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CONTENTS OF THIS NUMBER:

CANADIAN WATER POWER AND ITS ELECTRICAL PRODUCT IN RELATION TO THE UNDEVELOPED RESOURCES OF THE DOMINION.*

Canada with a small population and insufficient capital has nevertheless held a foremost position in the products of the forests and the fisheries, as well as in the quality of those cereals and fruits which attain their highest development in a northern latitude. In live stock she has not suffered by comparison with any other portion of this continent, while in dairy products she is pre-eminent. If she has not, until recently, made much progress in mineral development, it has been more from want of money than of mines. If she has been long in attaining a position as a manufacturing country, it is accounted for by the fiscal and financial conditions of a sparsely-settled country, the smallness of a home market, and the competition of greater capital and out-put, and therefore cheaper production elsewhere. Amongst the many partially developed resources of Canada, perhaps there is none more widespread or more far reaching in future results than her unsurpassed water power. The value of this has been enormously enhanced, first by the expansion of the wood pulp manufacture, and the introduction of electro-chemical and metallurgical industries for which this country possesses the raw material; and, more recently, by the revolution which has been brought about by success in transmitting the energy of water falls from remote and inconvenient positions to those where the work is to be done. Electrical transmission brings the power to the work, and when the prime mover is water, we have the cheapest power, and perhaps nearest approach to perpetual motion which it is possible to obtain—one which is always "on tap," and, like gravity, maintained without cost and applied without delay.

An examination of any good map of our broad Dominion reveals, as its most striking feature, an extraordinary wealth and remarkably uninterrupted succession of lakes and rivers, suggestive of ample rainfall, the first great requisite in the occupation of any country. This feature would be still more impressive if all the waters could be shown on the map. Over large areas only the more important rivers have been explored and delineated; while in the surveyed districts many are necessarily omitted to leave room for other information to be given. These rivers and lakes have been the most important factors in the settlement of the country, as they formed the earliest lines of approach for the penetration and exploration of the interior, and for the exploitation of our forests. The lumberman followed the trapper and the fur trader, the axe supplanted the rifle, and thus the country was opened up by men who knew not only where to begin, but, by their calling, were best equipped as pioneers. The frontier, where not already occupied by the French, was necessarily rapidly settled in the first place by the Loyalists of 1776, who could not stand upon the order of their departure after their homes were confiscated. These found the rivers their earliest friends, from whence they obtained the means of shelter and of employment in the only industry by which money could then be obtained, viz., the floating of timber and potash to Montreal and Quebec.

Over a length of several thousand miles between Labrador and Alaska and over a width of several hundred miles, there is an almost continuous distribution of lakes, lakelets and rivers—the lakes of varied outlines, dimensions and elevations above sea level, and many possessing facilities for the storage of their flood waters. This power of storage has been largely taken advantage of by lumbermen to retain the needed supply for their spring "drive," into the main stream. In many places the outlet from the lake, or the connection between a chain of lakes, is a narrow cleft in rock where an inexpensive dam will hold back the water supplied by the winter's accumulation of snow. With the exception of her prairie region, the rivers of Canada differ from the Mississippi, Missouri, and Ohio, and the larger part of their tributaries, in that they are not naturally navigable from their mouths, or above

*Presidential Address read before the Society, May 23rd, 1899, by Thos. C. Keefer, C.M.G., President of the Royal Society of Canada.

tidal influence to any considerable extent, except in detached sections; while the former are navigable for thousands of miles and are therefore without water power. Those great western rivers flow upon a nearly uniform grade of a few inches per mile, whilst the St. Lawrence and its tributaries are interrupted by rapids, chutes and cataracts, affording a great variety, quantity and quality of water power.

In the United States, between the Atlantic coast and the Rocky Mountains, as far south as the Gulf of Mexico and as far north as the Dakotas (with the exception of part of New York and New England), there is an entire absence of lakes; while throughout Canada, north of the St. Lawrence and stretching north-west toward the Mackenzie river basin, these are innumerable, in fact have never been numbered, and thousands of the smaller ones have never been represented on any map. The upper sections or sources of most of the Canadian rivers are chains of lakes, occupying in many instances the greater portion of the water course. These head waters are often upon nearly the same elevation and interlocked with the sources of other rivers flowing in opposite or different directions, and separated by narrow necks of land at a low divide, rendering diversion from one to another possible, a feature which has in some places been utilized by lumbermen—fearless of any legal injunction. This terrace-like profile of the rivers and their frequent expansion into lakes, often dotted with islands, not only enhances the beauty of the scenery, but, for utilitarian purposes, constitutes a series of elevated natural mill ponds, containing latent power of unknown extent and value, awaiting that demand upon them which is now being made in consequence of the discovery that our second-rate forest growth which has hitherto served chiefly to ornament their shores and islands has become the most important, and can be ground into pulp and rolled into paper to meet the ever-increasing demands of the newspaper, the bookmaker, and the innumerable forms into which wood pulp can be compressed for useful or ornamental purposes—or as a substitute for wood or metal. These steps from high to lower levels in every rivulet, branch, tributary or main stream of nearly every one of our northern rivers produce more or less broken water which never freezes over but remains open during the coldest weather, giving an alteration of closed and open water sections, of ice-covered lakes and of broken water in rapids, which may cover miles in extent, as well as at chutes or cataracts with more or less open water above and below them.

It is an interesting question for specialists to determine what effect, if any, this often large percentage and almost general distribution of open water during the coldest weather (of which every stream large or small has a portion), may have in modifying the extremes of temperature in these northern latitudes. When all the ground is frozen solid and covered with a deep mantle of snow, extending over the lakes and checking increasing thickness of their ice covering, large bodies of water are impounded and maintained at a temperature above the freezing point, although there may be fifty degrees of frost in the air, and are constantly poured forth into this frigid atmosphere. It is conceded that our Great Lakes modify the temperature of their border lands, and although these open water spaces in our northern rivers may be inferior in surface, they exist on every river having rapids or falls, and extend over such a vast field that their aggregate area must be very large. Unlike the Great Lakes these open spaces are constantly receiving fresh supplies of warmer water to temper the severity of the air. Such "breathing holes" (as they are sometimes called), are necessarily comparatively shallow, and are the only places, after all other water is frozen over, where "anchored" ice is formed and found. This differs from the lake ice in that the latter melts where it freezes, while anchor ice, when compelled by milder weather to let go its hold upon the bottom, rises, and is immediately drawn under the fixed ice below, and does not dissolve until the river breaks up in the spring. The latent heat of water disengaged in freezing—which process occurs so frequently during the five months of winter—is imparted to the atmosphere, but is not again absorbed by melting ice, as would be the case in lakes, or in deep, sluggish rivers. Again radiation is supposed to play an important part in "anchoring" the floating particles of ice to the river bottom, which is said to be cooled so rapidly by the ice-laden current above it as to become frozen, and then begin to attract the passing ice needles, and fix them to its bed. If mother earth, in mid-winter, contributes any of her impounded heat to the outer atmosphere, these almost innumerable unfrozen spaces certainly offer great facilities for giving vent to her suppressed emotions.

From the Straits of Belle Isle to Montreal, and thence ascending the Ottawa, the tributaries of the St. Lawrence and of the Ottawa descend, through the Laurentian region, from elevations of 1,800 to 1,000 feet above tide, and debouche within a few miles of each other, except immediately about the Saguenay. In many cases they bring their principal cataracts very near their outfall, notably in the case of the famous Falls of Montmorency, which, leaping directly into the St. Lawrence from a height of 250 feet, are utilized to light the streets and drive the tram cars of Quebec. Somewhat similar conditions exist on the south shore of the St. Lawrence until the Richelieu river (the outlet of Lake Champlain), is reached, where at Chambly, water power is about to be used to send the electric current into Montreal, in competition with steam, and with a similar water power from the Lachine Rapids. The divide between the St. Lawrence and the Ottawa is studded with lakes west of the Rideau Canal, a principal outlet for which—on the south—is the river Trent discharging into the Bay of Quinte, with large mills and much undeveloped water power at its mouth; and on the north, some half a dozen important tributaries discharging into the Ottawa. At Sault Ste. Marie, a water power canal fed from Lake Superior supplies the largest pulp mill yet erected in Ontario and a similar work at the Lake of the Woods (which lake is 1,000 feet above tide), gives power to the largest flour mill in the Dominion. The waters of the Winnipeg river (the outlet of the Lake of the Woods), descend about 300 feet, unused, into Winnipeg Lake, adjoining Lake Manitoba, from whence the water system extends to the Saskatchewan, and thence via Athabasca, the Great Slave, and the Great Bear lakes, to the Arctic circle.

No reference has been made to the long established water power in the older districts, on the Saguenay, or those between Montreal and Quebec, and upon the Ottawa, nor to the more recent and extensive pulp and paper establishments—it being the object of this paper to draw attention to the continuity and broad distribution of water power across the continent, on Canadian territory, and to the unnumbered natural reservoirs of water at elevations which impart to them latent powers for the future development of this country. British Columbia has not been included in this field, because its occupied portion is separated by our great prairie region from the lake system of Eastern Canada, which system is deflected toward the North-West at the Lake of the Woods. This province is by no means deficient in water power, although it has been little used as yet where mines are on high levels, and because steam could be more readily applied. On the other hand, it is the only province in which hydraulic mining is in operation; and where gold is found in quantity sufficient to warrant the great outlay of capital necessary in connection with that system. In the Kootenay, water wheels, with or without electrical transmission, are necessary for water power, in order to mine, pump, and crush the gold-bearing rocks; but in the Cariboo district, water power is applied in the simplest form, without wheels or wires, by direct pressure from a nozzle, as is done in Ottawa from a fire hydrant. While the mountains south of the Canadian Pacific Railway are rich in metallic veins, the region north of this railway, extending into the Arctic Circle, appears to be a veritable land of Havilah, a continuous "Placer" gold field, in which much of the precious metal is to be obtained by hydraulic mining, wherever that is practicable.

This gold field, over a thousand miles in extent between the Fraser and Yukon rivers, and of unascertained width, has been exploited at Cariboo, (from whence fifty million dollars has been taken), at Cassiar and Omenica, and recently at Atlin, all in British Columbia—as well as in the far-famed Klondyke, in the Yukon district, said to be the richest gold field in the world. Water, in whatever way it is used, is necessary to the recovery of this gold, but in many places water power alone will profitably unearth it from its hidden recesses. This is collected in quantity from lakes, and reservoirs on the high levels, and carried for miles by ditches, aqueducts and flumes, to the banks of a primeval, deserted river channel, at the bottom of which, under forest-covered clay banks, lies the auriferous gravel studded with boulders and resting on the bed rock. Under a head of about 300 feet "six-inch rapid fire," hydraulic guns are pointed against the bank, breaking down the earth, uprooting trees, scattering boulders and washing out the gold—which remains in the traps set for it in the bottom of the sluices after all else has been carried off by the power of the water. These "machine guns," called "giants" and "monitors," are models of simplicity as well as of ingenuity and efficiency. While working they are great consumers of water—and can only be used when the ground is unfrozen, but this season is generally sufficient to use up all the water which can be collected at the necessary elevation. It requires at least two men to hold and direct the force of the issuing stream from an Ottawa fire hydrant, but a boy can direct the movement of a stream, twenty times greater in quantity and fifty per cent. stronger in pressure, as it rushes forth from the nozzle of one of these "giants"—which is fixed to a loaded platform, and moved forward as the bank in front of it melts away. A thin, short tube, of larger diameter, projects beyond the nozzle to which it is fixed by trunnions, so that the tube can be moved independently, both horizontally and vertically, to touch the issuing stream, which immediately recoils from the obstruction moving the "giant's" nozzle in the opposite direction. Thus a boy "behind the gun" can control its movement and compel the "giant" to fall back upon his own resources for motive power.

It is impossible to give anything but an approximate estimate either of quantity or value of the available water power over so vast an area, becuse the first would involve the survey of every power site; and, as to the second, the value begins when the power is wanted. All which now can be done is to state the conditions and endeavor to estimate the quantity, hypothetically. What is needed for an estimate is the quantity of water and the amount of fall which can be relied upon at the site for each power. To get the first, a measurement of the minimum flow at each point would be necessary in low water years, and for the second, some local knowledge as to river levels, back water, etc. In the absence of such surveys we must fall back upon the average rainfall of the whole region as far as that can be procured for any time, and assume the proportion of this precipitation (of rain and snow), which, after deductions for evaporation, the demands of vegetation, or infiltration, would reach the wheels. An allowance must also be made for that portion of the rainfall which may be carried off in floods. The area over which this precipitation would be in reach for water power purposes would embrace all the main land of Canada south of the St. Lawrence as well as all north of it in the St. Lawrence valley, and so much of the Hudson Bay watershed as can be utilized, or imported by transmission. As regards the power of the water thus estimated, we must embark in a much more speculative estimate as to the average fall which should be assigned to it for the whole region. We have in the undeveloped districts some scattered meteorological observations to assist us in estimating probable rainfall, and we have also a few barometrical observations giving the height above sea level of summit waters. On lower levels we have more numerous rain gauges, and summit levels ascertained by railway surveys.

For the whole river the total fall may be less than 100 feet, as in the case of the French river, which has Lake Nipissing for a mill pond, or rise to 1,500 feet or more as at the rivers below Anticosti. In the case of the French river (which is the lower part of a longer stream), we have surveys, and know that its whole fall can be utilized, as would be done if it is made navigable by locks and dams. In the others (where no surveys have been made), some will be more or less like French river, while at others only a portion of the total fall upon them may be profitably utilized. The most valuable will be those which, like Montmorency, bring all their water with sufficient head to the point where it is worth most. The upper sections of the rivers will be the least valuable, as having less water and being more remote until reached by a new railway, or a transmission wire. We can therefore only state a hypothetical case especially as to the power to be assigned to the available water. Where the rainfall is known, the proportions which reach the streams have been ascertained, in the construction of reservoirs for water supply and other purposes. The chief difficulty with respect to the quantity of water is the want of rain gauges over so great an extent of unoccupied territory. Assuming therefore an average annual precipitation of twenty-four inches and taking one-half of this as available for water power, every ten square miles would yield an average of nearly one horse power for every foot of fall. A million square miles (and there is much more), would give nearly 100,000 horse power for every foot of fall; as there would be several hundred feet of fall which could be utilized, our water power must be immense—and commensurate with this country in other respects.

The above applies only to the tributaries of the St. Lawrence and the Ottawa, and to the Hudson Bay watershed so far as that may be utilized. The Canadian portion of the water power of the St. Lawrence, from Lake Superior to Montreal, in which there is a fall of 546 feet, is not included, being below the level of the tributaries. We have measurements of the flow in both the St. Lawrence and the Ottawa in cubic feet per second, as follows:

	c. ft. per sec.
In St Mary's river, outlet of Lake Superior.. ...	80,000
In St. Clair river, outlet of Lake Huron..........	225,000
in Niagara river, above the falls..................	265,000
In St. Lawrence river, above the rapids............	300,000
In Ottawa river, above Lake of Two Mountains...	35,000

Canada's share of the St. Lawrence water power from Lake Superior to Montreal would be about ten million horse power. Canada has half the water of the St. Lawrence from Lake Superior to Cornwall, and all of it between Lake St. Francis and Montreal: but only a portion of this half could be utilized—and this would apply more or less to the Ottawa and other rivers, where all the power could not be utilized without an expenditure probably beyond its value. The power at Niagara has been estimated at seven million horse power, from less than half of the fall between Lakes Erie and Ontario, but the flow of the Niagara river, as given above, does not support so high an estimate. The whole of this fall (over 320 feet), can be utilized on the Welland Canal, but the quantity is comparatively insignificant, from the limited channel and necessarily low velocity of the current in it. In like manner the whole fall upon our canals in the St. Lawrence can be utilized subject to the limitations imposed by the requirements of navigation. Because these canals have not had the work for which they were intended, they have in some cases become mill races rather than slack water channels. This has been the less felt, hitherto, on account of the lightness of their west-bound traffic, the strong current toward the mills being in favor of the deeper laden east-bound craft, thus incidentally compensating for a violation of canal maxims.

While w ter power was at first the only substitute for the windmill in new countries, and its economy as well as superiority has always been recognized, several causes have contributed to limit its more general application. Before the invention of the turbine in the first half of the present century, heads exceeding about seventy feet could not be utilized on account of the comparative weakness and excessive cost of wheels of large diameter. In these days of structural steel, and "Ferris" wheels, this difficulty could be overcome; but, with the turbine, the conditions are reversed, the higher the head the less the size and cost of wheels, so that the most valuable water powers were the most cheaply utilized in this respect. A previous check to greater extension of water power was given in the latter part of the last century by James Watt's discovery of the steam engine, which by bringing the power to the work, to the city, and to the mine, revolutionized industrial conditions. A still greater revolution has recently occurred which brings water power to the front again, by its amalgamation with electricity, whereby its economical power is transferred to the work, over many miles of distance, upon a single wire. Within the last ten years high voltage electricity has been firmly established with annually increasing power of extension, and this has brought Canada into the first rank of economical power-producing countries. Water is thus represented by a power to which it can give birth, but which is superior to its own, in that, wherever transplanted, it can do nearly all the parent power could do, as well as give light, heat and greater speed; moreover it has given rise to industries only possible with abundant cheap electricity. What is more important to us is that such industries are those for which Canada possesses the raw material, but which, without water power, she could not engage in. There are important industries in which we have for some time utilized water power, for which electricity is not indispensable; but which equally require large amounts of cheap power, and are capable of indefinite extension; but while these may not need the intense electric current necessary for electro-chemical industries, they will find electrical transmission of inestimable value in many situations; while, for lighting and heating purposes, water power is invaluable to all. Heretofore we have cut our spruce into deals and exported it to Europe, and more recently into pulp wood and exported that to the United States; but, manufactured by our water power into paper, the raw material would yield this country ten times the value it is now exported for. The extension of railways, combined with electrical transmission, will promote the local manufacture of such wood products (including all valuable hardwood), as can bear transportation; thus giving the largest amount of local employment, as well as tonnage to the railway; and delivering us from the position of "hewers of wood" for other countries.

(To be continued).

AN ELECTRICAL CENTRE.

We speak of the natural resources of Canada in a vague way as we do of the sands of the sea, and with no more clear conception of what we are saying. It is sometimes a surprise to us when something comes up which gives us a more definite idea of what are our resources. Such is the map issued under the authority of the Board of Trade of Ottawa, which shows that within a radius of 45 miles from Ottawa city there is water power which at low water amounts to 917,603 h.p., and at high water to 3,347,630 h.p. Of this half a million h.p. (maximum flow), is within four miles of the centre of the city. The rest of this vast power is distributed over the territory surrounding the city in about 42 units of from ten to one hundred thousand horse power. The compilation of the water powers in the area included in this map are from reports, estimates, and information given by the following gentlemen at the request of the Ottawa Board of Trade: T. C. Clark, C.E.; Walter Shanley, C.E.; Thomas C. Keefer, C.E.; George P. Brophy, C.E.; Robert Surtees, C.E.; Henry A. F. McLeod, C.E.; Frank A. Hibbard, C.E.; David Scott, C.E.; Henry Carre, C.E.; Andrew Bell, C.E.; J. H. Matte, C.E.; Andrew Holland, Ottawa; George L. Dickinson, Manotick; Alex. McLaren, Ottawa; W. C. Edwards, M.P., Rockland; R. McRitchie, Bryson; J. A. Cameron, Thurso.

A feature of these water powers, which makes them very valuable, is that almost all are so situated as to have many lake expansions, and all offer opportunities for the creation of artificial reservoirs so that the mean flow may be made regular. In many cases these dams have been already built by the lumbermen and are very important works; one on the Gatineau river gives a depth of five feet in a lake 30 miles long. To those who think of Ottawa as either the Washington of the North, or the seat of the lumber trade, we must point out that both are correct but incomplete descriptions of that city. It is the centre of a very rich agricultural and mineral country, and in addition to its lumber manufactures must very soon take a leading position in other lines of production. On every side of the city iron mines of great value are found. At Ironsides, to the North of Ottawa, one of the earliest attempts at iron smelting was made, but it was found unprofitable, and abandoned. At Bristol, to the West are iron mines which are very rich and have successfully shipped ore in spite of adverse duties in the United States. At Calabogie, to the South-west, is an iron mine which was sold for $100,000 a few weeks ago. These are all within the 45-mile radius, and all have communication by rail with the city. Some ten miles up the Ottawa river beyond this line are situated the galena mines, which have attracted so much attention in the past two years, and are now being profitably worked. Here are also four water powers on the Ottawa river aggregating one million horse power. In the electrical age, as next century will probably be called, Ottawa will undoubtedly be one of the industrial centres of the continent.

THE PROTECTION OF LOW TENSION WIRING AGAINST DANGEROUS HIGH POTENTIAL CURRENTS *

BY W. J. PLEWS, MONTREAL.

