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The Canadian Engineer.

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CIVIL, MECHANICAL, ELECTRICAL, LOCOMOTIVE, STATIONARY; MARINE, MINING AND SANITARY ENGINEER, THE SURVEYOR, THE MANUFACTURER, THE CONTRACTOR AND THE MERCHANT IN THE METAL TRADES.

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CONTENTS OF THIS NUMBER :

MUNICIPAL OWNERSHIP AT FORT WILLIAM.

The Mayor of Fort William has issued a reply to the special commissioner of the Ottawa Free Press, whose article was published on December 30th last. The Mayor's report not only confirms the statements made in the February Canadian Engineer as to the negative value of evidence opposing municipal ownership of public utilities, but also exposes the methods adopted by corporations to influence public opinion. The Mayor of Fort William states that the "Bell's" special agent, W. C. Scott, was in the town at the same time as the special commissioner; that they stayed at the same hotel; that they returned on the same train; that it is reported on what Mayor Jackson considers good authority that the article was prepared by the two men, on the train, and submitted to the company's head office, before publication. The Mayor in his reply goes on to state that "the city of Ottawa was at that time in the heat of a municipal campaign, in which a by-law for $50,000 for street lighting was before the people, and the mayoralty campaign was based on the question of the city owning its own franchises. The question of the city installing its own system of telephones is also strongly talked in Ottawa. The by-law was carried by 638 majority, and the Mayor, who favored it, was elected by an equally large majority. The Ottawa Free Press was in opposition to both the by-law and the Mayor."

This is on a par with the tactics of the New England Telephone Co. (Bell), which gathered a mass of distorted statistics designed to show that independent telephone companies had been financial failures. These pamphlets have been quietly circulated in Canada, where competition was threatened. The ex-Mayor of Fort William, on a previous occasion, publicly charged the Canadian Bell Company with publishing falsehoods which were inserted in leading papers as news letters, but were in reality paid advertisements. Truly monopolies must have a very weak case if it is necessary to adopt these methods of "educating" the public. These practices, however, cannot have lasting results, for, as has been well said: "You can fool some people all the time, and you may fool all the people sometime, but you cannot fool all the people all the time." It is this feeling on the part of the people that they are being "fooled" by the monopolies that is responsible for the public ownership wave of to-day. If corporations desire to stem the tide they should get down to solid business, get rid of the dropsy, which is becoming a fatal disease with many companies, and give good service in return for rates sufficient to pay fair dividends on legitimate capital. The methods adopted by some companies are not only costly, but in the end ineffective.

The figures supplied by the Mayor of Fort William show that the net result of municipal ownership to end of 1903, is a surplus of $31.86 on the water, electric light, and telephone plants; not a large one it is true, but municipalities aim at supplying service at cost, instead of piling up profits for stockholders. The expenditures include all charges to date, for maintenance, interest and sinking fund, the full amount of the latter being on deposit with the Bank of Montreal. The Free Press commissioner's statement that the chairman of the Fort William Board of Commissioners admitted a large expenditure was necessary to put the waterworks system in shape, has already been publicly denied by the chairman himself as an unqualified falsehood. The commissioner also gives the debenture indebtedness as $437,223, but omits to state that there is a sinking fund in existence of $71,-012.64, making the net indebtedness $356,220.54. There are other misleading statements alleged to have been made by the Commissioner, but enough facts have been given to render the whole article valueless, to seekers after truth, in regard to public ownership.

The following extract from the annual address of

the president of the Fort William Board of Trade, last month, affords ample evidence that municipal ownership in Fort William is not the dismal failure which the Free Press commissioner would have us believe. The president says: "The town has now invested in its municipal franchises nearly $400,000, which I am pleased to report have just closed another successful year. The waterworks plant shows a surplus of nearly $2,000 and with the proposed slight increase of rates there is no doubt that the electric light plant will in the future have as good a showing. The telephone system is giving universal satisfaction, and only requires the loyalty of the ratepayers to make it one of the most successful franchises. The battle now being waged around municipal trading by mammoth trusts and greedy monopolies can only have one effect, viz., the awakening of the public to the immense benefits that follow in the train of properly managed municipal ownership of public utilities."

It is also well to bear in mind that even if it could be conclusively proved that municipal ownership had resulted in financial failure in a few cases, it would be no better argument against public ownership than the failure of individual companies, which are of almost daily occurrence, would be against the carrying on of business by private corporations. The fact remains that with an equally efficient staff and capable management a municipality paying only 3½ or 4 per cent. on the actual cost of a system, must in the natural order of things, be able to give service at lower rates than corporations having to earn 8 per cent. on a capitalization which includes nearly 50 per cent. of "water."

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PROPOSED BOILER INSPECTION ACT.

In the Ontario Legislature, a bill regarding the "Inspection of Steam Boilers and Steam Threshing Engines" has been introduced by A. G. MacKay, member for North Grey. The motives of the framer of this bill have no doubt been the best, for his desire is evidently to lessen the loss of life from accident, but the ultimate effect of any legislation along the lines proposed may be to increase rather than diminish such loss of life. It will provide safe loop-holes for the clever man—whether maker or user of engines or boilers—who can and will evade the Act, it will shift the responsibility for accidents from the shoulders upon which it should rest and permit those really culpable to escape, and it will prevent many a perfectly competent man from operating agricultural engines. It is not clear, however, whether the Act is limited to agricultural engines, and in this, as in many other respects. it is vague.

Section 5 defines the qualifications of an inspector as one who "must have had such experience in the manufacture of boilers as to enable him to properly perform his duties." He may be utterly ignorant of an engine and how to run it, but so long as he has worked in a boiler shop he would pass. The duties of the inspector are also indefinitely described, and where they are defined they betray a plentiful lack of knowledge on the subject. One of the inspector's duties, for instance, is "to see that the arrangements for delivering the feed water are such that boilers cannot be injured thereby." This is rather hazy. Another duty is to see that a fusible plug is inserted in the crown sheet. As most boilers of this class in Ontario are of the horizontal tubular type, in which the crown sheet is directly over the fire, which would prevent the fusing of the plug till there was no water left in the boiler, it will be seen that the instructions are rather irrelevant to the conditions. So the instructions for keeping the water at a proper level in upright boilers are quite inapplicable to other types, for which there are no regulations whatever. One section provides that in the making of a boiler any person who drifts a rivet hole is liable to a fine of $200, a penalty double that for using a boiler after it has been condemned by the inspector. In other words, a defect which may not affect the safety of a boiler at all, is visited with a penalty twice as great as that of the worst offense possible—that is the use of a boiler that is known to be dangerous. How is the Government to reach an offending boiler maker who is in an Ontario shop to-day and in Quebec or the United States to-morrow? These are a few only of the weak points in the details of a measure whose first principles are unsound.

Before proceeding further with this measure, we would commend to Mr. MacKay and the Provincial Government a study of the British act dealing with such matters. We have on previous occasions shown how admirably the British act works in practice, simply because, while leaving every man unhampered as to the way in which he will conduct his business, it fixes the responsibility exactly where it belongs. This is common sense as well as justice.

Under the British act the onus of responsibility as regards the condition of a boiler rests upon the boiler owner. He has to see that it is in such a state as not to be a menace either to his employees or to the public. There is no interference on the part of the Government with the owner or user until an explosion takes place when it steps in, holds an investigation. fixes the responsibility of the explosion on the right person—whether the maker, owner or user—and mulcts him in costs. These costs do not relieve the boiler owner or user from his liability at law to his employees. On the contrary, the finding of the Court is considered the basis of an action at law against whomsoever is found at fault.

The law works out in this way: Notice of an explosion, stating the locality, the day and hour, the number of persons injured or killed, the purposes for which the boiler was used, the part of the boiler which failed, and the extent of the failure, must be sent to the Board of Trade [which in Great Britain is a Government department], by the boiler owner or user, within twenty-four hours of the occurrence. A preliminary enquiry is then held, and if the Board sees fit a formal investigation may follow. This enquiry is made by commissioners, one or more of whom must be a competent independent engineer or engineers appointed by the Board of Trade for the purpose of the enquiry only. These commissioners have the power of a court of summary jurisdiction, and the scope of their enquiry can reach back to the time the boiler was built. It covers the boiler owner, the user, the engineer, or others in the employment of the user, the person whom the owner or user has employed to inspect his boiler, a boiler repairer, a second-hand dealer

from whom the boiler may have been bought, or the boiler-maker. Any one of these persons may be found responsible for the explosion. The owner or user is relieved of responsibility by showing that the boiler has been efficiently examined, at proper intervals, by a competent person, and, if any repairs have been recommended, that they have been properly carried out. He is, however, liable for the acts of his servants, and if the engineer were found to blame, the owner or user would be held responsible. A boiler insurance company may be found responsible where its inspector has been negligent in making an inspection, or the commissioners find him to be incompetent. A second-hand dealer may be found to blame for selling a boiler which he knew to be defective, or misleading a purchaser as to its condition. And a boiler maker can be found to blame for improperly making repairs, or where a boiler has been improperly constructed.

When one takes into consideration the fact that this act has been in force for twenty-two years, that there are a far larger number of boilers in use there than in Canada, that the density of the population is far greater, that in comparison the number of boiler explosions is considerably fewer, and the number of persons killed and injured much smaller, there can be no doubt that the British law is founded on common sense and works well in practice. Legislation in Canada could not follow a better model. The Act should be a Dominion and not a Provincial Act, as the machinery required would be adapted to every province, and would be more effective and cheaper by having a single commission of competency, which could not be attained by a multiplication of boards.

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THE COMING SYSTEM OF MEASURES.

In another part of this issue will be found Mr. Halsey's reply to the letter of the secretary of the Decimal Association of Great Britain, referring to the continued use of certain old terms of measures in countries using the Metric System. The survival of terms used in special trades might naturally be looked for alongside of the acceptance by the general public of any national system of weights and measures. But while the terms referred to are used in the silk factories, they are not recognized beyond. When the silk merchant puts his goods on the market, he uses the terms of the Metric System. The sailor still takes his soundings in fathoms, but when he goes ashore he finds he cannot buy cloth by the fathom. He must buy by the yard. So with the silk manufacturer; and the survival of a factory custom in a particular trade or place does not diminish the significance of the steady and uninterrupted advance of the Metric System for general purposes over the world. The circumstance that some English terms are still used in the textile trades on the continent merely follows from the predominance hitherto held by British textile manufacturers in the markets of the world, and not because there is any inherent disadvantage in adapting the metric measures to the trade. At the recent international congress, at Paris, held to promote a universal standard of yarn counts, it was agreed by the British representatives that such a universal system should be in metric terms and no other; and Mr. Halsey's present arguments on these points are pretty fully answered in a report published by the American Chamber of Commerce, in Paris, last year on a conference with the Société des Ingénieurs Civils de France. The Chamber, with a view to weighing all objections to the Metric System, submitted thirty questions to the society, and these were answered in detail. Considering the conservatism of British manufacturers, the report of the yarn congress referred to is a striking testimony in favor of the Metric System. We have this report before us and two paragraphs are worth quoting. They are: "The urgent need of the trade is a system of counts which will embrace all classes of yarns, be convenient for the spinner and reeler, and also for the manufacturer, and which will be understood in all countries. 'Count' being the relationship of length to weight it is obvious that such a system could not be attained unless there were one uniform system of weights and measures. The Metric System of weights and measures is so perfect and has been adopted so widely that it forms the most suitable basis for a uniform system of counts of yarns."

Mr. Halsey is struck by the fact that the United States appears to be the strongest fortress of the English system of weights and measures. This is because the United States has, nationally speaking, lived like the oyster, self-contained within its shell, and with comparatively little foreign trade outside of the English-speaking peoples until in recent years. Great Britain lives by her foreign trade, and her past refusal to adopt a system now used by practically all the rest of the world has cost her the loss of millions of pounds. Now she realizes it, and hence the House of Lords has passed the second reading of a bill to render the Metric System compulsory in Great Britain on and from 5th April, 1906. Inasmuch as a majority of the members of the House of Commons have already signed a memorial in favor of the system, there appears to be little doubt that it will pass. Canada and the other colonies will fall into line, because the Premiers of all the colonies at the last Colonial Conference in London, expressed themselves formally in favor of the change. Costly and inconvenient though the change may be for the time being, the gain will be worth the cost, as all Canadians will realize when they compare our present decimal coinage with the old Canadian currency of pounds, shillings and pence.

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—The Canadian Telephone and Telegraph Company recently took a number of Ottawa aldermen on a jaunt to the United States to inspect various independent telephone systems. The same company is also offering telephones at reduced rates to aldermen in London, Ont., if they obtain a franchise. While there may be nothing intentionally wrong in either of these acts, they are not worthy of public commendation. If independent telephony is for the benefit of the people, and there is incontestible evidence that it is, companies by avoiding all appearance of evil, in their dealings with aldermen, will stand a better chance of obtaining competitive franchises, and securing the confidence of the people. Any act which indirectly places an alderman under an obligation, however slight, to an applicant for a public franchise, is deserving of the strongest censure.

—The steam turbine may now be accepted as the coming type of marine engine, at least for the larger ships. The Cunard Company recently appointed a special commission of experts to investigate the record of the turbine steamships in use on the English Channel, and this commission has reported that under equal conditions the turbine engines show a saving of 10 per cent. in fuel over triple-expansion reciprocating engines. The new Cunarder that is to be next built will have turbine engines aggregating 60,000-h.p., and this great vessel will fairly inaugurate the turbine era in transatlantic navigation.

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—Anyone who, after reading the official reports of surveyors and explorers in our north country, takes a map of Canada, will be struck by both the commercial and strategic advantages of running a transcontinental railway well to the north. The opinions of Mr. Frood, quoted elsewhere, are confirmed by the high authority of Sir Sandford Fleming, in a pamphlet just issued in support of the Grand Trunk Pacific. Sir Sandford points out that "a second transcontinental railway opens up the alluring prospect of consolidating the Dominion by establishing a great national highway removed from the frontier. This feature of the scheme alone invests the question with special interest to every intelligent and patriotic Canadian." A route such as this, Sir Sandford points out, would save 1,423 statute miles over any existing route from Yokohama to Liverpool. There is not only this saving in distance in connecting Europe with Asia, by way of Canada, but the northerly route gives easier grades which is an advantage of great practical importance in cost of operating. But more important still is the fact that a new Canada will be created in the region to be traversed which could not be developed except by such an arterial line of transportation. Sir Sandford speaks of the arable land making a belt whose northern edge would be 400 miles away from the frontier. We believe this belt of cultivable land will prove to be more than 700 miles broad, measured from any point west of Winnipeg, and that the forest and mineral wealth of the eastern section will also make it pay to keep north through Ontario and Quebec, possibly terminating eventually at a port on the east coast of Newfoundland or on the coast of Labrador, when science has triumphed over the difficulties of navigation in that part of the ocean. It appears to us that, in the light of the success of State-owned railways in India, South Africa and Australia this great highway should be built and owned by the Dominion; but whether owned by the State or not, the work should go on.

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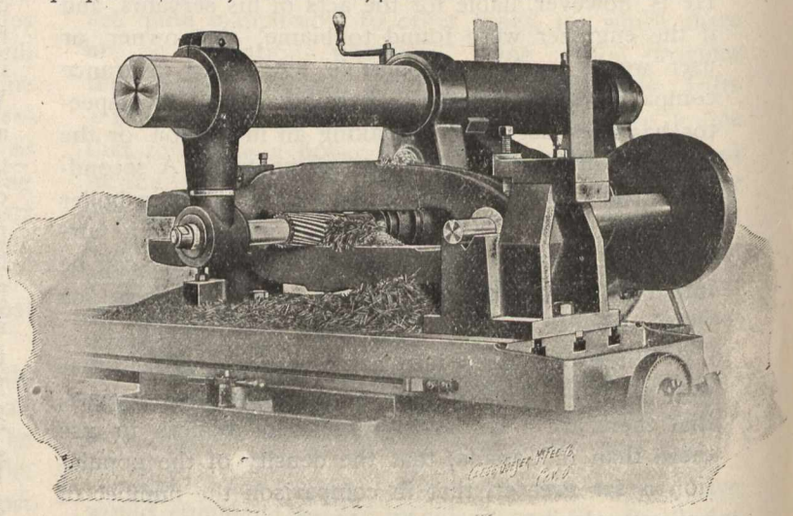
MACHINE SHOP NOTES FROM THE STATES.

III.

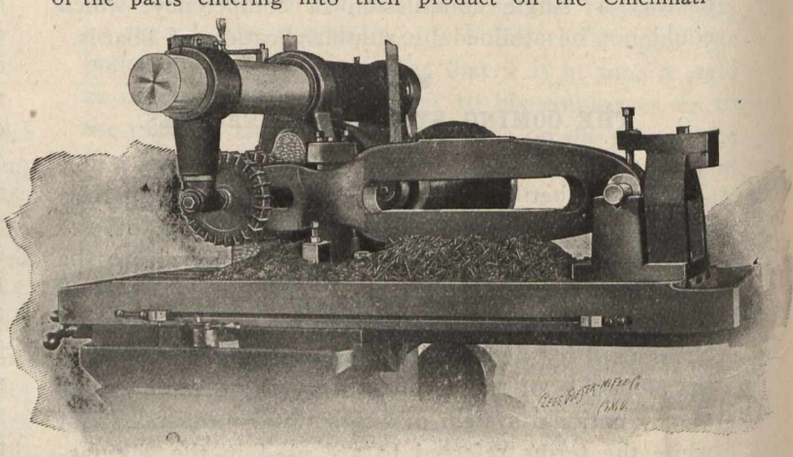
While visiting the machine tool shops, in Cincinnati, recently, I saw the Cincinnati Shaper Co. doing some very interesting things by way of rapid processes of manufacture. These people have just moved into their new shops, and have the best tool equipment that is procurable.

Among the things which I saw, probably the most interesting was the job of milling their rocker arms, which process is made clear by the illustrations herewith. The particular rocker arm photographed is about 36-in. long over all, and about 10-in. wide by 2¾-in. thick. The work is held in the very simple fixtures shown, and the slot is milled to size by using a spiral mill, as shown in Fig 1. The slot in forks at the left hand end is also milled to size in the same manner, as are also the pads at the top and bottom of the main body of the rocker arm. The two sides of the piece are finished by using a 9½-in. diameter face mill to bring the arm to a proper thickness, which is 2¾-in. Then the forked end is



milled by using a gang shown in Fig. 2. All these operations except that of milling the bottom pad and the face of the piece farthest from the body of the machine, are finished without changing the setting. Then the piece is reversed in the fixture and these two surfaces are finished. The job is remarkable because of the simplicity of the fixtures, and the simple way in which the finishing is done.

Although these people make a specialty of building shapers, they find it profitable to finish a large proportion of the parts entering into their product on the Cincinnati



Geared-Feed Miller—the one shown in illustration being one of the half dozen in use. I was told that not very long ago they had been finishing their rocker arms on planing and shaping machines, and in looking over the time cards, we found that they thought they were doing it very well when they got the work done in 14½ hours. They are now milling these pieces by the method which I have just described, in two and one-quarter hours each, which illustrates the saving that can be effected by keeping in close touch with improved tools and methods.

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The Scientific American states that at the Jefferson Ironworks, Ohio, a new composition has been tried which is said to have remarkable effect in welding scrap steel. The scrap is placed layer upon layer, with the composition between, after which heat and mechanical pressure are applied, the result being a homogeneous union of the several parts. A billet of steel thus made was put through the furnace and rolled into a sheet, after which the metal was cut up into smaller pieces, from which nails and washers were made. These were found to be of excellent quality. The cost of making the billet, including the composition and labor, is from 25 to 50 cents per ton.

THE ENGINEERS' CLUB OF TORONTO.

At the meeting of this Club, on February 2nd, J. Alex. Culverwell read a paper on "The Enlarged Erie Canal and Its Relation to Canadian Waterways," reported elsewhere. On February 25th, Captain Killaly Gamble, the new president, delivered his inaugural address, in which he referred to the opening up of the northern portions of Canada by the construction of new railways; the completion of the Pacific cable, which was of great service to the Empire; and the proposed "Trans-Isthmian" Canal. He also pointed out the importance of the boundary lines of our northern limits not being lost sight of. John S. Fielding also read a valuable paper on "Dams," which will be published in a subsequent issue.

LIGHT, HEAT, POWER, ETC.

The electric light plant, at Richibucto, N.B., is completed.

Sydney, C.B., proposes municipal ownership of a gas plant costing $75,000.

Acton, Ont., proposes installing an electric power plant, in conjunction with the present lighting service.

Power is to be generated at Meduxnakeag, two miles from Woodstock, N.B., for the Electric Power Company of that place. C. M. Garden, C.E., has charge of the work.

The light and power service of Winnipeg, Man., comprise 14,194 incandescent, and 66 arc lamps, in addition to its street lighting service, and motors aggregating 654-h.p.

Power is to be developed at Stave Lake, B.C., for electric locomotives to run from Vancouver to New Westminster, and ultimately right through to Seattle on the Great Northern.

The Sherbrooke, Que., Heat, Light and Power Co. have refused the city's offer of $20,000 for the gas plant. They ask $33,000, making the total cost of the electric light and gas plants $233,000.

Westville, N.S., is dissatisfied with its present electric light service, and will ask the Legislature to give the Intercolonial Coal Mining Co. power to light the town instead of the New Glasgow Electric Co.

What is claimed to be the biggest water-pipe in the world is being laid by the Ontario Power Company on the Canadian side of Niagara Falls. It is of steel throughout, one and one-quarter miles in length, and 60 feet in circumference. The plates are half inch, and will require 200 tons of rivets.

The Empire Power Company, of Owen Sound, Ont., has been chartered for the purpose of dealing in electricity for light, heat and power, and developing the same from water power or natural gas. Capital, $500,000. The company includes J. M. Kilbourn, H. B. Smith, G. S. Kilbourn, of Owen Sound, and E. A. Peck, of Peterboro.

