City Council did not suspend the right that had been granted to the Street Railway Company, by clause 2 of its by-law, giving it the exclusive right, and that as long as the Street Railway Company was proceeding in accordance with the provisions of the agreement to occupy the streets, it had the right to do so unobstructed by the City or its officials, until by operation of the provision of Sec. 21 that right was suspended.

(Section 21 of the by-law provides that when other persons propose to construct a railway in the City of London, the London Street Railway Company shall be given the option to construct the railway, and in the case of a refusal, the City to have the right to give the privilege to the said persons.)

The judgment was given so late in the season that the construction of the portion of track in question was delayed until 1893, when in July the Company again commenced to build their track on Dundas street west, and the City ordered the Company to stop the work, and take up the rails that had been laid (about 120 ft. of street.) This the Company refused to do, whereupon the City ordered their workmen to tear up the tracks under police protection, on the ground that it was a double track, when the agreement only provides for a single track with the necessary switches and turn outs. The Company then entered an action against the city for damages, and the case was heard before Hon. Mr. Justice Falconbridge early in October, 1893, who delivered judgment as follows;

"The contention of defendants that the bylaw and agreement are ultra vires, as set forth in the first paragraph of the statement of defense, is res judicata, having been disposed of by the judgment of Mr. Justice Rose in the su : of the present defendants against the plaintiffs, in the chancery division. And no new facts were shown bearing on Paragraph 5, which sets up that the plaintiffs have no right now to construct tracks on Dundas street, west of Richmond street, and that issue is also res judicata by the same judgment.

"The experts all agree that it is not possible to tell on the ground whether the two uncompleted tracks were, or were intended to be, part of a double track or of a switch, and the defendants had therefore no right to assume that work which had not in fact actually become a nuisance would do so. (Garrett on "Nuisances," page 315.) Easton, etc., Passenger Railway Company vs. City of Easton, Pa. St. 505, is strong authority in plaintiffs' favor.

"True, the plaintiffs were assuming to work on defendants' property—an element of distinction from some cases on this subject—but plaintiffs were not there as trespassers, but of right, as Mr. Justice Rose has found, provided they are in other respects within the bylaw and agreement.

"The argument that 'single track' in section 2 of the bylaw means just a single line of rails, and that the company cannot even have a switch on Dundas street, west of Richmond, is too refined and subtle for me, and I cannot give effect to it.

"Nor do I think section 6 (which deals with what in street railway parlance is known as 'the devil's strip') can apply to switches where the rails must converge at both ends.

"And I read the whole of section four together, and hold that the supervision and satisfaction of the city engineer have relation to the 'substantial manner and according to the best modern practice,' as to which there is no real complaint, but the complaint is founded on a supposed construction of the bylaw and agreement. Section 22 provided that the railway shall not be opened until he shall have given his certificate in writing that the road is in good condition and has been constructed in all respects conformably to the provisions of the bylaw. That is another matter.

"There will be judgment for plaintiffs as prayed with an injunction and a reference as to damages, in which reference the master is to have regard to the agreement of Aug. 2, 1893, filed before meant the argument.

"Cost to plaintiffs to issuing of this judgment. Further directions and costs reserved until after report.

[As we go to press it is learned that the above decision has been reversed by Chief Justices Armour and Street in the High Court at Toronto]

THE DUTY ON STEEL RAILS FOR ELECTRIC RAILROADS.

Under a ruling of the Customs Department at Ottawa, steel rails for use on steam railroads may be imported into Canada duty free, while on steel rails for use on electric railroads, a duty of $6.00 per ton is imposed. A deputation of gentlemen interested in electric railroads in various parts of the country, waited upon the Premier and members of the Dominion Cabinet a few days ago, and urged that the ruling of the Department be changed and the import duty on rails for electric roads removed. Sir John Thompson in reply to the deputation stated, that while personally he was of the opinion that the Act provided for the imposition of the duty, he was free to admit that the clause in the tariff was open to two constructions, and this being the case, the Government would leave the question to be decided by the courts. We have some recollection of a decision having been given against the Government on this point in one of the inferior courts some months ago. There is reason therefore for the hope that the ultimate decision will be favorable to doing away with the present anomalous interpretation of the tariff by the Customs Department. *The Canadian Manufacturer* urges the Government, instead of removing the duty from rails for street railroads, to impose it upon rails of all kinds, with the object of developing the manufacture of steel rails in Canada. Our contemporary, in pointing to the advantages which would accrue to the country from a steel rail manufactory, overlooks entirely the fact that in order to build up one such manufactory, a burden must be imposed upon electric railroad development and indirectly upon manufacturers of electric railway appliances. We contend that the growth of electric railroads will do more for the development of Canada than a manufactory of steel rails, and the government in dealing with the matter, should legislate in the interests of the many rather than the few.