All persons in connection with electrical supply companies, especially in lighting service by alternating currents, have long recognized the necessity of some reliable apparatus to prevent low tension service wires inside buildings from becoming a possible source of danger to human life, or as regards fire, in event of contact with high tension conductors. That this condition often exists, and that the danger therefrom can hardly be overestimated, is a well known fact to all electricians who have had experience with alternating current systems. Some years ago, the principal element of danger was the liability of transformers to break down between the primary and secondary coils. Of late, however, conditions have changed considerably, the more recent types of transformers being a vast improvement on the older ones. While the contingency as regards transformers is not now so great as in former years, the change in the system of secondary distribution involving as it does the use of large secondary units and a net-work of wires covering a great area, has given rise to another and if anything a more important element of danger, namely, the increased liability of accidental contact between high and low tension conductors. This change in secondary distribution has been rendered necessary from an economical standpoint, and as it is not at all likely that anyone will revert to the old system, the proper course seems to be the protection of individual equipments. The contingencies previously mentioned have proven a frequent cause of fire, and in some instances have resulted in fatal accidents. Recognizing these dangers, various earthing devices have been contrived to cope with the difficulty. It seems, however, that the idea has been to afford protection from the breaking down of transformers only, by means of blowing the primary fuses, the inventors apparently not having taken into consideration the contingency of accidental contact between local and foreign conductors, whereby a large volume of current at a high potential may flow over the secondary apparatus and destroy both it and the protective device, in which event the protective device itself would probably become a source of fire. Several of the cases which have come under the observation of the writer, wherein conditions as mentioned have existed, have been of such a nature that any earthing device, depending upon the blowing of a fuse for its action, would have been a positive fire hazard. One instance in particular was a cross between a fallen secondary and a trolley wire. In this case had there been any device of the type mentioned, a volume of current would have flowed through the apparatus sufficient either to destroy it or blow the secondary fuses; this latter occurring, it is reasonable to assume that the high tension current would have maintained an arc across the terminals of the cut-out (one such as generally used for low tension wiring), and produced disastrous results. As far as the writer's knowledge extends, the principle, common to all safety devices of this nature, heretofore developed, has been to disconnect the local system from the source of danger by means of blowing fuses. This principle appears to be radically defective, the blowing of a fuse under such conditions being an uncertain element, attended at times with undesirable results.

In any apparatus designed to protect local low tension systems from currents of higher potential than they are constructed for, or expected to carry, it would seem more rational to employ a device that will automatically and instantaneously disconnect the high tension current from the low tension system to be protected, without depending upon the uncertain action of fuses. It is also believed that a device of this nature should be one in which the amount of current necessary for its successful operation is a known quantity, and that this quantity be as small as possible, so as to avoid dangerous arcing. Considering the matter from this point of view, the writer believes that an apparatus can be constructed which will embody the desirable characteristics, and it is to this possibility that your attention is respectfully invited. One form of such an apparatus, which is on exhibition here, is similar in action to a double pole knife switch, and is so constructed as to automatically open the circuit instantaneously, whenever the low tension wiring is brought into connection with conductors charged with dangerous high potential currents, either through a break-down in a transformer, or a cross between secondary and primary, or other high tension conductors. The great advantage claimed for this apparatus is that no matter how large the volume of current may be, only a small fraction is required to operate the device, and this only for an infinitesimal period of time, the device in opening disconnecting both the safety apparatus and the interior wiring from the outside source of danger. Another advantage is in the fact that the device provides special facilities for rapidly testing the local system for grounds, without the use of other apparatus. During the past few years many fires have originated from high potential currents accidentally traversing secondary systems and breaking down the insulating joints which intersected the junction between fixtures and gas pipes. From the manner in which first-class electric light wiring is installed at the present day, it would seem impossible for a current at a potential of say two thousand volts, to cause a rupture between secondary wiring and ground, and the writer's experience leads him to the conclusion

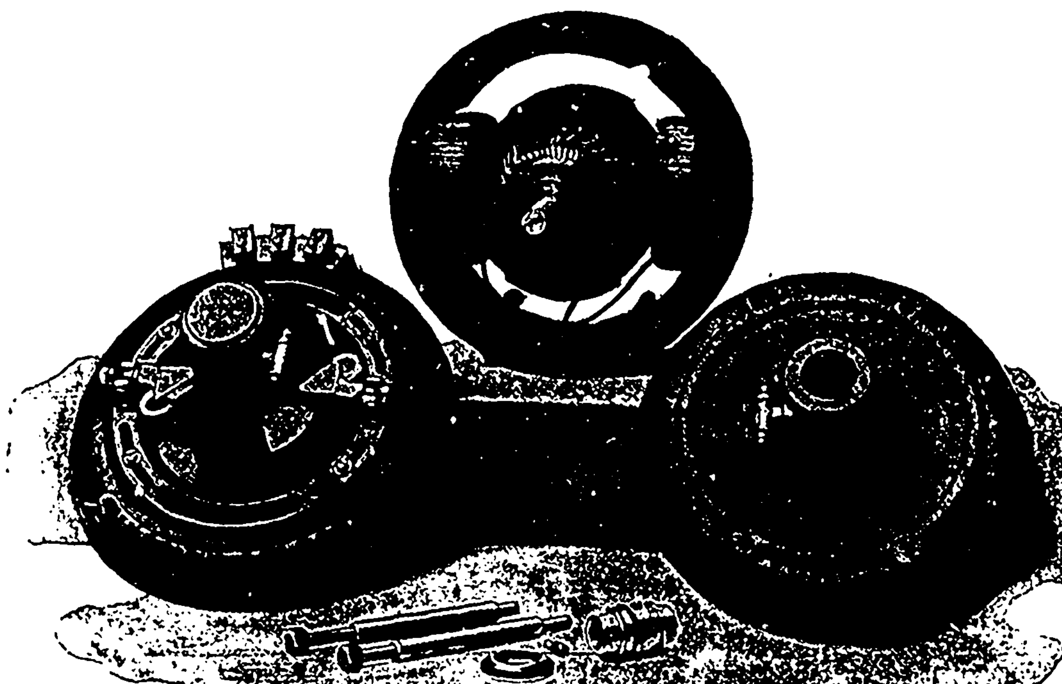
*From a paper read before the Canadian Electrical Association.

that if the so-called insulating joints properly performed their function, fires from this cause would be extremely rare.

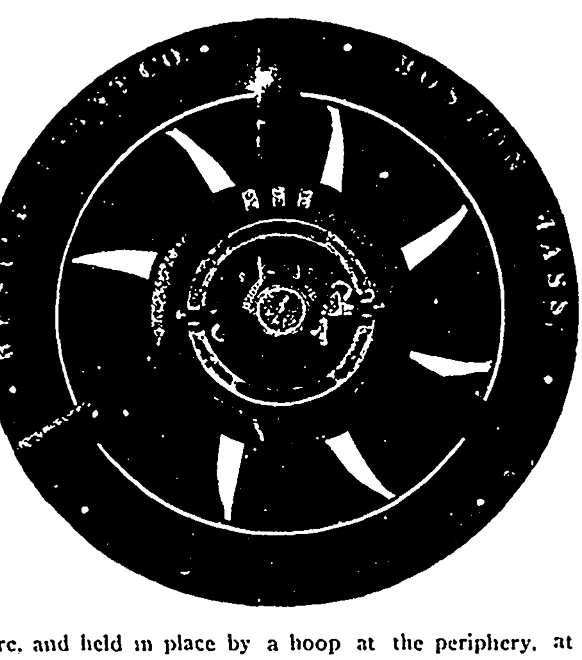
If on the other hand low potential systems are so arranged that there is no chance for high potential currents to rupture to ground, there remains the danger of some person receiving a fatal shock while handling the apparatus. In view of these facts, it would seem advisable to equip all low potential systems, which are exposed to the contingencies herein mentioned, with an automatic device that in time of need will operate effectively.

A NEW TYPE OF ELECTRIC PROPELLER VENTILATING FAN.

Since the B. F. Sturtevant Co., of Boston, Mass., has entered extensively upon the manufacture of electric motors and generating sets, it has been carefully studying the problem of inlet edge of the blades at low velocity. When well under the influence of the blades, it is accelerated to its maximum velocity with the least amount of slip. The result is an extremely efficient wheel. The motor likewise has been the result of very careful study in the attempt to provide a light machine, entirely enclosed, and at the same time to avoid the excessive temperature which is incident to the operation of most enclosed motors. The result is a machine capable of continuous operation for ten hours, with a maximum temperature rise of not exceeding 30 deg. F. A practical efficiency of over 80 per cent is obtained even with the small sized motors, and an excess load of 75 per cent. above the rated capacity may be carried without sparking, and without changing of brushes. This feature, combined with the small temperature rise, allows of carrying temporary overloads with impunity. The bearings are self-oiling and self-aligning, and are fitted with phosphor-bronze sleeves, which are



the manufacture of a compact, efficient and convenient type of electric ventilating fan. Exhaustive tests were made with different types of fan wheels. The result is made clear by the accompanying engravings, showing views of one of its electric ventilating fans, which have just been put upon the market. The fan wheel has eight blades rigidly attached to a spider at the



centre, and held in place by a hoop at the periphery, at an angle of approximately 30 deg. The angle is increased in such a manner that as the centre is approached, the theoretical velocity of the air remains practically constant. In other words the delivery edge is helical, and the air is picked up on the

removable from the outer ends of the boxes. The wheel is partially enclosed in a conoidal inlet ring, which decreases the frictional resistance to the entering air, and furnishes at the same time a rigid support for the motor, to which it is attached by the tripod hanger. These fans are built in sizes from 18 inches to 120 inches, with motors designed for either medium or maximum speed, and to run at any ordinary direct current voltage. A speed controller is always provided by means of which the fan can be efficiently operated at different speeds.

THE PRACTICAL MAN.

To find the proportions of a toothed wheel.—Pitch of teeth = circumference of pitch circle ÷ number of teeth; number of teeth = circumference of pitch circle ÷ pitch of teeth. circumference of pitch circle = pitch of teeth x number of teeth.

To find the diametral or Manchester pitch.—Divide the number of teeth in wheel by the diameter of pitch circle in inches.

To find the angular velocity of a wheel.—(1) Multiply the circumference of wheel by number of revolutions it makes per minute and divide by 60 = linear velocity in feet per second; divide linear velocity by radius of wheel = angular velocity. (2) Multiply number of revolutions per minute of wheel, 360°, and divide by 60 = angle described by wheel in one second; divide this angle by 57.296° = angular velocity.

To find revolutions per minute of a driving or following wheel or disc.—Revolutions of driver = revolutions of follower x diameter of follower ÷ diameter of driver; revolutions of follower = revolutions of driver x diameter of driver ÷ diameter of follower. Note.—The number of teeth may be taken instead of diameter of wheel.

To find the diameter of a driving wheel or following wheel or disc.—Diameter of driver = revolutions per minute of follower x diameter of follower ÷ revolutions per minute of driver; diameter of follower = revolutions per minute of driver x diameter of driver ÷ revolutions per minute of follower.

To find the velocity ratio in a train of wheels.—Multiply together the number of teeth in each driving wheel, multiply together the number of teeth in each follower; the first product will be the number of revolutions the first driver makes, while the second product is equal to the number of revolutions the last follower makes in the same time.—From Rules and Definitions by Wallace Bently, A.I.Mech.E.

LONG BURNING ENCLOSED ARC LAMPS.*

BY WM. A. TURBAYNE, HAMILTON.

The major factor of expense coupled with the operation and maintenance of arc lamps arose from renewing the carbons, which, in the sizes adopted in practice, had a life of some seven or eight hours only. As the all-night lighting of streets demanded that lamps should be capable of giving an uninterrupted service of from twelve to fourteen hours' burning, various means were devised whereby this period could be covered by a single trimming of carbons. Innumerable types of lamps were designed with this end in view, but there remained to be adopted as standards the double carbon lamp, which burned two successive pairs of eight hour carbons and, as an alternative, the single carbon lamp fitted with circular or elliptical carbons of sufficient cross section to insure a life of fourteen or sixteen hours. Aside from the matter of trimming, however, the carbons themselves were a source of heavy expense, and early endeavors were made to perfect some means whereby their life could be materially prolonged without at the same time incurring a sacrifice of the light. It was clearly understood that the rapid wasting away of the carbons was caused mainly by their combustion in the open air, and it naturally occurred that if the arc could be maintained in a transparent chamber, from which the oxygen of the air had been excluded, that this combustion would cease and that then the only waste would be that due to vaporization. Experiments along these lines were conducted and the results would undoubtedly have been encouraging had it not been chiefly for the fact that, in burning in an enclosing chamber, such a deposit soon accumulated on its inner surface as to seriously obscure the light and thus render the arrangement unpractical and, therefore, as these attempts to increase carbon life proved futile, fourteen or sixteen hours per trim was, until very recently, accepted as the burning period of an arc lamp. The great demand within the last eight or ten years for interior arc lamps operating from incandescent lighting circuits was met by a marked improvement in carbon manufacture, until finally a practically pure article was obtainable, the advent of which made possible the maintenance of an arc in an enclosing chamber and allowed of the development of the long burning lamp as we have it to-day in which a carbon in size equal to the eight-hour carbons of open arc lamps has a life of one hundred and fifty hours or more.

This longevity is effected by preventing combustion by a removal of the oxygen from the space immediately surrounding the arc, the oxygen not being literally removed by exhaustion, but rather by a process of chemical conversion wrought by the action of the arc itself. The carbons are surrounded by a glass globe of small area, closed at the base and only sufficiently open at the top to allow of a free passage of the upper carbon. On the formation of an arc the air contained within this globe is heated and rarified, the surplus finding an outlet through the upper opening, the remaining oxygen is reduced by combustion with the carbon to carbon monoxide (C.O.), a gas which is somewhat lighter than air, having a specific gravity of .969, and although combustible will not support combustion. This, together with the nitrogen which is liberated, completely fills the chamber and prevents further combustion of the carbon, although a small amount of air diffuses through the upper opening—a condition essential to satisfactory operation, as otherwise the vaporized carbon would condense and appear as a sooty deposit on the inner surface of the globe, while as it is, the oxygen of the entering air unites with this vapor and forms a gas. A slight deposit of silicon accumulates, which, however, does not seriously absorb the light, and which may be readily wiped off during trimming.

As a result of the absence of oxygen in the enclosing globe the ends of the carbons do not become tapered by burning but remain flat and blunt, and the device could not be adapted successfully to the existing lamps in use, which maintain a potential difference of some 45 volts across the arc, as, in the small separation of one-eighth inch or under consequent upon this voltage, too much of the light would be intercepted by the lower carbon. It was therefore imperative, in order to obtain proper distribution, that the carbons be more widely separated, and it was found that in the enclosure an arc of approximately ⅜-inch in length could be maintained with an E.M.F. of some 75 or 80 volts. Meanwhile it is necessary that the current employed should not exceed 6½ or 7 amperes, for obvious reasons associated with the cleanly burning of these lamps for long periods, and in order further that the watts expended may correspond with those expended in an open arc lamp of like rating. While a so-called 2,000 c.p. lamp of the latter type operates with a current of 10 amperes at an E.M.F. of 45 volts or 450 watts, an enclosed lamp of like rating may operate at 6.5 amperes and 70 volts, or at 5.5 amperes and 82 volts, the higher E.M.F. and reduced current resulting within certain limits in better operation. Enclosed arc lamps in general require special features in the feed mechanism, although the governing principles are identical with those obtaining in the open lamps. As it is necessary to separate the carbons from ⅜ or ½ inch it is usual to have the magnets act directly on the upper carbon without the intervention of levers, and this calls for a long range magnet of considerable power. In order also to obtain good regulation it is desirable that the moving armature be of considerable weight, as compared with the weight of the carbon to be lifted, as therefore decrease in weight of the carbon is not accompanied by an appreciable lengthening of the arc. Enclosed lamps will operate efficiently in series on direct constant current circuits employing currents not greater than 6.8 amperes, and on alternating current circuits in conjunction with constant current transformers. In these instances the lamps must be of the differential or shunt feed type, and must be further provided with short-circuiting cut-outs such as are found in the well-known open series lamps. A similar type of lamp is required for operating in series multiple on street railway and power circuits, but in place of the short-circuiting cut-out a device for shunting a resistance, equalling that of the arc, across the terminals is used in order that if one or more lamps cut-out or proved defective the current traversing the remainder would not rise. It is necessary also that a steadying resistance be placed in series with each group of such lamps.

Enclosed lamps for operating in parallel on direct and alternating current incandescent lighting circuits require a very simple feed mechanism and contain neither shunt magnets nor cut-outs. For adjusting the carbon a single magnet only is required connected in series with the arc. Such a magnet responds to variations in the current strength and tends to maintain this factor constant irrespective of variation in terminal voltage, but as this latter is a constant factor the magnet therefore in keeping the current factor constant must likewise keep the arc resistance and length constant also. A retarding device such as a dash pot is required in these lamps to allow of a gradual separation of the carbons, alternating lamps especially demanding a comparatively slow separation. As direct current lamps usually operate on circuits of 110 volts it is necessary to interpose a resistance in order to reduce this to about 80 volts as required across the arc, and, while this resistance wastes energy, yet it is necessary to the successful operation of the lamps. The alternating lamps are more fortunate in this respect inasmuch as a reactance coil may be placed in series with the arc which will reduce the voltage to that required across the arc with but little waste of energy. They may also be operated direct from transformers delivering the necessary arc voltage, or from economy coils, or auto-converters.

A type of lamp which represents simplicity in the extreme is that in which the separation and feeding of the carbon is effected by the expansion and contraction of a strip of metal interposed in the path of the current. Such a device, while not satisfactory when used in conjunction with open arc lamps, appears to be excellently adapted to parallel burning enclosed lamps, in which the arc is protected from draughts of air, and which feeds only

*From a paper read before the Canadian Electrical Association.

at long intervals. For this particular purpose, as compared with electro-magnetic feeds, the advantages all appear to be with the thermal feed. Such lamps strike their arc quietly and slowly without being necessarily retarded in their action by dash-pots, their feed is positive, and slight frictions in the moving parts introduce no noticeable error; they may be operated at will on direct currents, or on alternating currents of either of the standard frequencies. On alternating currents the power factor of a load of these lamps would be high as compared with a load of lamps having large magnet coils and cores, and in the matter of maintenance there appears to be nothing about such a lamp to suggest repairs, although the replacing of an occasional regulating strip would be much cheaper than the renewing of magnets.

Aside from the economies of enclosed lamps resulting from the increased life of the carbons they possess other advantages peculiar to themselves. As a result of the absolute enclosure they burn quietly, being free from hissing or flaming even though not accurately adjusted, and, as it is impossible for sparks to make their exit, all possible fire risk is eliminated, a feature which meets with the unanimous endorsation of the boards of Fire Underwriters generally. By virtue of the long arc which is maintained more perfect distribution of the light over large areas is obtained than is possible with open arc lamps Direct current lamps of the latter type exert their greatest illuminating effect at an angle of about 45 degrees from the vertical so that a very intense light is noticeable within a radius slightly exceeding the height of the lamps from the ground, while beyond this the illumination rapidly falls away. Enclosed lamps on the other hand spread their rays more horizontally, their angle of maximum intensity being about 75 degrees, and as a result the light is more regularly diffused over a large area and does not assume the form of concentric zones of rapidly diminishing intensity. The economy in maintenance however, affords the most striking example of the advantages of enclosed lamps over the open and the gain will be clearly noted by a comparison of the two systems. As an example we may compare the maintenance costs of 450 watt open and enclosed alternating current lamps operating 10 hours per day per year of 365 days, assuming for the former a life of 14 hours per trim of carbons costing $36 per 1,000, while for the latter a life of 80 hours per trim of carbons costing $30 per 1,000. In this comparison the matter of interest and depreciation allowance may be dismissed on the assumption that it will be similar in each case and thus there remains to be calculated the cost of carbons and trimming.

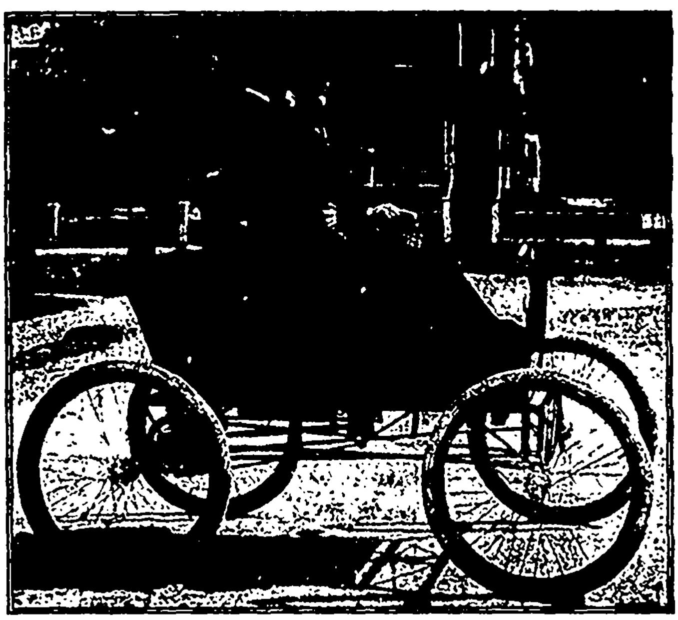
As the open lamp requires two new carbons per trim it will in a year therefore, on the above basis of 10-hour runs per day, require some 261 pairs of carbons, costing $18.80; on the other hand the enclosed lamp requires but one new carbon per trim and in a year will consume but 46 carbons, costing $1.38, so that an annual saving of $17.42 per lamp is effected by the use of the enclosed lamps The cost of trimming will depend largely upon local conditions, but we may assume that one man at $2 per day can trim one hundred open lamps, or one-half as many enclosed lamps, which will make the cost per trim, therefore, 2 cents and 4 cents respectively. On the 10-hour basis the trimming, therefore, will cost approximately $5.62 per open lamp per year, as against $1.84 per enclosed lamp per year, resulting in a further annual saving in favor of the enclosed lamp of $3.78, making the total saving $21.17. With direct current lamps the saving will be in like ratio, allowances for differences in the life and cost of carbons being necessarily taken into consideration, but whether direct or alternating the advantages of the enclosed lamp are so apparent that before a great period elapses not only will they largely supplant the open arcs, but they will further enter the arena in competition with large incandescent lamps and regenerative gas lamps.