In 1901 arbitrators valued the Kingston Electric and Gas plants at $170,373, and said the franchise, which the company claimed was worth $80,000, was valueless. The owners refused to turn the plant over to the city, and a final appeal to the British Privy Council having been dismissed, the city will now secure the plant.

It is proposed to form a merger of the water power interests at the Chaudiere Falls, Ottawa, Ont., for the purpose of economically distributing power to each user in proportion to their holdings. Those interested are the Ottawa Electric Co., the Bronson Co., the Ottawa Investment Co., J. R. Booth, E. B. Eddy, and the Ottawa and Hull Power Companies.

In the article in last issue, headed, "Electricity and Fires," the statistics refer to the whole of the United States and not to Montreal, as stated. The article was reproduced from a Montreal paper whose correctness was assumed. As a matter of fact, only one fire traced to defective wiring was recorded in Montreal during the three months in question.

Millbrook, Ont., is agitating for a supply of light and power, which could be obtained by the rebuilding of the Lockie dam. It is said that enough contracts could be obtained to make the undertaking successful.

Tenders for electric power, for the municipal street lighting, will be received by Ald. Robert Hastey, City Hall, Ottawa, Ont., up to March 14th. A minimum of 350 electric horse-power will be required by May 1st, 1905, with the privilege of increasing to 600 horse-power. The power must be available at all hours, between dusk and daylight, throughout the year. Bonds to the amount of $10,000 will be required from the successful tenderer in addition to $500 deposited when tendering.

At the annual meeting of the Shawinigan Water and Power Co. the treasurer reported that the company was selling in Montreal 6,000-h.p., and at Shawinigan Falls 20,000-h.p.; that the total estimated capacity to be developed was 100,000-h.p. The successful transmission to Montreal had demonstrated the commercial feasibility of transmission within a radius of 100 miles. They had applications for large amounts of power, and anticipated extensive additions to its electrical plant during the present year. The following officers were elected: President, Hon. Robert Mackay; vice-president, J. N. Greenshields; treasurer, J. E. Aldred; directors, Hon. Robert Mackay, Thomas McDougall, Wm. MacKenzie, W. R. Warren, J. N. Greenshields, John Joyce, Denis Murphy, H. H. Melville, J. E. Aldred. It is reported that the company has in contemplation the supplying of power to the large centres of the Eastern Townships, Que.

TELEPHONE AND TELEGRAPH.

The Bell Telephone Company are installing a local system in Lacombe, Alta.

The telephone plant at Victoria, B.C., has been improved recently at a cost of $75,000.

London, Ont., has decided to take no action in the telephone franchise matter until Toronto and Ottawa have settled the question of independent systems.

An order-in-council has been passed granting the British Yukon Railway Co. free right of way for a telephone line from White Horse and Dawson City.

The York County Council, will require the Metropolitan Railway Co. to institute a system of telephones connecting the towns and villages along their line.

Narvik, Norway, the terminus of the world's most northern railway, and within the Arctic circle, has been connected by telephone with Stockholm, Sweden, a distance of 600 miles.

The Mayor of Toronto believes the city should grant a franchise to an independent company, and give them all municipal phones in the City Hall, fire halls, hospitals, etc. This would ensure the success of a new company.

The case of the Bell Telephone Co. vs. Dr. W. W. Birdsall, Fort William, Ont., who ceased using the Bell service, the company claiming another six months' rent under their self-renewing contract, was heard in chambers recently, and dismissed with costs.

In the action of Price vs. The City of Hamilton, to quash the franchise of the Bell Telephone Co., Justice Street has dismissed the application. His Lordship found no grounds for the charge that the franchise law had been secured by corrupt methods. The decision will be appealed.

The Grand Trunk is establishing long-distance telephones on its southern division from St. Thomas to Fort Erie and Niagara Falls, and the middle division from London to Niagara Falls. The telegraph wires are used for the telephone system, without interfering with the telegraph service.

A Swedish engineer, named Orling, has invented in England, in conjunction with the Armstrong firm, a new electric capillary recorder, which will revolutionize the method of telegraphing to great distances. The system permits the placing of twenty-five instruments, side by side, giving the same effect as a single apparatus. A telegram of fifty words can be despatched in ten seconds.

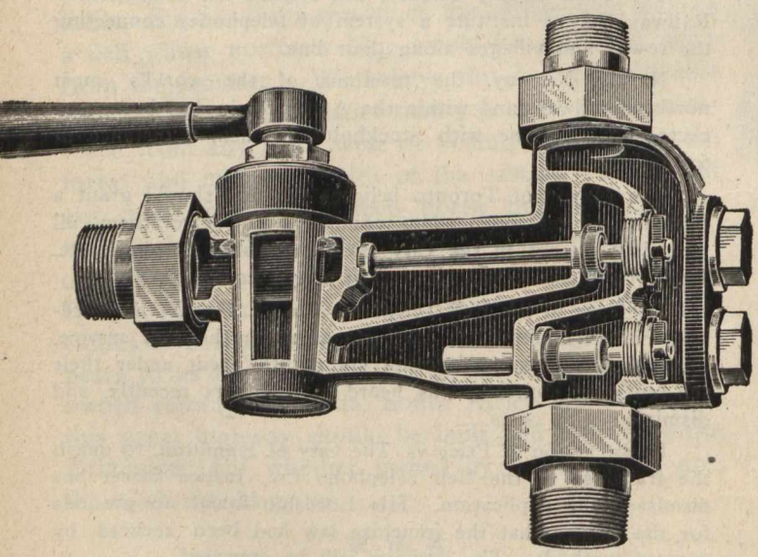
The report of the Bell Telephone Co., of Canada, for 1903 shows: Subscribers added during the year, 8,691. Total instruments earning rental, 57,172. 421 exchanges and 672 agencies. 4,121 miles of wire were added to the Long Distance system in 1903; 1,738 in the Ontario department, 1,260 in the Eastern department, and 1,123 in the North-Western department. The long distance lines now comprise 30,969 miles of wire on 7,685 miles of poles. Total receipts, $2,522,-275. Expenditure, $1,940,123. Net revenue, $582,152. After paying a dividend of 8 per cent., a balance, including surplus for 1902 of $138,078, remained, out of which the following appropriations were made: Insurance reserve, $24,563; accident reserve, $22,979; contingent fund (i.e., depreciation), $50,000. The capital issued is $6,000,000. Bonded indebtedness, $2,000,000.

THE "EASY" DOUBLE TUBE INJECTOR.

This injector is a double tube, positive working machine. Two sets of jets are shown, one being the lifter, and the other the forcer. A positive working cock communicates with all nozzles, and through a simple turning with a handle, opens or closes all connections with the atmosphere and boiler.

Steam is admitted simultaneously to the lifting and forcing steam jets, direct from the boiler. The velocity of the steam passing through the tubes of the lifter and out to the atmosphere, creates a partial vacuum in the water chamber of the lifter, in consequence of which the pressure of the outside atmosphere will force the water into the lifting water chamber. Any excess of steam which cannot find its outlet through the small sectional area of the delivery tube, finds an outlet to the atmosphere, whereby instant relief throughout the length of the tube will be obtained. The velocity of the steam entering the forcing steam jet results in the formation of a partial vacuum; also in the water chamber of the forcer. Therefore, the forcer serves also as a lifter during starting operation.

On account of the lifting power of the forcer, the water discharged by the lifter is simultaneously and automatically taken up by the forcer, even by an entirely open overflow, without necessitating any special construction to secure the entrance of the water into the forcer. The high velocity of steam by higher pressure does not prevent prompt lifting



and starting, because there is instant relief. The result is an instantaneous formation of a current of water and steam to enter into the boiler by the simultaneous and direct admission of steam to both lifter and forcer since no back pressure can exist to prevent the establishment of a working jet. The full or sudden opening of the steam valve cannot have a detrimental effect to the starting of the injector, for the same reason. The sub-dividing of the reliefs for the lifter and forcer makes a sudden closing of the outlet to the atmosphere possible, after the jet is established, without danger of breaking the latter, and, finally, the instant relief and free outlet of the steam from all the tubes makes it possible to start the injector immediately at a full head of steam, on a lift, or under a head of water against any pressure, equal or less than the actuating steam. The whole operation consists in opening the steam valve and turning the handle of the overflow cock in line with the boiler outlet.

This injector will work from 10 to 375 pounds pressure, and higher, without any adjustment of steam or water. The construction of the machine is such that small particles of dirt, etc., are not liable to interfere with its working, and as all tubes are in a straight line, they can readily be cleaned by removing the front nozzles, without disconnecting the injector from its piping.

The inventor of this injector is Francis Sticker, 69 Beekman street, New York. It is now manufactured in Canada by the Canada Foundry Company, Toronto.

MINING MATTERS.

Japan's output of coal in 1901 was 7,428,000 tons, or nearly three times that of 1890.

The White Bear mine, Rossland, B.C., is installing a 20-drill compressor and 350-h.p. motor.

The nitrate mines of Chili last year yielded 1,250,000 tons, on which the Government tax amounted to $21,000,000.

The Dominion Coal Co. contemplate opening new mines in Cape Breton, possibly at Big Glace Bay and Victoria.

The Canadian Commission on electric steel smelting will also investigate the operation of peat plants when in Europe.

A Hendrix electric-cyanide plant for treating ores is being installed at the Mountain Lion mine, near Rossland, B.C.

The large mill of the Canada Corundum Co., at Craigmont, Ont., is completed. Its initial capacity is 300 tons per day.

The Dominion Iron and Steel Co., Sydney, C.B., are erecting a washing plant, with a capacity of 2,000 tons a day, costing $150,000.

What is claimed to be the richest radium bearing earth in the world has been discovered in the Llano gold and coal fields, 115 miles north of Austin, Texas.

The Montreal and Boston Copper Co.'s smelter, at Boundary Falls, B.C., has installed a third furnace and made other preparations for enlarging their capacity.

The Atlin Mining Company, of Ontario, Limited, the British Gold Mining Company, of Ontario, Limited, and the North American Ore Company are to be wound up.

It is announced that Dr. Ludwig Mond's nickel mine, at Victoria, Northern Ontario, has been leased to the International Nickel Company for a year. The mine will be closed, and the smelter used to refine the ore of the iron mine at Massey.

The Rossland Power Co. are erecting a mill for the treatment of ores from the War Eagle and Centre Star mines, Rossland, B.C. The work includes the mill building, 360 by 105 feet, a stone building, 100 by 26 feet, and 700 feet of trestling to carry the railway track over the ore bins, 32 feet high.

J. Obalski, inspector of mines for Quebec, has sent to Prof. Rutherford, of McGill University, a mineral containing radium. Professor Rutherford says the sample contains radium in workable quantity, and compares with the best pitch-blende used for that purpose in Europe. The mineral comes from an old mica mine back of Murray Bay, in Charlevoix County.

The Bridgeport, N.S., colliery of the Dominion Coal Co., which produces coking coal and has an output of 1,000 tons per day, is temporarily closed, owing partly to depression in the United States trade and the reduction of demand in the Canadian market in the winter season. The 600 hands employed will be provided with work elsewhere, as far as possible. A water purifying plant is to be installed at this mine, the first of its kind in the province.

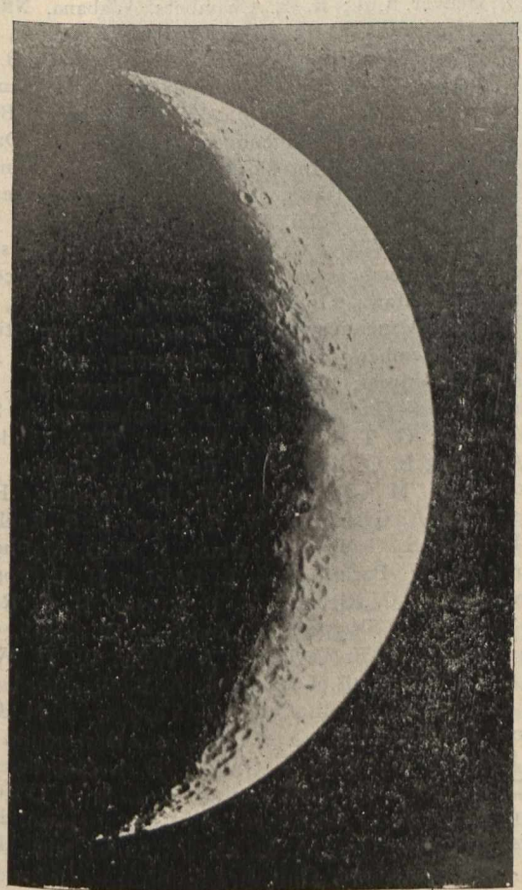
To conserve the Yukon water supply, the Government has approved a plan to impound the surplus water of the spring and rainy season, by the construction of reservoirs in the creeks and gulches, and the storage of water on worked or worn-out ground. Judge Britton and B. T. A. Bell have been empowered to continue the enquiry into hydraulic concessions. Mr. Bell, who was injured by a fall down an elevator shaft. in Ottawa, last month, died on the 1st inst.

According to an order-in-council, passed at Ottawa last month no more hydraulic mining leases will be granted in the Yukon, and those who now hold such leases will be required to fulfil the conditions.

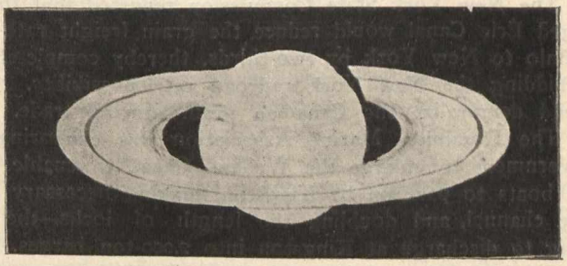
A syndicate of Canadian and American capitalists, headed by H. M. Whitney, of Boston, has been formed to develop and operate the extensive submarine coal areas at South Head, Port Morien. Extensive purchases of surface lands, water privileges, etc., at Southhead, Port Morien, have been made, and an elaborate survey under the direction of Hiram Donkin, C.E., of the Dominion Coal Company, has been completed. The new collieries, which will constitute the greatest submarine mining project in the world, will resemble the submarine collieries in North Wales, where similar undertakings have been successfully accomplished. C. O. Macdonald, who has investigated the Welsh methods, reports that conditions at Port Morien are more favorable than in British submarine collieries.

PHOTOGRAPHS OF THE MOON AND SATURN BY RADIUM LIGHT.

We believe that to the Rev. Dr. D. B. Marsh, president of the Astronomical Section of the Hamilton Scientific Association, belongs the honor of printing the first photograph taken of a heavenly body by radium light. By the kindness of Dr. Marsh we are able to publish engravings from these two photographs, with the following note as to the method employed:



"I am sending the photographs you have asked for. One is a photograph of the moon, taken by myself, with my own telescope (a 5-inch), and printed from the negative with radium light. Also I enclose a photograph of the planet Saturn, drawn by G. P. Jenkins, F.R.A.S., of Burlington, Ont. Mr. Jenkins drew the planet at the eye of his own telescope in 1895, in Wales, England. The telescope was a 5-inch Wray. From the drawing I have, I made the enclosed photograph. And did it (also the one of the moon enclosed), in this way. To the negatives I placed sensitive Illford lantern plates in direct contact. These were put in the holder of my camera. I then took a tube containing 1 grm. of



radium of 240 radio-activity, the property of, and kindly lent me by, J. R. Collins, of Toronto. I placed this tube containing the radium inside the camera in the position of the inner lense of the camera. I then drew out the bellows till the radium and plate holder were about 3 inches apart. This being done, I drew the slide and exposed the sensitive plate to the radium light through the negative. The exposure was for 13 hours; the plates being developed, resulted in what I am sending by parcel mail."

THE TRENT VALLEY CANAL.

At the Canadian Institute, Toronto, on February 6th, J. Alexander Culverwell delivered an address on the above subject, which was illustrated by some forty lantern views, showing topographical maps, structures and scenes on the Trent Valley, Soo Canal, Welland-St. Lawrence, the new enlarged Erie Canal, and the Dortmund-Ems German Canal, an interesting description being given of these waterways. Mr. Culverwell argued that the Trent Valley Canal followed out the same method adopted in the $100,000,000 German canal system, connecting the coal and steel districts of Germany with the North Sea, namely, length and breadth of lock rather than depth. It was recognized that by this means, bulk of barge could be accommodated more cheaply, and a cheaper means of transportation afforded. The draught of each system would be eight feet, and the locks of the Trent wider, but not so lengthy. New York State was also building a barge system in the enlarged Erie Canal, which had at present capacity for only 250-ton barges, costing $100,000,000, to accommodate boats of 1,000 tons, 150 feet long, 25 feet wide, and having 10 feet draught. The Trent Valley Canal would accommodate 800-ton boats; the dimensions of the locks were 134 feet long, by 33 feet wide, with 8 feet draught, and the total cost would be only $9,000,000, of which $4,000,000 was already spent on the section between Lake Couchiching—an arm of Lake Simcoe—on the north, and Rice Lake on the south. The balance of $5,000,000, would open up the two outlets, viz., the northern outlet between Midland on Georgian Bay, and Orillia on Lake Simcoe, and the southern outlet between Rice Lake and Lake Ontario, either at Port Hope or Trenton. This waterway would then open up 1,000 miles of inland shore line, many of the lakes and rivers lying transversely to the line of canal.

The speaker explained that the purpose of the Trent Valley Canal was to connect the upper lakes, at Midland, on Georgian Bay, where the great lake carriers would discharge the grain into Trent Valley barges, which, passing through this series of canals and lakes, via Peterboro, where is the greatest lift lock in the world, would enter Lake Ontario either at Port Hope or Trenton, and proceed by the St. Lawrence canals to Montreal, where they would discharge into the ocean-carriers for Europe. Only 18 miles out of the 200 miles comprising this waterway, would be actual canal, as compared with the Erie Canal, which had 257 miles of continuous canal, therefore the natural advantages of the Trent system were most apparent. The Trent route would also be 730 miles shorter, between the Soo and Liverpool, than by the Erie, and one day shorter than the Welland route between the Soo and Montreal.

Views were shown of the immense double hydraulic lift-lock, at Peterboro, and the lecturer explained that the five hydraulic locks to be used on the canal would save six hours over the ordinary system of lockage. Views were also shown of similar locks in Europe.

The New York State Commission reported that the enlarged Erie Canal would reduce the grain freight rate from Buffalo to New York by two-thirds, thereby completely underbidding the New York railroad rate possibility. This would demoralize the Canadian grain-carrying trade.

The Dominion Marine Association was clamoring the Government to enlarge the Welland Canal, to enable 6,000-ton boats to pass on to Kingston, making necessary a 21-foot channel, and doubling the length of locks—the idea being to discharge at Kingston into 2,000-ton barges. This request was made just after $40,000,000 had been spent on enlarging that system. The speaker advocated, first, the spending of the five millions necessary to complete the outlets of the Trent Canal, thus giving an international grain route, in addition to water communication, between Peterboro, Lindsay, Orillia and other points with Toronto, Hamilton, and Western Ontario. He pointed out that marine experts writing in American journals have stated that the only Canadian route that they feared was the barge route through the Trent Valley, which, as they express it, was simply a connecting-up of lakes and rivers. In concluding, Mr. Culverwell said that the Trent Valley Canal had obtained a bad name owing to political considerations, but he hoped that a fresh start would be made immediately to complete this great work of utility, and that the public would recognize its true worth in comparison with the modern canal systems of the world.

ROBERT BOWIE OWENS, E.E., M.A., D.SC., F.R.S.C.

Prof. Owens, one of the new members of the Council of the Canadian Society of Civil Engineers, is head of the electrical department of the Applied Science Faculty of McGill University. He is a graduate of Charlotte Hall Military School, Maryland, and special student in physics, mathematics

and electrical enginering in the John Hopkins' University, Baltimore. He afterwards studied at Columbia University, New York, and received from the Columbia School of Mines the degree of E.E. and from the Faculty of Pure Science, same institution, the degree of M.A. He was appointed to the John Tyndall Fellowship for the Encouragement of Research, and twice reappointed. From McGill University, Montreal, he received the degrees of B.Sc. (ad eundem), M.Sc. and D.Sc. He was Professor of Electrical and Steam Engineering, in the University of Nebraska, 1891-1898, and in the latter year accepted the offer of Professorship of Electrical Engineering, McGill University, which he now holds. He has had practical shop experience with the Baxter Motor Co., The Excelsior Electric Co., Westinghouse Electric and Mfg. Co., etc., and has done construction and consulting work in electric lighting, electric railways and power transmission and distribution at various times during the past ten or twelve years. He is an associate member American Society Mechanical Engineers, member and past vice-president American Institute of Electrical Engineers, honorary secretary, for the Dominion of Canada, of the American Institute of Electrical Engineers, member Institution of Electrical Engineers of Great Britain, honorary sec.-treas. for Canada for the Institution of Electrical Engineers, member New York Electrical Society, member and past member of council Society for the Promotion of Engineering Education, president of the Electrical Section of the Canadian Society of Civil Engineers, Fellow of the Royal Society of Canada, member, International Electrical Congress, 1893; member, Jury of Awards, Columbian Exposition; member of Committee of Organization of International Electrical Congress, 1904. Prof. Owens is the author of "Dynamo Design," and of a number of valuable papers and reports to technical societies.

E. H. McHenry, another new member of the Council of the Canadian Society of Civil Engineers, is Chief Engineer of the Canadian Pacific Railway, in succession to P. A. Peterson. Mr. McHenry engaged with the Northern Pacific Railroad Company in the spring of 1883, and successively filled the positions of rodman, chainman, leveller, transitman, resident engineer, locating engineer, assistant engineer, division engineer, principal assistant engineer, chief engineer, and receiver until the termination of the receivership on January 1st, 1897. From that date to September 1st, 1901, he held the position of chief engineer to the reorganized Northern Pacific Railway Company. After a vacation of nine months spent in Oriental travel, he engaged with the Canadian Pacific Railway Company in his present capacity of chief engineer.