The City Council of London Ont., have finally decided not to submit the question of changing the street railway system from horses to electricity to the electors at the coming elections as was talked of some time ago.

The American Street Railway Association has under consideration an invitation extended by the Canadian delegates to the recent convention at Milwaukee, Wis., to hold its convention in 1895 in the City of Montreal.

The City Engineer of Halifax has recommended the Council to accept the plans and specifications submitted by the Halifax Street Railway and Motor Co. for operating by the trolley system the street railway of that city. A charter empowering the company to use electricity was granted by the Legislature two years ago, but owing to internal dissensions in the management of the company, the change was not carried out.

THE PHILOSPHY, APPLICATION, CONSTRUCTION AND IMPROVEMENT OF THE STEAM ENGINE. *

By J. C. Gough.

I have much pleasure to-night in reading to you the first of a series of papers on the philosophy, application, construction and improvement of the steam engine, which, arranged in my simple way, may be of some moment to you in the pursuit of your daily avocation as electrical engineers. It is a question that interests us all, and one that cannot be too often repeated and studied with interest.

The philosophy of the steam engine presents an interesting study, as well as that of the successive changes in its mechanism. In the operation of the steam engine, we find many of the important principles which constitute the physical sciences. The steam engine is an ingenious, but not yet a perfect machine for transforming the heat-energy obtained by the chemical combination of a combustible with the suppoter of combustion into mechanical energy. But the original source of allth is energy is found far back of its first appearance in the steam engine. It had its origin at the beginning, when all nature came into existence. After the solar system had been formed from the vapory chaos of creation, the glowing mass which is now called the sun was the depository of a vast store of heat energy, which was thence radiated into space with unmeasured intensity.

The heat energy received from the sun, during the past life of the globe, upon the earth's surface, was partly expended in the production of great forests, and the storage, in the trunks, branches and leaves of the trees of which they were composed, of an immense quantity of carbon, which must have previously existed in the atmosphere, combined with oxygen, as carbonic acid. The great geological changes which buried these forests under superincumbent strata of rock and earth resulted in the formation of coal-beds, and the storage during many succeeding ages, of a vast amount of carbon, of which the affinity for oxygen remained unsatisfied until finally uncovered by the hand of man. Thus we owe to the heat and light of the sun, the incalculable store of potential energy upon which we depend so much for life and all its necessaries and comforts.

This coal thrown upon the grate in a steam boiler, takes fire, and, uniting again with the oxygen, sets free the heat in precisely the same quantity that it was received from the sun and appropriated during the growth of the tree. The *actual* energy thus rendered available is transferred, by conduction and radiation, to the water in the steam boiler, is converted into steam, and its mechanical effect is seen in the expansion of the liquid into vapor against the superincumbent pressure. Transferred from the boiler to the engine, the steam is there permitted to expand in doing work, and the heat energy with which it is charged becomes partly converted into mechanical energy, and is applied to useful work in the electrical power house or in driving locomotives or steamboats. Thus we may trace the store of energy received from the sun until it is finially set at work (thanks to science for the light thrown on this dark subject).

The transformation which takes place in the furnace is a chemical change; and we might still go further and observe how, in each case, it is again usually retransformed and again set free as heat energy; the transfer of heat to the water and the subsequent phenomena accompanying its passage through the engine, are physical changes, some of which require very minute mathematical operations. Therefore we will be content with reviewing the different points of interest attached to the phenomena of physical science as we encounter them from time to time in these papers, in a simple and practical sense.

As has been already stated, the steam engine is a machine which is especially designed to transform energy, originally dormant or potential, into active and usefully available kinetic energy. When, millions of years ago, in that early period referred to in this paper and which geologists call the carboniferous, the kinetic energy of the sun's rays, and of the glowing interior of the earth, was expended in the decomposition of the vast volumes of carbonic acid, with which air was then charged, and in the production of immense forests which then covered the earth with their almost inconceivably luxuriant vegetation, there was stored up for our benefit, then uncreated, an inconceivably great treasure of potential energy, which we are now utilizing to an extent. This potential energy becomes kinetic and available wherever and whenever the powerful chemical affinity of oxygen for carbon is permitted to come into play and the fossil fuel stored in our coal-beds or the wood of the existing forests is, by the familiar process of combustion, permitted to return to the state of combination with oxygen in which it existed in the early geological periods.

