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NEW SERIES, VOL. V.—No. 5.

MAY, 1895

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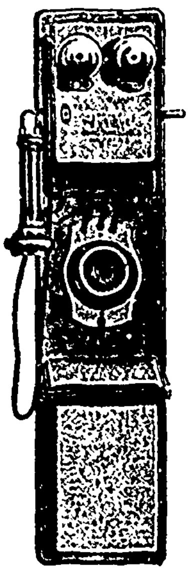

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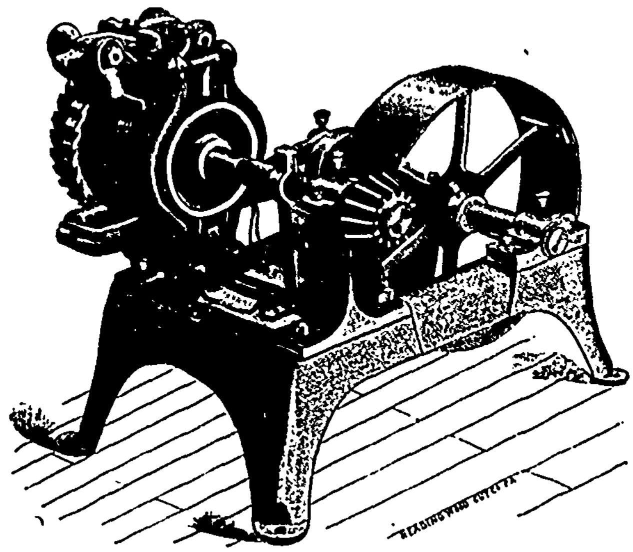

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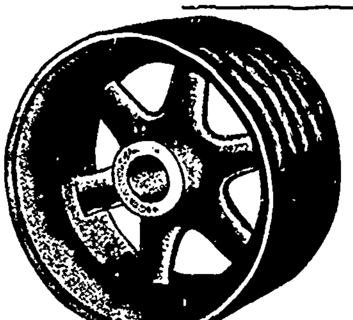

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ELECTRICAL NEWS

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STEAM ENGINEERING JOURNAL.

VOL. V. MAY, 1895 NO. 5.

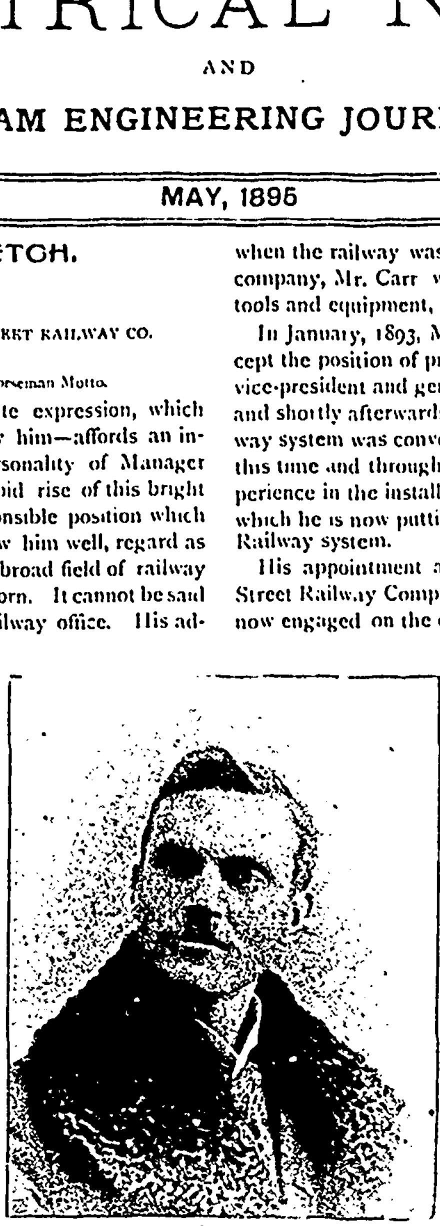
CHARACTER SKETCH.

CHAS. E. A. CARR.

MANAGER AND TREASURER LONDON STREET RAILWAY CO.

"Either I will find a way or make it. —Norseman Motto.

"To let you know that I live"—a favorite expression, which might properly be employed as a motto by him—affords an index to one phase of character in the personality of Manager Carr, which explains the phenomenally rapid rise of this bright young Canadian, to the trusted and responsible position which he holds to-day, and which, all who know him well, regard as a stepping-stone to higher honors in the broad field of railway enterprise. Mr. Carr is not to the manner born. It cannot be said that he grew up with a railway, or in a railway office. His advancement is due to sheer natural merit and adaptability, and the intuitive recognition of these qualities by Mr. H. A. Everett, of Cleveland, O., the well-known street railway promoter, whose interests are identified with great railway corporations in nearly every large city in the United States and Canada.



MR. CHAS. E. A. CARR.

Sir John A. Macdonald was wont to say that his greatest discovery was Sir John Thompson. It was Mr. Everett who discovered Mr. Carr, while the latter was employed as a clerk in the City Engineer's office in Toronto, and Mr. Everett claims him as one of his ablest and most trusted associates to-day—one of his best finds.

Mr. Carr was born Feb. 8th, 1870, a little over 24 years ago, on his father's farm near Barrie, in Simcoe County, Ontario, and he received his early education in the public schools of that town. When sixteen years of age he came to Toronto and passed through a three years' course in one of the leading commercial colleges. An initial experience in practical office work in the "Mail Order" department of the T. Eaton Co. lasted but a few weeks, when he accepted a position in the office of W. T. Jennings, then City Engineer of Toronto.

Mr. Carr's active career may be said to date from that time. His genial frankness and manly sociability soon made him one of the most popular attaches of the office, and a conscientious fidelity to duty, combined with an exceptionally high order of ability, won him the confidence and generous approbation of his superiors in office. During his stay of nearly three years at the City Hall, Mr. Carr acquired a thorough general insight into routine work in one of the most important branches of the municipal service, and a practical knowledge of civil engineering.

The investigations for the transfer of the Street Railway from the Frank Smith Company to the city, which was chiefly carried on through the City Engineer's office, was brought on while Mr. Carr was connected with the department, and first brought him into familiar association with street railway matters. He was one of the party of City Hall attaches delegated to make the memorable midnight demand for the surrender of the railway to the city on April 30, 1891. Later in the summer of that year, when the railway was turned over by the city to the present company, Mr. Carr was assigned to checking over the stock, tools and equipment, which went with the transfer.

In January, 1893, Mr. Carr left the employ of the city to accept the position of private secretary to Mr. H. A. Everett, then vice-president and general manager of the Toronto Railway Co., and shortly afterwards the greater portion of the Toronto Railway system was converted from horse to electric power. During this time and through 1894, Mr. Carr acquired the practical experience in the installation and operation of an electric railway, which he is now putting to good account in the London Street Railway system.

His appointment as manager and treasurer of the London Street Railway Company was made Feb. 11, this year, and he is now engaged on the conversion of that railway from horse to electric power, negotiations having been going on between the Company and the city of London for some months.

The new system in London will cover over 13 miles of streets within the city limits, and will also include an extension of the line to Springbank, a delightful summer resort on the River Thames, some three miles below the city, popularly known as the Water Works Park, and which is visited by many thousands every season.

In railway circles Mr. Carr bears the distinction of being the youngest railway manager in America, and his success affords a present illustration of the prominent place occupied by young men in business, as well as in many other walks of life. But it is with Mr. Carr, as with everyone who would succeed in life, be they young or old, a definite and earnest purpose must follow them in everything that they do. Those who best know this young street railway manager know that "he lives," and those whose business dealings are kept in touch with his tactful energy and enterprise, are quick to perceive why he has made a success, even in his short life-time, of whatever he has put his hand to.

Mr. Carr is married and an active member of the Methodist church, and though but twenty four years of age, has already won a measure of self made financial success, which would be reckoned remarkable, gauged even by modern ideas of affluence.

A NEW contrivance for scraping boiler tubes has been introduced in Australia. Hitherto the appliances in general use have been worked by spring expansion, and are soon rendered useless. The new scraper works on a hinge, which is closed as the cleaner is pushed into the tube. In the act of drawing out, the hinge is opened, and two disks, which can be gauged to fit any tube, are thrown out. These disks fit so closely to the inside of the tube that their passage causes the removal of all dirt and scale. It is claimed that the new apparatus is cheap, that it cleans the tubes more effectively than any other scraper, that no brushes are required with it, and that it pulls soot, etc., before it, instead of pushing it into the fire-box at the back end of the tubes. It is stated that the scraper has been found especially serviceable on board large steamers.—The Age of Steel.

DYNAMO DESIGN.*

By E. B. Merrill.

(Continued from April number.)

THE MAGNETIC CIRCUIT.

We now come to the consideration of the magnetic circuit which produces the fields to be cut by the armature conductors. There are a great many different types of magnetic circuits. Dynamos are classified by the forms and arrangements of these. They can only be utilized for dynamos by conductors cutting through gaps in them. The rest of the circuit is, therefore, only of use as it provides the fields. Electric current circulating in a continuous direction, in coils which surround the material of the magnetic circuit, is necessary to produce and maintain the magnetic flux. The excitation is proportional to the product of two terms, the current and the number of times it encircles the flux or to NC. Only the current involves energy, so that we are able to reduce the energy waste by increasing N.

As they are inter-related we may consider together the questions: *How do we adjust the proportions of the magnetic circuit? what excitation will be needed for it? and how shall this be provided?*

They are, in fact, the discussion of the equation

$$N\,C = \frac{10}{4\pi \times 2.54}\,\phi \frac{l_1}{S_1\,\mu_1} + \frac{l_2}{S_2\,\mu_2} + \frac{l_3}{S_3\,\mu_4} + \&c.$$

where l_1, l_2, l_3, etc., are the average lengths of the magnetic paths in the different parts of the magnet circuits.

s_1, s_2, s_3, etc., the corresponding areas of cross section.

u_1, u_2, u_3, etc., the corresponding permeabilities.

ϕ the magnetic flux forced through the circuit by the ampere turns NC.

In this equation we have to fix the quantities ϕ and for each part of the circuit the term $\frac{l}{S\mu}$. To fix ϕ we have already the intensity of the field $\mathfrak{B}_a$, its width, which is taken as the length of the pole face, and its depth is calculated from the ratio of polar arc and the circumference of the armature; so that we have the area of the pole face, which is taken as the cross section of the field S and therefore $\phi = S\,\mathfrak{B}_a$ is determined.

We will now consider the terms $\frac{l}{S\mu}$ for (1) the air gaps, (2) the armature core, (3) the pole pieces, (4) the magnet limbs, and (5) the yoke or connecting pieces.

For the air gaps, we have already settled S, μ is unity, and l is the distance between armature core and the pole face, which is made up of depth of winding and clearance. The depth of winding has already been settled. The clearance varies with the diameter, in practice, between 1-32 and 7-16 of an inch. The larger distances are for slotted armatures, being found necessary to prevent sparking; it should be as small as possible, but there should be safety assured, for the surface of the armature, from touching the pole face. The smallness of μ makes this the most important term in the calculation. The main reason for making S large or $\mathfrak{B}_a$ small is now apparent.

Let us now deal with the armature core. In the first place, it has to be well laminated, for the reason that iron is a good electrical conductor; so that if the core were made of solid iron, this, cutting the magnetic lines which pass through it, would have the same effect as though conductors on the surfaces were short-circuited, which would waste power if it did nothing worse. The current that would flow in it would be in the same direction as in the conductors; the lamination, therefore, is to effect discontinuity in this direction. *If the lamination is too thick, there* will still be formed circuits in it sufficient to cause serious loss. The range of practice seems to be between 10 and 80 mils in thickness. Special insulation is not required between the plates; the coating of oxide formed by heating the iron is sufficient.

The radial depth of the core is fixed so that, after allowing for air space in the lamination, the total cross-section is sufficient to keep the value of $\mathfrak{B}_a$ in it well within the limits of saturation. In bipolar machines the total flux has two paths to take about the centre. In multipolar machines, for each magnetic circuit, it has but one path in the armature. The S for the armature is now fixed, since we know the length and have corrected it for lamination already. We must determine μ from tables giving the relation between $\mathfrak{B}_a$ $(=\frac{\phi}{S})$ and μ. l is the average length of magnetic path through the armature core, and may be estimated. The hysteresis losses in the core are proportional to the number of magnetic reversals and to the 1.6th power of the intensity of magnetization; for this reason $\mathfrak{B}_a$ should be lower as the speed increases, to keep down the heat and the heat losses.

The quantities, l, s and μ are readily estimated for the pole pieces—the pole face has already been fixed. The general design of the pole should be such as to prevent the unequal distribution of the field. They are often made of cast iron, especially in smaller sizes, when the intensity of the magnetic flux carried by them is not great, and therefore the permeability is large.

The magnet limbs, on the other hand, should be of the best annealed wrought iron, for the cross-section, as it affects the cost of winding, as well as the weight of metal, should be a minimum. It should also be as nearly circular as possible, as this has the least circumference for a given area. The limbs are usually run pretty well up to saturation, so that $\mathfrak{B}_a$, and therefore $S = \frac{\phi}{\mathfrak{B}_a}$ can now be fixed. For the present, the value of l will have to be estimated. This may be done from comparing similar machines. It is decided later, when we find the space required for winding. μ is fixed by $\mathfrak{B}_a$. If the dynamo is to have field regulation for electro-motive force or speed over any considerable range, then the value of $\mathfrak{B}_a$ chosen should correspond with the field needed for maximum pressure or minimum speed, so as to keep the field below saturation.

The cross-section of the yoke or other connecting pieces between the limbs should, at least, be as great as the latter, if of the same kind of iron. It is better to have it somewhat larger, so as to bring $\mathfrak{B}_a$ and μ down. If of cast iron, the value of S, being decided by $S = \frac{\phi}{\mathfrak{B}_a}$, *would be considerably larger, as the* permissible $\mathfrak{B}_a$ would be much smaller. It is again the length of the average path of the magnetic lines (not the length of the yoke over all).

We now have all the data for calculating the ampere turns NC necessary to produce the field for the armature conductors to cut. We should find, however, that if we took this value and designed the fields according to the cross-sections, etc., above obtained, and provided windings and current accordingly, that the useful flux that we should actually obtain would perhaps be only ½ or ⅔, perhaps, even less, of the amount calculated upon.

The explanation is this. air is a magnetic conductor not a good one, but still it has conductance, and magnetic lines, instead of passing around, and keeping within the bounds of the circuit, run out from the exciting coils, in more or less wide paths through the air, constituting magnetic leakage. The part of the total flux that does not go through the armature is considerable.