THE CANADIAN SOCIETY OF CIVIL ENGINEERS.

At the last ballot of the Canadian Society of Civil Engineers, Montreal, the following were elected members: H. C. Abell, Denver, Col.; R. E. Chambers, Wabana, Nfld.; B. J. Forrest, Inverness, C.B.; J. C. Gwillim, Kingston, Ont.; R. D. Mershon, Montreal. Associate Members—G. B. Ashcroft, A. Balsley, D. E. Blair, W. J. Camp, M. A. Sammett, V. H. Schwabe, all of Montreal; H. S. Badger, Bridgewater, N.S.; J. Causley, Vancouver, B.C.; E. H. Darling, Hamilton, Ont.; F. J. McIntosh and D. A. Ross, Winnipeg, Man.; John Murphy, Ottawa, Ont.; G. E. Revell, Peterboro, Ont.; P. H. Smith, St John, N.B.; W. F. Thompson, Rossland, B.C.; E. T. Wilkie, Carleton Place, Ont. Transferred from Associate Members to Members—R. F. H. Bruce, and P. Weatherbe, Ottawa, Ont.; J. L. Morris, Pembroke, Ont.; H. B. Walkem, Vancouver, B.C. Transferred from Students to Associate Members—R. C. F. Alexander, and J. A. D. Montrouge, Montreal; G. G. Grundy, Rivere du Loup, Que. Associates—C. F. Eicks, F. J. Gilman, and A. Stansfield, Montreal; G. T. Kennedy, Windsor, N.S. Students—M. B. Atkinson, B. O. Bay, W. L. Bird, C. J. Chaplin, W. C. M. Cropper, J. M. Donaldson, W. F. Drysdale, H. K. Dutcher, J. M. A. Gariepy, J. W. G. Greey, F. S. Kaelin, G. K. McDougall, S. G. F. MacDermot, J. McD. McPhee, R. V. Morris, N. W. Parlee, A. S. L. Peaslee, H. B. Pope, A. D. Porcheron, C. C. Richards, A. B. Ritchie, H. G. Rogers, G. W. Scott, G. P. Sharpe, J. C. Smith, S. W. Smith, G. St. George Sproule, R. F. Taylor, J. A. Walls, W. D. Wilson, and F. C. D. Wilkes, all of Montreal; A. B. Blanchard, Parry Sound, Ont.; C. St. G. M. Campbell, Toronto; J. M. Campbell, Port Hastings, C.B.; J. H. Congden, Dartmouth, N.S.; H. C. Kennedy, Hawkesbury, Ont.; J. D. Lachapelle, Sorel, Que.; D. H. Nelles, Grimsby, Ont.; J. E. L. St. J. O'Connor, Parkbeg, Assa.; J. F. Robertson, Jr., Charlottetown, P.E.I.; J. Sears, Kingston, Ont.; A. L. Sharpe, Summerside, P.E.I.; M. H. Sullivan, Ottawa, Ont.

The following meetings were held by this society in February: On the 18th, in the Electrical Section, a paper entitled, "Some Problems in Storage Battery Engineering," was read by Dr. W. E. Winship, of New York. On the 25th in the Mining Section, short illustrated papers on "Iron Mining in the Lake Superior District" were given by H. W. Parlee and C. Campbell, followed by further illustrated matter and discussion.

THE FAIRBANKS COMPANY.

Probably no enterprise in Canada is of more widespread interest to engineers than that of The Fairbanks Company. Certainly no business has made more rapid progress or extended its trade over a larger area in the short period which has elapsed since it entered the Canadian field. The chief offices, warehouse, and salesrooms in Montreal were established in 1898, and since that date branches have been opened in Toronto, Ont.; Winnipeg, Man.; and Vancouver, B.C.

The Montreal premises, situated at Nos. 747 and 749 Craig St., are handsome and commodious, the floor space aggregating 24,000 square feet; The continued increase in the volume of the business, however, necessitates enlarged accommodation, and the company is now negotiating for further extensions. The showrooms rank among the finest in the city, and contain a varied and heavy stock of the numerous products of the company.

The Fairbanks Co.—Montreal Warehouse.

About three-quarters of a century ago, Thaddeus Fairbanks, who owned a woolen and grist mill in St. Johnsbury, Vt., experienced much trouble and loss of time in weighing the wagon loads of merchandise bought and sold by him, there being no other method than that of dividing the goods into parcels or small lots and weighing them separately on an old-fashioned even balance. After much experimenting to devise a machine which would weigh a whole load at a time, his efforts resulted in the invention of what are now the "Standard Platform Scales." They were pretty rough looking propositions, but since that date there has been a progressive development of these scales, and whenever inventive genius or money can devise any improvement, these are at once embodied in "Fairbanks' Standard Scales," in consequence of which they are to-day recognized as the standard —being what their name implies.

Famous for the manufacture of Fairbanks' Standard Scales, asbestos packed cocks, tools and machinery, trucks, portable forges, railway and mill supplies, the Fairbanks Company has secured, and is constantly acquiring, new patents and inventions, for the improvement of its manufactures, enabling it to maintain the highest standards and the most up-to-date methods, thus securing its position as a world's leader in its particular branch of industry. No other concern in the world manufactures a greater variety of scales than this company, comprising, as they do, those to indicate weights used in any part of the world, and to accord with the standard weights of any country.

A specialty, which the company has found to be a most important line, is the manufacture of its patent renewable asbestos disc valves, which have been installed in most of the large and important buildings in New York City, and the principal American, Canadian, and European centres. Other specialties handled by the Fairbanks Company include trucks in all sizes, shapes and styles, baggage barrows, depot express wagons, push carts, Cole's patent "Coronet" belting, portable forges, gas and gasolene engines, and machinery and tools of every description. They also carry the largest and most complete stock of pulp and paper mill supplies in Canada, and manufacture special makes of trucks for handling paper in rolls, as well as ream paper and pulp. They also carry a full line of tools and other requisites for paper and pulp mills, such as paper scales, micrometer calipers, speed indicators, etc., etc. Their mill supply and valve catalogue is the most complete in Canada, and may be obtained on application by any interested readers.

In addition to goods of their own manufacture, The Fairbanks Co., in Canada, handle the products of the following firms, and in many cases are their sole agents in the Dominion; American Spiral Pipe Works, Chicago, Ill., hydraulic and exhaust steam pipe, galvanized and asphalt coated standard fittings, etc. American Steam Gauge and Valve Mfg. Co., Boston, Mass., gauges, indicator whistles, and other steam specialties. American Tool Works Co., Cincinnati, O., builders of lathes, planers, shapers and drills. Edwin E. Bartlett, Boston, Mass., the Greenerd Arbor press. Bignall & Keeler Mfg. Co., Edwardsville, Ill., pipe cutting and threading machines. The Burt Mfg. Co., Akron, O., "Burt" oil filters and "Burt" exhaust heads. The Colburn Machine Tool Co., Franklin, Pa., boring mills. Henry A. Cole, Liverpool, England, coronet belting. E. M. Dart Mfg. Co., Providence, R.I., the Dart patent union coupling. The

Duff Manufacturing Co., Pittsburg, Pa., jacks and track tools. Emmert Mfg. Co., Waynesboro, Pa., vises. Foster Engineering Co., Newark, N.J., pressure regulating valves, etc. Hill Tool Co., Anderson, Ind., tool holders for lathes. H. W. Johns-Manville Co., New York, N.Y., asbestos packing, etc. The Keystone Mfg. Co., Buffalo, N.Y., ratchets, wrenches, drills, etc. The R. K. LeBlond Machine Tool Co., Cincinnati, O., milling machines, etc. J. J. McCabe, New York, N.Y., double spindle lathes. The Merrell Mfg. Co.,

Fairbanks, Toronto.

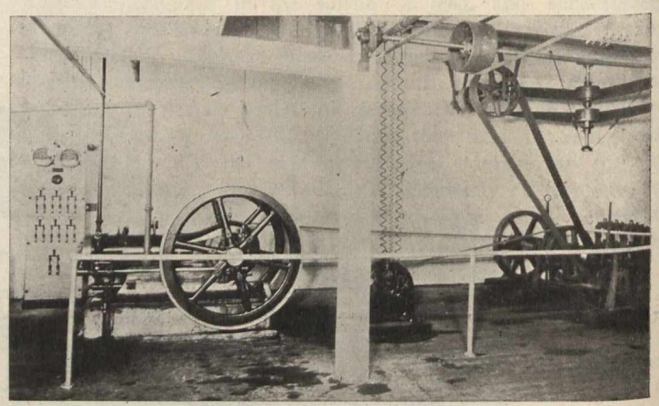
Toledo, O., pipe threading and cutting machinery. The Moran Flexible Joint Co., Louisville, Ky. R. F. Morse, Providence, R.I., gauge glass preservers. National Tube Co., New York, N.Y., iron pipe. New Process Twist Drill Co., Taunton, Mass. Niles-Bement-Pond Co., New York, N.Y., iron working machinery. The Norton Emery Wheel Co., Worcester, Mass. The O.K. Tool Holder Co., Shelton, Conn. The Oneida Steel Split Pulley Co., Oneida, N.Y.

Main Floor, Toronto.

The Oster Mfg. Co., Cleveland, O., pipe tools. The Pratt & Whitney Co., Hartford, Conn., machinists' tools, and machinery. The Reed Mfg. Co., Erie, Pa., vises, pipe wrenches, etc. The Reliance Machine Tool Co., Cleveland, O., bolt cutters. The Reliance Safety Water Column Co., Cleveland, O. The Taunton Locomotive and Mfg. Co., Taunton, Mass., feed water heaters. The Thorpe-Platt Co., New York, N.Y., Geipel steam traps. The Union Chuck Co., New Britain, Conn., lathe chucks. J. H. Williams & Co., Brooklyn, N.Y., drop forgings. Wilmarth-Morman Co., Grand Rapids, Mich., twist drill grinders, and Yale & Towne Mfg. Co., New York, N.Y., chain blocks.

The Fairbanks Company is undoubtedly the largest engineering supply house in the Dominion, and with its various branches carrying, as they do, a stock of goods specially adapted to the needs of the industries peculiar to the districts in which they are located, it is enabled to meet all demands promptly, and with a degree of satisfaction to its customers not surpassed by any other firm in the trade.

In the company's Toronto branch, recently opened at 41 Front St. West., situated in the centre of the wholesale section of the city, no expense has been spared in building suitable fixtures, so that stock can be arranged systematically, and the necessity of unnecessarily handling goods obviated. The warehouse has a frontage of 33-ft. by 198-ft., having four



Fairbanks Gas Engine.

floors. In the basement is installed a very complete engine room, equipped with a 16-h.p. Fairbanks' gas engine to run the scale repair department and lighting plant. The sample warehouse on the first floor has been arranged in departments, the head of each having his samples and catalogues at hand, so that in waiting on customers no time is lost in

The Fairbanks Co.—Winnipeg.

looking through the stock for samples which a buyer may wish to see, these being displayed in their respective departments. The second floor has been devoted entirely to the handling of iron pipe fittings, valves and engineers' brass goods, being fitted up in sections for the various lines covered

by the above goods. The third floor is suitably arranged for scales and transmission appliances. In connection with this warehouse is a very desirable pipe shed located on the railway siding, having rolling doors, so that pipe can be taken off or loaded on cars, whichever the case may be. It is also fitted

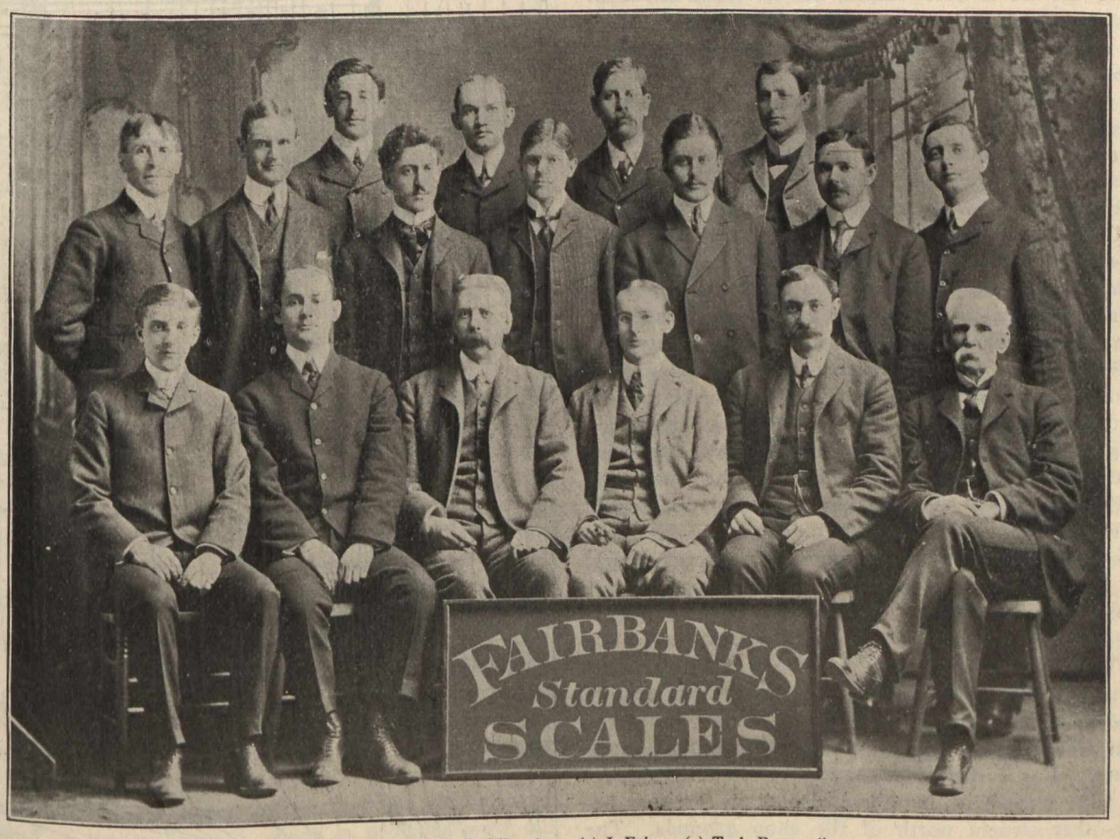
Fairbanks, Vancouver.

with rolling door on the yard side, so that goods can be easily placed on dray for local delivery. The location of the warehouse is such as to give shipping advantages, by rail and water, that very few enjoy, owing to the fact that it is one block from the G.T.R. or C.P.R. freight sheds, and the shipping dock immediately at the back.

shipped in. The results have been so satisfactory that permanent accommodation has been secured, and now the new warehouse in Arthur street, adjoining G. F. & J. Galt's spice mill, is stocked with a complete assortment of the firm's goods. The warehouse has a floor space of 37,800 square feet; six floors, a 54-ft. frontage, with a depth of 100 feet. While the firm does not own the premises it will occupy, they have been built after specifications of its own choosing. The hoists are the biggest in Winnipeg, having a capacity of at least ten tons, and capable of handling the heaviest machinery in which this firm deals. An electric lighting plant will be installed, power being furnished by a gas engine and dynamo. In addition to a large local staff, four travellers will cover the territory between Port Arthur and the Rockies, including the Edmonton branch.

Fairbanks, Vancouver.

The Vancouver house is located at 153 Hastings street. The warehouse is particularly well adapted to the handling of heavy machinery and allied lines, has 54-ft. front, 160-ft. deep, and the main floor is on the level with the front sidewalk, while the basement is on a level with the lane in the rear. In this branch is made a specialty of such goods as are particularly adapted for the needs of the trade—principally mines and lumber interests. For the mine interest they represent the Jenckes Machine Co., and Canadian Rand Drill Co., and carry a full line of boilers, engines, air compressors and parts for same. For the lumber trade they carry a full line of S. A. Woods & Co.'s American woodworking machinery, also that manufactured by Cowan & Co., Galt. They also carry a full stock of "Goodhue" belting, being the exclusive agents for British Columbia. The above special lines are in addition to the regular stock of mill and factory supplies handled in common with other houses of The Fairbanks Co., and are fully equipped to meet all requirements of the territory. The Fairbanks Co. is the only concern in British Columbia carrying a stock of iron and brass-working machinery, the demand for which is at present somewhat limited. Of the various branches of the company, no house has brighter prospects at the present time for business than the one at Vancouver. It is in charge of John



(1) M. P. Shea, (2) J. R. Miquelon, (3) J. Fales, (4) T. A. Pownall,
(5) D. Gutteridge. (6) J. S. Sanson, (7) F. A. Lytle, (8) J. MacLeod, (9) J. R. Wells, (10) H. C. Cochran, (11) H. Flett,
(12) A. W. Bremner, (13) C. M. Rudel, (14) D. A. Kearns, (15) Henry J. Fuller, (16) E. J. Sarle, (17) Ed. Corbett.

About January 15th, 1903, the company decided to establish in Winnipeg a warehouse, stocked with its own goods, and F. R. Newman was sent from Montreal. Temporary quarters were engaged in Thistle street, and a stock of goods

E. Botterell, formerly of the Montreal house; the office being under the supervision of T. M. Cullen; C. J. Roger has charge of the supply sales department, and W. A. Akhurst, the machinery department.

The accompanying illustrations show the Canadian headquarters in Montreal, also the branches at Toronto, Winnipeg and Vancouver.

The headquarters staff of the company's Canadian business is as follows: Henry J. Fuller, general manager for Canada; D. A. Kearns, cashier; E. J. Sarle, in charge of valve department; C. M. Rudel, in charge of machine tool department; E. Corbett, in charge of transmission department; A W. Bremner, purchasing agent; T. A. Pownall, secretary to manager; J. R. Wells, advertising department, and the following sales staff: D. Gutteridge, A. Fred. Lytle, J. R. Miquelon, J. Fales, M. P. Shea, J. S. Sanson, H. C. Cochran, and H. Flett.

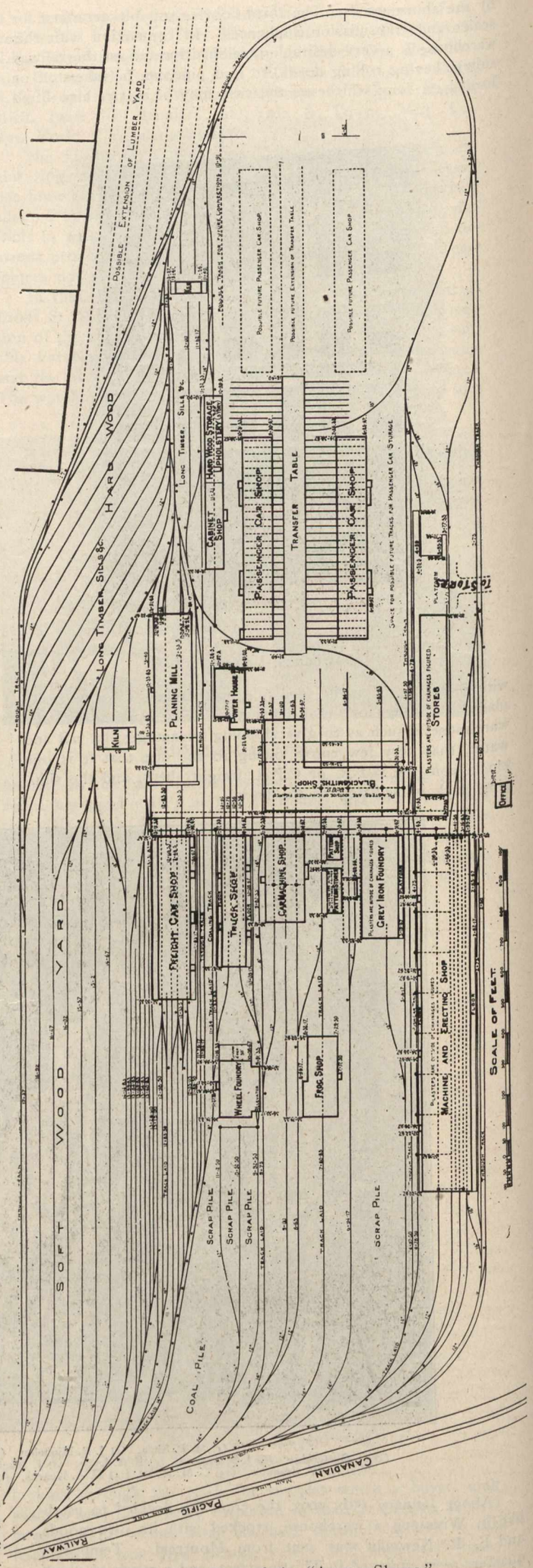
In addition to the Canadian business, The Fairbanks Company have warehouses in New York, Boston, Buffalo, Philadelphia, Baltimore, Pittsburg, Albany, N.Y.; Syracuse, N.Y.; New Orleans, Hartford, Conn., and London, Eng.

The advertisement of the Taunton Locomotive Mfg. Co., of Taunton, Mass., another of the firms represented in Canada by The Fairbanks Co., appears for the first time in this issue. The Wainwright even-flow, feed water heater is one of the specialties made by this company.

THE "ANGUS SHOPS" OF THE CANADIAN PACIFIC RAILWAY,

BY HENRY GOLDMARK, C.E., ENGINEER IN CHARGE OF CONSTRUCTION.