The philosophy of the steam engine, therefore, traces the changes which occur from this first step, by which in the furnace of a steam boiler, this potential energy, which exists in the tendency of carbon and oxygen to combine to form carbonic acid is taken advantage of, and the utilizable kinetic energy of heat is produced in equivalent amount to the final application of mechanical energy to machinery of transmission, through which it is usefully applied to driving machinery of all kinds.

The kinetic heat energy developed in the furnace of the steam boiler is partly transmitted through the plates which enclose the steam and water within the boiler, there to evaporate water, and to assume that form of energy which exists in steam confined under pressure, and is partly carried away into the atmosphere in the discharged gaseous products of combustion, serving, however, a useful purpose on its way, by producing the draught needed to keep up combustion.

The steam with its store of heat energy passes through winding pipes and passages to the steam cylinder of the engine, losing more or less heat on the way, and there expands, driving the piston before it and losing heat by the transformation of that energy while doing mechanical work of equivalent amount. But this steam cylinder is made of metal, a material which is one of the best conductors of heat, and therefore one of the very worst possible substances with which to enclose anything so subtle and difficult of control as the heat pervading a condensible vapor like steam. The process of condensation and reevaporation, which is the great enemy of economical working, thus has full play, and is only partly checked by the heat from the steam jacket, if there be any, which, penetrating the cylinder, assists in keeping up the temperature of the internal surface and checking the first step, condensation, which is an essential preliminary to the final waste by reevaporation. The piston is also of metal, affording a most excellent exit for the heat escaping to the exhaust side.

Finally, all unutilized heat rejected from the steam cylinder is carried away from the machine, either by the water of condensation, or in the non-condensing engine, by the atmosphere into which it is discharged. Reviewing the operations which go on in this machine during the process of transformation of energy which has been outlined, and studying it more in detail, we may deduce the principles which given its design and construction, guide us in its management and determine its efficiency.

My next paper will be more in detail, coupled with calculations by way of illustration, etc.

* Paper read before the Montreal Electric Club.

THE ART OF SUCCESSFUL ADVERTISING.

By Ernest H. Heinrichs.

Advertising has become generally recognized as a necessary and important adjunct to every business, trade, profession and mercantile or commercial enterprise. The cobbler advertises his handwork on the window-ledge; the grocer puts his best stock of vegetables on the sidewalk, the clothier, the dry-goods man and the furniture dealer fill the pages of the newspapers; the actor seeks to attract the attention of the public in flaming posters, and the manufacturer advertises his specialties in the trade papers and magazines. The time worn axiom that good goods do not need advertising is now relegated into the deepest recesses of the business man's vault containing memories of the past, and is brought out only to serve as a dampener upon a too persevering advertising solicitor. In this age of keen competition, it is not likely that any man will have a purchaser for his goods simply because they have the characteristic of excellence. He must promulgate their distinctive advantages or their superiority.

To do this successfully, he must advertise. There are as many ways of advertising as there are roads leading to Rome, and the question is how to find the right one.

To the writer it seems that the first point to be considered is, how much money will the capital of the business to be advertised permit to be used for this purpose? This point, once disposed of, will immediately suggest another one,—how may this sum be expended to the best advantage, or, how can the business be advertised most effectually with this stipulated sum

The thorough study of these points is of the utmost importance. There must be method pursued in the manner of advertising, if it is to be profitable else there will be absolute failure. One who decides to embark in any enterprise invariably makes it his first business to find out how much it will cost him to make a start. The same principle applies to advertising. It is a business in itself, the management of which requires the greatest care and attention.

Some people say that they give the papers an advertisement occasionally just to get on the good side of them; others, that they give some man from the papers an advertisement, because he is a "jolly, good fellow." In fact, one gentleman remarked to the writer some time ago that "there is a good deal of sentiment connected with advertising!" Now there is much truth in what this gentleman said, and more is the pity. It is this kind of advertising which is dangerous, inasmuch as it reflects upon advertising as a legitimate business, because it deteriorates to a form of bribery, and it disheartens as well as disgusts both the reputable publisher and the honest advertiser.