STEAM POWER FOR AUTOMOBILES.

For some years Sir David Salomons and other experimenters and engineers in Britain have been vaunting the praises of steam as a motive power for autocars, arguing for it as the ideal power on account of its expansiveness or range, and hence being superior to the gasolene engines, whose limits are but too well known, and resembling electricity minus the difficulty of re-charging batteries. The Serpollet boiler gave Sir David and his friends good ground for argument, and as a matter of fact steam is being pushed to the front in Britain, especially for heavy traction. The Americans have done much better with steam automobiles than either British or French inventors—the latter having given chief attention to gasolene, or "upetrol," as it is called. Some rather sudden and surprising developments in steam autocars have been made in New England. It is to be noted that the Western and Middle States of the Union have as yet produced no steam autocar. The reason stated by experts is that nowhere in the United States except in New England can the extremely fine work be had that is required on steam vehicles. Every engineer will understand that a 4-wheel two-passenger carriage, whose total weight empty does not exceed 400 lbs., the boiler shell being only 14 inches diameter by 13 inches high, and yet containing 306 tubes, requires exact adjustment and minute mechanism that would drive the ordinary machine shop foreman crazy. Yet the Stanley brothers had no difficulty in getting such work done in a rush, so that their first carriage was completed within six months. New England now boasts three prominent steam carriage makers—Whitney of East Boston, Stanley Brothers, the famous dry-plate makers of Newton, Mass., and the Overman Wheel Co. of Chicopee Falls, Mass.

At the motor vehicle contest in Boston in November last, the performance of the steam carriages astonished the crowd of 2,000 persons, for steam power done up in such compact form was decidedly novel. On a 3-lap cycle track the Whitney wagon, weighing 1,000 lbs., made a 2-mile run in 5.40 2-5, while the Stanley wagon, weighing 400 lbs., finished the mile in 2.11. Whitney says he has often made a straight-away mile inside of 2 minutes.

The hill climbing contest gave the hardest test. A plank track 85 feet long was laid level for the first 10 feet, and the balance in sections of 10 feet, each section raised 5 degrees higher than the preceding, the final angle being 35 degrees. This made a constantly increasing up-hill angle of track, which is



STANLEY STEAM CARRIAGE.

vastly difficult. Some seemingly powerful cycle riders tried it with a flying start, but could not go much above half way up. Whitney with 125 lbs. of steam ran up the grade beyond his brake control, and had to be caught by men standing on the incline, and steadied down to where his carriage could take care of itself. Stanley took the hill, running up to the top, and bumping the cross-bar at the end, from a standing start at the bottom of the incline, no headway run on the level being made. Stanley had probably 150 lbs. boiler pressure for this hill effort. It looked as though Stanley was going to come down with a rush, but after some hurried scrambling the wagon was seen to be under control. The Stanley engines were not made to reverse, but the reversing feature has been added since this test.

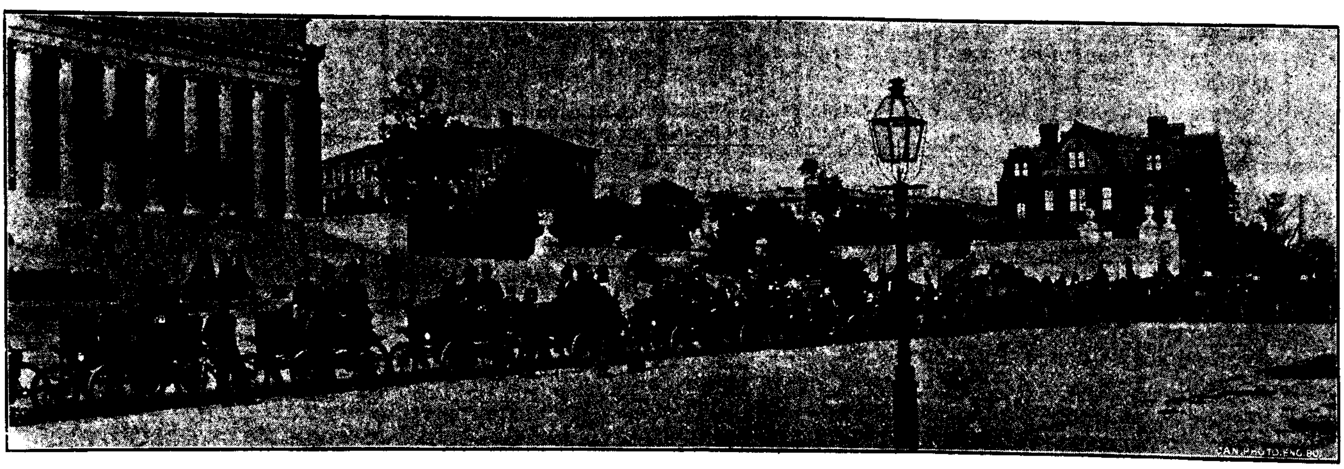
The following particulars in regard to the power and gear of the Stanley steam wagon, given by Hugh Dolmar in The Cycle Age, will be of interest to steam engineers: "Boiler shell, copper, 14 inch diameter by 13 inch high; No. 20 B. & S. sheet metal gauge in thickness; 306 tubes, copper, ½-inch diameter, 13 inches long, No. 20 B. & S.; fuel, gasolene; cylinders, a pair of simple engines, 2½-inch bore by 3½-inch stroke, plain eccentric valve motion, plain slide valves, no link, fixed cut-off at about 9-16 stroke. The speed reduction from the engine shaft to the compensating gear box is 2½ to 7, 12 tooth sprocket on engine shaft, and Baldwin separable chain to a 30 tooth sprocket on the gear box. Driving wheels, 28 inch diameter, with suspension, laminated wood rims and 2-inch Hartford single tube tires. Running a mile in 2.11, the engines made 720 by 2½, or 1,800 revolutions, and the number of exhaust was 7,200. The engines made a little under 837 turns per minute. The boiler pressure was probably about 140 lbs., and as all the connections are very direct and short, it seems that the mean effective pressure on the pistons should be little short of 80 lbs. However, the combined piston area is 9.8 square inches, and the piston travel was 487 feet per minute, going something like 11 h.p. nominal. This seems incredible for a boiler of the dimensions given, and it seems therefore probable that the mean effective pressure must have been below the 80 lbs. assumed."

In speaking of the conduct of the Stanley wagon during the exhibition mile run, Mr. Dolnar states that there was a perfect absence of odor, ease and celerity of movement, and almost total silence. At Stanley's top speed the connecting rods and cranks were invisible, and the noise of the exhaust was an agreeable hum, almost a musical note, there being 3,348 puffs per minute. The exhaust steam spread out in a thin gray veil, and extended about six feet in rear of the wagon. Stanley and Whitney had practically the same boiler, and the only practical difference between them was that Stanley had a perfect burner under his boiler, while Whitney's was by no means so good.

The Victor Automobile—the name of the steam carriage just put on the market by the Overman Wheel Company—is introduced as marking a new era in the use of steam, "pre-eminently the power to use on automobiles," The makers claim they "have solved the problems which heretofore prevented the use of steam in the hands of the general public. With a Victor Automobile," they say, "it is possible to go for 25 miles and do absolutely nothing except to put the power on by opening the throttle and to steer." The height of water in the boiler and the pressure on the fuel tank are maintained automatically, and guaranteed not to vary beyond an inch of water or a pound of pressure. The wagon to seat two persons has 4 h.p., and is geared according to the hill-climbing or speeding necessities of the purchaser.

A curious feature of the development of the steam carriage in the United States is that the Stanley Brothers are neither of them engineers, and neither of them is to-day familiar with the ordinary details of steam engine construction; yet they have produced what Mr. Dolnar—an engineer of forty years' experience—regards as the closest approach to a practicable mechanically-propelled road wagon yet shown. They are men of unique personality, accepting nothing as authoritative, except the result of their own independent investigation and researches, and are utterly scornful of all practice and precedent. Whitney had built steam wagons before them, but they did not adopt Whitney's boiler construction, but originated an entirely new form of boiler shell, which makes the tube expansion and shell expansion always the same, and hence makes such a thing as a leaky tube unknown in their boilers. They also originated a gasolene burner for firing this boiler, which uses no forced draught or air pressure, and produces a silent fire without any of that roaring which had hitherto marked all oil-burning steam generators of rapid action.

There is just one bit of data that is lacking in the various accounts of the exploits of steam wagons which we have read, that is, the clogging of the tubes with lime deposit. If "scale" proves such a detriment to ordinary steam boilers, what may be expected of a multitude of minute tubes when limestone water is taken from the wayside pump, or dipped from the side-road ditch? How long would a traveler be safe from explosion if his runs should be made in a locality such as Guelph or Limehouse?



HORSELESS VEHICLE PARADE AT COLUMBIA COLLEGE, NEW YORK.

THE PROPER EFFICIENCY OF INCANDESCENT LAMPS FOR CENTRAL STATIONS, INCLUDING A DESCRIPTION OF THE NERNST LAMP.*

BY E. E. CARY, ST. CATHARINES.

Few questions in the field of electric lighting are of greater importance to central station managers than that of the efficiency of incandescent lamps, and few questions seem so thoroughly misunderstood, and yet the fault is not entirely with the central station. In the first place, only the larger companies will invest in the necessary apparatus, and surprisingly few of these will purchase enough apparatus to determine the efficiency of their lamps. The initial outlay, including photometers and instruments, will more than pay for itself in the first year. In the absence of the proper outfit, the managers have to depend upon the statements of manufacturers or more often upon those of their representatives, and what is the result? Dissatisfaction. One maker will supply lamps guaranteeing them to be of a stated efficiency, and these lamps will give satisfaction. Should the next order be placed with another company and the same efficiency guaranteed, chances are strongly in favor of the second consignment not giving satisfaction, assuming the specifications call for efficient lamps. Both lots of lamps may consume the same current at the stated voltage and in reality be intrinsically equal, yet one will be thought well of and the other condemned. A situation such as this, upon the face of it, seems incredible, yet such is the daily experience of every lamp manufacturer until by long and often costly experience he becomes thoroughly acquainted with the actual state of affairs upon the lines of all his customers.

For many years generators, and later transformers, have been rated in light capacity upon the basis of fifty watt lamps. It has been unfortunate that 3.1 watt lamps have become such a household term, as their use has often proven very costly to companies before experience made them alter first ideas. Everyone will probably agree that it is desirable to use the most efficient lamps possible, consistent with fair life where current

*A Paper read before the Canadian Electrical Association.

is supplied upon the meter basis. Two questions immediately arise; what should be considered fair life, and at what efficiency under conditions existing upon the lines can this life be most economically obtained. Every lamp maker, however worthy of the name, has on record the results of many tests showing the average life to be expected of lamps of different efficiencies when operated at normal or at voltages other than normal. Below in table 1 will be found the efficiency and average life of lamps at various voltages. Though these results are in one sense approximate only, yet they are the average results of many tests. Before discussing the table, it is well to state that the efficiency of an incandescent lamp is generally given in watts per candle. A lamp radiating sixteen candles when operating at fifty volts, and one ampere of current, consumes fifty watts, and has therefore an efficiency of 3.1 watt per candle. When lamps are tested for efficiency, one grievous error is generally made. The voltage is taken carefully as labelled on the lamp instead of being taken at the point of the lines where the lamp will be used. For example any lamp, whatever its normal efficiency may be, can, and often is operated at a much higher efficiency. For instance a four watt lamp is often burned at three watts, and a three and a half watt often burns at two and a half watts. This is simply to show that when a manager talks of using more efficient lamps, he may be operating at that very time, lamps at a higher efficiency than he contemplates using.

If a station is using 3.5 watt lamps and had absolutely steady voltage, an average life of 900 hours could be expected. If the voltage, however, is 2 per cent. high, this life is reduced to 700 hours, and the efficiency increased to 3.27 watts. If, however, the voltage is 4 per cent. high the life is reduced to 550 hours, and the efficiency increased to 3.05 watts. Though the candle power is increased, the total watts consumed is not proportional and the station suffers doubly in consequence. Four per cent. increase in voltage of a sixteen candle power lamp increases the light emitted about 20 per cent. This table will probably impress on central station managers how vitally important it is to know the voltage at which their lamps are operating upon different portions of their lines. Unless the regulation throughout the system is unusually uniform, it is most profitable to have the entire system divided into sections or zones, and order lamps of different efficiencies adapted to give the life settled upon as desirable. If the fluctuations are comparatively the same in the different zones, then the same efficiency can be used, only the lamps should vary in voltage, the voltage to be used to be the same in each zone. The manager immediately states that this causes too much confusion, etc., yet it is good business, and is a no more confusing problem than many others in manufacturing. When a method like this is carried out, very black lamps would disappear, average life be greatly increased and customers would be much better pleased. Take a customer upon your lines where the voltage is 4 to 6 per cent. high, not to speak of 20 per cent. as is often found, and when you replace burned out lamps what is the result; the new lamps may emit from twenty to thirty-two candles and the old lamps eight to ten. Naturally the customer complains that the old lamps are worthless, and to keep peace, you replace these also and he starts with practically all new lamps, the same trouble to be gone through with later on. In the meantime you are apt to write the manufacturer that his lamps are blackening badly and return these specimens as fair samples. Troubles arising from causes similar to this have forced manufacturers oftentimes, who cannot or will not investigate the trouble, to send out their lamps uniformly of a higher voltage than is marked on the labels. This is one sense self protection, which the manufacturer is forced to do if he wishes to retain the trade which is often at such a distance that he cannot afford to investigate personally.

Most lamps imported from the United States to-day are much higher in voltage than indicated on the label. Yet the central station, if it has not due regard for the light emitted, will be pleased with the lamps, as they may last almost indefinitely. The most welcome information a manufacturer can receive is to the effect that a central station does not wish a lamp to last forever, so to speak. Consider for a moment how small the expense of the renewal item is under normal conditions. Assuming only 600 hours average life at the low average meter rate, 6-10 cents per lamp hour, the income is 3.60. Good lamps can be purchased for 20c. each or less than 6 per cent. of the income. When lights are furnished upon the flat rate basis, and the renewals are paid for by the consumer, highly efficient lamps are not desirable.

When central stations will determine intelligently the proper efficiencies of lamps which they should use, and take means to hold manufacturers to their specifications, then their lamp renewal account will considerably decrease and the legitimate lamp maker prosper proportionately. Below is given another table of current in amperes taken by lamps at various voltages and candle powers at different efficiencies, which may be found useful for reference:

EFFICIENCY AND AVERAGE LIFE OF LAMPS AT VARIOUS VOLTAGES.

Efficiency in Watts per C.P. at Normal Voltage.	Average Life at Constant E.M.F.	98 per cent of Normal Voltage.		99 per cent. of Normal Voltage.		100 per cent. of Normal Voltage.		101 per cent. of Normal Voltage.		102 per cent. of Normal Voltage.		103 per cent. of Normal Voltage.		104 per cent. of Normal Voltage.		105 per cent. of Normal Voltage.		106 per cent. of Normal Voltage.	
		Actual Watts per C.P.	Actual Life in Hours.	Actual Watts per C.P.	Actual Life in Hours.	Actual Watts per C.P.	Actual Life in Hours.	Actual Watts per C.P.	Actual Life in Hours.	Actual Watts per C.P.	Actual Life in Hours.	Actual Watts per C.P.	Actual Life in Hours.	Actual Watts per C.P.	Actual Life in Hours.	Actual Watts per C.P.	Actual Life in Hours.	Actual Watts per C.P.	Actual Life in Hours.
4.5	2400	4.85	3500	4.68	2900	4.5	2400	4.34	2060	4.21	1830	4.06	1600	3.92	1400	3.8	1240	3.7	1120
4.	1500	4 31	2000	4.16	1750	4.	1500	3.86	1330	3.74	1160	3 62	1020	3.48	880	3.38	800	3.28	710
3.5	900	3.77	1200	3 64	1040	3 5	900	3 38	800	3.27	700	3 16	620	3.05	550	2.96	490	2.87	440
3.1	580	3.34	760	3.22	660	3.1	580	2.99	500	2.9	460	2.8	400	2.7	360	2 62	320	2.54	280
2.5	260	2.69	350	2 6	310	2.5	260	2.41	230	2.34	210	2.26	190	2.18	170	2.11	150	2 05	140

CURRENT IN AMPERES TAKEN BY LAMPS IN VARIOUS VOLTAGES AND CANDLE POWERS.

3.1 Watts per Candle.

Candle power.	50 volts.	55 volts.	80 volts.	95 volts.	100 volts.	105 volts.	110 volts.	120 volts.	220 volts.
8	.50	.45	.31	.26	.25	.24	.23	.21	.11
16	1.0	.90	.62	.52	.50	.47	.45	.41	.23
25	1.6	1.4	.97	.82	.78	.74	.70	.65	.35
32	2.0	1.8	1.3	1.1	.99	.94	.90	.83	.45
50	3.1	2.8	2.0	1.7	1.6	1.5	1.4	1.3	.71

3.5 Watts per Candle.

Candle power.	50 volts.	55 volts.	80 volts.	95 volts.	100 volts.	105 volts.	110 volts.	120 volts.	220 volts.
8	.56	.51	.35	.30	.28	.27	.26	.23	.13
16	1.1	1.0	.70	.59	.56	.54	.51	.47	.26
25	1.8	1.6	1.1	.92	.88	.84	.80	.73	.35
32	2.3	2.0	1.4	1.2	1.4	1.1	1.0	.94	.51
50	3.5	3.2	2.2	1.9	1.8	1.7	1.6	1.5	.80

4 Watts per Candle.

Candle power.	50 volts.	55 volts.	80 volts.	95 volts.	100 volts.	105 volts.	110 volts.	120 volts.	220 volts.
8	.64	.58	.40	.34	.32	.31	.29	.27	.15
16	1.3	1.2	.80	.68	.64	.61	.58	.54	.29
25	2.0	1.8	1.3	1.1	1.0	.95	.91	.84	.45
32	2.6	2.3	1.6	1.4	1.3	1.3	1.2	1.1	.58
50	4.0	3.7	2.5	2.1	2.0	1.9	1.8	1.7	.91

Before describing the Nernst lamp I will say in reference to 220 volt lamps that great progress has been made in their manfacture during the past year or two, but that little further is necessary in making them more efficient before they will be on a par with 110 volt lamps. In addition to this, plants must be installed calling for a range of 220 to 240 volts before the cost of the lamps can be brought to its proper level by the manufacturer.

During the past year vague rumors have occasionally been wafted across the water of the discovery of a new light, although details of the discovery were entirely lacking until Mr. Swinburne delivered his now famous lecture before the Society of Arts in London, February 8th. I will quote from this lecture a few descriptive remarks and then give some criticisms of the lamp from other sources. Mr. Swinburne in speaking of Nernst's discovery says: "Nernst's, like most great inventions, is exceedingly simple as soon as it is understood. The efficiency of an incandescent body, as far as radiation goes, depends simply on temperature of the filament only, providing there is no loss by convection. The carbon will not stand a sufficiently high temperature. Nernst therefore chose a material that would stand higher temperature than carbon, and his material has the incidental advantage, that its specific resistance is so high, that strong rods can be used for high pressure instead of thin filaments. Nernst takes highly refractory oxides as his material. It does not seem promising, because such oxides are notoriously good insulators. But such insulators are electrolytes when hot; Nernst therefore, heats the rod to make them conduct, and then heats them electrically, preserving a temperature which is within the limits that the material can bear without softening. * * * The material is worked up into little white rods. Each rod is mounted on two platinum wires, a little paste made of refractory oxides being applied to the joints. The little rod with its two wires, is then mounted in holder which fits ordinary electric light fittings. As the rods fall in resistance as the temperature increases, after the manner of electrolytes, an increase of current produces a decrease of resistance. This tends to give some instability in running in parallel on supply circuits. This instability is corrected, as in an arc lamp which has analogous properties due to a different cause by a series resistance. The Nernst rod has therefore a resistance in series. This is made up of exceedingly fine wire. and for ordinary circuits amounts to 10 or 12 per cent. of the whole resistance of the lamp. The consumption, including the resistance is 1.5 watts per candle for large lamps, and 1.6 for small lights of low pressures. In small or low pressure lamps the loss of heat at the ends is larger in proportion. Such a lamp as I have described will not light up of itself, for the rod is an insulator when cold. The simplest way to start it is to warm it with a match, or better with a small spirit lamp. Such a lamp as this is not only very cheap as regards first cost, but economical in running. The life of rods, running at an efficiency of two-thirds of a candle per watt, including the resistance, is already more than 500 hours in good specimens. If the Nernst lamp advances as much in the first years of its existence as the carbon lamp did between 1880 and 1882, it will soon be made so well that the rods will last a lifetime. When the rod is worn out, a new rod with its little mounts is all that is replaced. The whole lamp is not thrown away at all. The small lamps and the lamps of medium size are in practice started by a heating resistance. This is arranged close to the rod, and in shunt to it. As soon as the rod is hot enough to conduct, its current works a tiny cut-out in the resistance circuit. In large lamps the heating system is a little more elaborate, as the resistance arrangement is arranged as a sort of hood which covers the rod. As soon as the rod conducts, not only is the resistance circuit broken, but the electro-magnet lifts the little hood clear off the rod. In all these forms, the rod and its mounting are replaceable without interfering with the rest of the lamp."