The "Angus Shops" are situated on the Quebec line of the Canadian Pacific Railway, in Hochelaga Ward, Montreal, about two and one-half miles from the Place Viger Station. The site is a plateau with an average elevation of about 127 feet above sea level. It is very nearly level, having a general slope of about one-tenth of one per cent. towards the river. The property is a rectangular plot about 4,700 feet long and 2,000 feet wide, its longer axis running north-east and south-west. The connection of the shop tracks with the main line railway is at the north-west corner, the steep gradient of the road making any other connection impracticable. Although the contour of the ground is favorable and the necessary grading comparatively moderate in amount, much expense had to be incurred in order to procure safe foundations. This was due to the fact that the solid rock bottom is from 8 to 20 feet below the ground line (except in the case of one or two shops), while the blue clay overlying the same is altogether too soft to support the foundations of the buildings. The increased expense involved in these extra foundations was nearly $80,000. In a few cases ordinary piles, capped with concrete, were used, but almost all the important shops are built on what may be called a dry wall foundation. For each wall a trench 3 to 4 feet wide was excavated to bed rock and fitted to a level of five feet below the ground with large, flat quarry stones, laid dry. On this sub-foundation the ordinary masonry walls were reared. As the ground was thoroughly saturated with water, this work was expensive and tedious. It is believed, however, that on the whole this was the most economical and suitable foundation that could be used. This was specially the case as the stone for these foundations, and likewise for all rubble and concrete work, was taken from a limestone quarry on the shop grounds about one-quarter of a mile from the buildings. Near the freight car shop an outcrop of the hard trap rock locally known as Banc-rouge, involved about 8,000 cubic yards of rock excavation. It may be added that the eastern portion was wooded and had to be cleared, while a part of the central portion was swampy, requiring a moderate amount of gravel filling. For surface drainage several open ditches 4 to 5 feet wide were built, but these also drain territory belonging to other owners north of the shop grounds. The surface drainage of the central part of the ground will go into sewers referred to later in this paper, which connect with the city system. The main purpose of the shop's sewers is, however, the carrying off of wastes. The Angus shops are intended primarily for the maintenance and repairs of the rolling stock in use on the eastern half of the transcontinental railway. In addition to this, provision has been made



Ground Plan of the "Angus Shops."

for the construction of a considerable number of new locomotives, passenger and freight cars. Besides this, a separate building is devoted to the manufacture of frogs and switches, while the machine shop and the foundry will turn out many miscellaneous articles required in operating the railway and in new construction. The general stores are to serve the entire system, while the general offices will serve as headquarters for the superintendent of rolling stock, master car builder, and general storekeeper. The shops naturally fall into three classes, the first those devoted exclusively to car work, the second to locomotive construction and repair, and the third being common to both departments. The first class comprises the planing mill and cabinet shop, the passenger car shops, freight car shops, truck shops, and car machine shop, as well as the wheel foundry and the dry kilns. Locomotive work is concentrated in the large locomotive, machine and erecting shop, while the blacksmith shop and grey iron foundry (with its pattern shop and storage building), serve for car work as well as engine construction.

The arrangement of the buildings, with reference to one another, and the best methods of moving the material within the shop's grounds, was of the first importance and became the subject of extended investigation. It was influenced largely by the shape of the property, the position of the main line tracks as well as the ground available for storage. The future enlargement of the shops had also to be considered. Every building is in fact so arranged as to allow future enlargement, while suitable locations have been reserved for additional buildings.

The main point to be considered in the arrangement was, however, the economical and direct handling of the material from the raw state to its incorporation into the finished car or engine. The general layout may be called a combination of the longitudinal and transverse system. The tracks running parallel to the buildings and to the long axis of the shop's grounds form the principal means of access. As may be seen by reference to the plan, most of the buildings are prepared along a traverse avenue, 80 feet wide. On this avenue, popularly called the Midway, the usual transfer table is discarded in favor of a 10-ton overhead electric travelling crane, running on structural steel supports over 1,000 feet long. It is believed that this crane will prove a most valuable adjunct in handling material between the different shops. It is supplemented by a surface track with turntables on the Midway. A similar outdoor crane serves the stock-yard adjacent to the grey iron foundry.

The different classes of work may be briefly indicated. The building of freight cars is one of the most important functions the shops will have to fulfil. A large and increasing number are a necessity to the road, while the existing facilities in Canada are meagre, and the prevailing duty makes importation from the United States expensive, besides being opposed to the policy of the railway to have all possible work done within the Dominion. The proposed output is twenty-five to thirty cars per day, requiring in the aggregate a very large amount of lumber and iron. The large wood storage ground indicated will probably prove scanty rather than too liberal. This lumber will all pass through the planing mill, though a large proportion of it must first be dried in the larger softwood kiln. The finished timbers emerge from the west end of the mill and pass on to the freight car shop, a small transfer table assisting the movement. The iron work for freight cars is forged in the blacksmith shop or cast in the grey iron foundry and machined in the car machine shop, whence it goes to the truck shop or the freight car shop for final use. In the truck shop the trucks for the freight cars, as well as for the coaches are put together. The chilled wheels are to be cast in the well-equipped wheel foundry with a capacity of 300 wheels per day; they are bored and pressed on the axles in the west end of the truck shop, which is provided with all necessary machinery for this purpose. The completed truck goes to the freight car shop where the car bodies are erected on it. There are four tracks for erection purposes each 540 feet long and two intermediate tracks for bringing in supplies. Six travelling cranes fitted with air hoists will handle the heavier material. The material for the passenger car shops is prepared in the mill and the cabinet shop, the mahogany and other hardwood being dried in the smaller kiln and stored in the hardwood storage, which forms the first floor of the upholstery shop. The coach shops are served by an electric transfer table 75 feet long, operated through an overhead trolley by a 20-h.p. alternating current motor. The coach shops are 100 feet wide, each shop has 28 tracks spaced 24 feet apart, centre to centre.

The locomotive shop is of the longitudinal type with three bays, each 1,165 feet long, of which 300 teet is devoted to the boiler and tank work. There are three bays, the erecting bay, which is 80 feet wide, and adjacent machine shop bay 50 feet wide, and a third bay 25 feet wide, with an overhead gallery of the same width to be used for lighter machinery. In the erecting shop there are three tracks with pits and two intermediate supply tracks. The engines are handled by two 60-ton electric travelling cranes each having a 10-ton auxiliary hoist. In the boiler shop there is a 20-ton travelling crane on the same runaway and numerous jib cranes. In the machine shop there is one 15-ton and one 10-ton crane of 50 feet span. All these cranes are driven by continuous current motors the voltage being 250. Besides this, the boiler shop has a hydraulic crane in the riveting tower to serve the riveter. In the designing of the building, adaptation to their respective uses and economy in both first cost and maintenance were the prime considerations. It is hoped, however, that the appearance of the buildings is not objectionable, though perhaps not æsthetically pleasing. Some care was indeed taken to avoid disfiguring construction. Among the principal requirements to be met in the construction, we may mention the necessity for good lighting in all parts of the buildings, and in all weathers; to ensure this the brick walls are pierced with as much window surface as possible without endangering their safety. Steel frame construction for the side walls was, however, not used, the walls being self-supported and also carrying the trusses, except in the south wall of the locomotive shop. The windows occupy about 50 per cent. of the wall surface. In addition to this, almost all the buildings have skylights; these generally run transversely, extending half the width of the building. As there is a skylight in every bay and its width is half the width of the bay, the skylight area is about 25 per cent. of the roof area. These skylights are of galvanized iron framing and covered with three-eighths rough-cast glass laid in putty. The panes are 2 feet wide and in one piece for each half-skylight, avoiding all joints in the glass. A revolving ventilator is generally fitted to each skylight. Another important requirement was a greatest possible safety against destruction by fire, consistent with reasonable economy. The buildings are all of a simply strong construction in conformity with the the rules for slow burning mill construction, as developed by the Massachusetts mill burners mutual insurance companies. The walls are of hard burned brick laid in Portland cement mortar. They are from 12 to 16 inches thick with pilasters about 20 feet apart. In the arrangement of the roof-framing and the spacing of the supporting columns, the demand of the operating department with regard to the layout of the machinery had to be considered, and the result is in some cases a compromise between their requirements and economy in construction. It is believed, however, that as built, no important requirement in the use of the shop has been sacrificed. The framing of the roof is of three kinds, first a column and girder construction (usually in timber), as in the truck shop and frog shop, the passenger car shops and the cabinet shop. Second, a roof frame consisting of Howe trusses, supported on steel columns, as in the freight car shop planing mill and car machine shop. Lastly, heavy steel columns and trusses are used in the locomotive shop, the foundries and the blacksmith shop.

(To be continued.)

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The two Curtis steam turbines generator units of 2,500-h.p. each, recently ordered from the Canadian General Electric Co., Peterboro, Ont., by the Toronto Electric Light Co., are now under construction.

INDUSTRIAL NOTES.

The Davis Tanning Co. will erect a $40,000 plant at Newmarket, Ont.

The Anderson Furniture Co. propose erecting a factory at North Bay, Ont.

The Arnprior Roller Mills have installed two new American turbine wheels.

The addition to the malleable iron foundry of the Martin Co.'s saddlery hardware works, Whitby, is about completed.

A. B. Jardine & Co., Hespeler, Ont. are making shipments of blacksmith's tools to New Zealand and New South Wales.

The Brewster Manufacturing Co. has been formed at Edmonton, N.W.T., to manufacture the Brewster patent tubular fanning mill.

Lacombe, Alta., have recently purchased from the Waterous Engine Works Co., a complete fire equipment, including a gasoline fire engine.

W. Craddock, of Ontario, and J. W. Singleton, London, Eng., propose erecting a wood-working factory at Woodstock, N.B. $50,000 will be invested.

The corporation of St. Johns, Que., have given an order to T. A. Morrison & Co., of Montreal, for a portable Champion stone crushing plant and steam roller.

Almon Reid, Foxboro, and Geo. A. Labey, Frankford, have purchased the Downes' water power at Deer River, Marmora, Ont., and will manufacture staves, heading, etc.

The Edwardsburg Starch Works, Cardinal, Ont., have acquired the plant of the Cardinal Manufacturing Co., and will manufacture their own barrels, packing cases, etc.

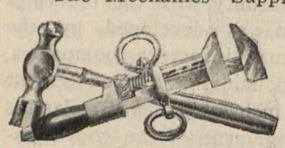
W. D. Bliss has established a mica factory at Smith's Falls, Ont. It is understood that the industry is controlled by the General Electric Co., of Schenectady, N.Y. From 60 to 100 girls are employed.

The Canada Glass Works Co. propose to locate at Sydney,, C.B. They will erect plant costing $500,000, and employ 250 to 350 men. Arthur M. Crofton, Sydney, is the secretary.

The rolling mill department of the Toronto Bolt and Forging Co.'s works were temporarily closed last month, as a result of a reduction in wages. The men afterwards returned to work.

The Sydney Cement Co. propose to erect a plant at Sydney, C.B., of a daily capacity of 250 barrels, and employing 200 men. Slag from the Dominion Iron and Steel Co. will be used as a compound.

The Mechanics' Supply Co., of Quebec, are introducing another attractive novelty, namely, a watch charm, designed as a machinist's hammer. Either this or the small wrench makes a popular watch charm, as mentioned in the advertisement, and they are sold at a low price.



A new agreement has been drafted between the town of Collingwood, Ont., and the Cramp Steel Co., the main features of which are that the company will operate a steel plant, having a daily output of 120 tons, and employing 200 men, continuously for thirty years from June 1st next, and invest $350,000 in the undertaking. The town will give the company 25 acres of land, and $60,000, payable when the plant has been in operation thirty days.

The insolvent Hamilton Motor Works, the assets of which have been purchased, has for several years been carried on in Hamilton, the manufacture of marine and stationary gasoline engines being its specialty. Lack of capital was reported to be the cause of the failure. The business is being reorganized, and a joint stock company formed with the following officers: J. A. Turner, president; W. G. Smart, vice-president; W. A. Logie, secretary-treasurer. These gentlemen are all interested in the Smart-Turner Machine Co. They have a good stock of engines, completed and in process of manufacture, and will be able to supply their customers promptly. The engines turned out by the old firm were generally highly spoken of by purchasers.

The Walkerville, Ont., Wagon Co.'s plant has been sold to a company at West Lorne, and is being removed to that village.

Work will begin this month on the Ottawa University. Instead of one building several will be erected, the main building to be finished this year at a cost of $150,000.

It has been decided not to attempt to reopen the Bailey Cutlery Works, at Brantford, which were recently closed owing to United States competition. The plant has been sold to a Toronto firm.

The Imperial Paper Co., of Sturgeon Falls, which is now turning out 40 to 50 tons of paper per day, contemplates extending its mills to a capacity of 120 tons per day. The extensions will cost about $1,000,000.

The recent Dominion order-in-council for the payment of bounties on articles made from steel, provides that on rolled round wire rods sold to wire manufacturers for use in making wire in their own factories in Canada, the bounty shall be $6 per ton; on rolled angle ties, joists, girders and other rolled shapes of iron, as well as rolled plates, when sold for consumption in Canada only, $3 per ton. The conditions under which the bounties may be claimed will be explained on applying to the Department of Trade and Commerce.

The Canadian Engineering Company has purchased the plant, buildings, and land owned by the late James Cooper, in the neighborhood of Rockfield, near Montreal, for $200,000. The plant was considered the most complete in Canada for the manufacture of mining machinery. R. W. Chaplin, of New York, former manager of the Ingersoll Rock Drill Company, has been appointed manager of the new concern, which will engage in the manufacture of machinery for the Canadian Bullock Electric Mfg. Company and the Ridgewood Hoist and Cable Company.

MARINE NEWS.

Capt. Stanton is building a 90-ft. steamer for Sparrow Lake, Ont.

The contract for the new dock, at Pembroke, Ont., has been awarded to W. J. Poupore, at $44,000.

Mr. Johansen, a Swedish steamship man, proposes to establish a service between Stockholm and Canada.

A steamship line is projected between Vancouver and Dyea to connect with traffic to Dawson City. Capt. McLennan is the promoter.

In 1870, Japan had no modern merchant ships. The mercantile fleet to-day has a tonnage of 1,000,000, and it occupies the seventh place among the world's shipping nations.

Bowring Bros., Limited, have secured the Government contract for the Newfoundland coastal service. English steamers will be chartered until the new boats have been built.

A lighthouse board has been inaugurated by the Government, comprising the Hon. R. Prefontaine, as an ex-officio member; Col. Gordeau, Deputy Minister; Colonel Anderson, Chief Engineer; Capt. Shain, Capt. Salmon and a representative of the shipping interest.

The Canadian Commissioner in Paris reports that the Messrs. Coulombier, of Bordeaux, contractors for the direct steamer service between Canada and France, are now in a position to carry out their agreement with the Dominion Government.

The lightship Lurcher parted her cables on February 15th, and returned to Yarmouth, N.S. Marine men in the Maritime Provinces allege that she is not suitable for her work, and bears evidence of being built by men acquainted only with fresh water requirements. The sketch of this vessel in last issue was from the Marine Review, Cleveland.

Two turbine steamers will run between Toronto and Port Arthur next year. Their capacity will be 242 passengers and 1,000 tons of freight on a 12-foot draft. Length, 250 ft.; beam, 41 ft.; speed, 16 knots. Cost, $250,000 each. The company will include the stockholders of the old Georgian Bay Navigation Co. The round trip will occupy eight days.

Miss B. F. Waring is manager of the Springfield Steamship Company, St. John, N.B. Her company intends putting the steamer Springfield on the Fredericton-Gagetown route when the river opens.

H. H. Gildersleeve, son of the general manager of the Richelieu and Ontario Navigation Co., is now general manager of the Northern Navigation Company, and is engaged in inspecting the fleet and appointing officers for the coming season.

The Reid Newfoundland Company are erecting new machine shops for building marine engines, repairing vessels, and railway work of all kinds, at St. John's. The machines are to be driven electrically, and hydraulic and pneumatic tools will be used in docking and repairing vessels. A building 220 feet long by 45 feet wide will be used for building and painting passenger and freight cars. There will also be a foundry for railway and marine castings. The electric power required to run these shops will be taken from the plant at Pelley Harbor. Heretofore ships could not effect heavy repairs at St. John's, but with the facilities now provided, the work can be effected as promptly and as cheaply as elsewhere. This is the first large machine shop and foundry in Newfoundland.

The report of the Richelieu and Ontario Navigation Co. for 1903 shows that the gross receipts were $1,104,802, an increase of $67,136 over 1902. The operating expenses and fixed charges were $915,169, leaving $189,633 net profit, and after paying a dividend of 6 per cent. $1,712.57 was carried forward. The assets of the company are $3,703,817.50, of which $3,465,712 comprise steamers, real estate, buildings, wharves, etc. The company's bonded indebtedness has been reduced from $571,833 to $404,420. The report also states that the steamer Montreal, which was damaged by fire last March, while in the builders' hands, is being reconstructed at Sorel, and will be ready for the season of 1905. The Carolina, which met with an accident in the Saguenay river, will be repaired in time for the coming season. The construction of a marine railway dry dock at Sorel, Que., is contemplated. The company will exhibit a model of the steamer Kingston at the St. Louis Exhibition. The location adjoins the British Marine exhibition, and near the Egyptian Government exhibit, which will make a special display of Nile boats. Senator Forget has resigned the presidency, and at the annual meeting Rudolphe Forget was elected to that position. George Caverhill was elected chairman of the executive committee, as also were the following directors: L. J. Forget, Wm. Wainwright, R. Forget, F. C. Henshaw, George Caverhill, C. P. Paradis, H. Markland Molson, E. B. Garneau, J. Kerr Osborne, Colonel H. M. Pellatt, and Wm. Hanson.

PERSONAL.

George O. Buchanan, of Kaslo, B.C., has been appointed inspector of lead bounties.

Hiram F. Donkin has been appointed chief engineer for the Dominion Coal Co.

The C.P.R. have appointed S. J. Hungerford superintendent of locomotive works, at Winnipeg.

E. A. James has been promoted from general superintendent to manager of the Canadian Northern Railway.

The C.P.R. have appointed William Cross assistant to the second vice-president, at Winnipeg, with general supervision of all mechanical matters on western lines.

G. J. Bury succeeds J. W. Leonard, as general superintendent of the C.P.R. in the West. Mr. Bury was superintendent of the Lake Superior district. His headquarters will be Winnipeg.

S. S. Dickenson, superintendent at Hazel Hill, N.S., for the Commercial Cable Company, has been appointed general superintendent of the company, with headquarters at New York. Mr. Gerrard, his assistant, succeeds him at Hazel Hill.

C. G. Atwater, superintendent of the coking plant of the Dominion Iron and Steel Co., has resigned, and goes to an important position with the Maryland Steel Company, at Sparrow's Point, Maryland. W. S. Hutton, superintendent of the blast furnaces, leaves for Pueblo, Colorado, to take a position with the Colorado Fuel and Iron Company.

Charles Brandeis, C.E., Consulting Engineer of Montreal has returned from a two months trip to England and Germany made in connection with some large electric lighting and railway plants in China. Mr. Brandeis while in Europe took occasion to make a careful study of water filtrating plants for large cities, and also of high speed electric railways.

W. C. Wallace, member of the Institute of Naval Architects of Great Britain, has taken offices at 22 Thames St., New York, as American representative of John Brown & Co., Limited, Atlas Steel Works of Sheffield. Mr. Wallace will continue to visit Canada in the general interests of his company whose Canadian agents are Watson Jack & Co., of Montreal.

F. A. Folger, senior manager of the Kingston Light Heat & Power Co., died on the 25th February, of heart failure following a fit of coughing. Mr. Folger had, however, suffered for four years from locomotor ataxia. He was born in Cape Vincent, N.Y., and married Miss Coundale, the daughter of a former city engineer of Kingston, by whom he had four children.

Ludger Trudeau, the new superintendent of the Montreal Street Railway, until a few weeks ago had charge of the Alexandria Tramway System and the Alexandria & Ramleh Railway Company, Limited, Egypt. Mr. Trudeau, who is an old employee of the Montreal Company, after managing the car service of Bordeaux, France, for two years, went to Egypt last June.

RAILWAY NOTES.

The C. P. R. are making large additions to its passenger rolling stock, including sleepers, dining and tourist cars.

The Pennsylvania Steel Co. have a contract from the C.P.R., for 40,000 tons of 80-pound steel rails at $21.75, f.o.b., Montreal, thus breaking the United States steel combine price of $28.

The Ottawa and New York Railway, operating between Ottawa and Tupper Lake, N.Y., is to be converted into an electric road this year. It is proposed to obtain power at Ottawa, Cornwall and Massena Springs, N.Y.

In a speech in the Ontario Legislature on the Temiskaming railway, E. J. B. Pense stated that of the 110 miles of the railway to be completed this year, 90 miles were over a rocky ridge to New Liskeard, but, that the sixty mile extension proposed would be over a level country and connected with colonization wagon roads so that the cost of construction would be one-third less. The estimated cost of $30,000 a mile for the first section included rolling stock at a cost of $5,000 a mile.

P. H. Wilhelm, formerly representing the New York Car Coupler Co., the Washburn Car Coupler Co., the Buckeye Malleable Iron & Coupler Co., the Railroad Supply Co., of Chicago, with headquarters at Atlanta, Ga., has accepted a position as railroad representative of the American Steam Gauge & Valve Mfg. Co., Boston, Mass., with branch offices at New York, Chicago, Philadelphia and Atlanta, Ga. Mr. Wilhelm has spent the greater portion of his life in railway service, and it will be remembered, that in 1893, he was, on the recommendation of the majority of the railways, appointed division superintendent of transportation at the World's Fair in Chicago. After the close of that exposition, he took up the active business of railway supplies, which he has followed up to the present time. Mr. Wilhelm has been very prominently mentioned for the position of superintendent of transportation at the St. Louis Exposition, but he prefers to remain in the active railway supply business. The American Steam Gauge & Valve Mfg. Co. now have the largest plant in the United States devoted to the manufacture of steam and other gauges, safety valves, steam engine indicators, whistles and steam supplies in general, and are the oldest house in America in their particular line.

A line is projected from White Horse to the International boundary, thence via White River Valley to Dawson.