Having decided how much money may be spent in advertising, the next question is, how and where is it to be done? To settle this question is very difficult, for the reason that the mediums for advertising are legion. Many old advertisers believe that advertising by circular letter affords the surest and best way to reach a customer. They argue that if they send out a stamped envelope with a type-written page or two of matter inside, the recipient will surely read these pages. Then there are others, who are not particular about having the matter even type-written; they are satisfied to get up an elegant advertisement, have a printer strike off as many copies as they have customers on their books, and then they send these circulars to their customers. Again, there are those who now and again get up a catalogue, in which are set forth descriptions in general and in detail of everything they sell, and they send these catalogues wherever they hope to catch a probable purchaser. Then there are firms who rely entirely upon their agents and representatives to advertise their goods by word of mouth. Most advertisers, however, consider all these methods auxiliary; they help a little, but they do not do much good alone. It may be safely asserted that newspapers, magazines, and trade papers, are now recognized as the standard advertising mediums.

The object of advertising is to make certain statements known to the public at large. Hence the more people see the advertisement the more thoroughly does it fulfil its mission. Of course this opinion may be questioned by the advertiser of specialties, who desires to reach a certain class of people only, but this statement is meant to apply to advertising in general, though it would require merely a slight modification to apply to all cases. Nevertheless, one fact, borne out by the most successful advertisers in America and in Europe, is that what is broadly understood by newspaper advertising is the best and cheapest advertising that can be had. The term "newspaper" includes of course periodicals of every class.

In choosing a publication some people have very peculiar ideas; if they see a paper with a large number of advertising pages, they take it for granted that an advertisement in such a paper means money thrown away, because the advertisement will be crowded out of sight. This is a mistake. The best papers, as a rule, have the largest amount of advertising; hence they must be the best advertising mediums. The best papers are apt to be the most widely read, so that advertisements in them must of necessity become widely circulated, which is the great object of advertising. To this reasoning it may be replied that it does not follow, that because an advertisement is circulated among ten thousand people, ten thousand people will read it. Certainly not, but an advertisement circulated among ten thousand people stands a better chance of being read ten thousand times than an advertisement circulated among only five thousand people. Apart from this deduction of simple logic it must not be forgotten that advertisements are read with as much interest as any other portion of a newspaper. This may not always have been so, but it is nevertheless true to-day. It may be that the busy man will carelessly pass over the advertising columns of the daily newspaper, but the housewife will read them twice and thus make up for his neglect. But take the popular magazines of to day, the advertising pages of which are truly remarkable, not alone in their appearance, but also as regards their contents. Does any one dare to assert that an advertisement placed anywhere in these pages is a lost investment? The advertising pages of these periodicals represent from month to month the most striking reflection of the commercial, the industrial, and the financial, as well as the intellectual, progress of this country, and the intelligent readers of these publications are just as much interested in the perusal of the advertising pages as of the essays, stories and other features.

A business man, having decided to advertise, and having set apart a certain sum for this purpose, should go to that publication which is read by the largest number of people interested in his business, which most probably will be that publication which has the most advertisements and pays the most attention to the manner of setting up and arranging the advertising pages.

The advertising rates in the best publications are very low. Many people, and even some advertisers of experience, will doubt this statement, but that does not detract from its correctness. The trouble is we expect too much from an advertisement. It must not be supposed that a single advertisement, for which perhaps $50 has been paid, is going to fill a store with customers for a year to come, thus bringing a profit on the investment of probably ten hundred per cent. Most people are satisfied, if they make one hundred per cent. on their invested capital, and everybody should commend them for their modesty. Why, then, should a larger profit be expected from an advertisement than from any other investment?

Advertising once commenced, must be kept up, and if conducted with the same thoughtfulness, the same care, and the same business methods exercised in any other enterprise, an advertisement will always prove a profitable investment.

There is one other feature connected with the business of advertising, which, although the writer has so far not made mention of it, is nevertheless of no less importance than the others. This is the manner of composing an advertisement. It is impossible to form any set of standard rules as a guide for the composition of advertisements, except in so far as that they should in all cases be so worded that they will at once attract attention and be read. To be brief, concise, clear, and to the point in writing an advertisement is undoubtedly commendable, and a plain statement is always more liable to carry weight with the reader than a long string of ambiguous phrases, which have no defined meaning when analyzed.—*Engineering Magazine.*

SPARKS.

The capital stock of the Vankleek Hill, Ont., Electric Light Co., has been increased from $3,000 to $10,000.

Steps are being taken to establish telephonic communication between Denmark and Sweden, under the Sound.

Mr. A. J. Corriveau, of Montreal, has registered his business under the name of the Canadian Electric Manufacturing and Supply Co.

At the recent annual meeting of the Brantford Electric and Power Co. Mr William Beuen, the president, was re-elected, as were also the other directors of the company.