The above extracts give a very clear idea of the Nernst lamp, as first described to the public by those interested in promoting a large company for its exploitation. There are however serious practical difficulties involved in the practical operation of these lamps at the present time. Assuming however for the sake of argument that the Nernst lamps can be operated successfully in practice, the relative cost of this operation compared to arc and incandescent lamps is what chiefly interests the central station manager. The English Electrical Review recently published an article by John I. Hall upon "The Nernst Lamp vs. The Arc and Incandescence Lamps." I quote for your information a part of this article, giving comparisons in cost between the Nernst and arc lamps. These are the only figures that have been recently published. After speaking of various methods of lighting, Mr. Hall writes: "But at present the position of the various illuminants may be summed up as follows. 1. The Welsbach system is an advance over the ordinary method of lighting by gas. 2. The enclosed arc lamp is an advance over the open arc. 3. The Nernst system is an advance in incandescent lighting. The electric lamps are placed in the order they will occupy in regard to cost of maintenance, for as the Nernst lamp supersedes the enclosed carbon lamp, so does the arc lamp supersede the Nernst lamp." J. Swinburne, in the prospectus of the Nernst Electric Light, Limited, states that: "It will, I believe, oust the arc lamp in nearly all cases." On examination it will be found that it will not oust one arc lamp at present in use, as the following particulars will show:

The Nernst lamp is said to give 1 c.p. for an expenditure of 1.5 watts. The arc lamp (2,000 n.c.p.) absorbs 500 watts and actually gives 1,200 c.p. The Nernst lamp to give 1,200 c.p., will require an expenditure of 1,800 watts, or 3.6 times more energy than the arc lamp; 1,800 watts = 1.8 kilowatts per hour, which will cost to the consumer 3.6d. per k.w. per hour. The arc lamp absorbs 0.5 k.w. per hour, and this at 3d. per unit equals 1.5d. These figures are for public lighting; for private consumers the cost is, of course, increased. Allow a liberal amount for carbons, trimming and cleaning, etc., say, 0.5d. per hour, then there is 1.5 + 0.5 = 2d. per hour as the cost of the arc lamp against 3.6d. as the cost of the Nernst lamp. The figures given above are for the open arc lamp, but for the enclosed arc lamp the cost would be about 1.6d. against 3.6d. for the Nernst lamp. In other words, instead of our corporations running their street arc lamps for, say £18 per annum per lamp, they will, by adopting the Nernst lamp, run them at £64, or spend £46 more per lamp.

It will therefore be considerable time before the municipal electrical engineer is found who will be ready and willing to come forward and suggest the ousting of the arc by the Nernst lamp. The Nernst Electric Light, Limited, prospectus further states that "there is no difficulty in running in parallel on 1,000-volt circuits without transformers." It will be of some interest to the electric light engineers to find the 1,000-volt circuits without transformers amongst the electric lighting stations. However, the merits of the 1,000-volt lamps can be considered as against the arc lamps. Suppose the advantages of the Nernst lamps are considered running in parallel on 1,000-volt mains. Is there any economy in conductors to be secured under these circumstances? Take a section of, say, 20 arc lamps, with transformers, running in parallel and controlled from a sub-station. The current required will be

$$\frac{20 \times 500 \text{ watts}}{2{,}000 \text{ volts}} = 5 \text{ amperes primary current.}$$

For 20 Nernst lamps the current will be

$$\frac{20 \times 1{,}800}{1{,}000} = 36 \text{ amperes primary current.}$$

Thus it will be seen that, taking the most favorable conditions set down by the prospectus of the company for the Nernst lamp to compete with the arc lamp, a cable of seven (7) times the sectional area will be required, in addition to the transformer, for them to run on existing installations where the E.M.F. is 2,000 volts. The cost of the lamp cases and posts now remains to be considered. It may be taken that the lamp-posts will cost about the same in both cases. The arc lamp complete, with hood and globe, costs, say, £6, and the Nernst lamp £1. This appears to be a fair price, allowing for promotion anticipations without actual figures as to cost. The first cost, and maintenance for 12 months, may now be considered, voltage 2,000 lamps in parallel:

Arc lamp and transformer, say	£12
Say cost of cables	3
Maintenance for twelve months	18
Total cost	£33
Nernst lamp and part cost of transformer situate in sub-chamber (voltage 2,000 to 1,000)	£ 3
Cost of cables	21
Maintenance for twelve months	64
Total cost	£88

There are other considerations of cost, such as conduits, depreciation and interest on capital outlay, which the electrical engineer will observe are not in favor of the Nernst lamp, and so they are, in kindness, omitted. To summarize the foregoing particulars, it is pretty plainly to be seen that the rosy and light-hearted view taken by the Nernst Company as to ousting the arc lamp will need some slight modification, especially on the score of first cost and economy. Unfortunately for the new-comer there are such things as cables to be taken into account and maintenance.

So, then, the manufacturers of open and enclosed arc lamps are not yet to put up the shutters, stop the machinery, and discharge the workmen; but it is not so pleasant an outlook to the carbon lamp manufacturer unless he commences to make the Nernst type of lamp (under license, of course) or improve the carbon lamp, as will appear later on. But there are other considerations to be taken into account where the advent of the Nernst lamp will be most beneficial, and where it will be appreciated, as we shall have for street lighting two illuminants to choose from, and where one is not applicable the other will be most serviceable. It may be considered that for lighting large areas such as squares, public markets, etc., and main streets and roads, the arc lamp will not be superseded, but for the lighting of narrow streets, public halls, etc., the Nernst lamp will be a most valuable acquisition, on account of the increased economy in running. In all the circumstances it must be considered that the lamp is automatic in its action, as the match-assisted lamp is out of question in 1899, excepting, of course, to the promoters. The engineer and manager of one of the most successful gas works in the country said to me, when discussing the merits of the Nernst lamp: "Why, you will be going back to the old barbarous times of gas lighting if you use a match to light your incandescent lamp, and all the advantages of the enclosed filament lamp will be dispensed with."

TRANSFORMER ECONOMY.*

F. H. LEONARD, JR., MONTREAL.

(Continued from last issue).

Central station practice has not yet settled down to uniform methods of installation, but the trend now seems to be in the direction of larger transformers with secondary networks preferably on the thin wire system. The general introduction of meter basis of charge, making it possible to safely connect double the rated transformer capacity in lamps to the secondary network—whereas with the older systems, providing a separate transformer for each connection, it was necessary to provide transformer capacity equal to the lamps connected. With separate transformers of small sizes, necessary for individual supply, the aggregate core losses become a serious drain upon the central station. We have frequently seen banks of small transformers serving a single customer or group of customers, this condition being brought about by the gradual growth of demand for light exceeding the capacity of the original transformer installed, a further growth exceeding the capacity of the second, and so on. In such cases the substitution of a single large transformer of modern design, displacing the small ones, would save its price in less than a year, if credited at the usual selling price, with the amount of current saved. Don't put a modern transformer of good regulation into a group of antiquated transformers of poor regulation; if you do you will lose your new transformer, which is likely to be unjustly condemned for trying to improve the regulation of its bad associates. Placed in such company, the new transformer tries to maintain the good regulation for which it was designed, while the lazy, old shirks, with which it is connected, steeped in the vice of bad regulation, throw their entire load on to the new comer, which good naturedly carries it all till it can no longer stand the strain, and literally roasts out and breaks down under the load.

In most of the smaller stations, and in many of the larger ones, money can be saved by remodeling the system of distribution, and at the same time improving the service by laying out a net work of secondary mains, starting first in the business portion of the town, with the installation of a few large transformers, reserving the small transformers, which these replace—if they are modern and worth keeping—for extensions in the more remote sections, where for the time the secondary network is impractical. It may occur in some cases the secondary network will be practical in several different sections, and these separate sections will, in most cases, gradually grow together, allowing taps to be made for new customers at intermediate points. In most cases, where prices are based on meter rates, such an arrangement can be installed at no greater first cost than the individual transformer system—the saving in cost of transformers, on account of their larger size and less total capacity required, paying for the copper mains. Such an arrangement always results in more satisfactory service to the consumers, at the same time greatly reducing the leakage current necessary to magnetize the transformers or supply the waste in core losses.

A few figures may serve to impress the idea more firmly in your minds. Let us take the case of a station having an average load, equivalent to 1,000 lights, most of which average four hours burning per night, and making due allowance for belting, dynamo, line, transformer and secondary wiring losses, we will allow that 10 lights are obtained per 1 h.p. at full load. In the first case we will suppose an individual transformer system is installed, using 10 10-light, 10 20-light, 10 30-light, 5 40-light, and 4 50-light transformers, even with modern transformers these would have an aggregate core loss of about 1,200 watts. If we substitute for this arrangement 6 150-light transformers, connected with a secondary main, retaining the 10 small transformers for isolated customers so scattered as to make it impractical to connect them to the secondary mains, our core losses will be reduced to 692 watts, or a saving of 448 watts for every hour the plant is run, which for twenty-four hours a day would amount to 3,920 k.w. hours per year, which at 10 cents per k.w. hour would be $392, or 6 per cent. on more than $6,500, a sufficient amount to more than pay for the change, if no consideration is made of the transformers left on hand, which would be superseded by the new arrangement. In the case just mentioned, we have assumed the original arrangement to be modern transformers. Had we assumed them to be old types, the saving would have been three or four times that shown, and would have allowed us to make a good or a better showing had we only charged 3c. per k.w. hour, which would be less than the cost of production in a station of 1,000 lights capacity. Some of our friends may argue that these losses cost them nothing, as they are running on water power, but we would like to remind them that the capacity in their generators, water wheels, or whatever prime movers they use, represent capital invested which add to the fixed charges their pro rata of interest and depreciation for which it makes no return, whereas, if the capacity used in overcoming these losses could be rented at the usual rates, a material difference in the capacity to pay dividends would be shown.

*Paper read before the Canadian Electrical Association.

CENTRAL STATION ACCOUNTING FROM A BUSINESS STANDPOINT.*

BY P. H. HART, MONTREAL.

The reasons why a standard system of accounting for central stations ought to be adopted are many and substantial. The individual owner of a small plant is as much interested in having accurate knowledge of the condition and details of his business and a determinate method of obtaining such condition and details, as the manager or directors of a large joint stock company. A proper system of accounting should show to the directors, manager, proprietor or other interested party (and for the sake of brevity I will hereafter refer to such parties as manager) besides the profits or losses of the business, the cost of producing what is sold, and should demonstrate this cost in such manner as to enable him to learn what the product costs in its various details, and particularly the costs separately of generation and distribution. These being determined and ascertained in the ordinary progress of business and due account being had of interest on investment and depreciation of plant, the manager can compare costs and determine where excesses arise, whether in the generation or distribution, and the reasons therefor. It should also show promptly and definitely the condition of affairs of a business at any and for given periods, which is a decided requisite and absolutely essential to sound business administration. It should be such as to enable the manager to determine the advisability of soliciting or catering for any particular line of business that may be offered or obtainable and

*A paper read before the Canadian Electrical Association.

indicate the most profitable, and be a guide, preventing indiscriminate investment in pole line construction, apparatus, etc., and show at all times the value of the investment for such purposes as insurance, arbitration, assessment, etc., etc. With such information created, compiled and formulated in the regular progress of the business, the manager will be enabled to consider intelligently operating costs and the advantages or disadvantages of further investment. I may here call your attention to some interesting information which appears in the 14th annual report of the Board of Gas and Electric Light Commissioners of Massachusetts, Public Document No. 35. This shows that out of 58 electric light companies operating in that State, with a total investment of over $17,000,000, five of the companies appear not to have earned expenses, and 32 have not earned sufficient to warrant the declaration of any dividend; thus very near 10 per cent. of the electric light companies operating in that State do not earn expenses, and 37-58, 63 per cent., are not earning sufficient to make a return to the investors on their capital. Many of them, no doubt, may have believed they were doing well until a rigid system of accounting had been applied. These commissioners are doing much to standardize the system of accounting in use by electric lighting companies in that State, and this statistical information is the direct result of a uniform method adopted by these commissioners in adjusting the statements submitted by the various companies. H. A. Foster, who investigated in detail 160 electric lighting stations of the United States, for the United States census, in a work based on the information gathered by him in the taking of this census and recently published, entitled "Central Station Bookkeeping," regrets the lack of system in accounting shown by the various electric lighting stations which came under his notice, and lays particular stress on the necessity of accurate accounting in central station work, for obvious reasons.

In addition to other reasons for and the advantages of a standard system of central station accounting, I might say that in the event of the question of municipal ownership or purchase arising the manager should have definite knowledge as to the cost of investment, cost of operating, etc., to compare with assumed cost of municipal operation. I will now present to you a system of accounting at present in use, having the objects above outlined in view, the results of which have been highly satisfactory, and in connection with it a system of records which form necessarily a part of a thorough accounting system. In the presentation I will indicate some of the various books and forms in use. Central station accounting from a business standpoint should proceed from and be based upon an order system, guiding, directing and allotting in advance the distribution of expenditure for investment, operation or maintenance and of revenue to the several distributions or sub-divisions of those general items that may be deemed desirable. And here I may say that such sub-divisions should be as numerous as the several details of a business, and when arranged for and determined upon beforehand, becomes, in practice, very easy of allotment or apportionment. A written order should be issued covering each and every transaction, indicating the character of the transaction and the accounting to which the expenditure incurred therefor is to be charged, or the revenue derived therefrom is to be credited. This to be determined and declared in the order before the expenditure is made or the revenue derived. Such system necessarily means that for every debiting entry to an account, something must be credited and all entries and accounts must result in a perfect balance, so that double entry bookkeeping is absolutely necessary to the practical working and comprehension of this system. The system referred to herein, and partially illustrated by various forms or blanks, can be readily put into operation by any company and practically at any time desired. Under the system described as at present carried out, the accounting is eventually grouped into what may be designated as general accounts, which are kept in a general ledger. All the other accounts, subordinate to these general accounts, and forming what may be designated as the working accounts, and which lead up to and are finally grouped into general accounts, are kept in other or subsidiary ledgers. This subdivision of books or ledgers is done in this instance simply as a matter of convenience, because the volume of business is large and necessarily requires to be attended to by a number of persons; but the principle involved would permit carrying all the accounts in one set of books if the volume of business were so small as to make that desirable. The general accounts consist of the assets and liabilities, and may be sub-divided in accordance with the wishes of the manager—as, for instance, the asset account of merchandise might, if desired, be sub-divided into fuel, line supplies, station supplies or wiring supplies, etc., such accounts representing materials on hand for use as required, either for any addition to construction or for operation or maintenance of plant. The asset account of plant and construction account may be subdivided into station construction, lines and poles, real estate, buildings, etc. The feature of the general accounts is practically no different from that of any other double entry bookkeeping system of accounts. The method in which this system may vary from ordinary methods of bookkeeping is principally in what may be known as the working accounts, and it is here that the formulation of the accounting and the determination to which account work under any given order shall be entered, arises. In the forms shown will be noticed the titles of sub-divisions of the working accounts representing expenditures. They show construction accounts, operating accounts and maintenance accounts subdivided into the various details, upon which it has seemed desirable to accumulate and record information. All orders issued involving expenditure recite thereon the account and sub-account to which the expenditures made thereunder are to be charged, and all returns of labor, material or expense incurred upon such order are reported, quoting the number of such order (all such orders being numbered serially). Expenditures which are continuous during the entire year, such as, for instance, labor and material and expenses for the operation and maintenance of the station, or labor and material required for the trimming and inspection of arc lamps and lines, may be dealt with by orders covering the entire year or parts thereof, say monthly, the latter being preferable. Monthly orders for work of this character are preferable to yearly orders, because as soon as the expenditure authorized under an order has been completed, such order is turned in to the office or bookkeeper, marked as completed, and thereafter no expenditure can be made chargeable to that order.

It will be observed that the purpose sought to be accomplished by these orders is the localizing and sub-dividing of the expenditures to the particular parts of the work being done upon which the management deems it necessary to have accumulated any specific information. In the forms submitted, there are sub-accounts representing different parts of the operation within the station, sub-dividing it into boiler room, engine room and the electrical generating room; similarly it sub-divides the work outside, the inspection, trimming of lamps, lines, the additions to the plant, whether within the station or outside, and also seeks to separate the different classes of service. It is, of course, important that the returns made upon these orders be in accordance with the instructions contained in the order. Thus, for instance, an order authorizing the inspection of lines should not have charged to it or reported against it the coal consumed under the boilers, and experience has demonstrated that employees very soon become accustomed to reporting and subdividing their work in accordance with the designations of the orders under which they are acting, so that in practice the allotment of expenditures for labor, material or other expense becomes automatic, with the result that the bookkeeper can indicate at any time the amount expended for any sub-account. By using subsidiary ledgers for this purpose, arranged similar to blank or Form No. 1, which, as will be perceived, is a re-arrangement of the items upon the Form No. 2, and total up month by month or day by day as they may be recorded therein, the costs of each sub-account. Periodically, say monthly, the totals of these accounts are transferred either to asset accounts or to the debit of the revenue accounts, according to their character. The bookkeeper in debiting the returns on these orders to their various accounts, must make corresponding credit to certain other accounts; labor to credit of labor account; material or merchandise to credit of material or merchandise accounts, sub-divided as it may be; expense to expense account, and the totals of the credit of these accounts must, of course, balance with the totals debited to the accounts represented by the orders. When the labor is paid, the amount paid is debited to the labor account, thereby checking the accuracy of the pay rolls, which may be made up either from the returns upon the orders or by independent returns, but all labor represented by either the independent returns, time sheets or otherwise as may be used.

(Continued on page 110).

Forms Accompanying Paper on

CENTRAL STATION ACCOUNTING

From a Business Standpoint.—By P. H. HART.

SUBSIDIARY LEDGER.

Form No. 1.

GENERAL CONSTRUCTION.

INCANDESCENT INSTALLATION

Date.		Real Estate and Buildings.	Office Furniture and Fixtur's	Maps, Instruments and Drawing		House Connecti'ns	Placing Transformers.	Placing Meters.	Meters Located.	Transformers Located.	Interior Wiring.	Total.
1895 June												
July												
August												
Sept.												
Oct.												
Nov.												
Dec.												
1896 Jan.												
Feb.												
Mar.												
April												
May												
1896 June												
July												
Aug.												
Sept.												
Oct.												
Nov.												
Dec.												
1897 Jan.												
Feb.												
Mar.												
April												
May												
1897 June												
July												
Aug.												
Sept.												
Oct.												
Nov.												
Dec.												
1898 Jan.												
Feb.												
Mar.												
April												
May												

Original size of Form, 11 x 14 inches.

Form No. 2.

Class of Account—GENERAL CONSTRUCTION.

Date.	Account.	Sub-Account.	Labor.	Material.	Total.
	Real Estate and Buildings.......				
	Office Furniture and Fixtures...				
	Maps, Instruments and Drafting.				
	Incandescent Installations......	House Connections.			
		Placing Transformers.			
		" Meters.			
		Meters Located.			
		Transformers Located.			
		Interior Wiring.			
	Alternating Arc Installations....	House Connections.			
		Placing Transformers.			
		" Meters.			
		" Lamps.			
		Meters Located.			
		Transformers Located.			
		Interior Wiring.			
		Lamps and Coils Located.			
	Arc Installations, City...........	Connections.			
		Lamps and Fixtures Located.			
		Placing Lamps and Fixtures.			
	Arc Installations, Commercial..	House Connections.			
		Lamps and Fixtures Located.			
		Placing Lamps and Fixtures.			
	Series Inc. Installations, City....	Lamps and Fixtures.			
		Connections.			
	Series Inc. Installations, Comm'l	Lamps and Fixtures.			
		Connections.			
	D.C. Motor Installations.........	House Connections.			
		Inside Connections.			
		Meters Located.			
		Placing Meter.			
	A.C. Motor Installations.........	House Connections.			
		Placing Transformers.			
		Transformers Located.			
		Placing Meters.			
		Meters Located.			
		Interior Wiring.			
		Placing Motors.			
	Lines and Poles..................	Incandescent.			
		Arc, City.			
		Arc, Commercial.			
		D. C. Motor.			
		A. C. Motor.			
		Alternating.			
	Subways and Conduits..........				
	Cables..........................	Incandescent.			
		Arc, City.			
		Arc, Commercial.			
		Motor.			
	Tools..........................	Incandescent.			
		Arc.			
		Motor.			
		Linemen's.			
		General.			
	Horses and Wagons...........				

Original Size of Form, 8×11 inches.

Form No. 3.

Class of Account—STATION CONSTRUCTION

Accounts for Each Station.