If we were to take a practical example of the magnetic circuit, and calculate the ampere turns, or the magnetomotive force necessary for each part of it, we should see that by far the greatest term would be that for the air gaps; so that if we consider the magnetomotive force about the magnetic circuit in the same way that we do electro-motive-force about the electric circuit, we see that the drop is proportional to the resistances. The air gap is to the magnetic circuit in very much the same relation that the space between plates suspended in acidulated water is to an electric circuit. The reluctance of the air gap is greater than that of the rest of the circuit, and, therefore, the greatest drop of magnetomotive force takes place over it. Wherever we have *difference of magnetic potential in a magnetic conductor, we shall* find magnetic lines. The pole pieces have great difference of magnetic potential. There are, we may say, two magnetic conductors between them, the air gaps and armature core as one, and the remaining possible paths as the other. Most of the lines will follow the former path, but only in proportion to its magnetic conductivity as compared with the other. In the same way there will be leakage between the limbs, and between the pole pieces and the yoke; there will be very little between the ends of the yoke. In all cases given the machine the magnetic conductivity of the air spaces is perfectly definite and can be ascertained, and, therefore, the proportion of the lines in a given case that leak through the air and those which are used in the armature can be ascertained.

As all the lines (or nearly all of them) will have to pass through the iron within the exciting coils, and through the yoke, we shall have to increase the cross-sections of these as calculated, if we wish to keep the value of $\mathfrak{B}_s$ and μ the same—adding sufficient to them to take the leakage of the rest of the circuit at the same densities $\mathfrak{B}_s$, *thereby retaining the flux ϕ for the armature.*

Doing this will be seen not to affect the value of *NC* calculated; the increased flux is simply proportional to the increased conductance. The ratio of the total to the useful flux is called the co-efficient of leakage, and ranges from 1.1 in large machines of good design to 2 for very small ones.

The determination of the conductances of the air circuits is rather troublesome, so that if it is not necessary to have very accurate results at first a value for the co-efficient of leakage may be assumed by comparing those of similar types of machines; and an allowance may be made for increasing or decreasing the excitations when the machine is tested.

There are two more items to be considered in providing ampere turns, which, in bad construction or in bad design, may become of considerable importance; they are the effects of joints and the demagnetizing action of the armature. The former becomes of importance when there are too many joints in the circuit, or when their surfaces are not perfectly even and smooth. The latter is due to a certain number of turns in the armature between the pole horns, which actually surround the magnetic circuit, and have a current in the opposite direction to that of the magnet. It is due to the lead given the brushes to prevent sparking. The effect, evidently, varies with the armature current, i.e., with the load. It can be allowed for, for some particular load, or it may be counteracted by compounding.

If the field and speed can be kept constant in a generator, then the electro-motive-force generated will be constant; but the terminal electro-motive-force will drop as the load increases, as we see from the relation $E_1 = E - Cr$. Now, as it is the terminal pressure that must be kept constant, since the speed cannot be very well increased with the load, the machine is compounded; that is, a winding is provided on the magnet which, by taking the armature current (or that, less the shunt field current), is designed to produce an additional flux, which will increase the electro-motive force generated by the amount *Cr* over as wide a range of load as possible.

A motor is compounded to maintain constant speed when run on a constant pressure circuit. The series winding acts against the shunt, decreasing the counter electromotive force by the part *Cr* in the relation $E_1 = E + Cr$ as the load increases. As the action of the armature turns, due to negative lead in the motor is opposed to that of the field turns, just as it is in the generator, it may be made use of in the design of the motor to maintain constant speed instead of providing a special series winding.

We may now decide the relations between the turns and current in the fields. We have for the shunt field.

$$NC = k_1$$

Where k_1 is the calculated value, we have also the relations

$$C = \frac{E}{R} \qquad \text{and}$$

$$R = k_2 \frac{L}{s}$$

Where *L* is the total length, and *s* the cross-section of the wire used, and k_2 is the resistance of unit length of copper conductor of unit cross-section. If *L* is in feet and *s* in circular mils, then k_2 is the resistance of one foot of wire of one mil diameter = 10.381 ohms at 75° F. Again $L = k_3 N$ where k_3 is the average length of a turn. Now, if k_3 can be considered nearly constant for a fairly wide range of turns of a given wire, then knowing the excitation required must fix the gauge of wire to be used, for we derive from the above equations the relation

$$S = \frac{k_1 k_2 k_3}{E}$$

k_3 is estimated at first from the diameter of the spools on which the wire is to be wound, and is corrected by trial, as the space to be occupied by the windings is determined.

We may now select a value for the current to be used, which must be within the safe carrying capacity of the gauge of wire determined, and calculate the number of turns. The adjustment should be made by balancing running loss against cost of construction. As the field losses are rather a matter of absolute than of relative cost, we find that much larger percentages of the total output are used in field circuits in small than in large machines. They range from about 15 to .015 per cent.

In adjusting the excitation due to the series field of the compound winding, the principal necessity is the knowledge of the properties of the magnetic circuit above the degree of its magnetization by the shunt coils, *if for a generator, or below, if for a* motor, because if lines are added to those already in the circuit or are taken away, it affects the value of $\mathfrak{B}_s$ and μ throughout, so that the ratio of the increase of $\mathfrak{B}_s$ per increase of the magnetizing force must be known.

LARGE ELECTRIC TRANSMISSION IN NORWAY.

A SYNDICATE has lately applied to the Norwegian government for a concession for an electric power transmission for some 20,000 horse power from the Raanaas waterfall at Sorum and the Fossum waterfall at Askin, to the town of Christiania. It is understood that the plan of the installation is made by an English electrical engineer, and approved of by Lord Kelvin. It comprises the transmission of 20,000 horse-power to Christiania from the above two falls, but it is proposed to commence with a transmission of 10,000 horse-power. The tension is not to exceed 10,000 volts. The length of the line from the Fossum fall is close upon 25 miles; it passes through Spydelizerg, Tomter, Ski, and East Aker. The other, the Raanaas line, is about a couple of miles shorter, and passes through Sorum, Skedsmo, and East Aker.

At the borders of the borough of Christiania it is intended to build a distribution station, where the high tension current will be transformed and distributed to the various parts of the town by means of underground cables, the proposed tension varying from 100 to 400 volts. The installation cannot only supply convenient and cheap power for the larger and smaller industries of the town, but it is also under contemplation to supply the whole town of Christiania—or at least the part of the same which is not lighted from the central electric station with electric light at a cheap price. The lighting of the public thoroughfares will, according to the plan, be effected by arc lamps of 2,000 and 1,000 candle-power, according to the importance of the street, the price will be much cheaper than that charged by the present central station.

There will be several large turbines at each waterfall, which are some of the most important in Norway, and the high tension will be generated either direct or by transformers. It is proposed to use naked wires.

The installation can, it is calculated, be completed in the year 1895, although much will depend upon the water level of the waterfalls, as the works in connection with leveling, damming, etc., require low water. The cost is calculated as 6,000,000 kr., or about 350,000*l.*—*Engineering.*

THE DIFFICULTY AT THE C. G. E. WORKS ADJUSTED.

It is understood that a satisfactory adjustment has been made of the difficulty which arose at the General Electric Company's works at Peterborough a fortnight ago, as the result of the employees being required to sign a certain agreement. Some of the features of the agreement to which objection was taken by the employees have been modified by the company, and as a result harmony has been restored and the works will resume operations.

PERSONAL.

Mr. John Langton, electrical engineer, Toronto, recently spent two months in the interest of Eastern States capitalists in visiting mining properties in Colorado, Arizona and elsewhere. He reports that business conditions across the border do not as yet exhibit anything like their former activity.

We chronicle with regret the sudden death from pneumonia, of Mr. Geo. M. Phelps, manager of the New York Electrical Engineer. The sad event occurred on the 11th of April. Mr. Phelps was widely known and most highly esteemed. The position made vacant by the death of Mr. Phelps has been filled by the appointment of Mr T. C. Martin, one of the editors of the paper.

Mr. W. J. Richardson, Secretary of the American Street Railway Association, died at his home in Brooklyn, N. Y., on the 26th of April. He was for many years connected in an official capacity with the Brooklyn Street Railway Company, on whose system occurred the recent great strike. This strike is said to have had much to do with bringing about his death. Mr. Richardson had occupied for many years the position of Secretary of the American Street Railway Association, and his loss will be deeply felt by that organization, more especially at the present time when arrangements are in progress for the annual convention to take place in Montreal in the autumn.

LIGHTING AND ELECTRIC LIGHTING AS A BUSINESS.

By Geo. White Fraser, E.E.

II.

Again, how many superintendents, and so-called "electricians," have the faintest idea of what goes on between the moment when coal or wood is thrown into the furnace and the other moment when the lamp key is closed and the lamp bursts forth into incandescence? They will all tell you that the fuel raises steam, which runs the engine, which turns the dynamo, which generates current (somehow), which lights a lamp. And then they go on to say that they burn 45 tons of coal per month, and get $470 per month on the average for rental of lights, and that therefore their business pays, or does not pay, as the case may be. And this, together with the cleaning of the machines, the tightening up of the lines, etc., is all the management the station receives.

Now, the generation and utilization of electricity, in connection with steam power, involves several very complicated transformations. I am perfectly well aware that it is the opinion of most Canadian station owners (an opinion which they endorse *by their practice) that there is nothing* whatever complicated about them, and that a perfectly inexperienced person can run an electric business. Still, I have used the word complicated, and I mean it. There are the following transformations: The potential energy of coal into the actual energy of steam, acting both by direct pressure and expansively. The utilization of this steam energy to produce first linear and then rotary motion. Up to this point we have mechanical energy. Here comes in the transformation of mechanical to electrical energy. We next have the transmission of electrical energy, and lastly the utilization thereof. The utilization involves either the retransformation of electrical to mechanical energy—by motors—or the transformation of electrical to radiant energy in the the incandescent or arc lamp. Perhaps this is not a complication; again, perhaps it is. Each person can judge for himself. Every one of these transformations, utilizations and transmissions is, and must be, accompanied by some waste of energy. Of the total heat in the coal, some goes up the chimney, some is used in heating the draft air, some in heating furnace walls, bars, grates, &c., and boiler shell, and the remainder in heating the water. Of the total heat in the steam generated, some goes towards running the engine—the rest is wasted in heating piping, cylinders, &c. Of the total theoretical power of the engine, a considerable portion is required simply to turn itself over against its own friction and inertia. Quite a considerable percentage is lost, between the engine and dynamo, by belt slippage. In the dynamo itself a still further loss takes place; yet another on the transmission lines and transformers, and in the last transformation—from electrical to radiant energy—such a tremendous loss occurs that one authority states that only 5% of the electrical energy given to an incandescent lamp is converted by it into light. The losses in lamps, wires and dynamos are unalterable, being dependent on design: *those in belting, shafting, engine, piping* and boiler are partly the result of necessity, but can to a great extent by care and attention be kept down.

What does our diagrammatic factory do? It watches every process in manufacture, and accounts for every pound of material throughout; recognizes some wastes or losses as inevitable, others as extravagant, and remedies them. Does our electric factory do this? No; it shovels coal into the boiler and is satisfied when the engine turns round. In blissful ignorance it doesn't weigh raw material (coal), buying it by the car load, and dumping it somewhere handy. It doesn't, by careful experiment, determine which is actually the cheapest coal to use in its peculiar condition as to draft, &c. Oh no! It trusts in Providence and keeps on shovelling coal. The turning over of the the engine is a stage in the manufacture. And seeing that the modern steam engine is the result of the concentration of great minds, and the application of scientific principles, it might be worthy of receiving some attention. The prime object of its being is to convert the energy of the steam into motion, linear and rotary; a special feature being the utilization of both the direct force and the expansive force, in such proportions as to attain the highest efficiency, i.e., the greatest force with the least loss of energy. As everyone knows—even our hypothetical "electrician"—this is done by cutting off steam at a point in the stroke and allowing it to act expansively afterwards. And all engines designed for electric service allow a variation in the point of cut-off from say a quarter to over a half, this variation being effected through the governor, eccentric and valves. All machinery is liable to fall out of adjustment; it must wear, and it requires attention. Any deviation from perfect adjustment means loss of energy, therefore, waste; and as it is caused by misadjustment, such waste is remediable. In how many stations operated by steam, is a card taken off the engine once a year? How, otherwise, can the operation of the engine be watched? It is quite possible for an admission or exhaust to open or close too late or too early, and every slight loosening of a nut will produce very appreciable results. And yet this matter is neglected, as is apparently almost every other matter connected with electricity, and hence it is that a comprehensive statement may be made, that "electric lighting stations run themselves."

Now, if electric lighting be not a business, then let that be clearly understood. But if it be such, then let electric business be conducted on business principles. I think it is evident to any one who has had the opportunity of watching the methods *followed generally, that seventy-five per cent.* of the electric stations in Canada neither know their consumption of fuel, nor the amount of their electrical output, with any degree of accuracy; have no person in charge who is in any smallest detail competent to manage; keep no checks whatever on any of their apparatus, and have not the faintest idea as to the interior economy of the plant. If the plant pays it is purely good luck, and they accept their dividends without question. If it doesn't pay, then "There's no money in electric lighting anyway." Their $1 a day "Fireman and Electrician," may, by injudicious use of the draft, waste pounds of fuel; the engine may through some slip in adjustment of cut-off, use 5% more steam than necessary; there may be a most healthy ground on the lines. No matter—"Electricity don't pay!" I should like to hear of the business that would pay under these conditions. Let all these precautions be taken and checks made, and see the improvement. Every station will know within a fraction of a cent, how much it has cost to produce a kilowatt hour; how much it has been sold for; where losses may be diminished, gains increased; and a report can be prepared, showing in an intelligent business way the working of the station, and the directors, or other authorities, will understand clearly what they are doing.

Among the many matters requiring consideration at the hands of electrical investors, as preliminaries, the one of capital investment is very prominent. The purchase of land, building, machinery and construction expenses, involve a capital outlay that, large or small, excessive or reasonable, once made has got to stand. The plant must pay its own proper operating expenses, and is expected to pay interest on the investment. The larger the investment, the less evidently, the percentage of interest. It is impossible to raise this percentage by decreasing operating expenses, beyond a certain limit, and it is equally impossible to *do so by decreasing the investment once made. Hence the* importance of keeping it down in the first place is obvious. This can be done by either providing cheap and nasty machinery, or by most carefully considering the entire conditions under which the plant will operate, and balancing cheapness against efficiency. The cheapest is often the most expensive; conversely, the most expensive is sometimes—generally—the least so. Why? Because the more expensive machine, by its being more carefully built, with better materials, and greater attention to scientific principles, will save in cost of operation, a greater sum than the interest on the difference in price between the more and the less expensive. True economy, therefore, is only attained at the cost of patient investigation.

There should be unity in all things, even in electric lighting, although it seems not to be generally admitted. An electric station is intended to perform a certain service—to give a certain quantity of current. It is a condition of all lighting that more is required at certain periods than at others, and so electrical machinery must be capable of supplying the highest demand, as well as the lowest, or average. Therefore, although in a 1000 light town, it is found that for ten hours of lighting only 300 lights are going; during 7 hours there must be the machine capacity to supply the whole 1000 lights during the three hours they are required. The dynamo capacity being fixed, there is no doubt as to the necessary size, but the engine capacity varies with the cut-off, and is generally rated at some particular point, say ¼ or ⅜ cut-off, with a range of variation from ⅛ to ⅝. The engine therefore may be chosen, so that it will be powerful enough for the 1000 lights at the maximum admission of the ⅜ cut-off. By so doing the rated capacity of the engine is less than that required, the actual capacity sufficient, and the price less than if one were purchased whose rated capacity at ¼ cut-off were sufficient.