The net profit of the Ottawa Electric Railway last year was $94,542, or nearly 11 per cent. on the average capital stock.

The G.T.P. Railway surveyors have established headquarters for the mountain section at Edmonton, N.W.T. J. R. Stephens is chief engineer.

The Cape Breton Electric Tram Co. propose to extend their system round the Arm from North Sydney to Sydney, and to Little Bras d'Or from Sydney Mines.

It is proposed to build a radial line between Brantford, Ont., and Hamilton, and transmit power to Brantford. Wallace & Little, Woodstock, Ont., are the solicitors.

A line is proposed from Thorold south to Fort Erie, and westerly to Brantford. The project includes operation of steamers and the construction of docks and wharves.

J. S. Clark, of the Grand Valley Railway Co., has located at Galt, Ont., and expects this year to complete extensions north to Galt and Guelph and south to Port Dover.

A railway is to be built from Midway to Vernon, B.C., with a branch to Kelowna. A. E. Ashcroft, engineer, Greenwood, B.C., is interested. The line will be financed in London, England.

The number of persons killed on Canadian railways in the year ending June 30th last, was: Passengers, 53; employees, 186; other persons, 181; total, 420, or 90 more than the previous year. Nine passengers were killed on electric railways.

The Transportation Commission is being urged to extend the I.C.R. from Moncton to Country Harbor, via Pugwash and New Glasgow. The distance is the same as from Moncton to Halifax, but the ocean route would be 100 miles shorter.

It is rumored that Mackenzie & Mann will shortly make the Government a counter proposition to the G.T.P. scheme. The new project comprises the completion of the gaps in their present system, from the Pacific to Edmonton; Port Arthur to Hawkesbury, and Garneau to Moncton.

The Egerton Tramway Co., New Glasgow, N.S., are building a power house, at Stellarton, and track-laying will commence immediately. The directors are R. T. McIllreith, president; Gardner Perry, Boston, treasurer; Charles Warren, and William B. Rogers, Boston and Maynard Reynolds, of Halifax. The Maritime Construction Co. are the contractors.

Canadian charter holders are opposing J. J. Hill's application to the British Columbia Legislature for a line, without bonus, from the Pacific to the Kootenays. It is alleged that Hill's plan is to get access to the Nicola coal and convey it to Everet, which would become the terminus, instead of a Canadian port. The application of the Coast-Yukon Co., of Vancouver, is also being opposed by the Pacific Northern and Omineca Co., which has a charter for a parallel line.

J. J. Nickson & Co., of Vancouver, have a three million dollar contract from the C.P.R. for an irrigation canal twenty miles long, near Calgary. The company propose to build four hundred miles of canal along the Bow river to irrigate great wheat lands adjacent to their railway. The present section is to be forty feet wide, will take two years to construct, and necessitates the excavation of 2,500,000 cubic yards of earth.

The report of the Temiskaming & Northern Ontario Ry. Commission, for 1903, is as follows: Expenditure to date—Location, $50,483.93; construction, $1,888,600.20; exploration north of New Liskeard, $5,841.18; rolling stock, $73,789.56; freight shed, $1,377.55; total, $2,020,092.42. Miles graded, 76. Rails laid, 57 miles. Engineer Russell says the road should be running to New Liskeard by the end of 1904. The cost per mile of the road complete is estimated to be: Grading, trestle work, bridging, etc., $18,000; rails and fittings, ties, ballasting, telegraph line, track-laying, etc., $7,000; terminals, sidings, stations, water-tanks, etc., $1,755; rolling stock, $3,000 per mile. Total, $29,755. It is proposed to extend the road 90 miles to the projected G.T.P. line.

The Terrebonne Electric Railway Co. is applying to the Quebec Legislature for power to erect lines within the counties of Hochelaga, Jacqus Cartier, Laval, Two Mountains, Argenteuil, Wright, Labelle, Terrebonne, Montcalm, and L'Assumption. Also to develop power for traction and lighting purposes.

Application will be made to the Quebec Legislature by the Hon. J. Sharples, Hon. N. Garneau, J. T. Ross, J. B. Forsyth, W. H. Wiggs, Robert Campbell, Dr. A. Lavoie, Armitage Rhodes, A. C. Dobell, Dr. M. H. Brophy, and others, for a charter to construct and operate electric railways between the city of Quebec and points in the county thereof.

The following applications will be made to the Dominion Government: To construct a railway from Ottawa and Hull to Buckingham, thence to the headwaters of the Lievre and James Bay; also from Buckingham to a point on the Ottawa river between Thurso and Templeton; also the right to erect electric power houses, mills and factories. The Ottawa Northern and Western Railway for an extension of time to build from Maniwaki to James Bay; also to build a branch to Lake Temiscamingue and other branches under thirty miles. The Manitoba and Keewatin Railway for an extension of its rights. The Manitoba & Northwestern Ry. to build a branch 100 miles from Sheho southward of Quill lakes, and from Churchbridge to the Pheasant Hills branch of the C.P.R. at Cutarm Creek. For the Walkerton and Lucknow Railway to connect these towns. The Quebec and Lake Huron Railway for an extension of its rights. For a company to connect Crawford Bay with Fort Steele, B.C. For the Edmonton, Athabasca and Mackenzie Railway to build from Edmonton to Peace River, and Great Slave Lake. For the Fort Frances, Manitou and Northern Railway from Fort Frances to the Albany river.

THE GURNEY SCALE CO.

Among the oldest and most successful factories in Canada is the Gurney Scale Co., situated at Hamilton. In 1856, E. W. Ware started the manufacture of scales but it was not until he became associated with the Gurneys, that the scale business began to be what it had a right to be, a prominent feature in the industrial life of that city. In the works today there are many expert scale makers employed and there is not a scale or weighing machine that can possibly be called for in any business that the company cannot make. The business was started right, its promoters determined to make scales that would stand the test, and all down the years of its existence the same determination has been ever before the management, with the result, that the Gurney scales have for years been regarded as standard throughout the whole of Canada. This company now ship scales to foreign countries and such scales are made to indicate the weights used in any part of the world. The latest catalogue of the company shows a great variety of different patterns of scales, and these are made in all standard sizes; but if a purchaser desires a scale to work under special conditions, the company will put its staff of draughtsmen to work out the problem of fitting a suitable scale into difficult or contracted situations. To show the ability of the company to accomplish the unusual, it may be mentioned that a short time since, it constructed and put in position at the Toronto Junction Union Stock Yards the largest stock scale in use in America. This scale will weigh three car loads of stock at one time, having a platform sixty-four by fourteen feet in size, and so true is it and so finely adjusted that the loss from friction according to the public test made when the scale was handed over, was less than five pounds.

While a full line of all sorts of scales is manufactured, the company's specialties are track, wagon and hopper scales, and in these makes the Gurney lines are to be found all over Canada. Here is their motto: "In the past Gurney scales have been characterized by the high standards of design, material and workmanship; in the future yet higher standards will be our aim, and improvements made which successful experience may suggest."

MONTREAL, THE GREAT ELECTRIC POWER CITY.

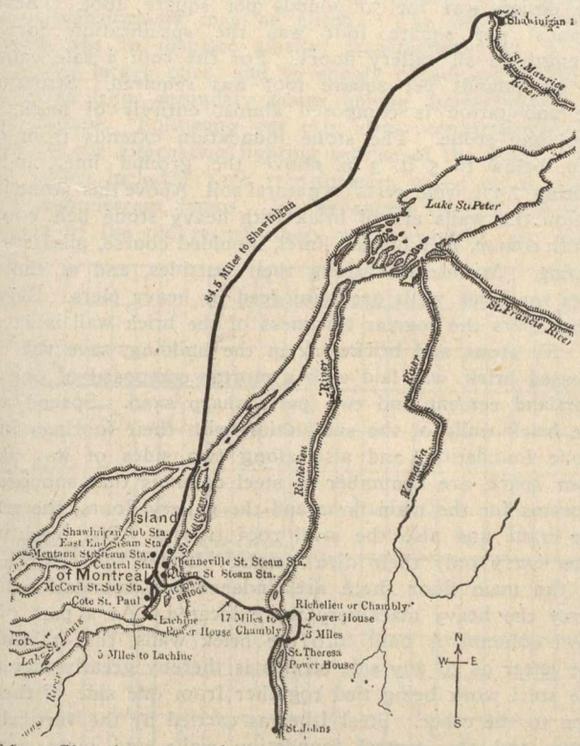
PART 2.

BY ALTON D. ADAMS, IN THE ELECTRICAL WORLD AND ENGINEER.

SUB-STATION WORK.

At the McCord street sub-station the 4,000-volt, three-phase, 63-cycle current from the plant at Lachine Rapids is transformed for distribution to 2,400 volts. This transformation is effected by means of twelve transformers of 250 K.W. each, and four transformers rated at 1,000-K.W. each, their combined capacity being 7,000-K.W. The four transformers of 1,000-K.W. each are connected so as to change the current from three-phase on the primary coils to two-phase on the secondary coils.

At the Shawinigan sub-station, in Maisonneuve, just outside the city limits, the three-phase circuit of three aluminum conductors delivers current at about 44,000 volts and 30 cycles. The generating plant at Shawinigan Falls, on the St. Maurice river, delivers current to the transmission line at approximately 50,000 volts, but the loss in conductors reduces the terminal pressure to about that just stated for the sub-station. Each of the three conductors of the transmis-



Map Showing Location of Water Power Plants and Distributing Stations.

sion line, after entering the sub-station, is connected to a series of 44 lightning arresters with six air-gaps each, giving 264 air-gaps between each line and ground. Between the connection to lightning arresters and the connection to transformers two static interrupters are connected to each of the three high-tension wires. Each of these interrupters is single-pole, and rated at 50,000 volts, 26 amp., and 2,600 alternations per minute. From the interrupters the 44,000-volt circuit passes to five oil-cooled transformers, which are rated individually at 1,000-K.W., with current at 30 cycles, and at 2,000-K.W. with current at 60 cycles per second. By these transformers the three-phase current is reduced from 44,000 to 2,400 volts, and then passes to five motor-generators that change the frequency from 30 to 63 cycles per second. As at first installed, two of these motor-generators delivered three-phase current at 63 cycles and 2,400 volts, and three of the motor-generators delivered two-phase current of the same frequency and voltage. It is the intention, however, to change two of the motor-generators so that the entire five will generate two-phase current. From these motor-generators the 2,400-volt, 63-cycle current passes to a switchboard in another part of the sub-station, and is thence distributed in part directly to customers of the Montreal Light, Heat and Power Company, and in part by passing through the central sub-station of that company. Under a 50-year contract between the Shawinigan Water and Power Company and the Montreal Light, Heat and Power Company, all of the energy delivered by the former is received by the Montreal electrical supply system save that a short local railway has the right to use a maximum of 250-h.p. The switch-board installed by the Montreal Light, Heat and Power Company is provided with motor-driven and manual oil switches, that connect the 2,400-volt, 63-cycle bus-bars with the various service feeders. This switch-board is also provided with indicating volt, ampere, and recording wattmeters. The five 1,000-K.W., 30-cycle, oil-cooled transformers, already mentioned, that reduce the transmitted energy from 44,000 to 2,400 volts' pressure, are worthy of note for their large dimensions. The tank of boiler iron, filled with oil, that contains each of these transformers, is cylindrical in form, 15 ft. high, 7½ ft. in diameter, and contains 750 gallons of petroleum. Each of the five motor-generators that receive the current from these transformers is made up of three complete machines, a 2,400-volt, 30-cycle, three-phase, synchronous motor, a 2,400-volt, 63-cycle, two or three-phase alternator, and a 125-volt, direct-current exciter of 583-amp. capacity. These three machines are direct-connected and operate at the common speed of 450 r.p.m. The motor and alternator are both of the type with internal revolving magnets, and stationary armature coils. A solid coupling unites the shafts of the motor and alternator and the extended shaft of the latter carries the armature of the exciter. The exciter magnet frame is mounted on a solid extension of the alternator base. To secure alignment of the motor and alternator in each unit their bases are bolted to four 15-in. I-beams that are embedded in the concrete foundation. Each I-beam is 25 ft. long. The extreme width of each motor and alternator base is 11 ft. 2 in. From the bottom of the I-beams to the top of the motor frame the distance is 9 ft. 5¼ in. Over the three machines that make up each motor-generator unit the extreme length parallel to the shaft is 29 ft. 5 5-16 in. Each direct-current exciter furnishes current to the magnet coils of both the motor and alternator to which it is mechanically connected. In the sub-station with the five motor-generators just considered there is a smaller motor-generator made up of a 100-h.p., 30-cycle, three-phase, 2,300-volt motor, direct-connected to an 85-K.W. 125-volt generator. Current for this 100-h.p. motor is taken directly from the secondary side of the static transformers. When one of the large motor-generators is to be started, each of which is rated at 800-K.W., the 85-K.W. generator is driven by the 100-h.p. motor, taking current from the secondaries of the static transformers, and the 125-volt direct current thus obtained is used to operate the exciter of the large motor-generator as a motor. As soon as the large motor-generator reaches its synchronous speed its motor is connected to the transformers that deliver energy from Shawinigan Falls, and the 85-K.W. dynamo is disconnected.

The Shawinigan sub-station is of brick 95 by 115 feet, one story high, with a roof supported on steel trusses, and a concrete floor. Internally the main building comprises two rooms in one of which the five 1,000-K.W. transformers are located, and in the other the motor-generators. A wing at one side of the main building contains the switchboard equipments through which energy is delivered to the lines of the electrical supply system.

THE CENTRAL SUB-STATION.

The central sub-station, located in the block bounded by Ottawa, Wellington, Prince and Queen streets, is the largest and most important connected with the Montreal system. To this sub-station come the high-tension transmission lines from the water power at Lachine Rapids, Chambly, while the Shawinigan system is also connected through the 2,300-volt feeders that come from the Shawinigan sub-station. Energy at 2,000 volts, 63 cycles two-phase from the McCord street station, and at 22,000 volts, 63 cycles, three-phase from Chambly, is transformed at the central sub-station to current at 2,300 volts, 63 cycles, two-phase, for general distribution. Ultimately, the equipment of main transformers at the central sub-station will comprise sixteen

units of 2,750-K.W. each, and of these units ten are already installed, giving a present capacity of 27,500-K.W. These transformers are of the air blast type, and were made by the Westinghouse Electric Manufacturing Company. Besides these main transformers receiving energy direct from the transmission lines, the central sub-station contains thirty transformers of 60-K.W. capacity each, for the operation of enclosed, alternating arc lamps in series for street lighting. Each of these transformers with its regulator delivers a constant, alternating current of 7.5 amp. and a maximum pressure of 4,000 volts. These constant-current transformers which take energy from the main transformers at 2,400 volts and deliver it at any desired voltage up to 4,000, were made by the Western Electric Company.

Current for the 250 and 500-volt, three-wire system, which operates direct-current motors, is supplied by two motor generators at the central sub-station. Each of these motor generators is made up of a 300-K.W., 2,400-volt, two-phase synchronous motor, and a 250-K.W., 250-volt, direct-current generator. These two synchronous motors draw their energy from the main transformers. To maintain the pressure in the air chamber beneath the air-blast transformers, space has been provided on the main floor of the sub-station for four blower units, and three of these units are in position. Each blower unit is made up of one 40-h.p., 550-volt, two-phase induction motor, of Westinghouse make, with a centrifugal blower with a 32-inch circular opening on each end of its shaft. These blowers were made by the Sturtevant Company, and are intended to maintain a pressure of 1.8 inches of water per square inch.

Provision is also made on the main floor for two motor-driven exciters to furnish direct-current to the magnets of the large machines, and also for an emergency set consisting of a 300-K.W., 2,400-volt, two-phase synchronous motor direct-connected to an alternator of equal capacity. All of the transforming and converting apparatus just named occupies a central position on the main floor of the sub-station, save the constant-current transformers. Ranged about three sides of the sub-station in galleries and on one side at the main floor level are the high and low-tension switchboards that receive, control and distribute the energy from the water power plants. In the gallery on one of these three sides are the marble and soapstone compartments that contain the knife switches for the high-tension lines from the water-power plants. From these switches the 22,000-volt, three-phase circuits pass to the primary coils of the main transformers. The secondary, 2,400-volt circuits from these same transformers go to the transformer panels and distributing board in the gallery on another side of the sub-station, by the way of manually operated oil switches located in the same gallery. The gallery on a third side contains another portion of the distributing switchboard. Beneath the gallery on one side of the sub-station are the thirty constant-current transformers, already mentioned, on the main floor. An arc lamp switchboard, connecting these transformers with the series circuits for street lighting, separates the space beneath the gallery last named from the central portion of the main floor, where the large transformers, motors, and motor-generators are located. This arc switchboard is the only one on the main floor level. The fourth side or front of the sub-station, where the large, main entrance is located, is free from electrical apparatus, and starting from this side a travelling crane sweeps the entire central space of the main floor. This crane is driven by electric motors, and has a capacity of 30,000 pounds. It was built by the Niles Company.

The building of the central sub-station is one of the largest and best to be found anywhere for this purpose. Because of the high voltage and great amount of energy entering this sub-station, and its importance in the Montreal electrical supply system, it was located in about the centre of a city block, so that a large, clear space was left between each of its outside walls and the public street. The building is one story high above basement, nearly square in outline, of pleasing architecture, and as nearly fireproof from foundation to roof as steel and masonry can make it. Inside the dimensions are 118 feet by 122.5 feet, and from the main floor to the lower cord of the steel roof trusses is 34.5 feet. The lowest part of the roof outside is 41 feet above the main floor. Beneath the entire main floor there is a basement paved with concrete 1 ft. thick. The surface of this concrete is 7 ft. 10½ in. below the main floor around the outer portion and 11 ft. below in the central portion of the building. In this central portion of the basement a space 37 feet 8 inches by 65 feet 2 inches is enclosed for an air pressure chamber by masonry walls each 2 feet thick. On the main floor over this air chamber are set the sixteen 2,750-K.W. transformers and the four blower units. The floor space actually occupied by the group of transformers with an aggregate capacity of 44,000-K.W. is within 38 by 40 ft., and it may be doubted whether an equal capacity of transformers can be found within so small a space elsewhere. Beneath each transformer and each blower an opening in the main floor permits the movement of air out of or into the chamber. The air forced into the chamber by the blowers rises through the transformers and may escape through the windows in the side walls, or the skylight.

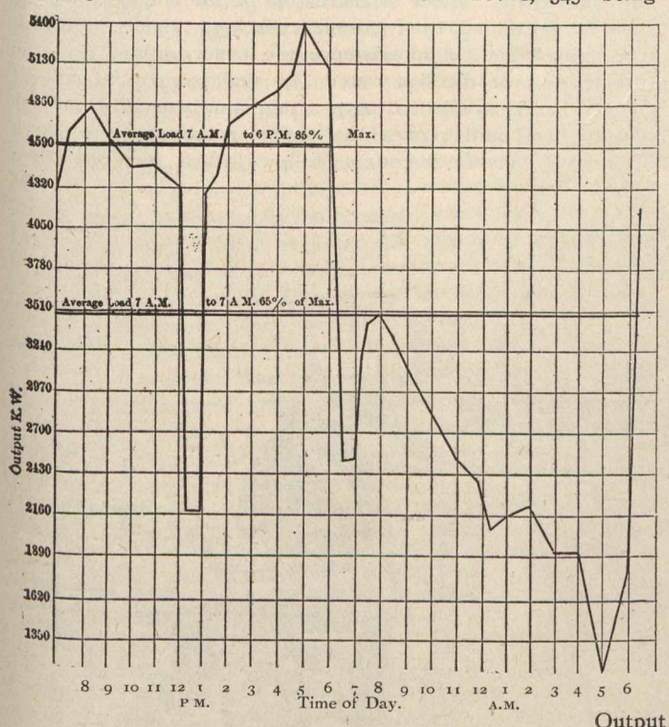
In its central portion the main floor of the sub-station was designed to support a superimposed load of 400 pounds per square foot, and along the sides beneath the galleries the design was for 70 pounds per square foot. Seventy pounds per square foot was the specification for the strength of all gallery floors. For the roof a safe capacity of 125 pounds per square foot was required. Structurally the sub-station is composed almost entirely of brick, tile, steel and stone. The stone foundation extends from 9 ft. 8 in. below to 5 ft. 3 in. above the ground line, and its footing 7.5 ft. wide rests on natural soil. Above this stone foundation the walls are of brick with heavy stone belt courses, plinth course, pier blocks, lintel, moulded course, pilasters and coping. At intervals along their outsides, and at the corners the brick walls are reinforced by heavy piers. Between these piers the regular thickness of the brick wall is 21 in.