Date.	Account.	Sub-Account.	Labor.	Material.	Total.
	Real Estate and Buildings....				
	Steam Plant...................	Boilers.			
		Piping.			
		Engines.			
		Pumps, Condensers and Heaters.			
		Shafting and Pulleys.			
		Belting.			
	Electric Plant.................	Incandescent Dynamos.			
		Incandescent Switchboard and Instruments.			
		Incandescent Switchboard Connections.			
		Arc Dynamos.			
		Arc Switchboard and Instruments.			
		Arc Switchboard Connections.			
		D. C. Motor Dynamos.			
		D. C. Motor Switchboard and Instruments.			
		D.C. Motor Switchboard Connections			
		Motors (in Station).			
	Station Tools..................	Steam Plant.			
		Electric Plant.			
		General.			
	Office Furniture and Fixtures.				
	Testing Equipment......				
	Interior Wiring..............				

Original Size of Form, 8×11 inches.

Form No. 4.

Class of Account—STATION OPERATING

Accounts for Each Station.

ACCOUNT.	SUB-ACCOUNT.
Rent	
Taxes	
Insurance	
Steam Plant	Fuel.
	Cartage of Ashes.
	Boiler Compound.
	Water for Boilers.
	Boiler Room Wages.
	Engine " "
	Oil and Waste.
Electric Plant	Inc. Dynamo Tenders' Wages.
	Arc Dynamo Tenders' Wages.
	D. C. Motor Dynamo Tenders' Wages.
	Incand. Switchboard Tenders' Wages.
	Arc Switchb'd Tenders' Wages.
	D. C. Motor Switchboard Tenders' Wages.
	Inc. Dynamo Brushes.
	Arc Dynamo Brushes.
	D. C. Motor Dynamo Brushes.
	Incand. Commutator Segments.
	Arc Commutator Segments.
	D. C. Motor Commutator Segments.
	Arc Blower Wings.
Arc Lamps, City	Oil and Waste.
	Carbons.
	Trimming.
	Inspecting.
Arc Lamps, Commercial	Carbons.
	Trimming.
	Inspecting.
Alternating Arc Lamps	Inspecting.
	Trimming.
D. C. Motor	Inspecting.
	Testing.
A. C. Motor	Inspecting.
	Testing.
Incandescent	Inspecting.
	Testing.
Lamp Renewals	Incandescent.
	Series Inc. City.
	Series Inc. Commercial.
Incandescent Lamp Changes.	
Lines and Poles	Inspecting.
(to be subdivided where possible)	Testing.
Removing Lines and Poles	Incandescent.
	Arc, City.
	Arc, Commercial.
	Motor.
Removing Installations	Arc, Commercial.
	Arc, City.
	Incandescent.
	D. C. Motor.
	A. C. Motor.
	Alternating Arc.
	Series Inc., City.
	Series Inc., Commercial
Fire Patrol	Arc, City.
	Arc, Commercial.
	Incandescent.
	Motor.
Testing (in Station)	Inc. Lamps.
	Meters.
	Alt. Arc Lamps.
	General.
Accidents	
General Expenses	Clerks.
	Stationary.
	General.

· Original Size of Form, 8× [illegible] inches.

Form No. 5.

Class of Account—STATION MAINTENANCE

Accounts for Each Station.

ACCOUNT.	SUB-ACCOUNT.
Real Estate and Buildings	
Steam Plant	Boilers.
	Piping.
	Engines.
	Pumps, Condensers and Heaters.
	Shafting and Pulleys.
	Belting.
Electric Plant	Arc Dynamos.
	Arc Switchboard and Instruments.
	Arc Switchboard Connections.
	Arc Lamps in Station.
	Incandescent Dynamos.
	Incand. Switchboard and Instruments.
	Incandescent Switchboard Connections.
	Incandescent Lamps and Circuits.
	D.C. Motor Dynamos.
	D.C. Motor Switchboard and Instruments.
	D C. Motor Switchboard Connections.
	Motors.
Lines and Poles	Incandescent.
	Arc, City.
	Arc, Commercial.
	D.C. Motor.
	A.C. Motor.
	General.
Installations Inc.	House Connections.
	Repairing Meters.
	Repairing Transformers.
	Replacing Transformers.
	Customers' Premises.
Inst. Alternating Arc	House Connections.
	Repairing Meters.
	Repairing Transformers.
	Customers' Premises.
	Lamps.
	Globes.
Inst. Series Inc. Commercial.	Lamp Fixtures
	Lamp Connections.
Inst. Series Inc. City	Lamp Fixtures.
	Lamp Connections.
	Lamps.
Installations Arc City	Lamp Fixtures.
	Lamp Connections.
	Globes.
Inst. Arc Commercial	Lamps.
	Lamp Fixtures.
	Lamp Connections.
	Globes.
Installations D.C. Motor	House Connections
	Customers' Premises.
	Repairing Meters.
Installations A.C. Motors	House Connections.
	Repairing Meters.
	Repairing Transformers.
	Customers' Premises.
	Motors.
Tools	Steam Plant.
	Electric Plant.
	Testing
	General.

Original Size of Form, 8×11 inches.

REQUISITION FORM

Form No. 6.

"Line Construction and Maintenance Dept." No.............

....189

Stores Dept. will please CHARGE to ....*for order No*...........

TO BE CHARGED

Blocks, Side
Bolts, Carriage, ⅜ x 4
" " ½ x 5
" " ½ x 7
" Machine, ⅜ x
" " " x
" " " x
" " ½ x
" " ½ x
" " ½ x
Brackets, Cross, 2 pin
" Flat, 2 pin
" Hook, with nut
" Leg
" 3 "
" Straight, 1 pin
" " 2 "
" " 1 " with nut
" " 2 " "
Braces for cross arms
Boxes, Junction
Cable
"
Cement, Roof
Charcoal
Cross arms, 2 pin
4 "
6 "
Cut outs, Film
Globes
Hanging Straps
Hangers, Iron Street
" Goose-neck
Hoods, Series Inc.
Insulators, Guy
Ordinary
D. P.
Porc.
Lamps, double arc, 2000 c.p.
" Single arc, 2000 c.p.
" Series 32 c.p., 9.6 amp.
" " 65 c.p., 9.6 amp.
Naphtha
Outriggers
" Plates
Pins, Oak
Poles, ft.
" "
" "
" "
" "
Rope, Manilla
Resin
Screws, Wood
" "
" "

Forward,

Forward,

Screws, Coach
" "
" Cap
Slings, rope
Solder
Spikes
Tape, Grimshaw
" Kerite
Transformers, Light No.
" " "
" " "
" " "
" " "
" " "
Turn Buckles
Tubing
Tripods
Washers, 5-16
" 7-16
" 9-16
" 13-16
Wire, Rubber Covered
" " "
" " "
" " "
" D. B. 4/0
" " 3/0
" " 2/0
" " 0
" " 1
" " 2
" " 4
" " 6
" " 8
" " 10
" " 12
" " 14
" " 16
" Cable
" "
" "
" Galv'd, 6
" " 9
" " 9 x 2 strand
" " 9 x 3 "

Received
Delivered by
D. B. Folio

Original Size of Form, 8 x 11 inches.

CREDIT

Form No. 6

No............ "Line Construction and Maintenance Dept."

....189

Stores Dept. will please CREDIT to ....*for order No*........ .

TO BE CREDITED

Blocks, Side
Bolts, Carriage, ⅜ x 4
" " ½ x 5
" " ½ x 7
" Machine, ⅜ x
" " " x
" " " x
" " ½ x
" " ½ x
" " ½ x
Brackets, Cross, 2 pin
" Flat, 2 pin
" Hook, with nut
" Leg
" 3 "
" Straight, 1 pin
" " 2 "
" " 1 " with nut
" " 2 " "
" Strap
Braces for crossarms
Boxes, Junction
Cable, Lead-concentric
"
"
"
Cement, Roof
Charcoal
Crossarms, 2 pin
" 6 "
" 10 "
Cut-outs, Film
Hanging Straps
Insulators, Glass, Small
" Ordinary
" D. P.
" Porc.
Naphtha
Outriggers
" Plates
Pins, Oak
Poles, ft.
" "
" "
" "
" "
Rope, Manillla
Resin
Screws, Wood
" "
" "
" Coach
" "
Screws, Coach
Solder
Spikes

Forward,

Forward,

Spikes
Tape, Grimshaw
" Kerite
" Okonite
Transformers, Light No.
" " "
" " "
" " "
" " "
" " "
" Straps
" Stays
" Tables
Tubing

Tripods

Washers, 5-16
" 7-16
" 9-16
" 13-16
Wire, Rubber Covered
" " "
" " "
" " "
" D. B. 4/0
" " 3/0
" " 2/0
" " 0
" " 1
" " 2
" " 4
" " 6
" " 8
" " 10
" " 12
" " 14
" " 16
" Cable
" "
" "
" Galv'd, 6
" " 9
" " 9 x 2 strand
" " 9 x 3 "

Received
Delivered by
D. B. Folio

Original Size of Form, 8 x 11 inches.

REQUISITION FORM.

Form No. 6.

Requisition No. **B**..........................

Montreal.......................................*189*

On General Manager's Order No...........................

	Class of Account.	Account.	Sub-Account.
For........... Debit........... Credit...........			

Received by.......................................*189* ....*Foreman*

Delivered by.......................... ....*Supt.*

D. B. Folio.......................... *For use in*..........................*Dept.*

Posted..........................

Original size of Form, 8 x 10 inches.

Form No. 6.

CREDIT.

Requisition No. **C**..........................

Montreal.......................................*189*

On General Manager's Order No...........................

	Class of Account.	Account.	Sub-Account.
For........... Credit...........			

Received by.......................................*189* ....*Foreman.*

Delivered by.......................... ....*Supt.*

D. B. Folio.......................... *For use in*..........................*Dept.*

Posted..........................

Original size of Form, 8 x 10 inches.

Customers' Record Book Form.

INCANDESCENT

For Month Ending June, 1899.

	Cir. No.	Led. Folio.	Name.	Date.	Meter Read'g in Ampere Hrs. Present.	Meter Read'g in Ampere Hrs. Consumed.				Meter Rental.	Total.	Led. Folio.	Date.

Original size of Form, 23½ x 18 inches.

Form No. 8.

LIGHTING DEPARTMENT.

	Ledger Folio.	Ck.	Customer.	Discount. Incand.	Discount. A. C. Motor	Totals.	Lighting. Incand.	Lighting. Com. Arc.	D. C. Motor. Current.	D. C. Motor. Rental.	D. C. Motor. Sales.

Original size of Form, 20 x 15 inches.

Note.—The Customer's Record Book Form and Form No. 8 should be read across the two pages.

Form No. 7.

CARD........................

INCANDESCENT METER CARD.

LED. FOL............ CONTRACT NO...... ....DATE............................ ....

DATE OF CONNECTION } ............................TERM..............EXPIRES...... ... .

NAME... ....

ADDRESS ....

BUSINESS.. ....

REMARKS ....

....

METER NO..CAP...AMPERES

GOV. CERT. ....PER CENT. OF ERROR.................................

CIRCUIT NO.......................................VOLTS...

Lamps Installed.

DATE.	ORDER	5 C.P.	8 C.P.	10 C.P.	16 C.P.	32 C.P.	C.P.	TOTAL EQ. TO 16 C.P.

Original size of Form, 8 x 4½ inches.

METER NO.......................... VOLTAGE.......................... RATE ....

REMARKS.	Original size of Form, 8 x 4½ inches. (Back of Incandescent Meter Card).
DAYS	
Current Regist'd	
READING.	
DATE.	
INSP.	

Manager's Order Form.

NAME.......................... ....   ORDER NO................. ......

ADDRESS ....   DATE..................................

....

THIS ORDER AUTHORIZES AND DIRECTS THAT ....

....

....

....

....

....

....

SIGNED...GENERAL MANAGER

Return this Order as soon as completed, and report labor, material and expenses on following accounts.

CLASS OF ACCOUNTS.	ACCOUNT.	SUB-ACCOUNT.	Station	No. of Circuit.	

TO.......... ....

REPORT HERE, REMARKS, ETC.

....

....

....

....

....

....

WORK COMPLETED, DATE .. ..

SIGNED BY.................................. ....

Original size of Form, 8 x 11 inches.

LIGHTING ACCOUNTS.

July, 1899.								August, 1899.									
METER READ'G IN AMPERE HRS.						Meter Rental.	Total.	Led. Folio.	Date.	METER READ'G IN AMPERE HRS.						Meter Rental.	Total.
Present.	Consumed.									Present.	Consumed.						

CASH RECEIPTS.

CONTRACT AND SALES.			A. C. MOTOR.			RENTAL.			MISCELLANEOUS.	TOTAL.
Wiring.	Lamp Renewals.	Line Construction.	Current.	Rental.	Sales.	A.A. Lamps.	Transformers	Poles.		

must balance with the accounts credited as above to labor account, and debited to the accounts represented by the various orders.

In the detail working under these orders through a number of employees, means of obtaining material and making returns under and to these orders become necessary, and where a large number of employees are engaged, these necessarily require the adoption of other forms or blanks, as, for instance, the requirement of material for the execution of any order necessitates that an application be made by the employee needing that material to the store room or storekeeper, where such material is kept on hand, or through whom it will be purchased if need be. In the system described, this becomes what is known as a requisition, blank No. 6, and in filling out such requisition the employee requiring the material quotes thereon the No. of the order on which he intends using it. Similarly in making returns of labor or time, the time ticket or labor return blank specifies the order No. authorizing such labor. Blanks or forms authorizing the return to storeroom of any surplus material that may have been taken out on an order, also recite thereon the order No. to which it is to be credited or upon which it is returned. In all these returns or reports, besides quoting the No. of the order, the accounting of such order is also recited, the object being to prevent the error of charging a wrong account through a mistake or transposition of the order numbers. Revenue accounts may also and in the system herein referred to are sub-divided or classified into various accounts of service from which the revenue is obtained, as, for instance, alternating current incandescent lighting, alternating current motor service, direct current motor service, arc lighting, etc., and this subdivision may be made as minute as desired.

Dealing with a large number of customers, it is important that means be adopted whereby none shall escape from the grasp of the bookkeeper or collector. Therefore no customer should be connected with the service lines except under an order, as above described, authorizing such connection and supply of the service called for. Upon completion of such order, it is returned to the bookkeeper, with notation thereon that connection has been made and supply of service begun. Meanwhile, that is as soon as the order to make connection has been issued, the contract signed by the customer upon which the order has been issued, is transmitted to the bookkeeper, who immediately opens in his ledger an account with such customer. On the return of the completed order, the bookkeeper notes in his ledger at the customer's account, the date of starting, which is also marked upon the contract. The customer's contract is not filed or put away or considered as being in operation, until such notation has been made. As an additional precaution, when the account is opened in the ledger, a card similar to Form No. 7 is prepared by the bookkeeper, giving the customer's name, address, ledger folio and number of contract (and all contracts are numbered serially), character of service, and generally the main details of the contract and service. This card is filed according to ledger folio, and accumulates the record upon which the debit side of the customer's account in the ledger is created. In cases where meters require to be read, these cards constitute the guide to the meter readers as to what meters are to be read. In sending out accounts to customers for service, every card must be accounted for by an invoice, and the fact of such invoice rendered noted thereon. In other words, the card is used to make out the invoice against the customer and the invoice is used to enter the account in the ledger, and every account in the ledger must be represented by an invoice.

The use of the method of making the entries in the day book and ledger from the invoice instead of making the invoice from the record book, is to hasten the transmission of accounts to customers, in order that they may not have any cause of complaint for delay in the opportunity to pay their accounts. In practice, the invoices are made out during the month as far as possible, leaving only the final entry to be made when the amount of the invoice has been determined, so that it becomes possible to transmit a large number of accounts within practically one day after the meter readings have been taken. The cards, in fact, constitute the history of the relations of the customer with the company, and at a glance show the variations in the use of service, for, as will be perceived, they are made to cover the year's transactions. They apply equally well for "flat" rate customers as for meter customers, though they are for recording meter readings. In the case of meter customers, they indicate the variations of use and afford a guide to the bookkeeper to enquire into the accuracy of the meter reading reported; any falling off or unusual increase in the use of the service as indicated by a reading immediately attracts the attention of the bookkeeper or billing clerk, thereby causing him to institute an immediate enquiry into its accuracy. In the case of "flat" customers, it declares at once the proper amount of the account to be rendered, by the record of the account previously rendered. The debits to customers are credited to the several sub-divisions of the revenue accounts, that is, the customer may be using several kinds of service, the amounts for which are debited to his account, but credited each to the revenue account to its individual class of service. This results in determining the revenue obtained during any period from each kind of service, the total of all, of course, representing the entire revenue obtained and offsetting the expenditures made therefor.

Companies having to deal with a large number of customers and various classes of service, and varying discounts, resulting from special or large consumption, will necessarily require for the convenience of the cashier, a secondary or subsidiary cash book in which can be noted the special discounts or allowances made, as well as the cash received for the various classes of revenue. A form of such cash book is indicated in blank No. 8. This cash book or rather entry book, for the receipt of cash and discounts, applies only to discounts stipulated in the contract. Other allowances, rebates or credits are made only by authority of order issued specially therefor in each case.

Assuming this system of accounting to have been properly and carefully carried out to the end of the fiscal year, we would now have before us the total revenue from the business in its various classes. On the other hand, we would have the total cost of operation and maintenance, general expense and the total expenditure on capital account for the year; taking the total revenue derived and deduct from that the total cost of operation and maintenance, will give the gross profit. From this gross profit is to be deducted the general expense. The general expense account should include only such items as are purely general. By that I mean expense which cannot be charged to any specific working account, and is purely general in its relation to the business, such as interest, office expenses, directors' fees, salaries of officials, legal expenses, travelling expenses, for instance expenses incurred in attending Electrical Association conventions. Deducting the general expense from the gross profit will give the net profits of the business for the year, exclusive however, of depreciation. This question of depreciation is usually determined by the management. It always has been a much discussed question, and authorities find it very difficult to agree on a uniform method of application, the changing value of apparatus being so widely different. However, one of the definitions of depreciations, given by E. Hartley Turner as "The re-payment of capital out of the total gross revenue earned during a given period of such proportion of the original capital outlay as has been absorbed or consumed in earning such gross revenue" is very good, could the amount so absorbed be readily determined. A definite plan, however, is to apply to property in which a residue of value under any circumstances must remain, a graduated percentage upon its changing value as representing depreciation. The amount of this depreciation, however, will be governed to a great extent by the amount of the expenditure on maintenance account.

In the presentation of this paper, I have endeavored to follow out the question of Central Station Accounting from a business standpoint solely. With this in view, it has been confined almost entirely to the question of the method of ascertaining costs of generation and distribution, and recording from whence revenue has been derived and the methods of assuring the obtaining of all the revenue derivable. I have assumed that the important features are the knowledge of costs and the sources from which the revenue can be most profitably obtained. The question of purchase of material and the recording of these purchases have not been touched upon, this method being practically similar to all lines of business; neither has reference been made to the obtaining or keeping of records pertaining more particularly to the Engineering Department, for the reason that this subject has been exhaustively considered in a paper entitled, "Some Central Station Economics," submitted by P. G. Gossler at the annual convention held in Toronto in

1897. Whilst, no doubt, the system herein described may appear elaborate and extensive in detail, and perhaps seem to entail expenditure for labor beyond the reach or desire of managers of small stations, I see no reason why the principle involved may not be used in any station at a slight expense. For while perhaps not requiring to employ all the sub-divisions indicated upon the blanks or forms shown, yet many of them can be utilized and put into practice with such modifications as the local conditions demand without imposing upon the manager or employees any labor or expense beyond that which can be afforded. and if I have succeeded in conveying ideas and information that may serve towards the adoption of a general system of Accounting for Central Station practice as suggested by the authorities referred to in the beginning of my paper, I will feel myself amply compensated.

RAILWAY ENGINEERING.

The Engineering News, New York, says recently: "We here have presented in book form a series of articles on railway construction originally published in The Canadian Engineer. The author has had a long and varied practical experience in railway work; and while he quotes freely from the late A. M. Wellington's 'Theory of Location,' and from other standard works on this subject, his aim is to serve those who wish to acquire some general information on subjects heretofore separately treated. In the first chapter he deals with fundamental considerations and statistics, chiefly applicable to Canadian railways. Train, curve and grade resistance and their cost, and vertical and horizontal and transition curves are treated in the next two chapters. Under Surveys, we have, the organization and methods for making reconnoissance, preliminary and final surveys, and some of the methods of passing obstacles. 'Roadbed Construction' covers waterways of various types, with designs for such structures and approximate cost, and includes large bridge foundations and the methods for sinking them; wooden trestles are treated at full length as still desirable where wood is abundant and other material unavailable. Foundations on land and in water are separately treated; the various methods are described and the approximate cost is given in many cases. The laying out and measurement of work is illustrated by diagrams and text, and notes are included on the methods of payment and classification of materials, etc. The sixth chapter deals with Canadian railway law, under the Railway Act; and Part II. of the book is devoted to track details. The work, taken as a whole, condenses into a small compass much information that will be useful to young railway engineers."

THE DART UNION COUPLING.