All machinery has a most efficient rate of working. A boiler will require less coal to be consumed to evaporate 1 lb. of water into steam, at a certain rate of supplying steam, than at any other rate. An engine will require least steam when a certain definite relation exists between the admission of steam into the cylinder, and the expansion thereof. A dynamo will waste less power when running a large number of lamps than a small number. As a rule, machinery is so designed that it will work at the highest efficiency when it is being worked at its full rated capacity. Therefore, a boiler rated at 100 horse power, will not furnish steam to a 50 h.p. engine, at anything like the same economy. It is very bad economy, and unwise precaution, to allow too large margins, for thereby an element of waste is introduced, and no useful purpose gained. On the other hand, too small margins are worse. Here is just where the question comes in, of the proper proportioning of the various apparatus that go towards the production of electric current. In any actual case there is always a happy mean—avoiding on the one hand excessive margins, which increase not only first cost, but also operating expenses; on the other, a mistaken economy that allows not enough. It has been said that in the most ordinary objects around us—the leaves on the trees, the beetle's wing, &c.—there is abundant evidence of design, and fitness for purpose. Nature allows sufficient material and no more—a beautiful harmony and symmetry being the distinguishing characteristics of her works. Nature would chuckle over a few of the the electric light stations in Canada. In some of these the only unity of design seems to have been to purchase in strictly the cheapest market. I have seen a 150 h. p. engine bought to run a 600 light incandescent dynamo, because it was second-hand, cheap. It would be very interesting to arrive at how much money this station is losing by the inefficiency of this proportion, remembering that the dynamo runs probably only 100 lights for half the time. Nature has not had much to do with these stations. An electric light man comes along and a dynamo is bought from him. An engine "big enough to run the dynamo" is duly put up, and a boiler. They have to have these things and so they get them. The engine man makes more out of a large engine than a small one, and so he recommends a good large one—two if they will stand it; similarly with the boiler man. And so the station grows; a source of waste and expense; is managed by a "Fireman and Electrician"; and "electric lighting doesn't pay!"

One word as to the use of meters. Dynamos are always wired for more lamps than their rated capacity, because all the lamps will never be going at the same moment. If a man pays by the meter, he will be very careful not to be using more at any moment than he actually requires. This has been found by experience to allow of a still greater margin of overload, and this is tantamount to a reduction of capital investment relatively.

This article will be seen by a great many to whom all the above is well known, also to a greater number who have not made electric lighting their study and profession for years. The former will, I hope, pardon the repetition; the latter will, I sincerely trust, come to see that electric lighting as a business is worthy of study; that it is not the simple affair they have hitherto regarded it, and that by the application of business methods, and in that way only, can they expect to succeed in it.

DAMAGE TO CHIMNEYS BY LIGHTNING.

An investigation was recently carried on in Germany, by C. Carlo, upon the subject of the damage done by lightning to chimneys, both with and without lightning conductors. From a study of twenty-four cases, he draws the following conclusions:

1. Lightning very seldom strikes a chimney in such a way as to leave any perceptible effect.

2. The damage done by lightning to chimneys is in most cases inconsiderable; only in one case was a chimney actually destroyed, and in four cases only was the damage so great that it was necessary to pull the chimneys down.

3. Lightning strikes chimneys both with and without lightning conductors; the latter appear, however to be struck oftener than the former. Of the cases reported on, two were with and fifteen without lightning conductors; in four cases it was not definitely known whether a conductor was in position or not.

4. In low, marshy grounds, lightning flashes seem to occur more often than in high and dry neighborhoods.

5. In one case only has lightning struck a steam boiler so as to necessitate repair.

WATER HAMMER IN STEAM PIPES.

Recently numerous explosions of high-pressure steam pipes led a German engineer to call special attention to the great danger from water hammer. To prove this experiments were undertaken to show the high pressure in a pipe when water hammer occurs. A pipe 12 inches in diameter, ¼-inch thick and 21 feet long, blank-flanged at one end, was partially filled with water, and at the other end steam supplied through a three-inch pipe. Three pressure gauges at equal distances were screwed to the pipe and one in the black flange. When steam of five atmospheres, 73 pounds per square inch, was admitted suddenly above the water, the pressure gauges indicated respectively pressures of 426 pounds, 114 pounds, 199 pounds and 114 pounds per square inch, or nearly 30, 8, 14 and 8 atmospheres. When steam entered slowly again above the water, hardly any concussions and abnormal pressures were noticed. Steam was then admitted through a valve 2 inches in diameter, and the steam, at a pressure of 5 atmospheres, now entered below the water. The concussion was so violent that the threads of four of the nuts were shorn off, the fourth gauge placed there was crushed, though the gauges were designed for a maximum pressure of 2,133 pounds per square inch, while the other gauges indicated pressures of 483, 385 and 923 pounds per square inch. The end of the pipe bulged considerably. On a new trial the first three gauges registered 313 pounds, 185 pounds and 853 pounds per square inch, the fourth, refitted, over 2,130 pounds; a rent of eight inches in length formed, starting about four inches from the far end. This damaged part was then cut off, the pipe closed again, and the water level lowered to 6¾ inches; pressures of 498 pounds, 498 pounds and 853 pounds per square inch were then observed. The water level was then raised to 10 inches and steam turned on again; this time two bolts broke in the end plate, and fissures formed near the middle of the pipe. In all cases air and water were thrown out through the air and water outlets. This occurred always in sudden rushes, after an interval of 15 seconds, when steam was turned on fully, and of several up to four minutes, when the valve was only partially opened, to one-fifth in the last instance. Only part of the water was forced out; a minimum of 3 inches always remained in the pipe. The experiments prove that the blow did not begin before the steam had condensed and the water had acquired the respective temperature. The different indications of the gauges seem to show that the blow was propagated in waves, which affected the pressure gauges according to their positions. The maximum pressure observed was 30 times higher than that of the steam which caused the concussion. If we consider that the steam inlet had only one-thirtieth of the area of the steam pipe, that steam pressures of three times the intensity of those experimented with are actually used on shipboard, and that part of a pipe might, under circumstances, be entirely filled with water, we must admit that these lodgments of water may lead to most disastrous consequences.—Engineer and Iron Trades Advertiser.

QUESTIONS AND ANSWERS.

H. Bros., Kincardine, Ont., write: We want to build a brick chimney 80 feet high, square chimney. What size should the base be for this chimney, and should cement or mortar be used.

ANSWER.—It will depend largely upon the nature of the soil upon which the chimney is to be built, as to the dimensions at the base. If built on clay soil, allow about three tons to the square foot; if on sand, about four tons to the square foot. You should take into consideration also, the thickness of the walls. Unless the chimney requires to be rapidly constructed, the use of cement mortar is not necessary, a good quality of ordinary mortar will be sufficient.

SOME NOTES ON THE GOVERNING OF STEAM ENGINES, PARTICULARLY WHEN COUPLED TO DYNAMOS.*

By G. L. Addenbrooke.

THIS is a subject which has always been in my mind in connection with central station electric lighting; and the fact that it has been brought into prominence by Mr. Swinburne, in his simple but lucid paper before the British Association, shows that the question is now beginning to attract the attention which it deserves.

In order to understand the exact position of matters at present, as regards the governing of the engines used for other than marine purposes, it is advisable to look back a little at the history of the steam engine governor, and the purposes to which it has been chiefly applied up to the present date, premising the fact that so far electrical engineers have not paid any very great amount of attention to the problem, as they have been occupied by other considerations of more immediate importance, and have been generally content in this particular to accept the practice of industrial engineers, and to rely on their judgment as having the greater experience.

What really caused careful attention to be paid to the construction of governors and valve-gear was the application of steam engines to driving spinning machinery, the rise of mechanical weaving and spinning and the best modern type of steam engines being almost contemporaneous. For a loom to work properly regular speed is essential, or the shuttles will not throw properly, and uneven strains are produced in the material. Not only, therefore, has the best steam practice been usually devoted to the construction of engines for driving textile factories for the sake of economical working, but at the same time the utmost pains have been taken to design valve and governing gear which would admit of the engine doing its work at a constant speed whatever the load. The latter condition was essential, because one engine was only employed for driving at a time, though the load would constantly vary as different machines were thrown in and out; and at times a part of the factory might be altogether closed if work in one of the departments was slack.

The engineers who devote themselves chiefly to the construction of mill engines have for many years been able to meet these conditions and to supply plant which would readily retain a speed within 2 per cent. or 3 per cent. of the normal, whatever might be the load. It is true that large fly-wheels and camparatively slow speeds have hitherto been chiefly in vogue for this class of plant, but this is a somewhat minor point.

Such being the state of affairs when electric lighting first became practical, electrical engineers naturally turned to the constructors of mill engines for advice and help; the result was the application of the mill engine, with rope driving, to turning dynamos, a system which has worked well wherever it has been applied, while for freedom from breakdowns and exactness of working this method has probably not yet been surpassed. Such plants, however, occupy a great deal of space, are rather expensive, and there is a certain loss of power in rope-driving. Consequently the high-speed engine has been developed to get over these difficulties, so far, chiefly of the single-acting type; but now that the conditions of running of such engines is better understood, and confidence in high speeds is increasing, there are indications that similar engines, but double-acting, will gradually come to be preferred.

Our cursory glance at the history of the application of governors to engines has now made it manifest that the best practice hitherto has been in the construction of governors to produce perfectly even motion whatever the load. Further, it must be noted that such engines have usually been engaged in supplying energy direct in the form of motion to lines of shafting, and to machinery which it is required to run at a constant speed.

Let us now turn to the driving of dynamos by means of steam engines. The proper methods of governing such engines will naturally depend on the purposes to which the current produced is to be applied. If for the transmission of power or the running of arc lights in series, very little alteration of existing methods is required; but if the engine is used for lighting incandescent lamps direct, whether for a private installation or in a public supply station—which latter is, of course, the most important case, and the one to which it is proposed to devote most attention—then it is desirable to clearly define the limiting conditions of the problem; so that, knowing exactly what is required, we may be in a position to judge how far existing appliances meet the conditions and where they are defective, and thus arrive at a definite idea of the directions in which alterations and improvements are required.

Now in a central station the ultimate object is the incandescing to a certain point of carbon filaments, to procure from which the standard amount—16 candles from a 16 C. P. lamp—the pressure or voltage must be steady and exact, with one per cent. on either side of the normal, any further variation either way making a great difference in the light.

Perhaps, in order that we may present to ourselves a clear idea of the conditions, an entirely mechanical analogue may be useful. Let us suppose that the engine room in a central station is the engine room of a large mill which is worked by several steam engines, driving by means of pulleys and friction clutches on to a line of counter shafting. Imagine that these clutches are not very well designed, and that there is always a certain amount of slip in them, not more than 6 or 7 per cent. at light loads, but increasing considerably at heavy loads. It is, of course, required to keep the mill machinery running evenly within 2 or 3 per cent. If the load is a light one not only will the engine or engines be lightly loaded but there will be very little slip in the clutches; on the other hand, as the work done in the mill increases and becomes heavy not only will the load on the engines increase, but, having to keep the mill machinery revolving at a constant speed, the speed of the engine will also have to be increased to make up for the extra motion lost in the clutches, the friction of which will absorb energy, which will be dissipated as heat as the losses in dynamos are. Under these circumstances it is clear that it will not be sufficient if we have a governor which keeps the engines running always at the same rate; we must over-govern to some extent, that is, we must not only have the speed of the engine under control, but we must also have an arrangement by which the engine shall go a certain percentage faster at heavy loads than at light. We may diminish the difference of slip at different loads by improving the efficiency of our friction clutches, but the fact remains that it exists to some extent and that it must be compensated for.

In an electric lighting central station the dynamo may be regarded as the friction clutches in the above simile. Besides a certain loss of power greater at heavy loads than at light, and which may be likened to the loss in friction in the clutches, there is also a loss of motion, increasing with the load, due to self-induction and the back action of the armature current on the fields, which weakens them and necessitates the speed being increased to obtain the same voltage; this is like the slip in the friction clutch. If not corrected by outside influences it may amount to from 10 to 20 per cent.

In the central station there is the further point that at the hours of heavy load it is necessary to run at a higher speed altogether than at light loads in order to keep up a higher general pressure in the mains to allow for increased loss in them.

Consequently, in driving dynamos in central stations for lighting, we have not only to secure regular running or absence of sudden variations of speed at all loads, but we have got to provide, taking the light load as a basis, that as the load increases the driving speed shall be increased in order—

1. To increase the pressure on the mains.

2. To overcome the increased armature resistance and provide increased excitation of the field magnets.

3. To make up for the slip or loss in pressure caused by the increased back action of the armature on the magnets and increased self-induction, which necessitates a higher rate of driving, though it does not directly mean loss of energy.

It is true that it is not absolutely necessary to increase the speed of the engines; it may be kept constant at all loads as in mill engines, and the requisite variations may be produced by the use of resistances or by varying the excitation of the dynamos, by means of resistance or the use of a separate exciting engine.

*Abstract from the London Electrician.

PUBLICATIONS.

The Arena for May is an excellent number, and the high character of its contents is one of the encouraging literary signs of the times.

THE ONLOOKER.

THE question of electric lighting continues a leading one with the people of Toronto. The Onlooker has no desire to add one more to the army of disputants. The economic side of the subject has been touched with a good deal of vigor by some writers. Let a word be added on this point. Because the cost per light in one place may be shown to be $5.00 less than in another, some writers have concluded that money is actually saved the municipality. Quality and quantity come into the question here, as much as with the good housewife, when she does her Saturday's shopping. Consideration needs to be given to the amount of work done by each lamp. Stating the cost does not state the real value. The Onlooker has been interested in an article in which are furnished valuable statistics on electric lighting by an expert. He has pointed out that as a matter of fact Buffalo pays $127.75 per year for a lamp, while South Norwalk pays less than half that amount; but Buffalo gets almost twice as much light. The question suggested is, Would the light which South Norwalk receives be sufficient to satisfy Buffalo, even if the latter could have it at the lower price, and if not, is the excess of lighting which Buffalo gets costing that city more than the same excess of light would cost South Norwalk if the latter were to increase output, plant and equipment, to a point where it could furnish a supply of light equal to that necessary to supply Buffalo? The Onlooker stops here, but commends this thought to the tyros who are telling where Toronto can secure electric light at a much greater reduction than some of the figures that are offering to-day. A penny saved is a penny made, sometimes, but not always.