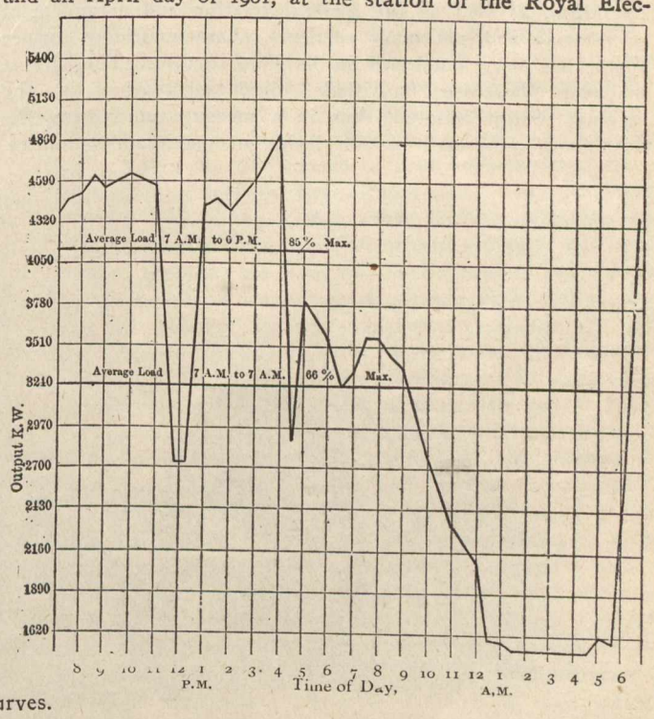
All stone and brickwork in the building, save that with pressed brick, was laid with a mortar composed of one part Portland cement and two parts sharp sand. Spaced along the brick walls of the sub-station with their footings in the stone foundation, and also along two sides of its central floor space, are a number of steel columns that support the I-beams for the main floor and the gallery floors, the traveling crane and also the steel roof trusses. The brick walls thus carry only their own weight. Under the central part of the main floor there are independent foundations that carry the heavy machinery there located. As a part of the steel columns is built into the brick walls, the stability of the latter as to any side strains is thereby greatly increased, the steel work being tied together from one side of the station to the other. Steel I-beams carried by the vertical columns and the central foundation walls and piers support the main floor of the sub-station. The first or lower gallery floors are also laid on I-beams secured to the vertical columns. In the second or upper gallery the floor is laid on heavy angle steel shapes that are carried with their supports by the columns in the brick walls. The framework of stairways leading from the basement to main floor, from the main floor to the first gallery, and so on up to the second gallery, and the roof is of iron and steel, and the treads are of slate. A framework for the sides and roof of the skylight is built up of angle steel and I-beams resting on the steel trusses carry the main roof.

The main floor, that of the first gallery and the roof, are all built up of terra cotta arches. On the second gallery the floor is laid with slate slabs. On the main and first gallery floors the tile arches are covered with a granolithic mixture of cement, sand and crushed granite 2½ in. thick. Over the terra cotta blocks and I-beams of the roof a coating of cement mortar at least ½ in. thick was laid to an even surface. On this surface there was placed a layer of boiling pitch, and then tarred felt roofing with another outside coating of the pitch. After this last was dry, boiling asphalt was spread over the roof to a depth of ¾ in., and in this hot asphalt book tiles 1 in. were laid with ¼-in. joints. The ceiling of the roof was plastered with a mortar composed of one part cement and two of sand, and then with cement and plaster of paris.

ECONOMIC ASPECTS.

The showing of 46 per cent. of the gross earnings as net income in the Montreal system, as above noted, has been made through good engineering. This will be appreciated from the fact that the regular rate for electric lighting in Montreal is 15 cents per K.W.-hour, while the rates to very large consumers like the cotton mills and the street railway compare favorably with the cost of steam power. Without neglecting the various other elements that affect the operative efficiency of a great system like that at Montreal, a special effort has there been made to reduce losses in distribution and build up a relatively large day load of motors. As has already been pointed out, the Royal Electric Company was the largest distributor of electrical energy in Montreal prior to the formation of the Montreal Light, Heat and Power Company, of which the former company is now one of the constituent units. In 1896, P. G. Gossler, until recently general superintendent and engineer of the Montreal Company, presented a paper at the annual convention of the Canadian Electrical Association, giving some interesting facts as to the methods followed to reduce distribution losses in the system of this latter company, among which the results of changes in the number and type of service transformers may be noted. The object in these changes was to displace smaller transformers by a less number of larger ones, and to supply consumers as far as practicable from secondary mains having approximately the lamp voltage. Following out this idea, reconstruction was begun on the alternating lighting service of the Royal Company, which included 1,160 transformers wired up to about 53,000 incandescent lamps. In the course of this construction 473 of the old transformers were removed, 345 being





Output Curves.

replaced by new transformers, eighteen taken down because the service was discontinued, and 110 disconnected because the customers served by them were connected to other old transformers nearby. Meantime 229 new transformers were connected to the lines, and of these 187 replaced old transformers and 42 were used for new customers. These changes left 916 transformers wired up to 60,000 lamps. With the 1,160 transformers and 53,000 lamps on the lines during the year preceding this construction, the smallest load at the station was 380 amp. During ten months after the reconstruction the minimum load on the station with 916 transformers and 60,000 lamps connected to the lines was 245 amp., or 135 amp. less than that with the previous smaller number of lamps and larger number of transformers. This saving of 135 amp. in the minimum load was obviously due to less leakage of current through the new transformers than through the smaller ones that were removed. For the 229 new transformers the leakage current was 19 amp., from which it follows that the leakage of the 473 old transformers that were removed amounted to 135 + 19 = 154 amp. Of the total saving of 135 amp. in leakage current, 36 amp. was due to the removal of the 110 transformers whose lamps were connected to other old transformers through secondary distribution mains. From this it appears that by replacing 345 of the old by 187 new transformers a saving of 99 amp. in leakage current was effected. The entire cost of making the changes in the 187 transformers and the distribution lines, including the cost of the new transformers, amounted to $65 per transformer on an average after the value of the old transformers, as scrap, was deducted. It was computed that the saving in the cost of coal at $2.75 per ton amounted to $25.58 annually for each of the 187 transformers on an average, so that the reduction in the outlay for fuel alone would pay for the change in about 2½ years. It was also computed that when the 1,160 old transformers have all been replaced by 636 new transformers, the leakage current would be reduced to less than 75 amp. As the Montreal plant was operated twenty-four hours per day, it was further estimated that the reduction of 135 amp. in the leakage current resulted in a yearly saving of $7,348 for coal at $2.75 per ton. Looking at the 135 amp. as capacity for an increase of load, it was said to correspond with 2,700 lamps of 16-c.p. in operation, or about 9,000 such lamps connected to the system.

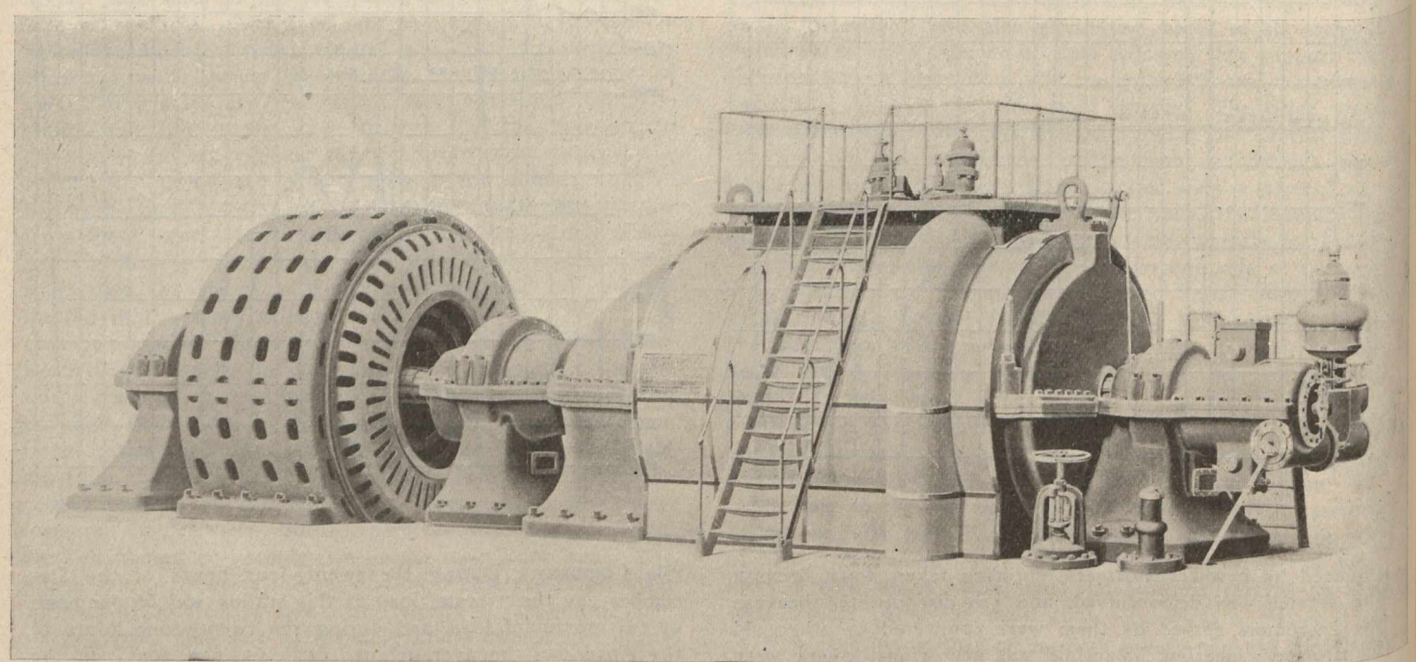
Perhaps the most notable result in the operation of the distribution system at Montreal, as it stands to-day, is the great increase in the connected load of stationary motors, and the relation of this motor load to the maximum load at the station. These results are brought out clearly by the records of kilowatt outputs during a December day of 1900, and an April day of 1901, at the station of the Royal Electric Company. During the twenty-four hours of the December day the average load at this station was 66 per cent. of the maximum load, and during the twenty-four hours of the April day the average load was 65 per cent. of the maximum there. These exceptionally high average loads show at once the influence of the relatively great capacity of connected motors, but the mystery is how a day load of motors, however great, can bring the average so far up toward the maximum load. As is well known, a day load of motors operating from 7 a.m. to 6 p.m. laps well over on to the heavy lighting load during the late hours of each afternoon during the winter months, and thus presents a direct addition to the maximum station load. With the great motor load at Montreal it has been necessary to avoid the conjunction of the normal motor and the maximum lighting demands. That this result has been reached at Montreal may be gathered from the fact that the average load at the station of the Royal Electric Company from

7 a.m. to 6 p.m. was not only 85 per cent. of the maximum load during the April day, but was also 85% of the maximum of the December day, when the annual maximum of the lighting load would naturally be reached. The fact that the regular motor and the maximum lighting loads do not coincide on the Montreal system is made still more evident by the location of the maximum station loads as to time of day in winter and spring. On the April day, above mentioned, the maximum station load occurred at 5 p.m., and on the December day this maximum came just prior to 4 p.m. Light must be had when wanted in Montreal, as elsewhere, and the maximum station load in December was kept down by cutting off a large part of the motor capacity before the great bulk of the lamps were turned on.

This disconnection of a large part of the motor load at 4 p.m. during the winter months is provided for in the contracts with some of the heaviest power users at Montreal, and the merit of the plan is shown by its success. If large consumers of power are able to purchase it at a very attractive figure prior to 4 p.m. on each day, there seems to be no good reason why they should not do so even though the supply is not available after that hour. The success of power sales on this basis seems to be in the nature of a personal triumph for Mr. Gossler, who has advocated it for several years. (To be continued.)

HIGH POWER WESTINGHOUSE-PARSONS STEAM TURBINES.

The 5,000-K.W. turbo-generating unit, illustrated herewith, is representative of the general type of steam turbines which will be constructed for large powers. The principle of operation, as well as the general relation and arrangement of rotating and stationary elements, characteristic of former types, has been employed in its construction. The largest machines therefore find their direct prototypes in the original design adopted, thus in a measure vindicating the wisdom of adherence to the design of maximum simplicity,



viz., the horizontal single-cylinder turbine. The most distinguishing features of the new type are the extreme compactness and low speed secured. The space occupied by the 7,500-h.p. turbine is approximately 27 ft. 8 in. by 13 ft. 3 in., and the height to the top of the hand-railing is 12 ft. This is equivalent to .049 sq. ft. (less than one-twentieth sq. ft.) per electric horse-power capacity, or 20.2-h.p. per sq. ft. of floor area required. For the complete unit a rectangular area of 47 ft. 4 in. in length and 13 ft. in width is required, equivalent to .084 sq. ft. per E.H.P. capacity, or 2 E.H.P. per sq. ft. of floor space.

The economy of space is well illustrated by the fact that four 5,000-K.W. Westinghouse-Parsons turbo-generators require a slightly less floor space, than two 5,000-K.W. compound engines and generators at present installed in the Manhattan Railway power house, New York.

In point of speed, the new type fulfills the demand for a unit operating at moderate speed. The 5,000-K.W. units operate at 750-R.P.M., the 2,000-K.W. unit 1,200-1,560-R.P.M., and the 1,000-K.W. unit 1,500-1,800-R.P.M., depending upon the frequency desired. These speeds, although not comparable to engine speeds, do not impose much greater stresses upon the rotating parts, and in addition secure the great advantage of reduction in the bulk, weight and cost of the unit. The unit rests upon a single bed-plate cast in two sections, which are secured by shrunk links. To the bedplate, which is heavily ribbed to secure rigidity, are bolted the pedestals, generator casing and turbine body, but the bedplate itself is not secured to the foundation by other means than the weight of the unit. Steam and exhaust connections are made beneath the floor level. In the smaller machines of this type, the cylinder barrel and both journals are cast in a single casting, thus largely minimizing machine work. In the large machine, however, the barrel is cast in two sections united by links, the outboard section carrying the journal and worm casing, and the inboard section the journal and exhaust opening which extends through the bedplate. As in former types. linear expansion and contraction of the turbine are provided for by a sliding foot. The inboard journal pedestal is bolted securely to the bedplate, but the outboard pedestal is free to slide between parallel machined ways. The main body of the casing is heavily lagged with non-conducting material, secured in place by sheet steel casings. Leakage of air from the atmosphere into the exhaust spaces of the casing at the entrances of the shaft is prevented by frictionless packing glands. No oil is employed and in consequence the condensation from the turbines is pure distilled water. In shaft construction great rigidity has been secured with a minimum use of metal. A central steel quill carries the entire rotating parts, both blades and balance pistons. Hollow forged steel ends are forced into the two ends of this quill, under hydraulic pressure, and are in addition secured by arrowhead links. High pressure steam is conveyed to all parts of this quill structure in such a manner as to eliminate stresses and consequent distortion due to highly superheated steam.

Power is transmitted to the generator shaft through a flexible coupling which is housed partly by the turbine and partly by the generator inboard journal. The coupling is split at the junction of the two shafts, so that by removing one bearing cap and the coupling bolts either section of the unit may be lifted out without disturbing the adjustment of the remaining section. In the smaller sizes the engagement surfaces of the coupling consist of the squared or hexagonal

ends of the shafts, but in the larger machines a crow foot sleeve is keyed to each shaft and the power is transmitted by an outside quill engaging the crow's feet. Thus great flexibility is secured, together with the greatest facility in dismantling. The journals in the larger machines are of the solid self-aligning type, similar to that employed in generators and cross-compound engines. The departure from the familiar oil-cushioned journal employed in the small machines is occasioned by the speed reduction secured. The journal shells are babbitt lined and are split horizontally, the two halves being united by bolts with shim adjustment. Oil from a central system is introduced at the centre under slight pressure, thoroughly flushing all parts. Axial adjustment is provided by metal shims arranged in quarter-box fashion. The diameter of the shaft at the journal of a 5,000-K.W. machine is 15-in., strikingly small in comparison to the 34-in. shafts required for a cross-compound reciprocating engine of corresponding capacity. Longitudinal adjustment, to reserve proper side clearance, is secured by a thrust bearing located next to the outboard bearing. The bearing is not subjected to longitudinal thrusts from the action of the steam and is consequently of small size. The two half shells are advanced in opposite directions by graduated set screws, so that the actual running clearances are measured in thousandths of an inch. Once set, these adjustments are permanent and do not require frequent "taking up."

Steam enters the turbines successively through an automatic quick closing throttle, hand throttle, strainer and the main admission valve. A circular steam port, surrounding the entrance to the initial stage conveys this steam to all points so as to avoid stresses incident to more localized admission of highly superheated steam. An important feature of the steam distribution system is the provision of a by-pass valve. This valve admits high pressure steam to the second stage of the turbine on overloads in order to increase its capacity, up to 50 per cent. in excess of full rated load. By properly proportionating the by-pass steam to the overload on the turbine, maximum economy may at all times be secured, together with reserve overload capacity. This results in a slight rise in the economy curve on heavy overloads, resembling in some respects the engine economy on loads exceeding that of maximum economy. The turbine, however only suffers in economy at heavy overloads while the engine economy decreases progressively from 75 to 80 per cent. of full load capacity. The main admission valve consists of a double beat poppet valve operated by a small piston, this in turn being controlled by a small pilot valve directly actuated by the governor mechanism. The valve admits steam to the turbine in puffs, the duration of which are proportioned by the governor to the load upon the turbine. This intermittent method obviates the throttling of steam to accommodate loading and secures the highest economy by using at all loads steam at boiler pressure. At the extreme outer end of the turbine shaft is mounted a worm-driving horizontal cross shaft. This shaft drives at one end the oil pump and at the other end the governor through bevel gearing. An eccentric provides the reciprocating motion necessary for the valve mechanism.

The governor is of the fly-ball type, with 90 degree bell crank ball levers mounted on knife edges and fitted with roller contacts. The governor sleeve and spring is mounted on ball bearings, and adjustment of the spring tension may be made while the turbine is running, thus affording a most simple and convenient means for paralleling alternating current generators and dividing the load proportionately between them. At the extreme end of the outboard pedestal is mounted an auxiliary speed limit governor. It is likewise of the centrifugal type, and may be set to release, at any predetermined speed, a small plunger valve which controls with high pressure steam the operation of the quick closing throttle before mentioned. This is normally held open by means of an overbalanced differential piston. At the moment the speed limit operates, the excess pressure is removed and the throttle closes. This device is employed for insuring absolute immunity from accident from excess speeds, due to the possible disablement of the governor mechanism. Copious lubrication is supplied to all journals by means of a plunger pump driven from the worm shaft. The warm oil returning from the bearings passes through a copper coil cooler in the bedplate and thence to a reservoir from which the pump draws its supply. The cooled lubricant is circulated at slight pressure, sufficient to ensure positive flow. At no point is oil under high pressure employed for preventing erosion of rubbing parts, bearing areas being sufficient for supporting the weight of the rotating parts.

In general construction the 5,000-K.W. turbo-generators conform to those now building for smaller machines. The field or revolving element is built from a solid cylinder of steel slotted for the reception of the bar windings, and provided with ventilating openings corresponding with openings in the laminations of the stationary element. The generators may be wound for high voltage, if desired, in order to avoid the use of step-up transformers in a system of power transmission at voltages ranging up to 15,000. The type here illustrated will form the initial equipment of the Pennsylvania Railroad Terminal property in New York City, operating with electric locomotives the heaviest Pullman trains through the tunnel approaches to Manhattan. Three units will similarly inaugurate the power service on the Philadelphia Rapid Transit Subway System now under construction. Eight 5,000-K.W. units will furnish power to the London Subway System, and three 3,500-K.W. units to the surface system of the same city. These units will operate under 175 lbs. steam pressure, high vacuum and 100 to 175 degrees of superheat.

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PUBLIC PATENTS.

Editor, Canadian Engineer:—

Sir,—Inventors frequently fail to put their ideas before the public owing to poverty, doubt of financial success, and other causes. A patent costs $50, besides search and model; and it needs $20,000 to ensure successful manufacture and sale. I once showed a self-inflating connection to fill a belt, buoy, or boat, to the late Steamboat Inspector, who stated that if I had the sum named to float advertisement and sale, it would be a fortune; but without that amount it would be a certain loss to the holder of the patent. A similar, if not identical, contrivance was successfully exhibited on the Serpentine, London, but it is not yet in general use. If facilities were offered inventors for placing their patents on record for national benefit, with security against any fraudulent imitation by private firms, more useful inventions would become public to the general advantage. It might be free to any person who took out a license to manufacture and sell, but without any monopoly, as in present patents. If its merits proved obvious and important, the Patent Office might pay the inventor say 5 per cent. on the average sales as a public acknowledgment of his service to the nation. Sales to foreign countries or individuals would be made by the Commissioner for the national treasury, so that each public patent would be a national asset.

I further suggest that a list of public and private patents be published monthly with notes on the more important—much in the style of the Scientific American—but as public information, like our cold storage and agricultural bulletins, for public benefit only. I claim that such a plan would stimulate invention, aid poor inventors, and distribute the accompanying benefits more widely than our present system. I cannot suggest a more suitable journal to place these inventions before the people than the Canadian Engineer. Much of the information it furnishes is for the benefit of the great public, as well as for engineers only, and public aid in illustrating and advertising new ideas offered freely to all the community would be as fairly earned as any other Government advertisements. The essence of civilization is the extension of co-operation in subsistence, defence, transports, education, and, in short, all the necessaries and comforts of life. The more a society co-operates in all the relations of citizenship, the greater the aggregate value of its labor, because there is no loss by competition duplicating the same labor; and no drones feeding from the civic honeycomb. A logical corollary from public

patents would be the national manufacture of utilities by national water-power or electricity derived therefrom. As these goods would be manufactured with every advantage of cheap patents and power absolutely at first cost, they could be sold at a uniformly cheap rate, and as the public needs required, without even being slaughtered below cost. A uniform quality, price, and demand, would, indeed, form an ideal condition in commercial life. As the province of Ontario has very properly assumed possession of the minerals discovered while grading the Temiscaming Railway, another vista is opened of a national mining, smelting, and metallic manufacture, entirely regulated by the Government under such conditions that the nation could be supplied without either trusts and syndicates to raise prices artificially, or slaughter below cost when suffering from redundant production.

A third vista is opened by assuming the lumbering operations on the public lands by Government mills, foresters, and transportation. By cutting only ripe trees, carefully carbonizing the waste material, and never overstocking the market beyond actual requirements, our lumber, minerals, water-power and transport can be made quite as stable as taxes, interest, or real estate. It would also enable a Government to regulate labor and wages; by employing only competent, reliable men, and paying such wages as would fairly remunerate them, we would secure the best men for the national service; and the careless, ignorant, intemperate, or unsettled, would be compelled to seek private employment, often at lower wages. By nationalizing all railways, vessels, and other means of transport, we could at length organize, discipline, and efficiently control all the forces of national activity, and use the whole force of strength, intelligence, organization, and administrative ability for its comfort and progress in peace, and its defence in war—either military or commercial. This is my ideal of a civilized nation.