We call the attention of our readers to the advertisement that appears now for the first time in a Canadian journal, of the E. M. Dart Manufacturing Co., Providence, R.I. This company is engaged in the manufacture of several excellent steam appliances that have won their way to the front by merit. The most conspicuous is the Patent Union Coupling, which is claimed by all parties to be "the best." One of the illustrations in the advertisement shows the patented features, which will be readily understood by steam users. The connecting parts marked Dart Patent, April 1st, 1890, are made of bronze, the other parts are malleable iron. This company has supplied to the Brooks Locomotive Works, Dunkirk, N.Y., fifty thousand of these couplings in the past four years. These couplings are now being furnished to the largest industrial works, including locomotive builders, railroad companies, factories, breweries, ship builders, miners, steam fitters, gas companies, plumbers, and others, for use in connecting pipes, for the conveyance of steam, water, gas, oil, air, etc. The E. M. Dart Mnfg. Co., in offering to the people of Canada this excellent device, can give assurances, born of experience, that the meritorious features have been subject to the "crucial test of time," and no risk is taken in buying the goods. We learn that the company contemplates having these goods on sale with the prominent jobbing houses of Canada soon. All enquiries for prices and discounts will be promptly answered by addressing E. M. Dart Mnfg. Co., Providence, R.I., U.S.A.

LEAKING VATS.

Editor CANADIAN ENGINEER :

Will you kindly tell me what to apply to the inside of cider tanks to prevent the cider soaking through the wood. I have lost hundreds of gallons in this way, and can find no remedy.

[The only satisfactory method, so far as we know, is to apply a special enamel to the inside of the tanks, such as brewers use. We have sent you by mail the name of a dealer in brewers' supplies, whom we can recommend. Ed.].

SMOKE CONSUMPTION.

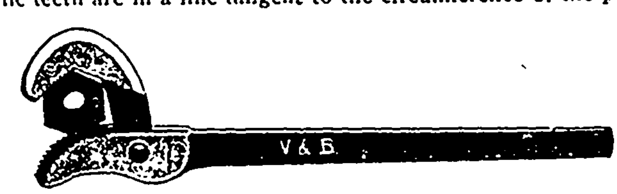
The Montreal Board of Trade has for some time used anthracite screenings as fuel in making steam for light and power. A forced draft is necessary to do this, which causes a considerable quantity of the ash, small particles of slate, and some unconsumed coal dust to escape at the top of the chimney in the shape of fine hard grit. This proved troublesome, not only to the Board of Trade and their tenants, but also to others in the neighborhood, and it was decided to at once put a stop to it. This has been accomplished most effectually in a novel manner, the sparks or grit as they leave the fire are caught and separated from the hot gases before they pass through the tubes of the boiler, thus preventing the accumulation of dust or ashes in the tubes and maintaining the boiler in its most efficient condition at all times. The sparks or grit, after being separated from the hot gases, are then immersed in water and conveyed outside the building by means of a special hydraulic conveyor, and are then separated from the water and are ready to be carted away. The water is then returned to carry out more ashes and grit. The system was thoroughly tested on one boiler for six months before being applied to the remainder of the plant, since which time it has been inspected by several prominent engineers, who all say that it is the best device for the purpose that could be thought of. John J. York, superintendent and engineer of the building, is the inventor of the system, and he is now preparing to take out patents on it.

CORRECTION.

In the issue of The Canadian Engineer for June, by a typographical error in John S. Fielding's letter on "Dam Building," the formula "$31.25h^{3}$" was made to appear as "$21.25h^{2}$."

THE V. & B. PIPE WRENCH.

Vaughan's improved positive grip pipe wrench combines lightness and strength, as well as durability, and its construction is the most simple, and the least complicated of any practical pipe wrench on the market. As will be seen from the above cut this wrench consists of only two pieces, which are drop-forged from bar cast steel; there is no malleable nor wrought iron used in its construction. It is solid cast steel from end to end; it has no threads to rust and wear out, nor springs to break; it cannot lock nor wedge on the pipe, and will release its grip instantly when the pressure on the handle is removed. The teeth are in a line tangent to the circumference of the pipe,



which combined with the oscillating angular toothed jaw, absolutely prevents crushing or slipping on the pipe. The jaws are oil tempered and the teeth can be sharpened with a file when dull. This wrench is especially adapted for use in limited spaces, such as narrow ditches, pump work in wells, pipe work for irrigation, wind mill pipe work, and for general use around agricultural machines. Every mechanic should have one. For screwing in stud bolts in steam pumps and engines. The makers claim for the V. & B. pipe wrench, simplicity of construction, combined with lightness and strength, and its positive rigidity when under a strain, and wherever it can be used there is no wrench that excels it. Every wrench is warranted. This wrench is equally suitable for square and hexagon nuts, iron rods, etc.

Length.	Capacity.
10 inch pipe	⅛ to ¾
14 inch pipe	¼ to 1½
18 inch pipe	¼ to 2
24 inch pipe	½ to 2½

For discounts and further particulars address Aikenhead Hardware Co., Toronto.

NEW CATALOGUES.

Lundell Fan Motors, catalogue 66; Sprague Electric Co., New York. Jack & Robertson, Montreal, sole agents for Canada. This is a most attractive booklet of 40 pages, bound in green and gold, and profusely illustrated.

Electric Power—The Lundell Motor, Catalogue No. 58; The Sprague Electric Co., New York. Jack & Robertson, Montreal, sole agents for Canada; 70 pages; paper; illustrated.

Greenfield Flexible Metallic Conduit, Catalogue No. 63; Sprague Electric Co., New York. Jack & Robertson, Montreal, sole agents for Canada. This valuable specialty is very fully illustrated in some 20 pages, paper.

FIRES OF THE MONTH.

July 5th. Winnipeg Trunk and box factory; loss, $5,000; insurance, $1,200.——July 12th. Hourd & Co.'s furniture factory; loss, $8,000; insurance, $4,000.——July 24th. Str. "Mistassini," on Lake St. John, Que.; loss, $50,000.——July 26th. J. F. Beckhan's saw mills, Holmes & Arpin's box factory, D. Gagne's door and sash factory and W. S. Scott's cabinet factory, Montreal; loss, $13,000.

LITERARY NOTES.

"Transformer Design;" a treatise on the design, construction and use of transformers, by Geo. Adams, A.I.E.E., A.M.I.M.E.; cloth, 75 pages, 34 diagrams: Spon & Chamberlain, New York.

The weekly news edition of the Street Railway Journal is a new and most welcome recruit to the ranks of technical journalism. This edition is devoted primarily to the publication of street railway news and current happenings related to street railway interests.

"A Practical Handbook on the Care and Management of Gas Engines," by G. Lickfeld, C.E., authorized translation by G. Richmond, M.E. This compact little volume also contains instruction for running oil engines. Cloth, 113 pages, illustrated: Spon & Chamberlain, New York, publishers.

"Small Accumulators; How Made and Used," is an elementary hand-book for the use of amateurs and students; edited by Percival Marshall, A.I.,Mech.E. This is a scientific handbook of great value to the class of readers for whom it has been specially prepared.

We have received the Transactions of the Association of Civil Engineers of Cornell University, Vol. VII., 1898-99. This volume contains addresses by non-resident lecturers, miscellaneous papers, constitution and list of members of the association. Among others these are interesting papers; Notes on the Use of Concrete in Dams, Data of Stream Flow in Relation to Forests, Locks and Lock Gates for Ship Canals, etc.

Wallace Bentley, A.I.M.E., Halifax, Eng., is the author of a most valuable series of technical works. Rules and definitions specially arranged for the use of students in the engineering subjects is a surprisingly full store of exact information contained in so small a compass as to be very convenient for reference. In our column, "The Practical Man," we quote a few paragraphs on Toothed Gearing, which will show the reader the value of these works of reference. Questions in Applied Mechanics (with answers), is a companion volume, as is Questions in Machine Construction and Drawing. Sketches of Engine and Machine Details is a cloth bound volume of some hundred pages, each crowded with carefully prepared drawings of details which cannot but be of great assistance not only to technical students but to everyone who wishes an exact knowledge of engine and machine details.

We have on our desk the calendar of the School of Mining, Kingston, Ont., for 1899-1900, which contains a full announcement of the work of this progressive institution. Wm. Mason, Bursar, School of Mining, Kingston, Ont.

The illustrated supplement to the Nelson Miner presents a great variety of views of the town of Nelson and surrounding localities in its numerous illustrations, and in the text gives a good deal of information as to the people and places shown.

The Department of Public Works, St. John, N.B., has issued the Engineer and Superintendent's Report on Sewerage and Water Supply. This work is in charge of Wm. Murdoch, C.E., and all engineers must feel interested in the thorough manner in which everything is carried on. Mr. Murdoch's methods in cleaning the city water mains have been fully described in The Canadian Engineer in the past. We shall give some of the more recent results in the early future.

We have received from the Civil Engineering Society of Perdue University, La Fayette, Ind., the Proceedings of the Perdue Society of Civil Engineering, 1898. There are some interesting articles on irrigation problems, and a discussion of block asphalt under the title of The Coming Pavement. We learn that paving blocks of crushed stone and asphalt were first manufactured in San Francisco in 1869. Since that time the methods of manufacture and the necessary machinery have been perfected until it became possible to manufacture them at prices that would permit of competition with other pavements. For the past thirteen or fourteen years the tests of this pavement have proved that it was no longer an experiment. Baltimore has a sample of the asphalt block pavement that has been in use for fifteen years, and is still in good condition. The blocks are 4 in. by 4 in. by 12 in. in size, composed of about 85 per cent. crushed stone and 15 per cent. asphaltic paving cement and subjected while at a high temperature to a pressure of 120 tons to the block. The blocks weigh eighteen pounds each, they are laid crosswise of the street, making a pavement 4 inches deep. The cost is about $2 per square yard.

THE ROYAL ELECTRIC CO., LTD.

The annual meeting of the shareholders of the Royal Electric Company was held July 18th. Among those present were: D. Morrice, Lieut.-Col. Strathy, F. L. Beique, C. S. Campbell, H. B. Rainville, Herbert Wallis, G. F. C. Smith, A. F. Riddell, J. R. Meeker, G. R. Marler, John Date, Edwin Hanson, Frank Newman, A. Brunet, W. H. Browne, the manager, James Wilson, Mr. Morrison, G. H. Smithers, Edward Rawlings, H. G. Strathy, George Caverhill, and L. McI. Spackman.

The manager, W. H. Browne, made some explanations in regard to the operations of the company since its inception and during the past year. He said that, in the electrical business, inventive genius was so prolific that the plant or apparatus for manufacturing electricity soon became obsolete. Hence, during the existence of this company, $1,800,000 of equipment had become useless, or superseded by improved machinery and methods. The whole of that $1,800,000 had not been written off, but $600,000 to $800,000 had, and, while there was certainly a million dollars in the nominal assets, which was really not in existence for any practical purpose, he thought the proper thing to do was to distribute the loss over a number of years, as they had been doing. Speaking of underground conduits, Mr. Browne said the time was coming, and they soon must meet the necessity. The cost of total conversion from pole wiring to conduits would be $1,500,000, but entire conversion was not necessary, as in some of the residential quarters it was not called for. He explained that, notwithstanding the large outlay for conduits, the expenses of maintenance would be sufficiently reduced to pay the interest on the outlay. The prices of current in Montreal would not be reduced to the point consumers expected, even if the source of supply was the water power of Chambly.

Colonel Strathy nominated as directors the following gentlemen: Col. J. A. L. Strathy, D. Morrice, James Wilson, H. B. Rainville, R. Forget, J. R. Meeker, A. Brunet, F. L. Beique and George Caverhill.

From last year's board there were left out of this year's nomination, the following: Hon. J. R. Thibaudeau, A. R. Macdonell, H. S. Holt, Edwin Hanson and Robert Cowans.

Those nominated were elected, though D. Morrice and F. L. Beique refused to act. At a subsequent meeting of the directors, R. Forget was elected president, and J. A. L. Strathy vice-president.

The following figures are from the fifteenth annual report of the Royal Electric Company for the year from May 31st, 1898, to May 31st, 1899:

The gross amount for the year to credit of revenue accounts aggregated	$1,113,770 87
Expenditure for labor, materials, operation, maintenance, and general expenses	791,486 58
Balance	$ 322,284 29
Less interest and fixed charges	54,600 11
Net profit for the year	$ 267,684 18
There have been declared four quarterly dividends of two per cent. each to the total amount of..	120,000 00
Leaving a balance of	$ 147,684 18
From which are to be deducted the following:	
Sundry debts uncollectible or of doubtful value, charged to profit and loss account	3,101 66
Depreciation of merchandise, and factory product, on hand	8,777 99
Apparatus and plant displaced and withdrawn from use, and of diminution in values of sundry items of assets	123,870 16
Added to the credit of profit and loss account ..	11,934 37

HOT WATER HEATING.*

BY P. TROWERN.

In my last address I told you about the different plans which were adopted by the people in different countries, for heating their houses. The furnace and plans of laying the pipes, invented by Mr. Perken for heating large buildings in England and other countries were brought here in the year 1850 from London by Mr. Howard, to this asylum, and fitted by Mr. Garth of Montreal, and after I took charge of it in 1856 it did good duty for 34 years; in 1890 I began to change the coil furnaces for tubular boilers, in the main building; we have now only four furnaces left in cottages A and C, which I will soon change for two boilers, although they have worked well for the past cold winter, keeping 100 people warm, with 60 tons of coal. I told you that I would give you my reasons for changing. Fully twenty years ago I saw a good change could be made after making and repairing 100 coils, and every year the brick-work had to be repaired, and made new, which became expensive, and took so much of our time in the summer, which seemed so short, in keeping new work and repairs in order for the winter.

I have shown you in my diagram of the furnace that the two pipes at the back are the flow or hot water pipes, rising out of the coils, inside and outside ones; the two in front are the return pipes with taps at the bottom and connected with each coil at the bottom. The pipes are connected with a cast-iron expansion cylinder, each one on a wooden pedestal in the ward; each coil has a cylinder, the flow pipe connects with the cylinder as near as possible in the ward, in the bottom so that the cylinder becomes very hot at times, the return pipe also connects with the cylinder in the bottom and extends around the rooms for about 500 feet of pipe, and returns in the same recess together to the coil. In this form the water is always moving around while there is any heat in the furnace or bricks.

We will now look at our middle ward, which is about 30 feet above our furnace, this 30 feet of 1-inch pipe will hold one gallon of water at about 40 deg., or 10 lbs., and when heated to 212 deg. it will expand so that 21 gallons becomes 22, one gallon or 10 lbs. will become with the water in the cylinder 15¾ gallons; the cylinder, however, is not always kept full, and if the return water be reduced in heat by one-half of the degrees it will be increased in weight by 3½ lbs. (say 3 lbs.), which gives the motion to the return. If the 500 feet of pipe lies horizontally in the recess, not having a fall to the furnace, it will reduce the weight and motion in getting back to the coils; so you see what a small weight or force we have to keep up the circulation. We will now go to a ward about 30 feet higher, 60 feet above the furnace. These cylinders and pipes work better because of the height and weight being increased. Here we will observe the air is not admitted to the water anywhere, but when we pump in any to make up for waste, we after a while let out, by opening the tap above, whatever air may have gone in with it, and also any steam which may have formed on top of the water; we fill and supply them all with the pump. We will now go to the dome tank, 15 feet above, or 75 feet above the furnace; a cylinder and a coil of 1-inch pipes around a 20-foot diameter and 6 foot deep tank of water supplied by city waterworks. This furnace worked well, but the pressure was so great the coils would not or did not stand the same length of time as the others, because we had to keep a larger fire, the coils being larger and the pipes connected being about 1,000 feet each. We will now go to the basement. The expansion cylinders are about 15 feet above the furnace; and the 500 feet about 3 feet above the furnace; this gave more expense and labor to keep going than any other, one reason was, I was obliged to return the water to coils in the furnace under the floor and below the top of the furnace. I then lowered the furnace but found it too wet for the fire to burn well and raised it again; here I began to see that if I put in a boiler large enough I could stop four fires and have one to do the same amount of work much better, and get the same amount of pressure alike in all the coils by having an expansion of 100 gallons up by the large tank, and instead of supplying them with a pump I could supply them from the tank 75 feet above, 35 lbs. pressure; I then drew a plan for a 40-inch boiler, 8 feet long, with two 11-inch flues for the heat after passing under the boiler to come to the front and then go back to the smoke pipe behind on top of division plate through sixteen 4-inch tubes. I had a division plate behind and a smoke box in front; I had holes tapped in the top and sides for 1-inch pipes, the same pipes which were connected with the coils I connected with the boiler, but the expansion cylinders in the wards were full, and became a part of the heating pipes; I took up to the expansion cylinder two pipes, one flow and one return. The water in the cylinder is about the same level as in the tank, and a pipe from the bottom of the tank to supply the boiler with a check valve and supply tap near the side of the boiler, each pipe has a cut-off tap so that if any dirt or scales choke the pipes in the wards, we drain the pipes and cylinder, and then let on the full force, on the top of the expansion cylinder. Up by the tank we have a relief pipe to discharge into the tank should a large fire be put in too quickly; the first boiler has been working for the last ten years without any repairs or changes, the same set of bars, burning hard coal, large egg.

We have now in the Toronto Asylum for the Insane, ten heating boilers and seven for giving hot water and four coil furnaces for heating in the two cottages, and three boilers for our greenhouses.

*From a paper read before the Canadian Association of Stationary Engineers

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—Sixty of the rollers and heaters in the forge department of the Ontario Rolling Mills, Hamilton, Ont., struck, July 3rd, demanding, it is understood, sixty cents more a ton piece work The men's demands were granted, and they returned to work in a couple of days.

—The construction of a canal between Lake Ashawaken, on the head waters of the Ottawa, to a point on the Gatineau river, a distance of some seven or eight miles, is being discussed. A large portion of the distance is watered by small lakes, leaving but a few miles of actual canal to be excavated. It is claimed that the freshets on the Ottawa are not of sufficient duration to take out the timber from the far northern regions in one year, and that no lumberman would hold limits and pay dues under these circumstances. The line of the proposed canal is just about twenty miles south of the height of land, latitude 48, and longitude 76, or about one hundred miles north of the present farthest north operations. Altogether the canal would, it is said, open up for operation about ten thousand square miles. It is rumored that the project may be laid before the Quebec Government for the purpose of obtaining a subsidy.

CANADIAN ASSOCIATION STATIONARY ENGINEERS' CONVENTION.

The convention opens at Berlin, Ont., August 15th.

The following is the official programme: Tuesday, August 15th.—11 a.m., reception of delegates, Mayor's address of welcome; 2 p.m., meeting of committees.

Wednesday, August 16th.—9 to 12 a.m., general business; 2 p.m., reading of papers and discussions; evening, open air concert by B.M.S. band in Victoria Park.

Thursday, August 17th.—9 a.m., business of convention continued; 2 p.m., election of officers and other business; 9 p.m., banquet at the Walper to the officers and delegates.

ARCHIBALD W. SMITH.

The publishers of The Canadian Engineer have pleasure in announcing the addition to its staff of Arch'd W. Smith, so well and favorably known for some years past as manager of the engineers' supplies and machinists' tools department of the Aikenhead Hardware Co., Adelaide street, Toronto. Mr. Smith was born in Quebec city in 1870, and attended the public and high schools of that city till 1884, when he entered the employ of Herman Young, now H. & J. Young, Quebec's leading hardware house. While in the service of this house Mr. Smith

ARCHIBALD W. SMITH.
C. H. Noble, Toronto, Photo.

was associated with W. H. Wiggs, founder of the Mechanics' Supply Co., Quebec, and to him he owes very much of his subsequent success in handling the large business in engineers' supplies and machinists' tools, which he has just left for newspaper work. In 1890 Mr. Smith came to Toronto, taking a position with Aikenhead & Crombie, and later when the business of this firm was taken over by the Aikenhead Hardware Co. Mr. Smith took charge of the department of machinists' tools, engineers' supplies and kindred lines, which has so flourished under his care as to fully justify the company in styling itself "Canada's leading tool house." Just previous to leaving the Aikenhead Co. Mr. Smith was presented with a beautiful gold chain and locket by Wm. Martin on behalf of the employees of the company. Thos. E. Aikenhead spoke on behalf of the company, expressing regret at the severance of a connection which had not only been very pleasant but materially profitable.

SURGEON-LIEUTENANT T. A. BERTRAM.