× × × ×

It is always the case when a boom is on—it matters little whether it is in real estate or electricity—the average man is prepared to take a good man chances, and the more uncertain the project the greater are likely to be the chances taken. If he does not know all about it he is ready to assume that he understands the whole situation, and often rushes in where angels would fear to tread. This thought is nicely brought out in a recent article in the ELECTRICAL NEWS on interurban electric railways, by Mr. Geo. White-Fraser. The Onlooker had the same thought presented to him a short time since, when discussing electrical projects with a well-known engineer of Toronto. This person drew attention to the injustice often done the experienced engineer by the manner in which his designs, which had been prepared by request and at the cost of much thought, are altered afterwards, or entirely ignored, by the directors or officers of electrical enterprises, while the suggestions of a novice, who may have a purpose to serve in selling a plant, are accepted, because, for the moment, it may seem a few dollars can be saved. The case was cited of an electric railway in western Ontario, where the engineer's plans, as to the laying of the road, were untouched, and the work of a road-man, who thought he knew all about the laying of tracks, was accepted. The road was built; the cost was less than if the plans of the engineer had been followed. But what of the work? It was not long before a large part of the road had to be taken up and relaid on a scientific and common-sense basis. By the way, the Onlooker is informed, that the criticism of Mr. White-Fraser as to the disposition of the boilers, engines and dynamos in the Galt & Preston power house, could not have been made had the plans of Mr. Wm. Jennings, C. E., engineer for the project, been followed; but after Mr. Jennings had done his work the directors of the road, and they certainly had a right to do as they pleased in this matter, viewing the question from at least one standpoint, fitted the machinery to certain buildings in their possession, and in cutting the coat to the size of the cloth, the designs of the engineer had to be discarded. To quote another old saw, it is possible to be penny wise and pound foolish in the building of electric railways, as in the matter of electric lighting.

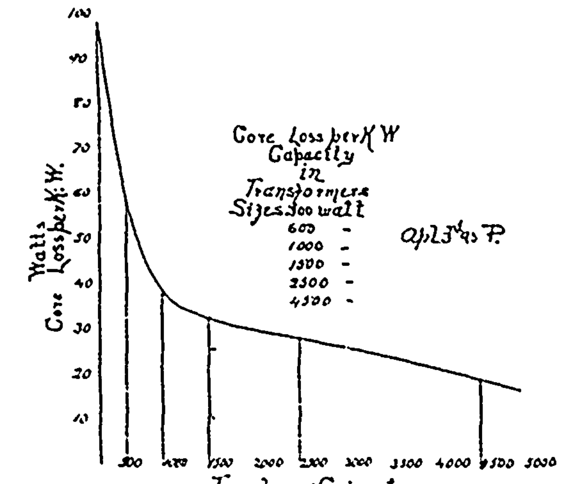
Two open double truck cars with accommodation for 150 passengers, are being constructed for summer traffic on the Kingston, Portsmouth & Cataraqui Electric Railway.

The Royal Electric Company recently recovered from Mr. Wallbank, the architect, who planned and supervised the erection of a chimney stack for the company's works, the sum of $1,281.04, on account of the defective manner in which the work was performed. The architect in turn brought suit against the contractor, from whom he secured damages.

ECONOMY OF SMALL v. LARGE TRANSFORMERS.

By F. G. PROUTT.

IT is to be supposed that every company operating an electric lighting system, operates it for the purpose of making money, and perhaps the best way to make money is to save it "A penny saved is a penny earned," is true in every case. In very many instances of plants operated on the alternating system, a separate transformer is used for each and every customer, and no attention whatever paid to the fact that the core loss in a small transformer is enormous when compared with the loss in a larger one, a fact which is very clearly shown by the accompanying curve.



We will take as an illustration, what is perhaps an extreme case. With 1,000 volts applied to the primary and the secondary open circuited, the watts core loss in a 300 watt transformer was found to be about 29, or at a rate of about 97 watts loss per K. W. of capacity. The core loss in a 4,300 watt transformer, was found to be only 88 watts, or at a rate of 19.5 watts per K. W. capacity. Now fifteen 300 watt transformers have the same capacity as one 4,500, whilst the loss in the former would be 435 watts, and in the latter only 88, a saving at all times, whether the transformer is running fully loaded, or only partly loaded, or on open secondary circuit of 347 watts, or enough energy to maintain six 16 c. p. lamps.

While it would perhaps be hard to find such an extreme case, there are plenty of instances where two or three or four transformers might be replaced by one of a larger size, necessitating perhaps the putting up of a little larger secondary wire for a few feet, but the slight addition in cost for a small amount of wire is nothing when compared to the saving of energy—not for a day or a week, but for as long as the customers have to be supplied with light.

A little explanation of the diagram may be necessary. The ordinates represent not the losses in the transformers, but the losses per K. W. capacity of the transformers; and the abscissae represents the capacity of the transformers. The transformers tested are of a very well known and reliable make, and range in size from 300 to 4,500 watt. Heavy ordinates have been drawn from points on the curve to the abscissae below which show clearly the size of each transformer tested and the point it takes on the curve.

It will be well to remember that even a little saved each day amounts to something in a year. If we can so arrange our transformers as to make a saving of one kilowatt, it means $50 per annum on the coal bill alone, allowing 4 lbs. of coal per h. p. hour, and a twelve hour run each day in the year, with coal at $4 per ton, and in electric lighting as in all other business, what is saved can be very conveniently used in paying dividends.

Malden, Mass., April 3rd, 1895.

Notice is given of application to be made for incorporation of the "New Light Co., Ltd.," to carry on an illuminating business and manufacture illuminating apparatus. The headquarters of the company is to be at Montreal. The names of the applicants are:—William Robertson, merchant, Angus M. Thom, merchant, Joseph A. E. Whyte, merchant, William D. Aird, merchant, of Montreal, and Geo. W. Booth, of Toronto, merchant, the first three of whom shall be the provisional directors of the company.

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

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THE negotiations which are understood to have been in progress of late between the General Electric and Westinghouse Electric Companies of the United States, with the object of arriving at a satisfactory adjustment of their patent disputes, are declared to have come to a stand-still.

THE entrance of women into business pursuits for which formerly men only were thought to be adapted, is one of the features of this evolutionary age. There are indications that ere long the position of the street car conductor will be invaded by the New Woman. Several applications from young women for positions as conductors are said to be in the hands of Superintendent Folger, of the Kingston, Portsmouth and Cataraqui Electric Railway. As usual the enterprising Canadian girl is the first to enter upon an untried path. Managers of suburban pleasure lines especially may possibly see in the lady conductor a means of increasing their passenger traffic and of still further popularizing electric railways in general.

IN view of the recent decision of the Canadian Controller of Customs, imposing a duty of twenty per cent. on electricity generated in the United States and transmitted to Canada, the New York Electrical Review wonders "just how the 'juice' will be measured." "Probably," it says, "at so much per H.P. for strong currents, but how the quantity used in transmitting telegrams will be taxed is evidently a refinement of calculation not yet attempted." It will be interesting also to notice what action the United States Government will take in the case of the company which is generating electricity at St. Stephen, N. B., and transmitting the same into the United States. Thus far, the American customs authorities have not attempted to collect duty from the company. The fixing of a rate of duty would seem to be a much easier task than determining the method of measuring the current and calculating duty on the same.

A FEW errors crept into the description of the central station of the Incandescent Light Co. of Toronto, printed in the ELECTRICAL NEWS for April. In the fifth line below cut in first column, first page, it should read "30 feet". On twentieth line, second column, of first page, "Size of vertical engine, 19 x 38 x 32 inch stroke." In last line on first page "25,000" should read "35,000."

ON all sides come reports of new electric light, railway and power enterprises, to be carried out in the near future. If these prospects should materialize, they will give rise to a demand for electrical apparatus, such as has not been experienced in Canada in any previous year in the history of the industry. In keeping with the brighter outlook, the faces of the manager and sales agents of the various electric manufacturing companies are marked by an unusually cheerful expression.

It is a consequence of the "Infancy" theory, that electrical enterprises do not receive that careful consideration and attention without which success is impossible. When it is clearly understood by electrical investors that the proper methods for the construction and operation of electrical machinery have attained a certain degree of finality, and that they can be formulated on thoroughly scientific principles, then a direct experience in electricity will be a necessary qualification for the appointment to positions in power houses, &c. It is not yet recognized as it should be, that electricity is a distinct business, to be studied carefully and intelligently.

A BY-LAW to authorize the expenditure of $277,000 for an electric lighting plant will shortly be submitted to a vote of the property owners of Toronto. It is very doubtful whether any saving could be effected in consequence of the ownership and control of the generating plant being vested in the city instead of a private company. It is altogether certain, we believe, that the saving, if any, would be so very trifling as not to warrant the city in entering upon such an extensive undertaking, involving so large an outlay. For these reasons, as well as the fact that aside from this expenditure it will be impossible to avoid increasing in a material degree this year the present rate of taxation, we believe the by-law is doomed to be defeated. Whether or not it will ultimately be to the city's advantage to own and operate its own lighting plant, will be much better understood say five years hence than it can possibly be to-day, when the business is to some extent in a transition state.

THE cost of steam production has declined in recent years in consequence of the introduction of devices for creating artificial draft, whereby it is possible to use coal screenings and refuse of various kinds instead of fuel of better quality and higher price. It will be interesting to notice what effect the increased demand will have on the price of the cheaper grades. The opinion obtains with some engineering authorities that the result must be to increase the price of these materials. On the other hand, coal for domestic purposes, shows an inclination to drop in price as the result of the lessened demand existing for steam purposes. The manufacture of artificial fuel for manufacturing purposes has already been commenced in Canada, and will doubtless prove to be an important factor in the future in keeping down the cost of steam production to a point to harmonize with the economical methods which are being adopted in every branch of manufacturing in the present day.

A CORRESPONDENT "J. M.," writes the ELECTRICAL NEWS as follows: "How does the enclosed application strike you? The question arises was he a good man? The copy is to my mind an improvement on the original." The application referred to reads as follows: "I have leave to inform you I have been A engine-here for over 20 years and has been a tester and prover of the—engine and is a good machinest to." Whether the author of the above application be a capable engineer or not from the standpoint of practical experience, it is certain that he would have been much more capable had he given more attention to self-education. An application which on its face so clearly displays the lack of even a rudimentary education, within the power of every man to acquire, is doomed to fail. In nine cases out of ten the person to whom it is addressed will not consider it necessary to enquire further into the qualifications of the applicant. There is a lesson here for every engineer who desires to improve his position. If he is not so fortunate as to have had educational opportunities in his youth, he may nevertheless pursue a course of self culture which will to a large extent make good the deficiency. The man who neglects to make this effort must expect to be counted out of the race for advancement.

WHY is it that there are so few high-speed engines in use throughout the Dominion for electric lighting? There are many very good makes, and they are specially adapted for use in smaller lighting stations, where the load, which varies greatly between maximum and minimum, is not great even at the maximum. The two types, high and low speed, have each their peculiar advantageous features, which adapt them more especially to peculiar conditions, and a choice between them, for any individual case, which is made on purely personal preference for one or the other, is not always certain to secure the best results. The fact is that every case should be considered on its merits, and selection made accordingly. In small plants, of say 500 to 1000 incandescent lights, the sudden extinguishing of 50 lights, as in the case of a church, large store, or other considerable building, relieves the engine instantly of between 10 and 5 per cent. of its load. This has the tendency to quicken the engine speed, and consequently to temporarily raise the electrical pressure at the lamps. This excess of pressure, as is well known, has a very injurious effect on the life of the lamps, which will be more marked in proportion as the regulation of the engine is slow. This regulation is affected directly by the variations in speed, and will therefore be very much more rapid in a rapidly revolving wheel. It is evident therefore, that for a small-sized plant, where any fluctuation will very greatly vary the percentage of the load, a high-speed engine has considerable advantages. This is not the only one, however. They have generally a very considerably greater range of cut-off, thus giving a much greater flexibility of service. For instance, a high speed engine rated at 100 H.P., at ¼ cut-off, and giving a range of ½ to ⅙, will, according as the cut-off is varied, and at the same steam pressure, give either 170 H.P. or about 65 H.P. Now, although it is not equally economical at these abnormal points of cut-off, as cards taken would show, it is plain that an engine that will increase its power to meet the heavy demand at about 8 or 9 o'clock, and that will just as amiably shut itself off to suit the light-running conditions at 1 o'clock in the morning, all the time regulating its speed very closely, has its strong features, and another point in its favor is that shafting, with its friction, can be done away with. All shafting requires an expenditure of energy to turn it round, and it makes very little difference whether the load be heavy or light, that is, the power absorbed by its own friction, is practically constant, and it is obvious that the smaller the load, the greater is the percentage required for the shafting only. So that towards the middle of the night, when the lights are dropping off, perhaps 25 or 30 per cent. of the total power developed by the engine is used solely by the shafting. This is quite worth saving. There is also the purely commercial aspect of the question. High speed engines are sold at practically the same figure as the low speed; they do away with one large main belt, belt tightening apparatus, and a quantity of shafting and standards, and so on. They take up less room, and altogether they can very well claim to have their merits considered in every case where a new installation is contemplated.

THE usual journalistic statement that "electricity is in its infancy yet," has been so persistently made, that the public, who somewhat naturally regards the public press as its guide, has come to accept that dictum, regardless of the numberless evidences of approximate perfection that are to be seen on every hand. If a generator with an electrical efficiency of 98%, and a commercial efficiency of 94% or 95%, is an "infant," what an efficiency we may expect when that puny infant attains full growth! Surely, we may confidently look for 300% or 400%. But when will the public learn that electricity is not in "its experimental state;" that it is a force whose actions are perfectly understood, easily controllable, and as capable of being chained to the service of man, as is steam or water power. This ignorance of the true state of affairs directly affects the interest of the public through their pockets; and it reacts indirectly on the electrical industries through the odium cast on the operation of electrical enterprises, either by reason of the poorness of machinery ignorantly purchased, or the unsatisfactory results obtained when employing unqualified persons to run it. It more especially affects that portion of the public who have small sums of money to invest, and who are continually on the watch for "snaps." This class is very much at the mercy of a fluent patent attorney, who can talk glibly of "largely increased efficiency"; improvements in "design of magnetic circuits," and consequent decrease of cost of manufacture and operation and so on; and invest their money in appliances that have probably been tried and found wanting, in the very early days of electrical investigations, twenty and thirty years ago. The extraordinary conceit of some professional inventors, is not less remarkable than the credulity of those who invest their money in the crude productions of an uneducated mechanic. The methods for the generation and utilization of current are so perfectly understood, and the proper design of the mechanical and other appliances necessary, has been so carefully investigated by persons in all civilized countries, having the advantage of scientific education as well as practical experience, and access to the most complete sets of tools, instruments, &c., and backed by plentiful capital, that it is improbable in the extreme that a person who never had other than ordinary every day education, and whose practical experience in electrical matters has been that of an ordinary mechanic, is going to effect any revolution in methods or any appreciable improvement in mechanical, magnetic, or electrical design of machinery. Electricity is not now, what it was when T. A. Edison, then a newsboy, started inventing in the telegraphic field. In those days almost anything was an improvement. The field for original investigation was so large, and the explorers so few, that intelligence and industry was almost the whole equipment required by the prospector. We have entirely changed that now-a-days. The system on which the young electrical engineer is now educated, seems to show not only the immense amount of work that has been necessary to evolve electrical science to the point it has reached, but also it clearly indicates that an incomparably more complete equipment is necessary before an intending investigator can consider himself competent to enter the field at all. An illustration of this whole souled conceit, on the part of an inventor, and guileless innocence on that of the investor, was recently manifested very strikingly in the case of a new motor, that was said to operate on a new principle, being a "magnetic motor," and the usual claims were made for it—more efficient, lighter, stronger, cheaper—going through the whole list to which we are so well accustomed. The "prominent capitalist" was also there, and altogether, everything went happily, the inventor being cordially congratulated on having produced such a marvel, and the only wonder was that all the scientific electricians in the world had not been able to forestall him. It was the unhappy fate of the writer to have to point out that the "new" principle was uncommonly old, that the motor was the exact reproduction of one that was a new design in 1837, just 58 years ago, when electricity really was an infant, and that therefore—to go no further into its peculiarities—it was not *likely* to be a better one than those built to-day, on the principles ascertained during a course of investigation in which this 1837 motor was but a low down rung on the ladder. Now, in the first place, had the intending investors not been in the habit of regarding electricity as in its infancy, they would have very much more carefully and thoroughly investigated the merits of this wonderful machine, before putting their money in, instead of afterwards, and in the second place, had the inventor had less conceit, and posted himself in the smallest degree, as to the developments of electrical machinery, he would probably have set to work to acquire the rudiments of electrical knowledge, which he very evidently lacked, and in course of time, he too would probably have discovered to his wonder, that to effect improvements in electrical machinery to-day, requires not only vast knowledge of electrical, magnetic and mechanical principles, but close study of electrical history, a highly trained mind, and—capital.