THOS. FROOD.

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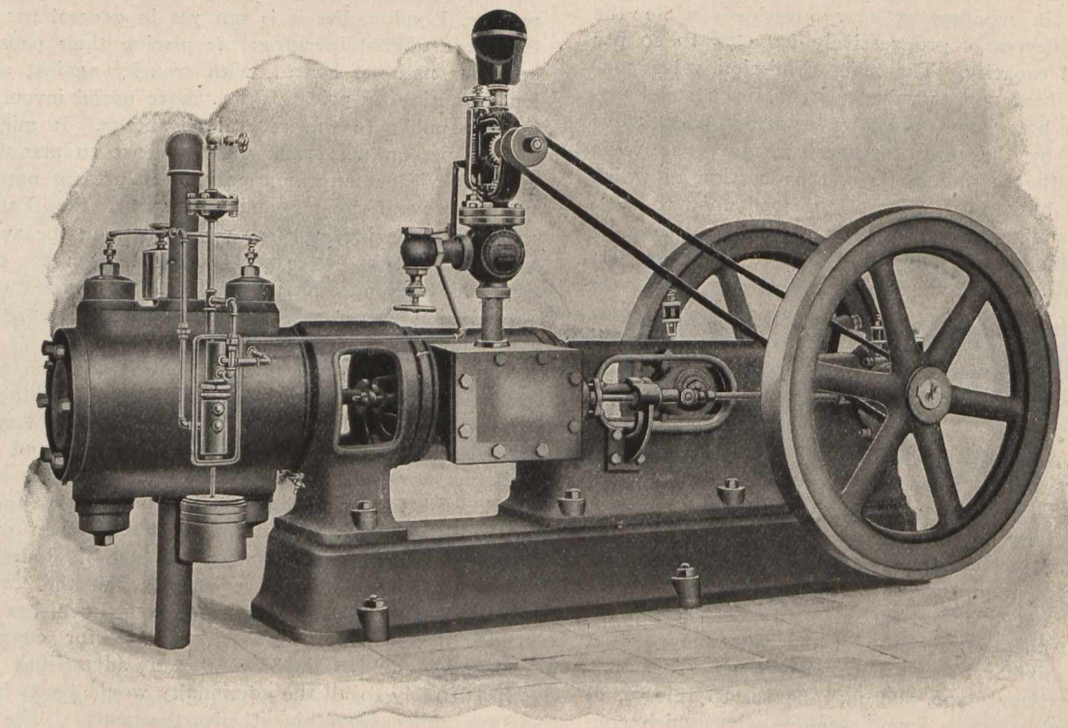
FRANKLIN AIR COMPRESSOR.

The new type of air compressor, here shown, is made by the Chicago Pneumatic Tool Company, Fisher Building, Chicago, and 95 Liberty street, New York, at their Air Compressor Works, Franklin, Pa., and is designed to meet the growing demand for an efficient, simple and compact compressor furnished at a moderate price. This form of compressor is made in a variety of sizes and styles, starting with a minimum capacity of 30 cubic feet of free air per minute, single, duplex, or compound, actuated by steam, belted, chain driven, or geared to an electric motor.

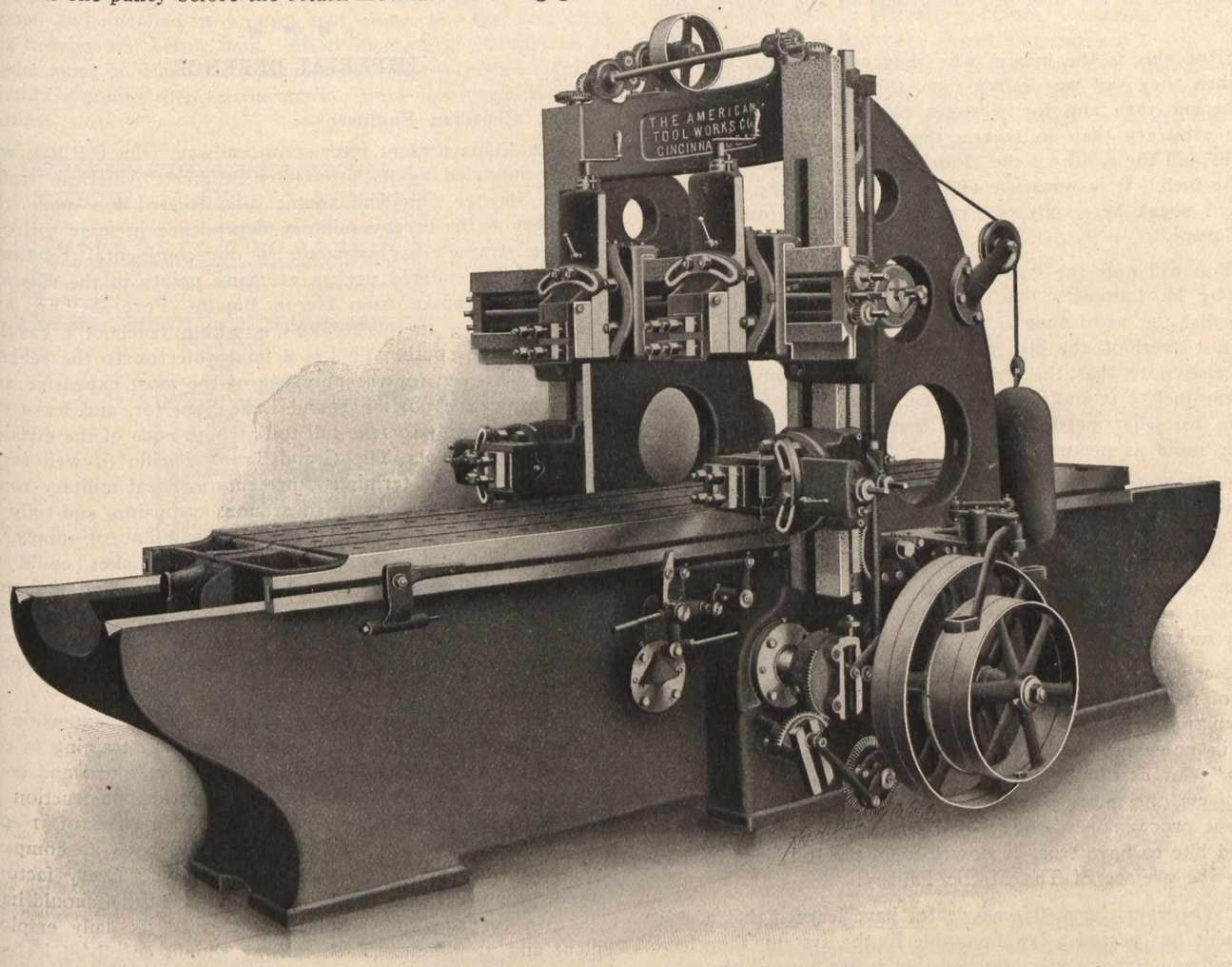


It is described by the makers as follows: The frame is of box section design, with large factor of safety to withstand all strains when working at maximum load. It has bored cross-head guide, and provision for catching and removing drip from bearings and stuffing boxes. Compressors having cylinders 8-in. in diameter and larger are furnished with or without sub-base. When furnished with base the compressor is entirely self-contained, obviating the necessity of expert services in erecting, and reducing cost of foundation. Air cylinder and heads are completely water jacketed, with thorough circulation of water, affording equal cooling at all points. Steam valves on cylinders under 12 inches diameter are of plain slide type accurately scraped to seat and securely fastened to rod. Cylinders 12 inches diameter and larger are provided with Meyer Adjustable Cut-Off Valves and Gear. Air valves are of poppet type, made from high grade steel, having removable seats and guides, easily renewed or repaired and thoroughly guarded from entering cylinder in case of breakage. They are placed radially in cylinder, making them readily accessible, ensuring accurate seating, and reducing wear to a minimum. The pistons are of solid type with cast iron spring rings accurately fitted. Piston rods are of best machinery steel. Shaft is of centre crank type with exceptionally heavy crank arms, made of best open hearth steel of ample diameter, accurately finished. Cross-head is of cast iron with adjustable shoes to top and bottom. Connecting rod is of best open hearth steel, with bronze cross-head pin boxes having wedge adjustment. Crank pin end is of marine type lined with genuine babbitt metal. Compressor is furnished with two wheels, one on each side of compressor, turned true, and keyed to shaft, of sufficient weight to ensure smooth operation. An unloading device is provided to relieve the compressor of all load when the desired air pressure is obtained, and automatically cause it to resume delivery when the storage pressure becomes reduced. Cylinders have provision for indicator connections. A pressure regulating governor is provided, to automatically control the operation of the compressor in accordance with the demand for air, working in connection with a speed governor for regulating the speed of the engine.

These compressors are submitted to a working test before shipment, and although designed primarily to supply compressed air power for operating pneumatic tools in railway shops, machine shops, foundries, shipyards, and stone yards, they are suitable for actuating rock drills, coal cutters and other machinery in mines, tunnels, and quarries, pumping water by the air lift system and for every other purpose to which compressed air is applied.

NEW THIRTY-SIX INCH PLANER.

The accompanying illustration presents the new standard metal planer just brought through by the American Tool Works Co. of Cincinnati. The machine contains a number of original features, radical departures from former patterns, in order to meet successfully the greatly increased strains imposed upon planers by modern methods in shop practice. The bed is exceptionally deep, extending almost to the floor line, with short, substantial legs, cast with the bed. Heavy box cross girts at short distances give the bed a great rigidity. Bed is very long in proportion to table length, leaving but little overhang to table when planing at full length. The central portion, where the strain is heaviest, is strongly reinforced. The table is of ample proportions, well braced by ribs to obtain great strength without unnecessary weight, is equipped with improved dirt-proof feature, and has quick return, reversing without shock or jar. An improved form of shifting mechanism removes the belt from one pulley before the return movement belt engages



the other, thus obviating all disagreeable shrieking of belts. A safety locking device prevents the table from starting before the operator is ready. Heads are firmly secured to saddles on cross rail by four bolts instead of two, as on most planers. Feeds are automatic in all directions, and can be operated from either side of the machine. Side heads can be furnished, as in the illustration, at any time after the machine is built, with slight modifications. Slides are so constructed as to permit of planing at some distance from the housing. Rail heads and side heads have separate feed mechanism, which operate entirely independently in all directions, and at either end of the stroke. The action of this planer is said to be remarkably smooth. In planing work, which is afterwards to be scraped to a surface, the evenness of the cut is such as to reduce the necessary scraping to a minimum.

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Additional plant is being installed at the Cumberland mines, Vancouver Island, and the output of anthracite coal will shortly be 300 to 400 tons daily. It is reported that J. J. Hill's Pacific liners will take the whole supply.

THE METRIC SYSTEM.

Editor, Canadian Engineer:—

Sir,—Referring to the letter on the Metric System, by E. Johnson, which appears in your issue for February, I note the statement that: "It is not a fact that in France and Germany there are used old units side by side with those of the Metric System. There do exist old names—or nicknames—for some of the present units," etc.

That statement could only have been made by some one who is in entire ignorance of the facts.

I have in my possession a scale, "made in Germany," on which there are graduations for the Rhenish and the French inches, which are in large use in their respective countries. Mr. Johnson may find an engraving of this scale on page 40 of The Metric Fallacy. Will he be so good as to say for which metric units the Rhenish and the French inches are nicknames?

In Zeitschrift des Vereines deutscher Ingenieure for September 5th, 1903, he may find a table (reproduced on page 42 of The Metric Fallacy), of a standard of pipe and pipe threads, which was adopted at the annual meeting of the German Society of Engineers last July, and in this table he will find the bore of the pipe and the pitch of the threads given in English inches and in no other way. Will Mr. Johnson please tell me for what metric unit the term English inch is the nickname?

In Leipziger Monatschrift for October 31st, 1902, he will find a German yarn table (reproduced on page 186 of The Metric Fallacy), in which, against the set of the loom in threads per Vienna inch, he will find the weight in English pounds of the yarn required for 100 meters of cloth. Will he tell me for what metric units the Vienna inch and the English pound are nicknames?

In L'Industrie Textile for October 15th, 1902, may be found an article by a leading French textile authority, M. Paul Lamoitier, reading in part as follows:

"It is absolutely unworthy of us French, who were the first to find and apply the Metric System, to retain the aune and denier for measuring silk. Ah! these Americans are not

considerate of our feelings and they are right. We are as much in the anarchy of weights and measures for the textile industry as at the time of the Revolution, for we have the denier of Montpelier and of Milan, for silk, with the aune as a unit of length. We still have the diverse standards of Roubaix, Fourmies and Reims for worsted, the moque of Sedan, the livre, the quart and the sous of Elboeuf, the yard for linen, etc. Ah! the famous aune, do you know its equivalent? Exactly 3 feet 7 inches 10 lines and 10 points, or in other words, 1.188447 metres, the foot being equal to .324839 metres and divided into 12 inches, the inch into 12 lines and the line into 12 points.

"The yarn count in the north of France is a length and in the centre, a weight. I will take my oath that the manufacturer of Rouen, if he has not studied each section separately, has no idea what is the standard of Reims or the denier of Lyons or Milan. And on the other hand, the manufacturers of Reims and Lyons are likewise puzzled in making comparisons of the diverse numberings of the diverse materials.

"And this is the reason why they are right in mocking us when they say we do not use the Metric System for numbering yarn and for weaving calculations. Nothing is more arbitrary than to reckon the yarn by the thousand metres and the width of the cloth and the picks of the filling by the inch. It is nonsense and a derision. Note also that, while I speak here only of France, I could say as much of all Europe."

You will note the value of the aune, given with so much care by M. Lamoitier, but Mr. Johnson would have us believe that the word aune is only a nickname for metre! Let him not overlook the last sentence by M. Lamoitier, and let him also note that the value given for the foot stamps it and the inch, line and point as French units, and will he then tell us for what metric units the French foot, inch, line, and point, stand as nicknames?

In Kalkulator für Artikel der Textil branche, by Friedrich Frowein, page 79, may be found a table (reproduced on page 181 of The Metric Fallacy), giving the value of eight of the old ells, which are still in use in German textile mills. The values are given in centimeters, as 67, 62, 78, etc., but Mr. Johnson would have us believe that the word ell is only another nickname for aune.

Since the exposure by my associate, Mr. Dale, and myself of the persistence of old units in metric countries, the explanation given by Mr. Johnson has appeared many times, but, in unfeeling Yankee slang, it is "too thin," it "won't wash." In hastily adopting this explanation of uncomfortable facts, the metric advocates are only continuing the convenient process of assuming anything to be true which they would like to have true, as described in the following extract from the preface of The Metric Fallacy:

"Whenever the metric advocates have learned that a government has passed a law favorable to the system, they have straightway conveniently assumed that it has become the common system in trade and commerce. They have not enquired into the working of these laws nor into their scope or nature. Their logic has been: 'Such a country has passed a Metric System law, therefore the people of the country have dropped their old units and taken up the new.' Their stories of the imposing number of hundreds of millions of people who use the system have no other basis than this. They have simply added the figures for the population of those countries which have passed some kind of a metric law, including those in which the laws are simply permissive, and those in which the system has been adopted for government purposes alone. If the facts which are given in these pages turn their case to ridicule, they have nothing to thank but their own credulous willingness to believe anything favorable to their system and to their free use of their own imagination without regard to facts."

Mr. Johnson should try again; really, though, Mr. Editor, doesn't it strike you as a little odd to see the English system assailed from England and defended from the United States? I do not need to remind you that Mr. Johnson is not at liberty to ignore or evade my questions. The large use of these old names is proven, and, having made this ridiculous explanation, he will now show for what metric units they are used as nicknames, or your readers will understand that he has abandoned his explanation.

I probably know about as much about the present state of the Metric System bill before the American Congress as Mr. Johnson does, and I am ready to stake my reputation as a prophet on the prediction that it has no better chance of becoming law than Mr. Johnson has of being struck by lightning.

New York, February 22nd. F. A. HALSEY.

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A. M. Chrisholm, of Kingston, Ont., has received an enquiry from Germany as to the cost of iron pyrites, feldspar and graphite. If prices are satisfactory a large trade may be worked up between Canada and Germany in these minerals. All three minerals are found in Frontenac County and graphite is plentiful in Lanark County.

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IMPERIAL DEFENCE.

Editor, Canadian Engineer:—

SIR,—Our present inter-ocean railway, (the C.P.R.), was mainly intended by its promoters to divert American traffic to the shorter Canadian route; it is located too near the boundary to be of any military dependence in case of our needing strategic arrangements in our continental relations. It could be rendered useless at many points in the Eastern part; it is exposed from Heron Bay to Port Arthur, and from Winnipeg to the Rockies is within reach of a cavalry raid from the south. This is a fatal objecton to the scheme of R. L. Borden for the purchase of the most expensive and least productive portion round Lake Superior, and leave the present monopoly to take full toll at both ends of the division under our control. The Grand Trunk Pacific (if well fortified at its western terminus), presents an ideal military route —only to be reached after an arduous campaign, and only to be held by an army able to cover a long line of supply.

By the Ottawa Ship Canal, the Great Lakes could be filled by gun-boats and cruisers within a few days, and present the best possible frontier defence for Canada. I consider this canal, the completion of the Rideau Canal, to meet enlarged requirements, and the first duty of our Government to provide.

The third and most essential would be the extension of our militia law, as to provide for the military training in our Public and High Schools of all our youth in squad and company movements, skirmishing, scouting, the construction of firearms, and some target practice with air-rifles of 1 per cent. power. Every school section should have its company of adults, and every township its battalion. Every factory, foundry or other industry (bonused by the tariff), should have its own corps, with special adaptation to its daily employment and usefulness. Each railway should enroll all its employees as minute men to guard and repair its lines in case of assault; they would know better than others what to guard, where to fight to advantage, and how to repair damages.

The older Grand Trunk lines would form the skirmish line; the C.P.R. the first main line of defence, and the Grand Trunk Pacific would be the central route and second line of defence. Troops could move with celerity and safety from the battlements of Quebec to the batteries of Port Simpson, and by cross lines send aid to the frontier at any threatened point.

The fourth and last line would be Hudson's Bay and the roads from it to the G.T.R. from Moose Factory, Churchill, and possibly Chesterfield Inlet, and the Mackenzie and Yukon basins.

Canada's lumbermen, miners, and pioneers would form a corps of nearly a quarter-million, who, in our back country could set all the world at defiance while supplies and ammunition lasted. The American Revolutionary War showed what pioneers can do against European troops; the war of 1812-14 proved that the invader is at an immense disadvantage; and the defender, who knows the ground, is able to perform miracles of defence and surprise. The chief merit I claim for

this scheme is that it requires no masses of men to be abstracted from useful employments and maintained by the workers. The only outlay would be for arms and fortifications. The latter could be largely erected by the men as a portion of their drill, and the railways by adding a few armored trains could largely increase their efficiency and the safety of their men.

Canada could thus be made a factor second only to the navy in the globe-encircling line of Imperial defence.

THOS. FROOD.

PUMPING BY ELECTRICITY.*

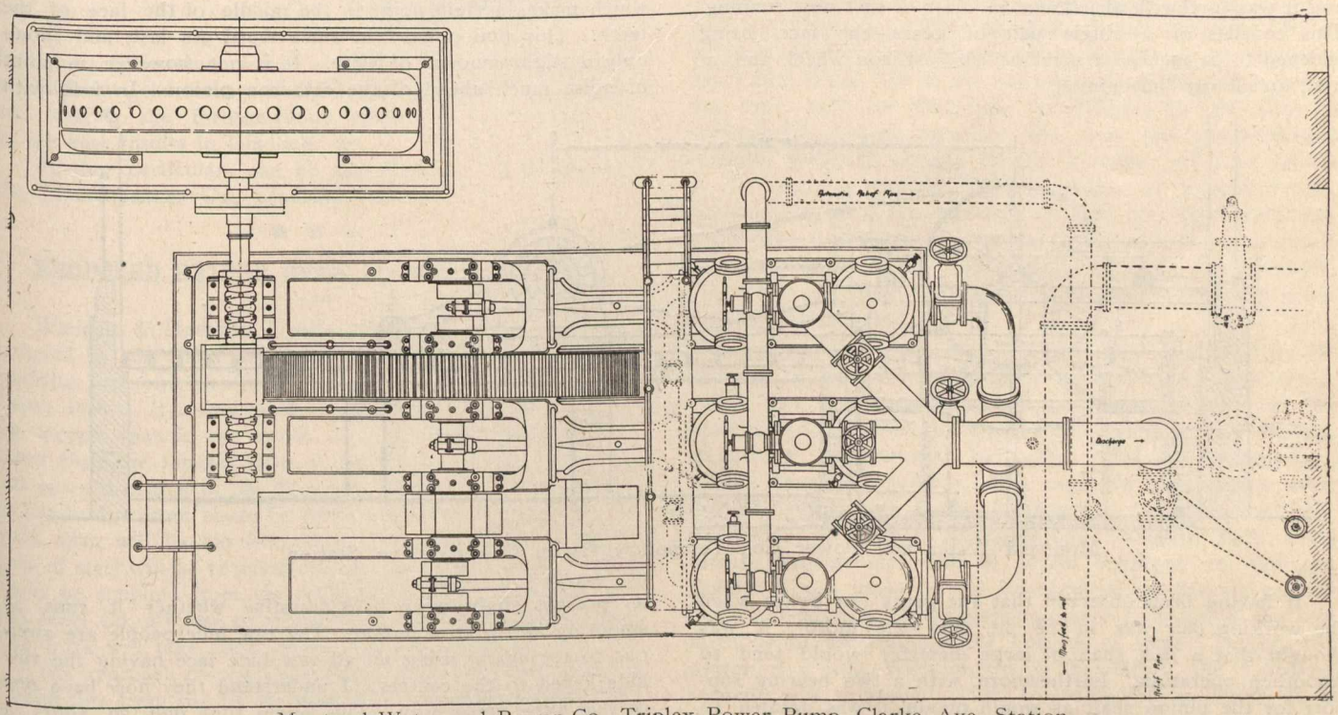
(Continued from February issue.)