The town of Dundas, Ont., has long been known as the headquarters of the famous machine tool builders, John Bertram & Sons, and of recent years it has added the distinction of being the home of Canada's best marksmen. The two circumstances have also some relation, for Pte. Hayhurst, who captured the Queen's Prize some years ago, was employed by John Bertram & Sons, and Surg.-Lieut. Bertram is John Bertram's son. T. A. Bertram is 33 years of age, and was born in Dundas. He received his education at the common and high schools here, when he went to Queen's University, Kingston, Ont., where he graduated and received his M.D. in 1886. He then went to London, Eng., and pursued his studies, and also attended the Royal College of Physicians and Surgeons, Dublin, where he graduated. On returning to Dundas, he went into partnership with Dr. Holford Walker for a few years. Afterwards, Dr. Walker retiring, to establish his present hospital in Toronto, he continued his Dundas practice. Dr. Bertram's brothers, Major Alex. Bertram and Staff-Sergt. Henry Bertram, members of the firm of John Bertram & Sons, are also good shots at the ranges. Dr. Bertram is a keen curler and has always distinguished himself in contests with

SURGEON-LIEUTENANT T. A. BERTRAM.

other clubs, bringing honor to the Dundas club. While at Queen's University he distinguished himself as an athlete, carrying off the championship cup for two successive years. The following is the record made by Dr. Bertram at Bisley: Queen's prize, place 26, £12 and badge; St. George, £2; All Comers' Aggregate 1st, cup valued at £250 and £15 cash; Corporation City of London, 1st prize, £25; Grand Aggregate Dominion of Canada Challenge trophy and National Rifle Association gold cross and £20, entitling the winner to have the letters G.C. after his name; Volunteer Aggregate 1st prize, Hop Bitter Co.'s challenge trophy and £15; Daily Graphic, 6th place; £5 and three framed sketches valued at 10 guineas each. In the Graphic, Daily Telegraph, Martin's Challenge Cup and other events he won a number of prizes. In the unlimited series he won £13. All the winnings in the above list are divided amongst the team, excepting the last one. Following are the scores made by Dr. Bertram in the principal competitions, together with the possible scores:

Grand Aggregate, 360 out of possible 385.
Volunteers' Aggregate, 164 out of possible 175.
All Comers' Aggregate, 196 out of possible 210.
Queen's, 324 out of possible 380.
Martin's Cup, 34 out of possible 35.
Alexander, 66 out of possible 70.
St. George's, 65 out of possible 70.

METAL IMPORTS FROM GREAT BRITAIN.

The following are the sterling values of the imports from Great Britain of interest to the metal trades in June, 1898-99 and the six months ending June, 1898 and 1899:—

	Month of June.		Six Months to June.	
	1898.	1899.	1898.	1899.
Hardware	£1,416	£1,855	£10,312	£9,450
Cutlery	4,797	5,150	19,497	26,120
Pig iron	384	1,618	6,158	5,049
Bar, etc.	1,516	2,192	5,659	5,716
Railroad	—	8,188	6,972	20,695
Hoops, sheets, etc.	4,995	16,177	16,255	38,835
Galvanized sheets	3,187	11,087	23,835	30,[illegible]3
Tin plates	11,319	22,718	71,652	77,094
Cast, wrought, etc., iron	1,986	5,279	13,369	17,535
Old (for re-manufacture)	1,571	1,086	3,075	1,659
Steel	3,513	6,921	27,642	30,547
Lead	4,127	6,821	11,932	21,469
Tin, unwrought	1,565	2,250	9,673	9,517
Alkali	4,238	3,365	20,872	16,602
Cement	1,793	3,692	9,883	12,705

Industrial Notes.

The Copper Crown Mining Co. is building a smelter at Pictou, N.S.

Welland, Ont., will spend $8,000 on a town hall, not $2,000, as stated in a former issue.

James Fleming, St. John, N.B., has the contract for the boilers for the new Cushing pulp mill.

The International Convention of the Brotherhood of Locomotive Engineers met in St. John, N.B., July 27th.

A by-law for raising $40,000 for the building of a waterworks system in St. Mary's, Ont., was carried July 24th.

The Georgian Bay Cement Company is building a switch from the main line of the C.P.R. to William's Lake.

The National Iron Moulders, in convention at Indianapolis, U.S., have selected Toronto as the place of next meeting.

In boring for oil at Athabasca Landing, natural gas has been struck at a depth of 1,800 feet. The flow is large and very steady.

John Addison has bought the East Hamilton Co.'s property, Hamilton, Ont., including the East End Incline Railway, and 40 acres of park, for $22,000.

A. E. Domville, of the St. Thomas Car Wheel Co., has been made a director in the International Car Wheel Co., lately formed, with a capital of $15,000,000.

W. B. Cleveland, T. A. Neef, and H. M. Stowe, of the Protected Rail Bond Co., of Cleveland and Philadelphia, are looking for a suitable location for a factory.

The International Correspondence Schools, Scranton, Pa., U.S.A., are offering special courses in mechanical and architectural drawing, book-keeping, stenography, and the English branches.

The Dowling Milling Co., Edmonton, N.W.T., has placed an order with The Goldie & McCulloch Co., Ltd., Galt, Ont., for the machinery in a new 175-bbl. flour mill, including engine and boiler.

Two large 400 or 450 h.p. cross-compound Wheelock engines, built by The Goldie & McCulloch Co., Ltd., Galt, Ont., have recently been placed in the power house at Bond Lake, Ont., for the Metropolitan Street Railway Co.

It is reported that Charles Leonais, Montreal, has sold several large tracts of spruce limits, situated on the north shore of the St. Lawrence, below Quebec, to a United States syndicate, for a large sum. Saw and pulp mills are to be constructed.

The Asbestos and Asbestic Company has taken out a writ of injunction against the William Sclater Co., alleging that the company defendant unduly uses the word "asbestic," to which plaintiff claims to have a sole right. The sum of $10,000 damages is also demanded from defendants.

J. W. Pyke, T. P. Howard, W. Ross, B. Shepherd, and R. A. E. Greenshields, Montreal, have received a Quebec charter as the Eclipse Acetylene Gas Company, with a capital stock of $50,000, to manufacture and construct machines used in the production of acetylene gas from calcium carbide.

The St. Thomas Times professes to be informed of the conditions on which the Standard Oil Company of the United States has gathered in the Ontario Natural Gas and Oil Company that has controlled the gas fields from which Detroit homes are being supplied with natural gas. The purchase price, it says, was $600,000, and, as there are only 25 shares, which sold in the original company at $600 each, the stockholders realize $24,000 for each share.

At Calumet, on the Ottawa river, about fifty miles above Ottawa, says The Montreal Star, there is a large floating sawmill, operated by steam and equipped with the most improved machinery; it can be floated anywhere there is a sufficient depth of water. This mill is owned by J. H. Dansereau, Vercheres, Que. His object in constructing the mill was to do away with the cost of towing logs from the mouths of the different tributaries of the Ottawa, between Ottawa and Grenville.

James Clemes is locating a saw mill at Grand Prairie, B.C.

A large pulp mill is to be built it is said by M. Menier at Macastey Bay, Anticosti.

S. F. Peters is architect of the new College of Pharmacy building, Winnipeg, Man.

Stewart & O'Leary have the contract for section 4 of the main drain, Ottawa, at $91,177.

It is reported that a Portland cement works will be established at Winnipeg this year by S. Walker.

Owen Sound Portland Cement Co., has just put in a 400 h.p. compound Goldie & McCulloch engine.

William Kennedy, Sons & Co., Owen Sound, Ont., are building a new moulding shop and enlarging their plant.

The Department of Lands and Works, Victoria, B.C., is building schools at Greenwood, Ashcroft, Slocan, Revelstoke and Fernie, B.C.

A by-law in aid of artificial stone works, which Arthur Jarvis proposes to establish in Belleville, Ont., is to be submitted to the ratepayers.

I. Matheson & Co., Ltd., New Glasgow, N.S., are running their plant night and day. This firm is now maker in Canada of the famous Case propellors.

The erection of a condensed milk factory is engaging the attention of some of the Sussex, N.B., citizens and may result in the establishment of such a plant.

The stove mounters in the stove foundries in Hamilton have had their wages advanced during the past month; in some cases the advance amounted to 25 per cent.

The plumbers' strike, Winnipeg, has been practically settled by the acquiescence of nine out of the ten employing concerns in the city to the wages asked by the men.

The large brick addition to the R. McDougall Company's moulding shop, Galt, Ont., is about finished. Other enlargements are contemplated on this property.

Cowan & Co., iron founders, Galt, Ont., will shortly commence the erection of a large addition to their works. It will be about 140 feet long, two stories high.

Wood Bros., Brantford, Ont., are turning the old Bain wagon works, recently vacated by the Verity Plough Co., into a flour mill; capacity, 100 to 200 bbls. a day.

The Hardill Compound Engine Co. of Mitchell, Ont., Ltd., has been chartered to make the Hardill compound engine; chief place of business, Mitchell, Ont.: capital, $40,000.

H. C. Cox, H. Sutherland, W. H. B. Aikins, T. R. Clougher, and R. H. Warden, D.D., have been incorporated as the Canadian Camera and Optical Co., Ltd.; capital, $150,000.

The MacGregor-Gourlay Company, Galt, Ont., is raising the roof of its moulding shop 8½ feet. The building is 104 x 40 in dimensions. The offices of the firm will also be remodeled.

F. S. Henning a marine engineer, and William Pigott, a painter, Toronto, have invented a fire escape which is a species of hydraulic elevator on the exterior of the building.

J. Lee, W. P. Robinson, W. H. Jenkins, W. Kemp and Nellie T. Clement, Woodstock, have been incorporated as the Caster and Metal Stamping Co., of Woodstock, Ltd.; capital, $5,000.

A bridge is to be built over Thunder Creek, near Shellmouth, Manitoba, including the erection of two stone piers, and the necessary grading of approaches. Wm. S. Wallace, Shellmouth, is the clerk.

J. Patterson has finished the plans for Shurley & Dietrich's iron and brass bedstead factory, Galt, Ont., which will be erected on a plot of land adjoining the firm's saw works. The new buildings will be of stone.

The recently organized Berlin Rubber Mfg. Co., of which Jacob Kaufman is president, George Schee, manager, and A. L. Breithaupt, secretary-treasurer, is now getting in shape to manufacture rubber shoes.

R. N. Sterling, F. S. Jackson, J. W. Ball, Phoebe Jackson, and R. F. Massie, Toronto, have been incorporated as the Diamond Machine and Screw Co., of Toronto, Ltd., to carry on the business of the Diamond Machine and Tool Co.; capital, $75,000.

The Trent Valley Peat Fuel Co. has its plant running on the Balsam Lake division of the Trent Canal. W. J. Sims is manager. In operation the plant is found to be even more economical than the promoters claimed.

The Pierre-Mahy Glass Works Co., Rahnsart, Belgium, will probably organize a branch to manufacture glass in Chatham, Ont. Local capital will be enlisted to the extent of about $30,000, half the proposed capital.

The Georgian Bay Portland Cement Co., Ltd., Owen Sound, Ont., is installing a 300 h.p. Goldie & McCulloch engine, and a large amount of other machinery. M. Kennedy is president of this company, and James Maitland secretary.

C. F. Sise, R. Mackay, C. Cassils, R. Archer, H. Paton, L. B. McFarlane, C. P. Sclater, Montreal, have been incorporated as the Wire and Cable Co., Ltd., to make brass, copper and other metal wires, cables, etc., and to make electrical supplies; chief place of business, Montreal; capital, $100,000.

The Canadian Office and School Furniture Co., of Preston, has extended its factory and put in new machinery which will increase the capacity of the works by one-third. The company has orders for the seating and interior fittings of the new seminary chapel of Quebec, and for the new court house at St. Thomas, Ont.

Brown & Sharpe Mnfg. Co. has issued an illustrated wall card, which should hang in every workshop aiming at turning out the best work. The card shows the leading lines of these famous tools, and carries also a pad of reference tables, which are of great value to mechanics. They include, decimal equivalents; inches, also millimeters; the sizing and cutting of gear wheels; circular and decimal pitches; tapers per foot and corresponding angles; drill list for machine screw tops; decimal equivalents of the numbers of twist drill and steel wire gauges.

Robert Bell, Jr., proprietor of the Hensall Engine and Machine Works, Hensall, Ont., has completed a large machine for making bricks composed of sand and cement. The manufacture of this particular style of machine is, Mr. Bell says, the filling of a long-felt want in localities where brick clay is not found; that bricks made of sand and cement are, in many respects, superior to those made of clay, possessing a handsomer appearance, and can be produced at about the same cost. The machine alluded to has been tested and proved satisfactory, and has been forwarded to destination at Vancouver, B.C.

The Buffalo and Fort Erie Bridge Co. is building the only foot and vehicle bridge above Niagara Falls. The bridge, or practically two bridges, is to cross the Niagara from a point between Buffalo and Tonawanda, to Grand Island across the island, and on to the Canadian shore. The eastern section was the one for which legislation was obtained from the American Government in October, 1898. The location of the bridge has been approved by the War Department of the United States; the contract has been let for $1,485,400, and already several piers have been built. The Canadian section will cross from the opposite side of Grand Island, to a point in Welland County.

The increased trade of the Dominion Bridge Company has decided the management upon building an addition to their works at Lower Lachine, Que. Throughout the United States and Canada the iron and steel business has for some months been growing in tremendous proportions, and the Dominion Bridge Company now feels the necessity of enlargement in order to meet the increased demand. The new addition to the works, which will be completed in about two months, will give the company an increased capacity of from 7,000 to 8,000 tons per year, or about forty per cent. increase on their present output. When the new buildings are in operation, the company will employ from sixty to eighty additional men.

The old established business of Wm. Hunter, brass founder, Hamilton, has been taken over by J. N. Tallman & Sons, who intend to maintain the reputation of the founder while extending the scope of the business. This they are well qualified to do, as Messrs. Tallman & Sons are experienced brass and iron founders, and understand every department of their trade, and are men on whom the fullest reliance can be placed. Since taking hold of the business they have put in a new electric motor, a water mill, a babbitt metal furnace and other plant, greatly improving their facilities for turning out work promptly. While maintaining the old firm's reputation for first-class babbit metal, the new firm will pay particular attention to special brass castings.

The Northey Manufacturing Co., Toronto, has under consideration a change which, if made, will result in an addition of $250,000 to the present capital of the company, and will involve the employment of at least 150 additional men, and possibly 500. The move which is contemplated is an amalgamation with a large Montreal firm which manufactures hydraulic and other machinery. A third company may also be induced to join forces with these two and to locate in Toronto. This would bring the total capital of the company up to $150,000. The Northey Company has been steadily increasing its sales of late, and is now sending machinery in large quantities to the Maritime Provinces and British Columbia, in addition to having a very large trade in Ontario.

Owing to the rapid growth in their business, Darling Bros., "Reliance Works," Montreal, have erected an extensive addition to their machine shop. The new building is a substantial brick two-story structure fronting on Ottawa street, adjoining the original premises, and occupies what was formally yard room. It affords some five to six thousand more square feet of floor space. The lower flat has a solid cemented flooring, with the latest slow-burning process of ceiling. The assembling will be done on this flat, where a driveway enters the western end, and where travelling cranes are used for taking up completed work from any part, and expeditiously loading it for delivery. The blacksmithing work will be done in this fire-proof department. The business offices are on the second story, entering by a broad stairway from Ottawa street, and are handsomely finished in oiled wood, and comprise a general office, private offices, draughting room, lavatories, etc., all well lighted. The equipment of the whole shop is of the most modern character.

As noticed recently in this Journal, the engine-building plant of A. J. Nie (previously the Osborne, Kieley Co.), Hamilton, has been purchased by the Smart-Eby Machine Co., composed of W. G. Smart and J. E. Eby, who have reorganized and extended the business and are now turning out large orders in the engine and machinery line. Mr. Smart was, until the present connection was formed, with the Jenckes Machine Co., of Sherbrooke, and Mr. Eby was for some years with the McGregor, Gourlay Co., and Cowan & Co., of Galt, having been manager of the latter firm. The new firm has set to work energetically and has made quite a success of one of its specialties—the Webster engine for gas or gasoline, of which it has the sole right of manufacture for the Dominion. The firm makes also electric light high-speed engines, pumping machinery and special machinery to order. Orders are now being filled for the Canadian Colored Cotton Mills, the dyehouses of which are now being enlarged. The firm will be pleased to send their catalogue to anyone interested in gas engines.

From April to the end of July the aggregate value of building permits issued to manufacturing establishments in Toronto was $283,300, making a total of $535,900 from June, 1898, to the end of the same month this year. Among the firms who have expended during the past year or are now expending large sums on factory additions or new factory buildings in Toronto are, the Massey-Harris Company, $28,000, on new works; the Allen Manufacturing Company, $30,000; and J. B. Kay, $30,000; the Toronto Carpet Company, $50,000; the T. Eaton Company, $21,000; S. F. McKinnon, $52,000, for buildings and warehouses; the Carling Brewing Co., $12,000; Wilson, Lytle & Badgerow, $16,000; the Gerrard Heintzman Co., $14,000; Christie, Brown, & Co., $25,000; Brown Bros. Co., $40,000; the Toronto Type Foundry, $20,000; the Henry Kent Estate, $20,000; John Patterson, $15,000; the Consumers' Gas Co., $25,000; George Weston, $15,000. Other manufacturers have expended all the way from $1,000 to $10,000, while the soap factory to be erected by Lever & Co., it is estimated, will cost over $100,000.

Electric Flashes.

The Nelson Electric Tramway Co., Ltd., Nelson, has been incorporated.

Barrie, Ont., is installing a 150 h.p. Wheelock engine as part of its electric light plant.

The Holmes Electric Protection Co., Montreal, has been taken over and will in future be operated by the District Telegraph Company, under the general management of John Murray.

St. Thomas council has made a ten years' contract with the St. Thomas Gas Co. for lighting the streets with the Adams-Bagnall lamps of 2,000 c.p. at 25 cents per night, or 26 cents on a moonlight schedule.

The Peterborough Light & Power Co. is building its new power house, which is to be finished in October. It will be of brick and steel, 36 x 55 feet, and from it will be developed 1,500 h.p.

The Montreal Railway Co. has adopted the fender invented and patented by G. W. Sleman, Guelph, Ont., which the management consider the best fender brought to their notice. It is used on the cars in Guelph and has been recommended to the Toronto Street Railway by the Toronto city engineer.

A new company, to be known as the Lorette Electric Light and Power Co., has been formed at Lorette, near Quebec, and will undertake the lighting of that village and of the Indian and parish churches; $2,500 has been subscribed and the capital stock will be $10,000.

The Bear River, N.S., Electric Light and Power Co. is making arrangements for extending its services to Digby and intermediate points. This has necessitated the increasing of the capital stock to $75,000, and will probably involve the purchase of the plant at Digby, owned by Major Daley.

Letters patent have been issued incorporating W. H. Coleman, Andover, Mass.; A. J. Gordon, North Hatley, Que.; F. E. Lovell, Coaticook, Que.; Jacob W. Barnard and John H. Champion, Andover, Mass.; W. D. Currier, Lawrence, Mass., as the Eastern Townships Electric Co.; capital, $300,000.

The Light, Heat & Power Co., of Lindsay, is constructing its long distance transmission plant. The current will be carried from the company's water power at Fenelon Falls, a distance of 14 miles, into Lindsay and will be completed in October. The company will have 1,200 h.p. available from the new works.

Thomas Maynard has been appointed chief clerk in the master mechanic's office of the Grand Trunk Railway works, Montreal, vice Donald Robertson, who has resigned after a service of over twenty years as chief clerk in this department, to accept the position of assistant to manager and engineer Wanklyn, of the Montreal Street Railway.

Robert Surtees, C.E., of Ottawa, has made a report on waterworks and electric light for the village of Shawville. The cost of a waterworks system is given at $11,000; electric light, $4,000. The engineer estimates that waterworks would give a total yearly revenue of $1,273, while that from electric light would be no less than $1,900. At present Shawville is without fire protection.

In the Divisional Court, Toronto, recently, Chief Justice Meredith and Justice Rose gave judgment in the case of Kirkpatrick vs. Cornwall Electric Street Railway Company, an appeal by defendants from judgment of Chief Justice Armour in favor of plaintiff in a mortgage action for foreclosure and payment of $100,000. They held that the mortgage was valid, but that that part of the judgment directing payment of principal, interest and costs, must be struck out.

The B. F. Sturtevant Co., whose well known "chimneyless" factory is situated at Jamaica Plain, near Boston, Mass., is making an addition to its already large floor space for electrical work. Another story is being added to two of its shops, one 125 feet by 50 feet, and the other 100 feet square, both of which will be used for this purpose. The increase in this department has been enormous. The company is now making electric motors up to 125 h.p., and generators up to 100 k.w.

The Bell Telephone Co. is burying its wires in the principal streets in Hamilton.

W. B. Cleveland, F. H. Neff and H. M. Stowe, Cleveland, are said to intend starting an electrical supply factory in the old Wanzer building, Hamilton, Ont.

The Penfield and St. George Telephone Co. is applying for a New Brunswick charter, S. L. Dakin, L. Conners, Beaver Harbor, N.B., and John Doyle, St. George, N.B., are directors; capital, $2,000.

Dr. Pyne and H. M. East asked the use of Toronto streets to distribute power from the Anglo-American Electrical Supply Company to private consumers at 1½ cents per h.p. per hour. They say they would produce power within 18 months.

J. C. McLachlan, G. McLachlan, C. Millar, C. W. Vernon and R. B. Orr, M.D., Toronto, have been incorporated to deal in electric apparatus, gas engines and autocars as the McLachlan Electric and Gasoline Motor Co., Ltd.; capital, $39,000; chief place of business, Toronto.

The Deschenes Electric Company denies the story which has been started that the Metropolitan and Deschenes Electric Companies have formed an alliance and that the Metropolitan Company had bought out the water power of the Deschenes Company. W. H. Taylor, secretary-treasurer of the Deschenes Electric Co., stated that there was nothing at all in the story.