The Welland Electric Light Co. are enlarging their buildings and putting in additional plant.

THE GAS ENGINE AND THE STEAM ENGINE JOINED.

Referring to the discussion of the gas engine question, a prominent engineer remarked in convesation that he failed to see why the gas engine and the steam engine should not be compounded, so to speak. He put the case something in this manner. In the gas engine one of the problems is to keep the cylinder reasonably cool, and in the steam engine to keep the cylindey hot. Now, suppose we have a gas engine running and jacket its cylinder with water, which is then used for boiler-feed water, thus saving the heat which is now thrown away. Then take the exhaust from the gas engine through the jacket of the steam cylinder, and, if necessary, as it probably would be, add a heating chamber for the steam to pass through just before reaching the cylinder, so that more heating force could be employed. Two such engines adapted to each other would probably mean a relatively small gas engine and a steam engine large enough to carry all the load in case the gas engine refused to work for any reason, and, arranged in this way, each would supplement the other so far as the proper distribution of heat is concerned. The proposition is a novel one, and there is a chance to do some thinking over it. Possibly someone may be so situated as to make it easy to try the plan and let us know the results.—American Machinist.

ZINC WILL PREVENT SCALE.

It is a well-known fact that zinc slabs suspended in steam boilers prevent the formation of scale, and large quantities are used annually for this purpose. The following directions will enable one to use it successfully. The proportions necessary to insure complete protection are one square foot of zinc to fifty square feet of heating surface in new boilers, which may be diminished after a time to one in seventy-five or even one in one hundred square feet.

Merely placing the zinc in trays, hangers or strips will not insure metallic contact, and the action of zinc to prevent corosion under such circumstances will be weak and limited. The best method of fixing the zinc is to place a number of studs in the sides of the furnaces and combustion chambers, and to bolt on to these studs the zinc plates, which should be about 10x6x1 inches. It is important to see that the contact surfaces are clean and bright and the nut screwed close to the zinc to exclude the water and deposits from the contact surfaces, thus comparatively insulating them and preventing the galvanic action. Otherwise the zinc is acted upon as a solvent that renders the water innocuous or non-exciting.

LONG DRIVING BELTS.

A very bad habit in mills where there are large driving belts, is shifting belts with a square stick, no regular shifters being used. The result of this is the belts are more or less injured on the edges. All heavy machines should have shifters to act so that they shift the belt over steadily, not putting too much strain on the driving belt too suddenly. Two pieces of gas pipe just large enough to revolve on round iron supports for shifters will lessen the friction on the edges of heavy belts, as these pipes revolve while the belt is being shifted. It effects a great saving in long driving belts, in fact any belt at all, leather or rubber.

The following gentlemen have been elected as the Board of Directors of the Ottawa Porcelain & Carbon Co.:—T. Ahearn, Thos. Birkett, G. H. Perley and Peter Whelen. At the close of the meeting Mr. T. Ahearn was elected president, T. Birkett vice-president, J. W. Taylor, general manager, and Jas. D. Fraser secy-treas. It is expected that the factory will be in operation by July 1.

The Vancouver Street Railway Co. have purchased at auction from the trustees of the debenture holders, the Westminster and Vancouver Tramway. The price paid was $280,000. The line will be operated in connection with the city lines. The City Council and the Street Railway Co. have come to an agreement with regard to new tracks to be laid down, the company to have the lease of the streets for five years at a nominal rental of $1 per annum, and the city to have the option of purchasing tracks at a valuation at the end of that period. Should the city not exercise this option, the company is to have the lease of the tracks for a further period of nine years, and so on from time to time for the unexpired period of the franchise for the streets granted the company for its original contracts. After the first five years the company is to pay a rental according to their earnings in excess of $5,000 per mile per year.

ELECTRIC LIGHTING FOR LARGE BUILDINGS.

By Geo. White Fraser, E. E., Toronto.

There have, until recently, been but two general methods employed for the electric lighting of large buildings. 1. The renting of the current from the electric company operating a central station; and 2. The installation in the building itself, of a private generating plant. There can be no rules laid down, of general application, pointing to the adoption of either method preferentially to the other; every case must be considered on its merits. Such consideration will reduce the question to its lowest terms, viz., a comparison of the costs of lighting by the rival methods. The variable quantities that will enter into this reduction as governing factors are: The price of current supplied from the central station per lamp hour, or per kilowatt hour on the one hand, and on the other, the cost of generating the current required in the building, using a private generating plant. This latter cost will be the total of such items as coal and water, etc., engineer's salary, little repairs, depreciation of plant and interest on capital expended in purchase of machinery, etc.

It is evident that local data will greatly influence the selection of method. For instance, a building full of dingy offices, and employing already an engineer and using quantities of steam, for heating, might very reasonably be expected to effect an economy in lighting by using a private engine or dynamo; while a church using a number of lights periodically, would not. These are, of course, extreme cases, illustrations merely, of the general principle, but it is a great mistake to assume in all cases, that because there is a central station operating, it must be better and cheaper to rent current instead of generating it.

The object of this article is to introduce to the owners and designers of large buildings a modification of each of the two general methods described above, that have the merit of presenting very interesting features from an engineering point of view, and of promising well from that of the owner.

The first modification is the use of a gas engine instead of a steam engine, to run a dynamo in a private installation. This plan presents many very advantageous features. No boiler is required, with its coal dust, dirt, and chance of explosion. Less ground space is taken up. Gas engines are very largely used in Europe, and in the States for working dynamos, and many of them are absolutely guaranteed to use only 15 cubic feet of gas per horse power per hour. In connection with this, there is a very interesting and suggestive calculation easily made. Thus:-One thousand cubic feet of gas in Toronto costs the consumer $1.10, for lighting purposes, and 90c. for power and heating purposes. If burnt in a 5 foot burner, this thousand feet will give 3200 candle power hours. If consumed in a gas engine requiring 25 feet per horse power per hour, this 1,000 feet will give 40 horse power hours. These 40 H. P. H., if used to run a dynamo, assuming 75% electrical efficiency and 4 watt lamps, will give 5584 candle power hours. The Toronto Incandescent Light Co. sells current at the net rate of 6 cents per 160 candle power hours, barring special arrangements.

Reducing these prices down to their equivalents per 1,000 candle power hours, gives:

Gas in burner............	costs,	34.375 cents	per	1,000	c. p. h.
Gas Engine and Dynamo	"	16.177 "	"	"	" "
Tor. Inc. Co.	"	37.500 "	"	"	" "

Now, one 16 candle power incandescent lamp burning for 62½ hours is equivalent to 1,000 c. p. h., so it can be seen how, in a large building requiring extensive illumination, it may very easily be actually less expensive to run a private dynamo, operated by a gas engine, than to rent either gas or current. So far, there is a difference, in favor of the gas engine, of over 100 per cent., but no account has yet been taken of two considerable items, salary of attendant, and interest and depreciation. These will of course greatly increase the cost as calculated above, but to what extent depends entirely on the size of the installation; there seems to be, however, a considerable margin to come and go on.

The second modification is the use of a storage battery located in the building, and kept constantly charged by wire from the central station. I am aware that the advantages of this plan are open to criticism, and would have to be the result of special arrangements with the central station. I am also aware that "Central Station Management" as understood in most Canadian stations, except the really large ones, is not the science that it has become in the States and Europe, and that as a fact, so little attention has been given to its study, that managers do actually not know those conditions of operation which are productive of best financial results to themselves. At the same time I am convinced that a little persevering effort on the part of interested persons would bring about a state of affairs favorable to the economical operation of the modification I have just suggested.

The position may be briefly and clearly described thus:-The best and most paying load for a central station is a *constant* one, one that doesn't jump from 0 at 5 o'clock p.m. to 500 H. P. at 8 p. m., but that remains fairly steady all the time. This is just the very kind of load that a storage battery gives, and moreover, it presents another very attractive feature to the central station as follows: A building is wired for say 500 lights; it will use these 500 lights all at the same time two or three times a year, but the machinery in the central station has got to have this 500 light capacity consuming interest and suffering depreciation all the year round, although it earns money only three or four times a year. A storage battery, however, that can be charged at the rate of 20 amperes continuously, will give out when required the whole current for the 500 lights, and keep them going for four or five hours. Thus the central station will only have to provide generating machinery sufficient for 20 amperes, which will be earning money all the time, instead of sufficient for 500 amperes which will be idle most of the time. Consequently it is to the obvious interest of the central station to encourage the use of the battery, and in order to do so it will lower price of current. A very well known authority on electric matters, has stated that it would pay central stations to sell current (for use with storage battery) at 4 cents per kilowatt hour in order to get the constant load that is so advantageous. This figure is equivalent to 16 cents per 1000 candle power hours, and to this must again be added interest of and depreciation on accumulators. Here again, particular conditions will affect the total per 1000 c. p. h., but as in the former modification a considerable margin is left. I have no doubt, that central stations would see the advantage of lowering their rates on such loads, if the case were properly presented, and advantage to both parties would result.

There being no particular installation to study, it is impossible to be other than general in this article; it was intended merely to point out to parties having large buildings to light, or to supply elevators for, that there are several ways of doing it, each of which is best only under certain favorable conditions, while under different conditions it should give place to some more efficient method, the actually best method being determined only after due consideration of the peculiar conditions.

THE S. K. C. SYSTEM IN BROOKLYN.

On Friday evening, March 22nd, says Electricity, an informal reception was given at the station of the Citizens' Electric Illuminating Company in Brooklyn, the guests being invited especially to see the S. K. C. two-phase system in operation.

A 600 k. w. generator supplied current, operating both a 3 h. p. and a 10 h. p. motor, in connection with a bank of 250 110 volt 16 c. p. incandescent lamps and twenty-eight arc lamps. The system worked to perfection, and nothing but favorable criticism was heard.

There was a large attendance of Brooklyn people, and a goodly delegation of New York men who had not been fortunate enough before to see the practical workings of the system.

The Citizens' Company, until recently, had been unable to make a feature of incandescent lighting owing to the patent situation. Now, however, it is freed from further annoyance, and will no doubt be a stronger factor than ever before in the local lighting situation in Brooklyn.

It is said to be the intention of the new electric light company organized at Gananoque, to operate on the underground system. They are said to have already in hand orders for 500 lights.

It is proposed to convey current for electric lighting purposes from the Chaudiere Falls to Notre Dame de Levis. These falls are 95 feet high, and are said to be capable of generating 500,000 H. P.

THE MONOCYCLIC SYSTEM.*

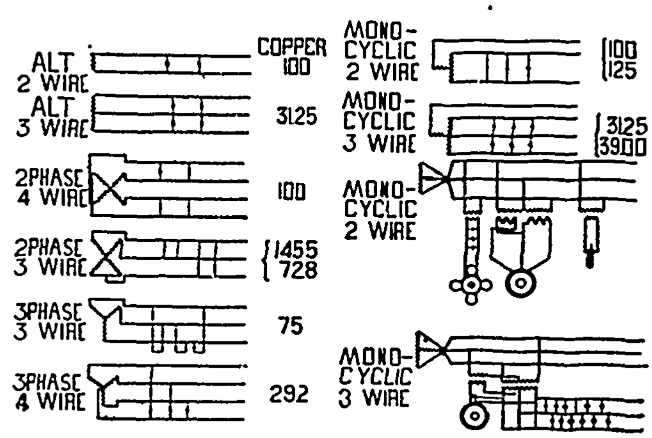
By Dr. Louis Bell.

It is the purpose of this paper to call your attention to the various methods of central station distribution, involving motor service on the alternating current system, and more especially to a modified single-phase alternating system, which lends itself very readily to a very simple and straightforward distribution of lighting without sacrificing the excellent motor service which makes the true polyphase systems so desirable. For all around central station work, the lighting service is of most fundamental importance, and convenience and economy must, in a vast majority of cases, be the first consideration. (The author here reviews the different systems of electrical distribution indicated by the accompanying diagrams.)

It is instructive to glance over this list of alternating lighting systems to see their relative complexity and advantages. It is especially noteworthy that any and every method of distribution that saves copper introduces in some form or other the question of balance. This is the price we pay for reduction in cost of conductors. It has not seriously interfered with the use of the Edison three-wire system; in fact, those most familiar with that system were the first to make light of the difficulty; nor do I think it stands as a valid objection to the use of the polyphase systems in cases where they are desirable, as none of them are more sensitive in the matter of balance than the Edison three-wire system which is now in such extensive and uniformly successful use. We may further note that in each of the alternating systems where a great saving of copper is accomplished, a fourth wire is necessary, at least if both lights and motors are to operated; in each case, however, of trifling size.

Having now looked over the field in general, we may pass to the more minute consideration of the somewhat striking electrical peculiarities of the monocyclic system; peculiarities which, although they do not involve any particular complexity, are yet of decided interest.