The new electric mail cars recently put in operation at Ottawa, have given very satisfactory results, having reduced by 75 per cent. the time necessary for the delivery of the mails.

Messrs. Robin & Sadler have received from the Eastern Townships Agricultural Association, a silver medal, for their display of leather belting at the Sherbrooke Exhibition, in September last.

The Bell Telephone Co. gives notice of its intention to apply to Parliament at its next session for an Act to increase the borrowing powers of the company to the limit authorized by the "The Companys' Act."

A limited joint stock company is being formed at New Hamburg Ont., composed of leading citizens of that town, with a capital of $50,000, to manufacture a new air motor and an electric dynamo. The company expect to commence operations early in the new year.

Messrs. Doty Bros. & Co., of Toronto, recently removed from the hull of the steamer "Sadie," at Oakville, Ont., what is believed to be the oldest marine engine in Canada. The engine was built at Birkenhead, England, in the year 1804, and parts of it have been in use constantly up to the present time.

A correspondent to the ELECTRICAL NEWS in London, Ont., advises engineers, instead of purchasing an indicator, to study Hemmenway's or Pray's Indicator Practice. He expresses the opinion that it would be better for them to possess themselves of the theory of the indicator, than to have an indicator without the knowledge which should precede its use.

It is said to be the intention of the Montreal Street Railway Co., to have all its cars vestibuled, thus affording shelter to the motormen and conductors. In a climate so severe as that of Canada in winter, the comfort of street railway employees as well as the safety and comfort of passengers, demand that this protection should be afforded. We observe that in some of the American States laws have been passed making it compulsory on street railway companies to place vestibules upon their cars.

Messrs. F. Nicholls, general manager of the Canadian General Electric Co., and Mr. H. P. Dwight, general manager of the Great North-Western Telegraph Co., have lately returned from a visit to British Columbia. A Vancouver dispatch intimates that their visit had something to do with the purchase by the city of Vancouver of the Victoria and Westminster Tramway, the Vancouver City Tramway, and the Westminster City Tramway, as well as the entrance into British Columbia of the Great North-Western Telegraph Co., as a competitor of the Canadian Pacific Telegraph Co.

At a recent meeting of the City Council of Ottawa, Ont., the following resolution was adopted:—"That in view of the necessity of the city providing its own electric lighting plant for street lighting and other purposes, the city clerk be instructed to write the Ottawa Electric Light company and ask on what terms they would be willing to sell their plant, giving the details of the cost of the machinery on hand and the water power privileges they possess in approximate horse power with a view of opening negotiations for the purchase of the same, and that the company be asked to return an answer before the 15th December."

The Reliance Electric Manufacturing Co., of Waterford, Ont., are seeking to obtain from the City Council of Toronto, permission to string wires and erect poles for the supply of electric light and power in the extreme western section of the city. They propose to use the old Parkdale water works pumping house as a power station, if it can be obtained for this purpose.

A half-inch three circuit metallic sub-marine cable of the best quality, upwards of 3,000 feet in length, was recently laid under the Fraser River by the Burrard Inlet Telephone Co. The laying of the cable occupied about three hours, and was done under the supervision of Mr. H. W. Kent, Manager of the Company, and Mr. George C. Hoidge, the manager of the local system. The first message over the new line was sent by the president of the company, Mr. J. C. Armstrong.

The steam and electric power plant of the New Westminster and Vancouver Electric Tramway Company, as well as the cars with which their line is equipped, amounting in value to nearly a quarter of a million dollars, are housed in one large wooden building. Mr. F. E. Handy, on assuming the superintendency of the line, was forcibly impressed with the danger to which this valuable property was exposed from fire, and immediately set to work to devise ways and means for its protection. For this purpose he organized the employees into a volunteer fire company, and placed in position a steam whistle, to the sound of which they were to respond. The men were drilled at regular intervals, and so efficiently, that at a recent inspection of the works by representatives of the City Council, only ten seconds elapsed between the sounding of the whistle and the turning on of a stream of water from the hose.

SPARKS.

It is reported that a strong company has been organized to build an electric car line from Rat Portage to Keewatin.

The married employees of the London Street Railway Company were each presented with a Christmas turkey by the company.

$70,000 of stock of the Hamilton, Grimsby and Beamsville Electric Railway Co. has been subscribed, and $10,000 paid up. Only half the authorized capital stock of $200,000 will at present be issued.

The London West Electric Railway has been operated without much difficulty during the recent severe storms, but great difficulty has been experienced in giving a good service with horses in the city.