The Hamilton and Lake Erie Power Co. have renewed their offer to the city of Toronto for the supply of electric power for lighting and pumping purposes. In a letter to the mayor, S. C. Biggs, presi... of the company, says that nothing has been done in this matter and that the continuation of the delay will result in the loss of thousands of dollars annually in the next lighting contract. He says that his company can show to the satisfaction of council their ability to carry out any contract they may make.

W. J. Poupore, M.P., has a very extensive contract with the Lachine Rapids Hydraulic and Land Co. The contract will include the addition to the present wing dam of one thousand feet. This was included in the original plan, and the original charter from the Government provided for it, but the company only constructed a certain portion of it to see how they would get along, and now they find it necessary in order to get into deep water. The work is to be finished by the first of December next.

The City Council, Montreal, recently decided to request the city attorneys to take action to compel the Lachine Rapids Hydraulic & Land Company to remove their lights from the incinerator. A contract was given to the company to light the incinerator, and after the contract had been completed it was found that the Royal Electric Company had the right under its street lighting contract to furnish all of the electric lighting required by the city departments. As a result both companies have been maintaining lights at the incinerator and charging the city for them.

Some time ago American capitalists purchased the controlling stock in the North American Telegraph Company, owned by the Folger Brothers and the Rathbun Company. The telegraph company has been in existence twenty years and owns 1,000 miles of poles and from 3,000 to 4,000 miles of wire. W. Bampfield, of Montreal, has been appointed general manager by the new company in place of R. C. Carter, who was held the position since the company was organized. The company owns and operates the telephone and telegraph wires in Prince Edward, Hastings, Frontenac and several other counties in Eastern Ontario.

Recently there was in Niagara Falls, N.Y., a fierce fire at the power house of the Niagara Falls Power Co. The trouble was caused by some contractors who were blasting under the Buffalo transmission line near the Carborundum Company, who threw a bit of fuse wire over the transmission wire. This caused a short circuit and the blowing out of a fuse in the power-house. The blowing out of the power-house fuse ignited several barrels of lubricating oil that stood in the oil room. The employees of the power-house took things very coolly, and the switchboard tenders never left their stations, although the smoke was so thick that they could hardly see. A still alarm was sent to the fire department and in a short time the fire was under control. The principal damage resulted to the power cables and the insulation, and amounted to about $6,000.

The postoffice authorities recently experimented with mail collections by electric auto-cars. The electric delivery wagon built by the Still Motor Syndicate for the Parker Dye Works was used. The trip extended about 9 miles and was covered in one hour and three minutes, including 2-minute stops at each of the eleven postoffices on the route. The actual running time was not more than thirty-five minutes, just about half the time required by the ordinary mail wagon. The Syndicate has sent in a tender to the department for a mail wagon, capable of running from fifteen to twenty miles an hour, with a carrying capacity of 1,500 pounds.

A special general meeting of the shareholders of the Standard Light and Power Company was held a short time ago in Montreal; W. McLea Walbank, the president, in the chair. The object for which the meeting was called, was to approve of the construction of the new fire-proof station on Chenneville street, now in course of construction, and of ratifying a loan of $75,000 which had been taken up by three of the Ottawa shareholders of the company Both of these matters were agreed to. The following contracts were awarded: That for engines to the Westinghouse Co. of Pittsburg; for rotary converters to the Canada Electric Company, of Peterboro, and for boilers to Babcock & Wilson.

A patent has been granted to a resident of Vienna, Austria, Anton Othmar, on a composition for arc light carbons, consisting of finely ground wood charcoal or carbon from gas retorts, or both, mixed with finely-ground quartz and diamond dust. The mixture is made up into a dough by incorporating it with a solution of copper salt and with jellied salicylic acid the pencils being moulded from this in the ordinary way and afterwards burned, as usual. The proportion of ingredients by weight are: Carbon, 83 parts; quartz, 7 parts; diamond dust, 10 parts. To 20 parts of the thoroughly mixed powder are added about one quart of a concentrated aqueous solution of copper sulphate and one quart of jellied salicylic acid. The inventor claims that carbons made in this manner burn much more slowly than those in present use.

Mining Matters.

A winding-up order has been issued against the Eastern Townships Chrome Iron Mining and Milling Company.

Leopold Myer, representing a Belgian syndicate, has purchased from T. B. Caldwell, Lanark, Ont., the Calabogie iron mine, for $100,000, paying $10,000 down.

Another attempt will, it is said, be made to utilize the magnetic iron sand of Moise, Bersimis, and other points on the north shore of the St. Lawrence and Gulf.

The announcement has been made that thousands of tons of iron ore have been bought in Newfoundland by Philadelphia capitalists for shipment to that port, to be manufactured into steel.

It is said that the deposits of nickel ore near St. Stephen, N.B., will be thoroughly investigated at once by the English owners, and a perpendicular shaft is to be sunk to the depth of two hundred feet.

The compressor plant reported in our issue of July as being sold to the Rosa Marie Mines on the West Coast of Vancouver Island, was sold and built by the Canadian Rand Drill Co. instead of the Jenckes Machine Co., as reported.

The Graham-McKellar group of iron properties on the Atikokan range, consisting of 16 locations, containing 1,200 acres, and covering 4½ miles of the range, has been bonded to Ronald Hunter, representing American capitalists, for $350,000, for 18 months, so that the parties may test the properties. The sum of $10,000 was paid for this option.

The additional thirty stamps intended for the Dufferin mill at Salmon River, N.S., are in course of erection, the foundations and mortars being already in place. It will be some months yet before the entire complement of sixty stamps are working, as another compound Corliss engine is to be installed to provide the required power.

The Vancouver, B.C., Province, publishes a story to the effect that rich placer fields of gold have been discovered near the upper entrance to the Alberni Canal on the Pacific coast. The distance to that part of the country is about 150 miles by water, from Victoria. It is said that as high as $2 to the pan has been gotten by prospectors.

There have been discovered in the Lake Temagamingue district vast deposits of arsenical iron, carrying gold, which, it is reported, are the largest and richest deposits of this mineral in the world. The ore is in a solid body, it is said, over 1,020 feet long by 310 feet wide. It would take over three generations to take a layer 10 feet deep off the whole tract. The assays show over 47 per cent. of crude arsenic to the ton and $8.20 of gold.

The Foley gold mine in northwestern Ontario has been sold to the Canadian Mines Development Company, Ltd., of London. The Foley Mines Company treasury receives $50,000 cash, and $354,000 in stock, to be divided pro rata among the shareholders. The mine will be started up at once, and the 20 stamp mill will soon again be turning out bullion. The British company is capitalized for 300,000 shares of £1 each. Of these, 150,000 shares go to pay for the property; 75,000 shares, par value $375,000, will be retained unissued in the treasury for a working capital, or to acquire other properties. Still 75,000 more shares have been placed on the market at par in London.

The Ontario Bureau of Mines has arranged for a series of summer mining schools to be held at points in the mining districts of the province, including Parry Sound, Rat Portage and Mine Centre. At each of these places there will be a course of ten days' instruction by lectures and demonstrations by Professors Goodwin and Nicol of the School of Mining, Kingston. The classes will be free to miners, prospectors and others who may desire to take advantage of them. In addition to the regular classes, popular lectures are to be given by Professors Goodwin and Nicol on mining subjects, at other points in the mineral districts. The class of instruction has been already opened at Parry Sound, where there is great activity, stimulated by the recent copper discoveries. So far 72 students are enrolled and the average daily attendance is 55. Two sessions per day are held, each being of two or three hours' duration. Lectures have been given at Marmora, where the Delora gold mine is in splendid shape. Manager Kirkgaarde has improved the plant in many respects, and the stamp mill is showing good returns. The old Arsenic Works are being overhauled and will be in operation in a few weeks.

Marine News.

Two Yukon steamers, the "Nahleen" and "Louise," have been totally consumed by fire at Victoria. The total loss will reach $100,000.

The Richelieu & Ontario Navigation Co. has already filed up receipts in advance of last year, though the season was much later in opening.

From the opening of navigation to the end of July over five million bushels of grain were received at Depot Harbor for the Canada Atlantic Railway.

The Canadian Canoe Co., Peterborough, Ont., reports a very busy season, being still crowded with orders. During the past season in addition to the home trade, this company has shipped several consignments abroad to Great Britain and other countries.

A. T. Wood, M.P.; Wm. Southam, C. E. Doolittle, C. Wilcox, Wm. D. Long, and A. B. McKay, Hamilton, Ont., have applied for the incorporation of the Quebec, Hamilton & Fort William Navigation Company, Limited. The capital stock of the company is $1,000,000. The head office is to be in Hamilton.

Recently the Calvin Company's new steamer "India" had a trial run around the harbor. Her engines worked well, and she answered her steering gear to perfection. Her first trip was to Cleveland, Ohio, to load coal for Fort William, after which she went to Serpent River, Wis., to load iron ore for Deseronto, Ont.

The Red river, which was the principal artery of commerce in Manitoba in the early days, but which has been almost out of use since the advent of railways, is again to be used for traffic purposes. R. A. Lister & Co have put a steamer on the river to gather up cream for their butter factory at Morris. This is probably the first attempt at utilizing the river for regular traffic purposes south of Winnipeg, since 1882.

The regulations made by the Ontario Government making it imperative that logs cut on Crown timber limits be manufactured in the province, has given the Ontario shipowners a share of the trade in carrying the lumber. The rafting of the logs to which the embargo applies from the Georgian Bay across to points in Michigan has now been stopped, and the Michigan lumbermen are compelled to have their logs sawn here. No vessels were necessary in towing the logs across except tugs, and under the United States coasting law, Canadian vessels could not afterwards help in carrying the manufactured lumber from one American port to another. One result is, that now Canadian vessels are conveying the sawn timber to the numerous ports on the American side.

Personal.

G. H. Garden, of the C.P.R. engineering staff, has gone to take charge of the double tracking of the line between Port Arthur and Winnipeg, a distance of 420 miles.

H. V. Short has been appointed manager of the machinists tools and engineers' supplies department of the Aikenhead Hardware Co., in succession to A. W. Smith, whose portrait appears in another column of this issue of The Canadian Engineer.

L. B. Stewart, Registrar of the School of Practical Science, Toronto, has reached Dawson, in the Yukon district, where he purposes spending the vacation surveying. A letter posted by him at Dawson on the 3rd July was received by Mrs. Stewart in Orillia on the 25th.

A Canadian, A. W. McCrea, of Merrickville, Ont., was selected from among his class of fifty at the Massachusetts Institute of Technology to represent the architectural department at the closing class ceremonies. He has taken a position with the firm of Cariere & Hastings, prominent architects of New York.

C. A. Woolsey, recently appointed sales agent of the Royal Electric Co., was for some time with the Thompson-Houston Co., as expert, and upon the amalgamation of that company with the General Electric Co. remained with the concern as expert engineer and salesman, with headquarters at New York. Mr. Woolsey has had a wide and varied experience, embracing almost every phase of electrical engineering.

C. J. Pusey, president and manager of the Irondale, Bancroft and Ottawa Railway, died at Peterboro recently from an organic affection of the heart. Mr. Pusey was in railway work all his life. In 1866 he purchased the nucleus of the present I., B. & O. Railway, six miles of complete line, extending eastward from the junction with the Victoria branch of the G.T.R. His object was to extend the line to Brockville, with connections to Ottawa, to give an United States outlet to mining products and to extend the line westward and north to the Georgian Bay. His idea was the establishment of large smelting works in Hastings County. By his own almost entirely unaided exertions, Mr. Pusey secured Ontario and Dominion charters, and in the face of great difficulties finished the scheme and extended his railway eastward by ten-mile sections till now 47 miles are in operation, with five additional miles to be completed this fall. The line has a fairly paying traffic and is doing much in developing the lumber resources of the region it taps, promoting settlement and giving access to promising mining areas abounding in gold, silver, lead, iron, corundum, mica, etc.

Railway Matters.

The last relic of the first epoch of railway engineering in Canada is passing away this month in the form of the tubular bridge on the G.T.R. at St. Anne's. This old bridge, which spans the Ottawa near its junction with the St. Lawrence, is being removed, and a trussed bridge erected in its place. This old bridge is not only the last of the tubular bridges in Canada, but the last on this continent, and its removal is a historic event. The double tracking of the Grand Trunk between Toronto and Montreal is proceeding. A short section of two miles from Trenton to Murray Hill and one of three and a half miles from Sydney to a point east of Trenton, both of which are in progress now, will make the double track complete between the two cities, excepting only a strip of 30 miles running east from Scarboro Junction, on which, however, the traffic is not so heavy as on the rest of the route. A double track is also being made east of Montreal from St. Lambert to St. Bruno. Of the twelve big passenger engines, recently described in this journal, six are now on the service between Montreal and Toronto, and the new train equipments on this part of the Grand Trunk are spoken of in the highest terms by the travelling public.

RAILWAY SUBSIDIES.

The Minister of Railways has proposed the following resolutions: That it is expedient to authorize the Governor-in-Council to grant a subsidy of $3,200 per mile towards the construction of each of the undermentioned lines of railway (not exceeding in any case the number of miles hereinafter respectively stated), which shall not cost more on the average than $15,000 per mile, for the mileage subsidized, and towards the construction of each of the said lines of railway, not exceeding the mileage hereinafter stated, which shall cost more on the average than $15,000 per mile for the mileage subsidized, a further subsidy beyond the sum of said $3,200 per mile of 50 per cent. on so much of the average cost of mileage subsidized as shall be in excess of $15,000 per mile, such subsidy not exceeding on the whole the sum of $6,400 per mile.

Central Ontario Railway Company, for an extension from, at or near either Coe Hill or Rathbun Station on the company's railway, at or near Bancroft, not exceeding 21 miles, in lieu of the subsidy granted by 55-56 Victoria, chapter 2—Re-vote.

Great Northern Railway Company, for a railway between Montcalm and St. Tite Junction on the Lower Laurentine Railway, Quebec, not exceeding 53½ miles, and for a branch from their main line to Shawenegan Falls, Quebec, not exceeding 6½ miles, 53½ miles—Re-vote.

Phillipsburg Railway and Quarry Company, shortage in the extension of their railway from a point on the company's line at or near the end of the subsidized section to the Government Wharf at Phillipsburg, Que., not exceeding 6 6-100 miles—Re-vote.

Strathroy & Western Counties Railway, for a line from Strathroy, Ontario, via Adelaide and Arkona to either Forest, Thedford or Parkhill, not exceeding 24 miles, in lieu of subsidy granted by 57-58 Victoria, chapter 4, partly—Re-vote.

St. John Valley & Riviere du Loup Railway Company, from Fredericton to Woodstock, not exceeding 59 miles—Re-vote.

For a railway from Port Hawkesbury, on the Strait of Canso, Nova Scotia, to St. Peter's, not exceeding 30 miles—Re-vote.

For a railway from Windsor, N.S., to Truro, via Township of Clifton, not exceeding 58 miles—Re-vote.

For a railway from a point at or near Brockford Station, N.S., on the Intercolonial Railway, to Eastville, not exceeding 25 miles—Re-vote.

For a railway from Cross Creek Station, on the Canada Eastern Railway, to Stanley village, N.B., not exceeding six miles—Re-vote.

For a railway from the village of St. Remi to Stottsville.

or some point on the Delaware & Hudson (Grand Trunk), in the parish of St. Valentine, not exceeding 19 miles, of which 12 miles is a re-vote.

For a railway between Pontypool and Bobcaygeon, via Lindsay, Ont., not exceeding 40 miles, 32 miles re-vote.

Pontiac Pacific Junction Railway Company, for a railway from Aylmer to Hull, Que., in lieu of the subsidy granted by 60-61 Victoria, chapter 4, not exceeding nine miles.

Portage Du Fort and Bristol Branch Railway Company, for a branch line on the Pontiac Pacific Junction Railway, at or near the village of Quyon, towards the village of Portage Du Fort, Que., not exceeding 15 miles, in lieu of the subsidy granted by 60-61 Victoria, chapter 4—Re-vote.

Oxford Mountain Railway Company, for a branch from their railway from a point between Lawrenceville and Eastman, to Waterloo, not exceeding 13 miles; 4½ miles re-vote.

Atlantic and Lake Superior, from Coplin to Paspebiac, Que., not exceeding 30 miles.

United Counties, from St. Robert Junction to Sorel, 6½ miles, and from Mount Johnson to St. George station, 1 mile, not exceeding 7½ miles.

For a railway from a point on the Central Railway, County of Lunenburg, N.S., to Liverpool, via Caledonia, or to the village of Caledonia, via Liverpool, or for any part thereof, the whole distance not exceeding 62 miles—Re-vote.

For a railway from Indian Garden, Queen's County, N.S., to Sherbourne, a distance of 35 miles—Re-vote.

The subsidy which the Ontario and Rainy River Railway Company is entitled to receive, under chapter 4, 60-61 Victoria, shall be $6,400 per mile, for the 80 miles provided for in the said Act.

Bay of Quinte Railway Company, for such extension, not exceeding $3,200 per mile, for 10 miles, nor exceeding in the whole $32,000—Re-vote.

Quebec and Lake St. John Railway Company, for 12 miles, from end of their line at Deep Water, on the Chicoutimi branch, to Ha Ha Bay, in lieu of the subsidy granted by chapter 4, of 1894.

For a line of railway from Hawkesbury, Ont., to South Indian, not exceeding 35 miles.

For a railway from Sault Ste. Marie, Ont., towards Michipicoton river and harbor, and to main line of Canadian Pacific Railway, not exceeding 40 miles.

For a branch line from the main line of the Ottawa, Arnprior and Parry Sound Railway, to the town of Parry Sound, Ont., not exceeding five miles.

For a railway from the village of Haliburton, via the village of Whitney, towards the village of Mattawa, Ont., not exceeding 20 miles.

For the extension of the Tilsonburg, Lake Erie and Pacific Railway, from Tilsonburg to Ingersoll or Woodstock, Ont., not exceeding 28 miles.

To the South Shore Railway Company, from Sorel Junction, along the south shore of Lotbiniere, Que., a distance not exceeding 82 miles.

Massawippi Valley Railway Company, for an extension to Stanstead Plain, Que., not exceeding 2½ miles.

For a railway from Port Hawesbury, on the Strait of Canso, to Caribou Cove, N.S., a distance of 10 miles.

For a railway from Fort Frances, Ont., westerly to a point at or near the mouth of Rainy River, a distance not exceeding 70 miles.

To the General Railway Company, of New Brunswick, for an extension from Newcastle coal fields to Gibson, N.B., not exceeding 30 miles.

Canadian Northern Railway Company, for a railway from a point on the present line of the Winnipeg Great Northern Railway, north of Swan River, to Prince Albert, N.W.T., not exceeding 100 miles.

For a railway from some point near Arthur Station to a point south of Moose Mountain, Manitoba, not exceeding 50 miles.

For a railway from Sunnybrae to County Harbor, and from a point at or near County Harbor cross-roads to Guysboro, N.S., to make up deficiency in mileage between points mentioned, additional mileage not exceeding 15 miles.

For a railway from Port Clyde to Lockport, N.S., not exceeding 20 miles.

For a railway from a point on the Intercolonial Railway at or near Halifax to a point on the Central Railway in the County of Lunenburg, not exceeding 20 miles.

For a railway from Labelle, in the Province of Quebec, in a north-westerly direction to Nominingue via Notre Dame Del Annonciation, a distance not exceeding 22 miles.

For a railway from Owen Sound to Meaford, not exceeding 21 miles.

Ottawa and Gatineau Valley Railway Company, for their line of railway in and through the city of Hull, Que., not exceeding four miles.

Western Alberta Railway Company, from a point on the United States boundary west of Range 27, north-westerly towards Anthracite, in the district of Alberta, not exceeding 50 miles.

Edmonton, Yukon and Pacific Railway Company, from South Edmonton, N.W.T., to North Edmonton, and thence westerly towards the Yellow Head Pass, a distance not exceeding 50 miles.

Restigouche and Western Railway Company, in addition to the 20 miles granted, and in continuation towards the St. John river, a further distance, not exceeding 15 miles, and towards Campbellton, a distance of 12 miles in all, not exceeding 27 miles.

For a railway in extension of the St. Francis branch of the Temiscouata Railway, to the mouth of the St. Francis river, a distance not exceeding three miles.

Canada Eastern Railway Company, from Nelson, N.B., to connect with the main line into Chatham, 2¼ miles.

Bay of Quinte Railway Company, for an extension in a westerly direction from Deseronto for a distance not exceeding two miles, also for an extension from Tweed in a northerly direction not exceeding five miles, in all seven miles.

Ontario, Belmont and Northern Railway Company, for an extension from iron mines in a north-westerly direction a distance not exceeding five miles, and also for an extension railway southerly from the present southern terminus to the Central Ontario Junction of the Canadian Pacific Railway, a distance not exceeding two miles, but the last-mentioned aid for the said two miles of railway shall not be granted in case the Railway Committee of the Privy Council finds that adequate running powers on fair terms cannot be secured to the company over that portion of the line of the Central Ontario Railway between the present southerly end of the Ontario, Belmont and Northern Railway and the Canadian Pacific Railway Company's line at Central Ontario Junction.

For a line of railway from a point on the Pembroke Southern Railway, at or near Golden Lake, Ontario, towards a point on the Irondale, Bancroft and Ottawa Railway, at or near Bancroft, not exceeding 20 miles.

(To be continued).