The general principle of this system is well shown in this diagram. So far as the main work of the generator is concerned, its winding is closely similar to that of any well-designed alternator. The armature is of the ironclad type, and the winding is made in machine wound coils which are invariably insulated, and can be very readily slipped into place. There is, however, upon the armature, a second set of coils of cross section equivalent to that of the main coil, but composed of comparatively few turns, so that the room taken up on the armature is very small, and owing to the shallowness of the slots necessary to accommodate this second or teaser coil, the output of the machine, considered as a single-phase generator, is not affected. This teaser coil is located with reference to the main coil as shown in the diagram. Its place on the armature is midway between the other coils, and the electromotive force generated is in a direction at right angles to that of the principal coil. It is evident now that if we connect the terminals of the main coil, we shall get an electromotive force compounded of the two, and in some intermediate direction. In general, by varying the proportions of the two coils, and hence their electromotive forces, we could obtain a resultant electromotive force between their terminals, having any angle we pleased with either the main or the teaser coil. If, then, wires are taken upon the line from the terminals of the main coil, and also from the teaser coil, we can obtain from the main line three electromotive forces, two of which are symmetrically situated with reference to the E. M. F. of the teaser coil, and bear to it any phase relation that we please. One of the most convenient arrangements, and that which is most generally adopted, involves such a relation of the electromotive force of the teaser coil to that of the main coil, that we shall have on the line three electromotive forces approximately 60 degrees apart. In other words, the resultant E.M.F.'s between teasers and main coils are each 60 degrees from the E. M.F of the teaser coil. Such an arrangement is that shown in the diagram. Under these circumstances, it is clear that if one of these electromotive forces were reversed, either in transformers or anywhere in the translating devices, the result would be three electromotive forces 120 degrees apart, one of them having been turned through an angle of 180 degrees. Meanwhile, the relation between the power wire, which is connected to the teaser coil, and the outside wire has no effect upon the electromotive force between these outside wires, since the electromotive force of the main coil itself does not interact with the power wire, except in so far as a portion of it may act with the power wire to form a resultant phase, and electromotive force for running motors. Consequently, so far as lights are concerned, the two outside wires behave precisely like the leads from any other alternating generator, while so far as motors are concerned, we have the power of getting our three electromotive forces 120 degrees apart, and hence have the same magnetic effect as with a three-phase system. The arrangement of lights and motors with this device is clearly shown in the diagram. It is evident that we can take from the outside wires of the monocyclic system either arc or incandescent lights anywhere and to any extent the capacity of the machine permits, working for the incandescents either two or three wire distribution at option. For a motor, two transformers are connected anywhere we please, one between the power wire and each of the outside wires. At this point the resultant phases come into play and the necessary reversal of one of the electromotive forces is accomplished by the very simple and obvious device of reversing one of the sec-



ondaries, as shown in the diagram. To the secondary circuit thus constituted, we can connect a standard induction motor which will start and run as well as if connected to a regular three-phase system, or instead of reversing one of the transformer secondaries we may accomplish the same virtual reversal of the electromotive force by reversing one of the coils in the motor itself. We therefore have a system which, so far as lights are concerned, is a simple alternating system; so far as motors are concerned, the dynamical equivalent of a polyphase system. With a differently proportioned formation we could place upon the secondaries two electromotive forces 90 degrees apart if necessary, and then run two-phase motors instead of three-phase motors, if there were any object in so doing. Such an arrangement, however, would be less desirable than that of the quasi three-phase system, for the reason that without gaining anything in the motors we should have to generate a larger electromotive force in the teaser coil, and hence take up more room on the armature with it, perhaps enough to have an effect upon the output of the machine considered as a single-phase generator. It is sufficiently evident that the method shown would not be the only way of getting the same result. For example, in this second diagram a somewhat different arrangement is shown accomplishing precisely the same end. Here our object is to operate secondary mains on the Edison three-wire system, and in connection with them to run motors at any point we please. A large transformer, to which the secondary is connected on the three-wire system, is, therefore, installed, and the secondary mains distributed in any manner we please. A second and small transformer, proportioned to the total amount of motor service desired, is connected as shown in the diagram, and the power wire leading from it is taken through the whole or part of the three-wire system. The device is analogous to the arrangement of the generating coils themselves, and the result is the ability to operate a standard induction motor by connecting it anywhere on three-wire system to the two inside wires and to the power wire. Such an arrangement as this is immensely convenient in distributing power and light in cities where, for example, it is desired to establish an extensive system of secondary mains through Edison tubes, or other convenient under-

*Abstract of paper read before the National Electric Light Association at Cleveland, Ohio, 1895.

ground distribution. It is, furthermore, interesting to know that one is not confined to the use of either two or three-phase induction motors, since a monocyclic generator connected to the primary circuit makes an excellent synchronous speed without the assistance of a starting motor, in this particular being vastly superior to the pure single-phase synchronous machine. But, it may be asked, how about this power wire? In case, for example, of a transmission over a considerable distance before the distributing point is reached, must the power wire be part of the transmission system? In answer, I need only call your attention to the fact that the essential point of the monocyclic system, so far as motors are concerned, is the establishing of an electromotive force bearing the same relation to the system as is borne by the teaser coil of the generator. Consequently, in case of a transmission plant, the main generators at the distant station may be simple single-phase machines, the subsidiary electromotive force being furnished by a synchronous motor or similar device at any point in the system. So we might readily have an extensive transmission with a monocyclic machine in the sub-station of such size as is necessary to furnish current for what motors may be upon the system. The power wire would then run only to the sub-station. Another interesting peculiarity of the monocyclic system, and one which is not without importance in case of an extensive power distribution, is the following:

Under ordinary circumstances, induction and synchronous motors are wound so that the counter electromotive force affects the system in a perfectly symmetrical manner, and the current flows over all the wires with some degree of symmetry in response to the demands of the motors on the system. It is customary, however, in the monocyclic system, to employ motors so wound as to throw a high counter electromotive force into the power wire when the motor is at speed and loaded, thereby reducing the normal current carried over the power wire to a purely nominal amount, and this can evidently be done without sacrificing much in the matter of starting, since at the start all the counter electromotive forces in the motors are zero. We have, then, a motor system of a type really peculiar to the monocyclic system, in that each motor will start under the same conditions of impressed electromotive force as if it were a polyphase motor, while, when at speed and loaded, it would be operating virtually as a single-phase machine. If, however, it were overloaded so that it would tend to slow down or stop, sufficient energy would flow over the power wire to bring it back to speed, just as if it were a polyphase machine. This is only one of various interesting ramifications in the system when developed to meet special conditions.

The connections shown in the diagram, however, are those of the most direct applicability and probably which would be most extensively used for central station service. At this point it may be appropriate to ask what is the advantage of such a system. It evidently secures exceedingly marked advantages in the ability to operate the lights on existing circuits or with the simplest possible kind of distribution, and at the same time to run at any point in the system synchronous motors or induction motors of well-tried and familiar types. The question can be readily answered; in fact, the question is almost obvious. The price which we have to pay for this advantage is the installation of the power wire, which necessarily adds something to the weight of copper in the system and to the trouble of installation. Under all ordinary circumstances the power wire need be of trivial cross-section compared to that of other wires, since, as a rule, the energy required for operating the motors from the given central station is small compared with the total capacity of the stations; and further, it is worth remarking that the monocyclic motors, either synchronous or induction, will run perfectly well if the power wire is disconnected after the power wire is at speed, operating them as single-phase machines. It is, of course, well known that the single-phase synchronous motor gives admirable results, and it is also true that a single-phase induction motor can be constructed of excellent efficiency and other electrical properties. The only material difficulty is to get the motor started with a good torque. The monocyclic connection enables this to be accomplished. After the motor is at speed the power wire becomes no longer necessary to successful operation, so that in spite of the necessary existence of the power wire it is easy to see that the additional amount of copper is not likely to be burdensome in central station operation. It would hardly ever be necessary to install a power wire of more than one-fourth the joint cross-section of the others, as given in the diagram, and generally a much smaller wire will suffice.

I have thus endeavored in a brief space to give a good working idea of the monocyclic method of combined light and power distribution which has been devised, and is urged upon the public as specially adapted for the work of *central station distribution* on account of its unique simplicity in practice. As to what has already been done in the installation of such apparatus, a considerable number of these monocyclic generators are in daily use in central stations, for the most part operating over circuits already established and displacing the higher frequency alternators which had been previously used. They are giving excellent results, and the operation of the motors, wherever employed, has been highly satisfactory.

MOONLIGHT SCHEDULE FOR MAY.

Day of Month.	Light.	Extinguish.	No. of Hours.
	H.M.	H.M.	H.M.
1......	....	A. M. 4.00	3.20
2......	A. M. 12.40	....	
3.	" 1.10	" 4.00	2.50
4......	" 1.30	" 4.00	2.30
5......	" 2.00	" 4.00	2.00
6......	No light.	No light.	....
7......	No light.	No light.	....
8	No light.	No light.	....
9......	P. M. 7.30	P. M. 9.30	2.00
10......	" 7.30	" 10.30	3.00
11......	" 7.30	" 11.30	4.00
12......	" 7.30	A. M. 1.00	5.30
13......	" 7.40	" 1.10	5.30
14......	" 7.40	" 1.40	6.00
15......	" 7.40	" 2.00	6.20
16......	" 7.40	" 2.20	6.40
17......	" 7.40	" 2.40	7.00
18......	" 7.40	" 3.00	7.20
19......	" 7.40	" 3.20	7.40
20	" 7.40	" 3.40	8.00
21......	" 7.40	" 3.40	8.00
22......	" 7.50	" 3.40	7.50
23......	" 7.50	" 3.40	7.50
24......	" 7.50	" 3.40	7.50
25	" 7.50	" 3.30	7.40
26.	" 9.00	" 3.30	6.30
27......	" 10.00	" 3.30	5.30
28......	" 10.40	" 3.30	4.50
29......	" 11.00	" 3.30	4.30
30......	" 11.10	" 3.30	4.20
31......	" 11.40	" 3.30	3.50
		Total,	148.20

EXPERIMENTS WITH SUPER-HEATED STEAM.

IN giving the results of their protracted experiments with saturated and super-heated steam, the Alsace Union of Boiler Owners say that, theoretically, it has never been denied that super-heated steam should give a higher efficiency than saturated, yet no experiments were undertaken with super-heated steam. Subsequently, however, after numerous trials, the oldest engine even was found capable of being safely used with super-heated steam, and not only without injury, but more economically than with saturated. It is also declared by the union that in installing a super-heater care is essential that the advantages gained are not lost either by less perfect combustion or by greater radiation losses—the cost of the super-heater not to exceed, of course, the saving obtained in coal consumption; the super-heater to be connected with the boiler, so that both can be fired from the same furnace; and after leaving the super-heater, the gases should come in contact with the heating surface of the boiler, and, lastly, with the heating surface of the economizer. Further, these experiments showed that the use of super-heated steam does not exclude the use of steam jacket. Though both super-heating and steam jackets were used, yet condensation in the high-pressure cylinder occurred. The use of low-pressure, seven and one-half atmospheres, did not give such good results as the use of high pressure, eleven and one-half atmospheres.

INSTRUCTIONS TO BOILER ATTENDANTS.

THE Manchester Steam Users Association of England, has issued a revised edition of its "Instruction to Boiler Attendants." In forwarding these instructions to its members, the Association says:

"These instructions have been drawn up with much care, it being desired to make them as complete and educational as possible. There are so many points affecting the safety and proper treatment of boilers, that it was found impossible to compress the instructions into a small space. In boiler and engine rooms, height of wall space is more generally available than width, and, therefore, the sheet was made long and narrow, rather than short and wide. If hung up so as to be about two feet from the floor, it can easily be read from top to bottom.

"It is desirable that the sheet should be mounted, and the best plan of doing this will perhaps be to have a board about ¾ in. thick built in three or four widths and stiffened by a batten at each end, the joints being grooved and tongued. On this board the sheet might then be pasted, and varnished for preservation. In most cases it might be well to have this done by a bookbinder.

"When mounted, the sheet should be placed in a good light, and where the boiler attendants can have convenient access to it. They should be encouraged to study and master its contents. Much of the information contained therein will be of service daily, and not merely on the occurrence of an emergency."

GETTING UP STEAM.—Warm the boiler gradually. Do not get up steam from cold water in less than six hours. If possible, light the fires over night.

Nothing turns a new boiler into an old one sooner than getting up steam too quickly. It hogs the furnace tubes, leads to grooving, strains the end plates, and sometimes rips the ring seams of rivets at the bottom of the shell. It is a good plan to blow steam into the cold water at the bottom of the boiler, or to open the blow-out tap, and draw the hot water down from the top.

FIRING.—Fire regularly. After firing, open the ventilating grid in the door for a minute or so. Keep the bars covered right up to the bridge. Keep as thick a fire as quantity of coal will allow. Do not rouse the fire with a rake. Should the coal cake together, run a slicer in on top of the bars and gently break up the burning mass.

Repeated trials have shown that under ordinarily fair conditions, no smoke need be made with careful hand firing. Alternate side firing is very simple and very efficacious.

CLEANING FIRES AND SLAKING ASHES. Clean the fires as often as the clinkers render it necessary. Clean one side at a time, so as not to make smoke. Do not slake the clinkers and ashes on the flooring plates in front of the boiler, but draw them directly into an iron barrow and wheel them away.

Slaking ashes on the flooring plates corrodes the front of the boiler at the flat end-plate, and also at the bottom of the shell where resting on front cross wall.

FEED-WATER SUPPLY.—Set the feed valve so as to give a constant supply, and keep the water up to the height indicated by the water-level pointer.

There is no economy in keeping a great depth of water over the furnace crowns, while the steam space is reduced thereby, and thus the boiler rendered more liable to prime. Nor is there any economy in keeping a very little water over the furnace crowns, while the furnaces are rendered thereby more liable to be laid bare.

GLASS WATER GAUGES AND FLOATS.—Blow through the test tap at the bottom of the gauge hourly, as well as through the trap in the bottom neck, and the trap in the top neck twice daily. These taps should be blown through more frequently when the water is sedimentary, and whenever the movement of the water in the glass is at all sluggish. Should either of the thoroughfares become choked, clean them out with a wire. Work the floats up and down by hand three or four times a day to see that they are quite free. Always test the glass water gauges and the floats thoroughly the first thing in the morning before firing up, and at the commencement of every shift.

It does not follow that there is plenty of water in the boiler because there is plenty of water in the gauge glass. The passages may be choked. Also, empty gauge glasses are sometimes mistaken for full ones, and explosions have resulted therefrom. Hence the importance of blowing through the test taps frequently.

BLOW-OUT TAPS AND SCUM TAPS.—Open the blow-out taps in the morning before the engine is started, and at dinner-time when the engine is at rest. Open the scum tap when the engine is running, before breakfast, before dinner, and after dinner. If the water is sedimentary, run down ½ in. of water at each blowing. If not sedimentary, merely turn the taps round. See that the water is at the height indicated by the water-level pointer at the time of opening the scum tap. Do not neglect blowing out for a single day, even though anti-incrustation compositions are put into the boiler.

Water should be blown from the bottom of the boiler when steam is not being drawn off, so that the water may be at rest and the sediment have an opportunity of settling. Water should be blown from the surface when steam is being drawn off, so that the water may be in ebullition and the scum floating on the top. If the water be below the pointer, the scum tap will blow steam; if above the pointer, the scummer will miss the scum.

SAFETY VALVES.—Lift each safety valve by hand in the morning before setting to work, to see that it is free. If there is a low-water safety valve, test it occasionally by lowering the water level to see that the valve begins to blow at the right point. When the boiler is laid off, examine the float and levers and see that they are free, and that they give the valve the full rise.

If the safety valves are allowed to go to sleep, they may get set fast.