As a result of a recent conference between the managers of the Toronto Street Railway and the Toronto City and Suburban Electric Railway, the Toronto company agreed to put electric cars as soon as possible on Bathurst street to connect with the suburban line.

The manufacturers of the Novak incandescent lamp, in the suit brought against them in the United States courts by the Edison Electric Light Co., for infringement of the Edison patent, admit the validity of that patent, and set up as their sole defence the claim that the lamp which they manufacture is non-infringing. The decision of the courts in this case will be looked for with very great interest in view of the contention upon which the defendants base their case.

The following tenders for the supply of an electric and steam plant have been received by the City Council of London, Ont.:

Company.	Electric Plant.	Steam Plant.
Standard Co........	$43,130	$15,565
Canadian Gen. Co. ..	36,300	
Fort Wayne Co......	42,224	
Reliance Co	32,990	
Royal Co	42,650	
Western Co	42,274 59	15,565
Siemens-Halske Co .	656,90 complete.	
Robb Armstrong Co.		14,700
E. Leonard & Sons..		15,565
Inglis & Son. . ..		17,000
Babcock & Wilcox...		10,979
T. A. Grant & Co....		8,550

The Canadian General Electric Co. offer the present city plant at the price of $32,670. A meeting of the City Council has been called to consider the tenders.

TRADE NOTES.

The Canadian Pacific Navigation Co., Ltd., of Victoria, B. C., last spring gave a trial order to Mr. S. Fuge, Canadian agent, London Ont., for 20 gallons of "Anti Scale." They are so pleased with its use, that they have now ordered 150 gallons.

"Business is rapidly improving with us." So say the Penberthy Injector Co., of Detroit, Mich. They add that their November sales are nearly double their October business, and that they are again running their factory on full time and with a full force.

The Robb Engineering Co., of Amherst, Nova Scotia, have been awarded a contract for two 250 h. p. cross-compound high speed engines for street railway and light for the Amherstburg & Sandwich Street Railway Co., and two additional Monarch boilers of 200 h. p. each, for the Canadian General Electric Co.'s new electric station at London. These boilers will complete a battery of five Monarch boilers, making 1,000 h. p. in all.

Messrs. Darling Bros., of Montreal, have furnished the Hamilton Electric Light and Power Company with one of their 18" Transmitters to drive a large generator; also two 9" Transmitters to the Ontario Government for Central Prison, Toronto, to drive two Reliance dynamos. They have likewise disposed of 125 Morse valve reseating machines since the first of January, 1893, amongst these sales being the railroads, cotton mills, electric stations, etc.

November has been a busy month with the Waterous Engine Works Co., Ltd., Brantford. In addition to four large marine boilers, they have received orders for four complete circular saw mills from 30 to 75 H. P., four single set of saw irons, ten standard chopping mills, three large under runner mills, one Prescott direct acting steam feed, and three Allis band mills with their attendant machinery, one pulp wood outfit, and two shingle mills, one veneer machine and a number of export orders. The company have also made arrangements with the W. E. Hill Co., of Kalamazoo, to manufacture their steam mill specialties.

SPARKS.

The British training ships have lately been connected by telephone with the Royal Navy Barracks at Keyham.

A movement is on foot with the object of federating the various unions of street railway employees throughout Canada.

The Gananoque Electric Light Co. are about to install a new 200 h. p. compound engine, manufactured by John Inglis & Son, Toronto.

The village council of Grimsby, Ont., have refused to grant right of way through the village to the Hamilton, Grimsby and Beamsville Electric Railway.

A telephone line is to be constructed by the Bell Telephone Co., from Danville to Duddsville, Que., via St. George, Wotton, St. Camille and South Ham.

The new Factory Act which is up for consideration before the Legislature of Quebec provides that employers must have a certificate showing that their steam boilers and attachments have undergone proper inspection.

It is stated that a suit for $20,000 has been issued by the sisters of the late J. W. Scobie against Messrs. W. A. Johnson, Toronto, and Phillips Johnson, Montreal, of the Ball Electric Co., and the Canadian General Electric Co. The suit is said to relate to their deceased brother's interests in these companies.

The earnings of the Toronto Street Railway for the month of November last were $[illegible], as against $93,574 in the same month in 1892, and $[illegible] in 1891. It is believed that the doubling of the ratio of increase this year is due to the recent adoption of transfer tickets. There is no doubt whatever that under the loose system which prevailed prior to the adoption of tickets a great deal of free riding was done.