OPENING DRAIN TAPS AND STEAM PIPES.—If the boiler is one of a range, and the branch steam pipe between the junction valve and the main steam pipe is so constructed as to allow water to lodge therein, open the drain tap immediately the boiler is laid off, and keep it open until the boiler is set to work again. If the main steam pipe is so constructed as to allow water to lodge therein, open the drain tap immediately the engine is shut down, and keep it open till the engine is set to work again.

If the water is allowed to lodge in the pipes, it is impossible to blow it out under steam pressure without danger. Attempting to do this frequently sets up a water-hammer action within the pipes, and from this cause several explosions have occurred. The only safe plan is not to let the lodgment occur, or to shut off the steam before opening the drain taps.

SHORTNESS OF WATER.—If the boiler is found to be short of water throw open the fire doors, lower the dampers, ease the safety valves, and set the engine going, if at rest, so as to reduce the pressure. If the boiler is one of a series, shut down the junction valve. If there is reason to conclude that the water has not sunk below the level of the furnace crowns, and they show no signs of distress, turn on the feed and either draw the fires quickly, beginning at the front, or smother them with ashes or anything ready to hand. If there is reason to conclude that the water has sunk below the level of the furnace crowns, withdraw, and leave the safety valves blowing. Warn the passers by from the front.

EASING THE SAFETY VALVES.—If either the construction of the boiler or the character of the feed water is such as to render the boiler liable to prime, the safety valve should be eased gently.

TURNING ON THE FEED.—From experiments the association has conducted, it appears that this is the best thing to do in nearly every case, especially where the feed is introduced behind the firebridge, as it would tend to restore the water level, and at the same time to cool and reinvigorate the furnace plates. While, however, the experiments showed that showering cold water onto red-hot furnace crowns would not, as has been generally supposed, lead to a sudden and violent generation of steam which the safety valves could not control and the shell could not resist, it is thought that if the furnace crowns were very hot and just on the point of giving away, the generation of a few additional pounds of steam might turn the scale and lead to a collapse. Thus it might be wise to turn on on the feed in some cases and not in others, according to the extent to which the furnaces were overheated, and this it is difficult to ascertain. Under these circumstances a hard and fast rule, applicable to all cases, cannot be laid down, and therefore, having regard to the safety of the fireman, the advice to turn on the feed, as a general rule is confined to those cases where the water has not sunk below the level of the furnace ground.

DRAWING THE FIRES.—This ought not to be attempted if the furnace crowns have begun to bulge out of shape.

It is an extremely responsible task to give any recommendation with regard to the treatment of a boiler when short of water and working under steam pressure, that shall be applicable to every case under every variety of circumstance. A boiler attendant has no right to neglect his water supply and allow it to run short; nor has he a right to charge the fires without making sure that the furnace crowns are covered. Should he neglect these simple precautions it is impossible to put matters right without some risk being run. A boiler with hot fires and with furnace crowns short of water is a dangerous instrument to deal with, and the attendant who has done the wrong must bear the risk. The best advice the association can give the boiler attendants on this subject is, do not let shortness of water occur. Keep a sharp look-out on the water-gauge.

USE OF ANTI-INCRUSTATION COMPOSITIONS.—Do not use any of these without the consent of the association. If used, never introduce them in heavy charges at the manhole or safety valve, but in small daily quantities along with the feed-water.

Many furnace crowns have been overheated and bulged out of shape through the use of anti-incrustation compositions, and in some cases explosions have resulted.

EMPTYING THE BOILER.—Do not empty the boiler under steam pressure, but cool it down with the water in; then open the blow-out tap and let the water pour out. To quicken the cooling the damper may be left open, and the steam blown off through the safety valves. Do not, on any account, dash cold water on the hot plates. But in case of an emergency pour cold water in before the hot water is let out, and mix the two together so as to cool the boiler down generally, and not locally.

If a boiler is blown-off under steam pressure the plates and brickwork are left hot. The hot plates harden the scale, and the hot brickwork hurts the boiler. Cold water dashed on to hot plates will cause severe straining by local contraction, sometimes sufficient to fracture the seams.

CLEANING OUT THE BOILER.—Clean out the boiler at least every two months, and oftener if the water is sedimentary. Remove all the scale and sediment as well as the flue dust and soot. Show the scale and sediment to the manager. Pass through the flues, and see not only that all the soot and flue dust has been removed, but that the plates have been well brushed. Also see whether the flues are damp or dry, and if damp find out the cause. Further, see through the thoroughfares in the glass water gauges and in the blow out elbow pipe, as well as the thoroughfares and the perforations in the internal feed dispersion pipe and the scum pipe are free. Take the feed pipe and scum troughs out of the boiler if necessary to clean them thoroughly. Take the taps, if not asbestos packed, and the feed valve to pieces, examine, clean and grease them, and, if necessary, grind them in with a little sand. Examine the fusible plugs.

All taps, whether asbestos packed, or metal to metal, should be followed in working, especially when new. The gland should be screwed down as found necessary so as to keep the plug down to its work, otherwise, it may rise, let the water pass, and become scored.

PREPARATION FOR ENTIRE EXAMINATION.—Cool the boiler and carefully clean it out as explained above, and also dry it well internally. When the inspector comes, show him both scale and sediment as well as the old cap of the fusible plug, and tell him of any defects that manifested themselves in working, and of any repairs or alterations that have been made since the last examination.

Unless a boiler is suitably prepared, a satisfactory entire examination cannot be made. Inspectors are sent at considerable expense to make entire examinations, and it is a great disappointment when their visits are wasted for want of preparation.

PRECAUTIONS AS TO ENTERING BOILER.—Before getting inside the boiler, if it is one of a series, take off the junction valve handwheel, and if the blow-out tap is connected to a common waste pipe, make sure that the tap is shut and the key in safe keeping.

From the neglect of these precautions, men working inside boilers have been fatally scalded.

FUSIBLE PLUGS.—Keep these free from soot on the fire side and from incrustation on the water side. Change the fusible metal once every year, at the time of preparing for the association annual entire examination.

If fusible plugs are allowed to become incrusted, or if the metal be worked too long, they become useless, and many furnace crowns have been rent from shortness of water, even though fitted with fusible plugs.

GENERAL KEEPING OF BOILER.—Polish up the brass and other bright work in the fittings. Sweep up the flooring plate frequently. Keep ashes and water out of the hearth pit below the flooring plates. Keep the space on the top of the boiler free, and brush it down once or twice a week. Take a pleasure in keeping the boiler and the boiler house clean and bright, and in preventing smoke.—The Safety Valve.

CANADIAN ASSOCIATION OF STATIONARY ENGINEERS.

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

HAMILTON ASSOCIATION NO. 2.

The annual dinner of the above Association was held at the Commercial Hotel on the evening of April 18th. There was a good attendance of members and visitors—about seventy in all. As usual, Mr. Maxey, the proprietor of the Commercial, distinguished himself by the manner in which the dinner was prepared and served. On the removal of the cloth the President, Bro. Joseph Langton, took the chair, and addressed a few well-chosen remarks of welcome to the visitors, after which the toast list was proceeded with, the first toast being that of "Her Majesty the Queen."

The toasts to "The Governor-General" and "The Dominion and Local Legislatures" were responded to by Mr. Alex. McKay, M. P.; "The Army and Navy," by a song—"Rule Britannia," by Prof. Cline, and a trio by Messrs. Maxey, Cline and Leroy Mallard; Alderman McKennan responded to the toast "The Mayor and Corporation"; "The Executive Head" was responded to by Bros. Edkins, Wickens and Blackgrove, of Toronto; Mr. Watson of Kingston, Bros. Clapperson, Holden and Brice, of Hamilton, responded to the toast "Our Manufacturers"; "Our Sister Associations" brought responses from Bros. Phillips and Huggett, of Toronto; Bro. Pettigrew, of the Board of Education of Hamilton, responded on behalf of "The Learned Professions"; The President, Bro. Joseph Langton, and the Corresponding Secretary, Bro. Wm. Norris, replied in a suitable manner to the toast "Hamilton No. 2," proposed by Bro. A. E. Edkins, of Toronto: Bros. Robertson and Stott, of Hamilton, responded for "The Ladies," and Mr. Mattie of the Toronto Globe, and Mr. R. J. Robb of the Hamilton Spectator, for "The Press."

The proceedings of the evening were enlivened by songs from Prof. Cline, Messrs. Martin, Maxey, Leroy Mallard, Thomas and Edkins.

Letters of regret were read as follows:—From S. S. Wrightman, M. P., J. T. Middleton, M. P. P., Hon. J. M. Gibson, and Mayor Stewart, of Hamilton; the Ottawa, Montreal and Kingston Associations, C. A. S. E., and the editor of the ELECTRICAL NEWS. The evening throughout was a most enjoyable one.

The members of this Association express their disappointment at the fate of the Engineers' Bill before the Ontario Legislature at its last session. They think it peculiar that a matter of so much importance should have been so lightly dealt with, and are in hopes that the leaders in the movement for legislation will carefully consider the most effective manner in which to bring the bill again before the Government.

The Berlin Gas Co. have closed a contract with the Canadian General Electric Co for a 65 Kilowatt generator from which they will furnish power for the Berlin and Waterloo railway.

The Town Council of Listowel, Ont., has invited tenders for lighting the town with 14 arc lights of 1,500 to 2,000 candle power. The plant is required to be in operation by the first of July.

Mr. F. S. Mead, of Quebec, has recently been granted a United States patent for a gas engine; Mr. G. E. Smith, of Ridgetown, for a machine for bending rails, and Mr. C. H. Waterous, Brantford, Ont., for a steam boiler.

WATER WHEELS--A QUESTION OF EFFICIENCY.

It was but a few years since when the old testing flume at Holyoke, Mass., was in charge of Mr. James Emerson that the manufacturer of turbine wheels who could not boast of a reliable (?) test that showed in useful effect a percentage of the power of the water from 80 to 85 per cent. was considered decidedly behind the times, and while it is a fact that some of those same wheels that gave such remarkable results at the testing flume when put into actual use in the mills under ordinary working conditions, proved to be less effective than many others which made no such claims, and had no other test than that of actual use. The writer was frequently scouted at by certain parties ten years ago when he asserted that, notwithstanding all the scientific tests that had been made, and the flaming circulars that had been issued by prominent water-wheel makers, that in every-day practice and under ordinary conditions where one wheel could be found that would yield 80 per cent. in useful effect ten would be found that would yield less than that amount. Now it transpires from the statements of Mr. J. McCormick, who has heretofore been considered by a certain class of hydraulic engineers as the "king of water-wheel designers" that the writer was correct. In a recent article by that gentleman with reference to the "Hercules," which had been by many considered the perfection of turbines, and has claimed a power of from 85 to 90 per cent., he says; "In the present testing flume with Mr. Emerson's apparatus those same wheels that had for several years been upon the market and guaranteed to yield from eighty-five to ninety per cent. in useful effect *required material alterations to bring them up to an efficiency of 85 per cent.*"; from which we may reasonably infer that those wheels which were rated at from eighty-five to ninety per cent. were in reality nearer from seventy-five to eighty. Again Mr. McCormick further says: "Wheels made from the same pattern which had produced from eighty-eight to ninety per cent. in the old flume (under the Emerson administration of course) would only yield a little over eighty per cent. in the new one" (under the charge of Mr. Hershel). In consequence he says "he was compelled to change the *vital patterns* of the Hercules wheels of all sizes, both right and left hand, after which they were tested and brought up to efficiency of *eighty-eight per cent. or better*." Now if it required those changes in order to bring the wheel up to eighty per cent. or a trifle better (he does not say how much better) the reader is at liberty to form his own opinion as to the efficiency of those wheels before those *vital parts* were changed. Now while all will admit that Mr. McCormick, one of the most experienced water-wheel designers in the country, has probably devoted more time and study to this subject than any other man, and while we do not for a moment question either his honesty or integrity, yet one thing is self-evident that the former tests made with the same instruments by Mr. Emerson, whether intentionally or not, certainly deceived him as well as the public, and we cannot but admire his honesty in coming out and practically admitting such to be the case; and further that either much of the former testing or the latter is a humbug. This only confirms what has often been stated that there is but little confidence to be placed in those tests, no matter how honestly they may be conducted, unless the identical wheel that has been subjected to the test is obtained, for the miller has no assurance that the next wheel of the same size will give the same efficiency. To those who have examined some of the wheels that have been fitted up for that purpose, it is unnecessary to say that they are fitted up with the utmost care and perfection. Everything is as perfect as mechanical skill can render it and the surface of the buckets are scraped smooth, and in some cases polished, and it is strange if such wheels do not give better results than the common every-day wheel where much less labor and care is bestowed. The fact is with the present condition between the different manufacturers and the low price that wheels are being sold, if the same labor were expended upon every wheel that is expended upon some of the test ones, the price would not cover the cost of production.

There is no doubt but all water-wheel makers endeavor to obtain as smooth castings as possible and fit up their wheels as well as prices will admit, but no extra work is found in the average wheel. Now when we consider that the efficiency of a wheel depends much upon the resistance offered to the water in passing through the buckets, it is evident that with those which are perfectly smooth the efficiency will be greater than those which are not. That many of the millers have but little confidence in those tests is well illustrated in the reply of an old miller to an agent of a certain wheel who was boasting of the high percentage of power that there wheel had shown at Holyoke testing flume. "Young man," said he, "I want a good wheel and one that will do the work. I don't care a —— for all your tests; if you want to put a wheel in my mill and hitch it on to my mill-stones, and if it will grind on an average of — bushels of corn per hour, I will keep it and pay for it; it not you will take it out at your own expense."

Another question upon which there is an honest difference of opinion, is the economy in wheels of small diameter and high speed, over those of larger diameter and less speed, both using the same quantity of water. There is no question but within a few years the tendency of all water-wheel makers has been toward wheels of small diameter with large openings, and that many of the present style of wheels of from eighteen to twenty inches in diameter use the same quantity of water that was formerly used by wheels of from twenty-five to thirty, while the speed is increased in proportion to the diameter, and all that has been said upon the subject of small turbines, not one *good argument* has been offered in their favor. It is true that it costs less to make a small wheel both in stock and labor, and by enlarging the openings so that the same quantity of water may pass through it, and figuring the power from the quantity of water *discharged, may enable the manufacturer to realize a greater* profit, and this may be one of the reasons, but if so, it is no argument in its favor in an economical point. The high speed is one of the objections to small wheels. If a turbine wheel was like a steam engine and could be placed in a shop where it could be looked after every day and kept in perfect order, the case would be different. An engine to run one hundred and fifty *revolutions per minute, must needs have an engineer to look* after it, and must be oiled and wiped at least once a day in order to keep it up and in good working order, while the poor little water-wheel is buried in some out-of-the-way place in a flume or penstock where it is practically inaccessible except when the mill is stopped and the water drawn off (which is not very often) and there left to its fate to run anywhere from three to eight *hundred revolutions per minute without oil and comparatively* no care, with mud, sand, stones, and other rubbish to contend with, and is expected to perform its daily work day after day and week after week without a murmur, and the only wonder is, that they last one-half as long as they do; and the faster they run the sooner they wear out. Now this, if nothing else, furnishes one good argument in favor of wheels of larger diameter and there is no question but a wheel thirty inches in diameter with a capacity for using the same amount of water as one of fifteen and run at one-half the speed, would be as efficient, if not more so, and much more durable. The thirty-inch wheel would cost a few dollars more probably in the first instance, but as the cost of the wheel is but a small item in the outfit when durability is taken into consideration, there is no question but the larger would be the cheapest in the end. There are other points in favor of large wheels with small openings which may be discussed in a future article.—C. R. Tompkins, M. E., in Milling.

NOISE FROM A GAS ENGINE.

Among the various engineering investigations which for some time have engaged the attention of mechanical experts is that having in view some ready method for deadening the objectionable noise made by the puffs from the exhaust of the gas engine, but only an indifferent amount of success has hitherto attended these efforts. The most recent contrivance of the kind is a device described in a French journal, and claimed to be simple, efficient and inexpensive. Briefly, a pipe split for a distance of about two metres is attached to the end of the exhaust, with the split end upward, and beginning at the lower end of the cut, which may best be made by a saw, dividing the pipe into two halves, the slotted opening is widened out toward the top until it has a width equal in extent to the diameter of the pipe. Under this arrangement the puff of the exhaust spreads out like a fan, and the discharge into the open air takes place gradually, the effect produced depending somewhat on the flare of the tube.

ELECTRIC RAILWAY DEPARTMENT.

UNDERGROUND RAILWAY SYSTEM AT WASHINGTON.

THE Metropolitan Street Railway Company, of Washington, D. C., who a few years ago are said to have dropped $360,000 on experiments for the propulsion of street cars by storage batteries, are now turning their attention to a metallic subway system, substantially on the lines of the Buda Pesth road. By a recent Act of Congress the company are compelled to adopt some underground system on their Ninth street line, and to have the same in operation by August next. The method of construction employed is thus described by a correspondent of the New York Electrical Review:—

"The line now under construction extends from the Potomac River to the northern boundary of the city, and is a double track road four miles long. It has about a dozen modern curves, and its maximum grade is three per cent. It intersects the busiest section of the city and crosses three cable lines.

The construction is, in the main, identical with that of the ordinary cable lines. The conduit, however, is only 24 inches deep, while most of the cable conduits are 39 inches. The track is laid with 83-pound steel rails, seven inches deep. The electric conductors consist of angle irons in 27-foot lengths, weighing 23½ pounds per yard, with a conductivity equal to 400,000 circular mils copper. They will be hung from porcelain insulators, four inches in diameter, placed 13½ feet apart. These insulators and their iron castings are set in place from the surface of the street and can be readily and separately removed and replaced. The conductor irons will be slipped into the conduit through narrow pockets in the slot-rail 500 feet apart, and snaked along to their places. They will be fitted with expansion joints and flexible copper bonds. Any section can be removed without disturbing anything else. In designing the road quite a number of new features have been devised by Engineer Connett and patented by the company. Provision has been made for easily substituting a cable should it for any reason ever be found desirable. Ample drainage for the conduit will be provided.

A 10-way terra cotta conduit of the Lake pattern will be laid along the track to carry the necessary feeder cables. Wire made by the General Electric Company will be used, and 35,000 feet of 1,000,000 circular mils will be required. It will have a covering of five-thirty-seconds india rubber and one-eighth lead with an insulation resistance of 750 megohms per mile. The manufacturers guarantee it to last five years.

SUGGESTIONS FOR REDUCING ACCIDENTS IN BROOKLYN.

The Advisory Committee appointed by Mayor Schieren, of Brooklyn, prior to the strike, to investigate the trolley system, as operated in Brooklyn, especially regarding the speed, made its report last month. The committee consists of Peter T. Austen, John Giff, Ditmar Jewell, William H. Nichols and R. S. Walker. The report is as follows:

In compliance with the request contained in your esteemed communication of December 29, 1894, in which you asked the undersigned to act as an advisory committee to investigate "the question of speed of the trolley cars, and a fender, or system of fenders, for them, and in general, the proper regulation of the trolley systems of this city," your committee has held a number of meetings, at which there have been present the officials of all the trolley roads, as well as representative motormen and conductors, and an opportunity has also been given the public to be heard.

After careful consideration of the information thus gained, together with considerable personal investigation of the practical details of the trolley system, we beg to submit the following recommendations for the regulation of the trolley system, which we believe will afford the best service to the public at the least risk to life:

1. The speed of trolley cars should not exceed ten miles an hour.

2. Every car should be provided with a device giving an audible signal when the car exceeds ten miles an hour.

3. Passengers should not be allowed to ride on the front platforms, and both gates of the front platforms should be kept closed when the cars are in motion.

4. The gates on the track side of the rear platforms should be kept closed.

5. Cars on all lines crossing main thoroughfares on which there are car tracks should come to a full stop before crossing. Cars on main thoroughfares must be kept under perfect control and run at a reduced speed at such crossings.

6. All cars should be provided with reliable fenders which should be approved of by a commissioner of experts.

7. In case of an accident through the negligence of a motorman, the motorman should be held criminally responsible therefor.

8. It being the opinion of this committee that accidents have occurred which have been due to the use of intoxicants by employes, we earnestly recommend that the companies provide at their respective depots comfortable waiting rooms *for the men*, where tea and coffee may be obtained at reasonable cost.

9. The tracks should be kept sufficiently sanded where needed.

10. As cars are often wilfully and unnecessarily obstructed by traffic wagons, we advise that the law that makes it a misdemeanor wilfully to obstruct, hinder or delay the passage of any car running on a street railway be rigidly enforced.

11. We consider that the present overcrowding of the cars is indecent and a fruitful source of inconvenience, delay, and danger, and we therefore strongly recommend that the number of passengers carried on any car should not exceed its seating capacity by more than 50 per cent. We are aware that the enforcement of this rule will necessitate an increase in the number of cars, but we consider that the public is entitled to proper and decent accommodation.

Mayor Schieren, it is said, will take action on the report at once. It is believed the Board of Aldermen will be called upon to adopt an ordinance in conformity with the recommendations made by the Advisory Committee.

AN OLD ELECTRIC RAILWAY PATENT.

ON February 24, 1881—that is to say, 14 years ago Profs. Ayrton and Perry took out their well-known patent, No. 783, for "improvements in electrical conductors applicable to electric railways and to electric signalling, and in apparatus connected therewith." The invention, it is stated, was "designed for the better and more convenient insulation of the electrical conductor for the transmission of power in electric railways, and for furnishing an automatic block system without the use of signalmen, and, further, by that method of insulation to give an easy and simple indication of the position of a train or carriage at any point of its travel." The inventors state that neither the third rail nor overhead conductor have been found to be satisfactory, and that their idea is to bring a sectional insulated conductor into temporary contact at stated intervals with a thoroughly well insulated conductor. The method by which this required contact was insured was by making use of the pressure of a contact brush on the car, or of the actual wheels to depress a stud on to the end of the insulated cable; the connection once made continued so long as the car remained on the section, and was broken electro-magnetically in the case of long sections as the car quitted the section. This device lent itself to the registration of the stud-depressing car, and to an automatic block being placed upon the following car if it tried to enter a section upon which there was already a car. The specification was a very lengthy one, and contained five claims—for the division of an *elastic* conductor rail into short insulated sections, the use of contact boxes of the kind described, the automatic and graphic method of showing the position of a car, the division of the conductor rail into comparatively long insulated sections, with automatic devices for disconnecting the conductor rails as the car or train left the section, the absolute block system.—The Electrician.

SPARKS.

It is said to be probable that the Toronto Junction electric railway will be extended to Islington.

An electric street railway for Amherst, N. S., is said to be among the possibilities of the present year.

Incorporation has been granted to the Hamilton Storage Battery Co., with a capital stock of $10,000.

The construction of lines of electric railway from Gananoque to Mallorytown and Lynn, Ont., is talked of.

It is proposed to construct immediately and have in operation by August, eight miles of street railway in Halifax.

The name of the Galt & Preston Street Railway Co. has been changed to the "Preston & Hespeler Street Railway Co."

Application has been made by the Selkirk Electric Co. for authority to increase their capital stock from $10,000 to $25,000.

The general meeting of the American Institute of Electrical Engineers is to be held at Niagara Falls commencing Tuesday, June 18th.

The president of the Waterdown, N. Y., Electric Railway is said to be one of the promoters of the Kingston and Gananoque Railway Co.

The Board of Trade of Kincardine have under consideration the question of the construction of an electric railway from Kincardine to Teeswater.

Mr. Sleeman, the principal promoter of the proposed Guelph Electric Ry., has purchased an acre of land on Gordon, Surrey and Wellington streets, on which to erect a power station.

Mr. J. M. Turner, of Detroit, late superintendent of construction of the Windsor Electric Railway, is said to be preparing plans for the proposed Windsor, Amherstburgh and Lake Erie Railway.

The Vankleek Hill Electric Light Co. is reported to have gone out of business. The plant is said to have been purchased by Col. Wm. Higginson, who will continue, and endeavor to extend the business.

It is said to be the intention of the Montreal Park and Island Railway Company to in future use in winter snow-plows made of a number of rotating scoops, followed by a rotating broom—a device which is said to give excellent results where heavy snow-drifts are to be encountered.

Mr. J. R. Roy, Chief Engineer of the Montreal Park and Island railway, is at present engaged in making a survey of the proposed extension of the company's lines from Mile End to St. Laurent and Cartierville, a distance of over seven miles. It is the intention to construct this extension during the present summer.

The Huntsville and Lake of Bays Transportation Co. propose to establish an electric railway on the Portage between Lake of Bays and Peninsula Lake, Muskoka, and to manufacture and distribute electricity for light, heat and power. The capital stock of the company is $25,000.

An incandescent lighting plant is being installed at St. Stephen, N. B.

The plant of the Brussels, Ont., Electric Light Co., is being offered for sale.

The promoters of the Peterboro' and Chemong Park railway Co. are J. Hendry, Thos. Catrill, G. W. Halton, Robt. Fair and T. A. S. Hay. The capital stock of the company is $100,000.

The Quebec Street Railway Co. are asking from the Council the privilege of substituting for the trolley system the electric storage battery system, provided permission is granted them to run through Dalhousie and St. Andrew streets.

Mr Geo. H. Campbell, manager of the Winnipeg Street Railway Company, has recently visited the eastern provinces and Minneapolis for the purpose of securing information with a view to making improvements in the Winnipeg system.

For the first six months of its operation, the Hamilton, Grimsby and Beamsville Electric Railway carried 69,851 passengers and a large amount of freight. The company is said to be making arrangements to establish a free fruit market at Hamilton.

The Nanaimo Electric Light, Heating and Power Co., Ltd., has been incorporated, to carry on a general electric business at Nanaimo, B. C. The incorporators are: Thos. J. Jones, Jos. Hunter and Albert Lindsay. The capital stock is $100,000, 5,000 shares of $20 each.

The city of Victoria, B. C., proposes to appoint a city electrician at a salary of $125 per month, to give his whole time to the service of the corporation. Mr. R. B McMicking, who has been acting for the city, is unable to give his whole attention to the duties of the position.

The Grand Trunk Railway have awarded the contract for the electrical apparatus required for the new depot to the Canadian General Electric Co. The plant, which will be of the very latest type, includes two fifty Kilowatt direct-connected multipolar generators and a most complete equipment of station apparatus.

Capt. Carter, the promoter of the Oshawa Electric Railway, has arranged with Messrs. Ahearn & Soper, of Ottawa, to construct and equip the road. Construction will begin almost immediately. Arrangements have been made with Mr. E. S. Edmonson, of the Electric Light Co., to supply the necessary power, for which purpose a special dynamo will be installed.

The amalgamation of the St. John Gas Co. and Street Railway Co., foreshadowed in a recent number of the ELECTRICAL NEWS, has been consummated. The basis of amalgamation as to capital stock is as follows: Street Railway Co., $600,000; Gas Co., $400,000. Each company keeps its own book debts and is paid for its supplies by the new company; which in the case of the Gas Company equals $33,000 in addition to the $400,000. A proviso was adopted, however, to the effect that of the nine directors of the new company four shall be shareholders of the present gas company. The new order of things went into effect on May 1st.

The Milton Electric Light and Power Co., Ltd., Milton, Ont., have closed a contract with the Canadian General Electric Co. for a 500 light alternating plant.

The T. Eaton Co. are adding a 1,000 light direct connected generator to their electric plant and have closed a contract with the Canadian General Electric Co. for the complete equipment.

The Toronto Ferry Co. are making extensive additions to their electric plant. They are installing Wood arc apparatus of 125 light capacity, manufactured by the Canadian General Electric Co., and the Goldie and McCulloch Co. engines.

The London Street Railway Co., which was recently granted a charter for the construction of a line to Springbank, is having the route surveyed and will push on the construction of the road as rapidly as possible. The solicitors of the railway company and of the city are having frequent conferences with regard to the street railway by-law. It is said that the matters in dispute are being adjusted, and the question will shortly be in shape to be again submitted to the Council.

TRADE NOTES.

Mr. R. E. T. Pringle, of Montreal, has arranged with J. W. Gibbony, of Lynn, Mass., to act as sole agent for the Gibbony & Thompson Alternating Telephone System.

The Robb Engineering Co. are getting out a new line of engines to meet the demand in some quarters for slow speed automatic machines, on which their governor will be used.

A new partnership has been formed between V. Thomas W. Ness Norman, W. McLaren and Charles Bate, under the name of T. W. Ness & Co., to manufacture and deal in electrical supplies at Montreal.

Application is being made for incorporation by the J. C. McLaren Belting Co., of Montreal. The applicants are. David W. McLaren, Mrs. A. Cummins Walker, Alexander Walker, B. S. Sharing, Joseph Ryan and G. W. McDougall, all of Montreal.

The Canadian General Electric Co. have been awarded the contract by the Galt & Preston Railway Company for the equipment of their extension to Hespeler. The contract covers a 100 Kilowatt generator, two passenger cars and one freight car, together with the necessary overhead construction.

We regret to announce the assignment of Messrs. J. Ross, Son & Co., manufacturers of wire for electrical purposes, at Montreal. The liabilities of the company are placed at $13,000 We trust that a satisfactory arrangement can be made with the creditors so that the business of the company may be continued.

Messrs. John Starr, Son & Co., of Halifax, N. S., advise us that they are meeting with excellent success with their "Unique" Telephones. They are said to be giving universal satisfaction wherever used, and a large number have been put out both in Canada and the United States. As an evidence of their superiority, the Imperial War Department at Halifax have adopted them after thorough competitive tests and are now equipping their forts with the Messrs. Starr's standard instruments.

The Packard Electric Co., Limited, of Montreal, announce that owing to increased business they have found it necessary to seek larger manufacturing premises. These have been found at St. Catharines, Ont., to which city the company have removed their business, and where all future correspondence should be addressed to them. They expect to have their new factory thoroughly equipped and in operation in a short time. In the meantime, they are prepared to fill all orders promptly from stock.

The Berlin and Waterloo street railway is being converted from horses to electricity. The Canadian General Electric Co. have the contract for the necessary equipment.