THE CLARKE AVE. ELECTRIC PUMP.

The chief considerations here in connection with an electric plant were, after durability and efficiency, the avoidance of undue noise and vibration. Accordingly a pump was designed and installed in August, 1901, much like the first one, but heavier and better built. Many mechanical changes were made, most of which were found to be improvements. Types of rotary pumps then on the market were considered but discarded.

the general arrangement of gearing was the same as the first. The motor being built for a slighter slower speed, viz., 160 revolutions per minute, allowed for the same piston speed with a correspondingly smaller reduction ratio. The gearing consisted of two mortise wheels carried by the same crank shaft, 140 maple teeth, 200.52 inches (16 feet 8½ inches) pitch diameter, 18-inch face, 4½-inch circular pitch (these teeth were hand dressed); and two machine-cut steel pinions carried by the same jack shaft, 25¾-inch pitch diameter, 18 teeth. Reduction ratio, 7.88. The steel forged three-throw crank shaft is 11¼ inches diameter through crank pins and journals and 13½ diameter at gear hubs; overall length 16 feet 11 inches. Distance between gears is 6 feet 3 inches. Arrangement of bearings, etc., is as with the other pump. The jack shaft is connected with motor through a 500-h.p. 48-inch Worrall clutch. This clutch consists merely of a cast-iron disc keyed to one shaft which is gripped between shrouds keyed to the other. The usual lever and toggle joint link is employed to operate it. The disc and shrouds are bevelled, which ensures accurate centering. On the whole this clutch has been found satisfactory.

The permanent induction motor for this pump, which was contracted for in 1901, was, at the time, the largest of the type ever built. There is only one other as large, and that



Montreal Water and Power Co., Triplex Power Pump, Clarke Ave. Station.

The capacity of this pump was fixed to begin with at 4,500,000 Imperial gallons. This gives easily an additional 1,750,000 over the old steam plant at this station. The new pump is, however, designed to run up to 7,000,000 Imperial gallons by merely changing the pinion. This is ample to provide for normal increase at this point for some years.

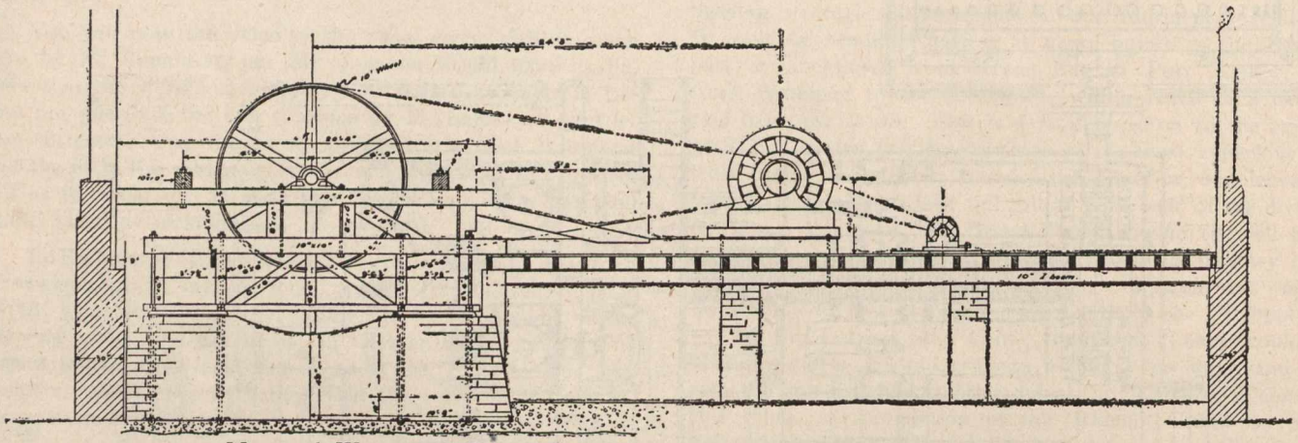
In event of a low-level reservoir being established at the proper level for the supply of the greater part of the territory, a heavier pump than the first would be necessary. At the same time, such a large one would then not be required at Clarke Ave. Accordingly, this pump was designed all around for a working pressure of 175 pounds, with a view to removing it to the river for the proposed new service. Its present head is about 118 pounds. This brought its weight (exclusive of motor), up to nearly 375,000 pounds, the lower pump being about 275,000 pounds. The chief differences between this pump and the other are, first, the gearing, which consisted of mortise gears and steel pinions; steel babbited boxes instead of phosphor bronze; marine crank ends; pillow blocks adjustable on frames; steel plunger rods instead of bronze and the carrying of these rods through the cylindrical plunger and securing by a taper in front and a locked nut at the back were other differences.

This pump is a 19½-in. by 24-in. horizontal triplex, and is a duplicate built for the electric pump of the City of Montreal now being erected. This machine, being a special one of very slow speed, was naturally late in coming. A temporary drive was therefore arranged so that the pump could be started in the summer of 1901. This consisted of a 200-h.p., three-phase, 600 revolutions per minute alternator, belt geared to a 10-foot pulley on a temporary jack shaft, erected on timbers from the permanent motor foundation. The regular clutch was used at this time and proved a very necessary part of the equipment. This arrangement had a pinion shaft speed of 100 revolutions per minute, which brought the load within the capacity of this temporary motor. This drive ran eight months, from August 1st, 1901.

When this pump was first started it seemed satisfactory. The gearing made only a slight rumble and there was very little vibration. It seemed as if the ideal in electric power pumps had been reached. Soon, however, it was noticed that the wooden cogs were fraying, and the action of the gears consequently became less smooth. In less than six weeks it was necesary to recog these gears. This was done by taking one out and running the pump in the meantime with the other pair. After the first one came back, and while the other was away to be recogged, it was noticed that the gears ran better and lasted longer with one pair than with two. On investigating it was found that at the periphery of these 17-foot wheels there was a spring between them of over one-

*From a paper read before the New England Waterworks Association, by F. H. Pitcher, chief engineer of the Montreal Water & Power Co.

quarter inch, when a tangential force equal to 150-h.p. at 100 revolutions per minute of the jack shaft was applied. This was, of course, due to spring in the crank shaft. When the stresses on the gears are considered in relation to the resultant of the three-crank effort curves, it is at once apparent that there is, during every revolution, a fluctuating load between these gears. This is brought about by the outside cranks, whose load is, from the nature of things, not shared equally at all times by each gear as with the centre crank. Taking this, together with the unavoidable spring in the crank shaft, it was apparent that there would always be a certain amount of hammering or pounding between these wooden wheels and their respective pinions. The writer was then satisfied that with this arrangement such large mortise wheels could not be made to work. The builders, however, claimed the trouble to be due to the unsteady support of the pulley end of the pinion shaft, which, being supported on timbers built up on a foundation about 7 feet below, was not of course the most rigid holding. Considerable oscillatory motion of this end of the jack shaft occurred. By turning the wooden wheels around, and running with one pair, the pump was kept in operation until the permanent motor arrived. When this was installed it was at once clear, even to the builders, that the gearing arrangement would not work, and it was forthwith abandoned in favor of that now running. This consists of a single pair of gears—the face being widened to 24 inches—a machine cut cast-iron wheel, and, at first, an all raw hide pinion.



Montreal Water and Power Co., Temporary Drive, Clarke Ave. Station.

It having been observed that the gears ran better when the working pair was in the pit next the motor, it was thought that a jack shaft of large diameter would tend to smoothen operation. Furthermore, with a two bearing support for the pinion shaft as would obtain, it was decided to abandon the spherical bearings and substitute stiff bearings of a greater length. Accordingly, a 10-inch pinion shaft with bearings of 3.9 diameters (approximately) was installed. The particulars of this pair of gears are as follows: One machine-cut spur cast-iron gear 24-inch face, 179 involute teeth, 3½-inch circular pitch, pitch diameter 199.42 inches, or 16.61 feet.

The all raw hide pinion has a 26-inch face, 24 teeth, 26.7 inch pitch diameter (approximately). Reduction ration, 7.45.

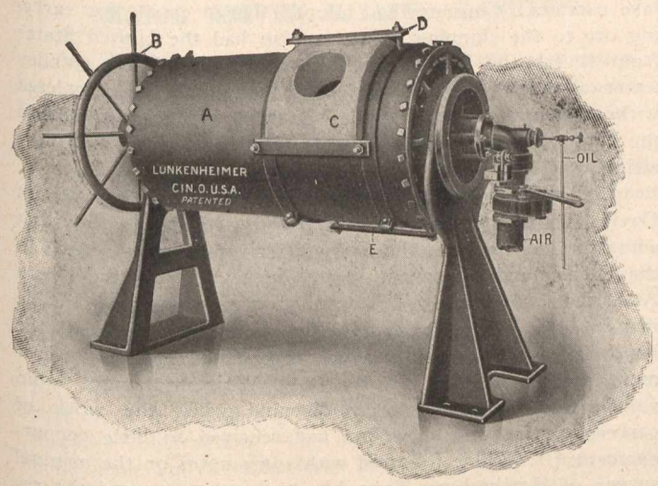
This pinion ran for six weeks, and then failed much as the others at the lower station did, but from another cause. The shrinkage was much less, the raw hide undoubtedly being a superior article, but something happened inside the pinion which prevented it being taken up. It is the writer's opinion that the raw hide contracted radially and got between the ends of the cast-iron centres carried by the shrouds. However, in spite of plenty of clearance at the ends of the pinion, it was found impossible to compress the hide in the middle so that it was sufficiently tight. The consequence was the load all came on the ends and the teeth got out of shape, causing extreme heating in the pinion. The co-efficient of expansion of this substance being high, the ten 1⅞-inch steel bolts holding the raw hide laterally were broken as quickly as they could be renewed. The raw hide itself stood the test, and did not break as with the other. The raw hide was not keyed to the cast-iron centre or otherwise secured, except by the bolts passing through from end to end. While this pinion ran it was extremely noiseless at times, but atmospheric changes, particularly the amount of moisture in the air, seemed to have considerable effect upon it. An appreciable variation in the running of gearing was observable, apparently from no other cause than atmospheric changes. A cast-iron pinion was cut as soon as possible and installed in place of the raw hide one, pending the arrival of the pinion now running. The first raw hide pinion was, of course, the largest ever attempted in face and mass of raw hide. But in the writer's opinon the very quality to which raw hide owes its noiselessness—viz., the spring—renders an all raw hide tooth of such a length impossible for heavy work. The teeth, as mentioned, spring away from the work in the middle, or point of maximum bending moment, and, the cast-iron teeth of the gear being relatively rigid, too much work comes on the ends, which in consequence show excessive wear in a few days. Unfortunately the writer was unable to hold a post-mortem on this pinion, without which the above is offered as an explanation of its failure.

The pinion now running is one-third brass; that is, it is cut from a blank having a section of brass in the middle 8 inches wide, with 8 inches of raw hide on each side. The whole is keyed as well as bolted to the cast-iron centres, which makes a rigid point in the middle of the face of the teeth. This pinion has run since April 9th last, and shows only a slight amount of wear. It is not, however, in point of noise much ahead of the cast-iron pinion. In fact, with its present slight wear it is doubtful whether it runs as smoothly as the iron pinion. The raw hide people are anxious to try again, using an all raw hide face having the raw hide keyed to the centres. I understand they now have one of that type under way. This pump runs only 20 hours a day, and there is therefore ample opportunity to take up the slack in the raw hide, etc.

LUNKENHEIMER METAL FURNACE.

The Lunkenheimer Metal Melting Furnace for melting brasses, bronzes, etc., has been evolved after considerable experimenting with nearly every type of furnace on the market. As will be seen from the cut, the furnace consists of a cylindrical sheet-steel drum A, having cast-iron heads. The interior of the drum is lined with fire-proof tile, and there are two openings on opposite sides of the drum. Only one of these openings is in use, the other being closed by a fire clay filling. The object of having two openings is to increase the life of the linings of the furnace. It has been found that the furnace wears out quicker around the filling hole (which also serves as outlet for the flame) than elsewhere. The advantage claimed for the Lunkenheimer furnace is that when one filling hole is worn out, it can be closed by a fire-clay filling and plate, the furnace reversed, and the other hole cut out and put in service. The oil burner is of a special type, designed to give the greatest amount of heat with a minimum consumption of oil. In the Lunkenheimer foundry there are ten of these furnaces in use, and they are able to secure from six to seven heats per working day of ten hours from each furnace. The weight of each heat will average

about five hundred and fifty pounds, and the oil consumption varies from two to two and one-half gallons of crude oil per hundred pounds of metal melted. The life of the linings is from three to four hundred heats, this varying with the kind of metal melted. It is easy to re-line, which cannot be said of all types of furnaces. With the first furnace



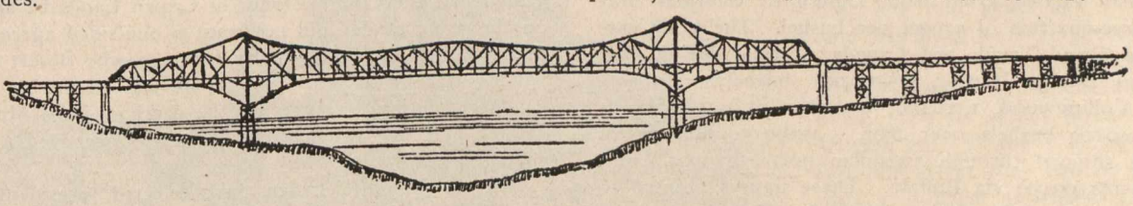
sold to each customer within a radius of one thousand miles of Cincinnati, the makers send an expert to start the furnace and instruct the furnace-room employees as to how to secure best results in handling, etc.

Further particulars can be had from the manufacturers, the Lunkenheimer Co., Cincinnati, O.

PROPOSED BRIDGE OVER STRAIT OF CANSO.

Waddell & Hedrick, Kansas City, Mo., have been instructed by the Strait of Canso Bridge Co. to prepare full working plans for the proposed cantilever bridge across the Canso Strait. It is estimated to cost $5,000,000, and will have the largest span in the world, viz., 1,800 feet, being 100 feet more than the longest span of the Forth Bridge, and 205 feet more than that of the Brooklyn Bridge. The total length of the bridge from shore to shore will be 3,300 feet, and the main span will be 150 feet above high water level. 35,000 tons of steel will be required for its construction, all of which could be supplied from the mills which the Dominion Iron and Steel Co. propose to establish at Sydney, C.B., this year. The work will take about three years to complete.

The approach on the Cape Breton side will be made by a branch line from the I.C.R., near Point Tupper, to the Hastings end of the bridge. The connection from Cape Porcupine will be by a spur line to the I.C.R., near Harbor au Bauche Station, thus overcoming the greater part of the present heavy grades.



Strait of Canso Bridge.

This bridge will save about one hour on every trip to and from Cape Breton at no greater cost than that of the present service. The completion of this bridge will enable the I.C.R. to run night trains to and from Cape Breton, and it is believed that it will increase the chances of Sydney harbor being made a port of call for the Canadian fast line.

Mr. Waddell, the head of the firm of Waddell & Hedrick, is a Canadian by birth, and is considered one of the best authorities on bridge structure on this continent. His text books: "De Pontibus," and others, for bridge engineers, are universally used by the engineering fraternity in the United States and Canada. He was professor of engineering in the University of Japan for some years, and was knighted by the Emperor for his services in that capacity.

THE ASSOCIATION OF ONTARIO LAND SURVEYORS.

The twelfth annual meeting of the Association of Ontario Land Surveyors was held in Toronto on February 23rd, 24th, and 25th, under the presidency of W. R. Aylsworth. Those present included: Capt. K. Gamble, Major V. Sankey, G. B. Kirkpatrick, H. de Q. Sewell, H. L. Esten, W. A. Brown, J. F. Whitson, W. A. McLean, A. J. Van Nostrand, D. D. James, A. T. Ward, T. B. Speight, and G. W. McFarlen, of Toronto; W. R. Aylesworth, Belleville; A. Niven, Haliburton; A. S. Code, Alvinston; E. T. Wilkie, Carleton Place; C. A. Jones, London; W. M. Manigault, Strathroy; L. V. Rorke, Sudbury; G. L. Brown, Morrisburg; James Robertson, Glencoe; J. W. Fitzgerald, Peterboro; J. H. Shaw, North Bay; G. A. McCubbin, St. Thomas; Thos. Fawcett, Niagara Falls; P. S. Gibson, Willowdale; J. W. Tyrrell, and E. G. Barrow, Hamilton; J. Patten, Little Current; W. J. Blair, Berlin; and J. A. Calvert, St. Joseph, Mich. The president in his address referred to the satisfactory condition of the association, and stated that efforts were being made to improve the present high standard of the profession. The secretary-treasurer, Capt. Killaly Gamble, reported that the association's finances were in a satisfactory condition.

At the afternoon session, a paper by E. C. Steele was read on "Surveys of Mining Claims," in which the writer referred to the surveying of claims staked out by licensees under the Mines Act in the unsurveyed territory of Ontario, and dealt with the difficulties encountered by surveyors in defining the correct boundary lines from the unprofessional methods generally adopted by the licensees. All lines should be run on an astronomical north, south, east or west course, but licensees as a rule possessed neither the instruments nor knowledge to enable this to be done and the surveyor's mission was to evolve mathematical accuracy out of chaos. The paper contained many suggestions as to how this could best be accomplished.

A paper on "Water Power Surveys and Reports," by W. A. McLean, was listened to with much interest. The writer stated that the estimated developed water powers of the principal countries of the world were: Germany and Austria, 180,000-h.p.; Switzerland, 160,000-h.p.; Sweden, 200,000-h.p.; United States, 400,000-h.p. The available water-power was: Sweden, 2,000,000; France, 10,000,000; Germany, Austria, Switzerland and Italy, 10,000,000-h.p. Niagara Falls could furnish 6,000,000-h.p., half of which belonged to Ontario. Reference was made to the Government regulations regarding water-powers, and suggestions were made as to the best methods of ascertaining the volume of water, height, and power of a fall. With regard to the latter, the following formula was suggested: H.P. = .00189 VH, in which H is the height of the fall, and V the cubic feet of water, per minute, passing over it. As turbines could utilize 75 per cent. of the total horse-power, in determining the effective horse-power, the formula could be reduced to H.P. = .0014 V.H. The permanency of the fall and opportunity for storage were matters to be carefully considered in estimating the value of water-powers. The cost of power depended upon the capital necessary for development, and in that respect must rest upon individual merits and the ingenuity of the engineer. The placing of dams, head-race, penstocks, flumes, tail-race, buildings and plant were dependent on natural surroundings and demanded originality in making the best use of them.

Other papers read were: "The Board of Examiners," by Charles Unwin, and "The Amateur Assistant on Survey Parties," by J. Cozens.

On February 24th the report of the Committee on Drainage was presented, after which P. S. Gibson read a paper on "A Few Points Relating to the Ditches and Water Courses

Act," in which he dwelt with disputes arising out of drainage, how to avoid and dispose of them. He recommended that councils should have the right to put in culverts on roads, if necessary, to get rid of water, without recourse to the cumbersome proceedings under the Ditches and Water Courses Act. A paper of exceptional value to surveyors in New Ontario, north of the "Height of Land," was read by James Robertson on "Equipment and Supplies." Many pointers were given to surveyors in that country, also as to the nature and quantity of victuals required, and the best mode of transporting and storing them. The outfit should average 100 pounds per man, exclusive of food supplies, and including instruments, tools, cooking utensils, tents, blankets, etc. Each package should not exceed 100 pounds, so as to admit of convenient handling. The paper concluded with a detailed list, stating number of articles, quantities and supplies taken by the writer on a 68 days' trip with twelve men in 1902. After the reading of this paper, a general discussion followed in which the members unanimously agreed that the present rate of nine cents per acre was totally inadequate for surveys in the district referred to, several of the speakers stating that instead of receiving any personal remuneration, the net result of their last season's work had been a deficit. G. B. Kirkpatrick, director of surveys, promised to lend his aid in endeavoring to arrive at a more satisfactory method of payment for these surveys in future, and a resolution was passed in support of the petitions of individual members asking the Crown Lands Commissioners to grant some compensation in those cases where losses have already been incurred.

"Transportation" was the subject of a paper by J. S. Sing, in which the writer referred to the large sums spent by Canada and the United States on the Soo canals and locks, amounting to $15,000,000. The tonnage of freight passing through the locks had increased from 181,938, in 1865, to 1,321,200 in 1885, and from 15,062,146 in 1895, to 35,961,146 in 1902. Of the total traffic, five-sixths passed eastward to the Atlantic, and one-sixth westward, the total value of this commerce being $358,306,000. The net tonnage of vessels passing through the Suez Canal was less than one-third of that of the Soo. 25,000,000 bushels of Canadian grain were exported from Canadian ports in 1902, and 22,000,000 bushels of Canadian grain were shipped via United States ports. Canadian grain last year supplied 21 per cent. of New York grain exports, 40 per cent. of Boston, and 65 per cent. of Philadelphia. Duluth had grown at the expense of Chicago. Duluth's wheat receipts in 1901 were 18,000,000 bushels; Chicago's, 41,000,000; while in 1902 the figures were, Duluth, 43,000,000; Chicago, 38,000,000. In 1903, 19,000,000 bushels of grain were carried by boat from Lake Superior ports to Kingston some of which cost only three cents a bushel for transportation, while from the same ports, via Georgian Bay, and thence by rail to Montreal, the cost was from three and three-quarters to four cents. The large lake freighters had carried grain from Duluth to Georgian Bay ports at three-quarters of a cent per bushel. The grain carried by the Grand Trunk and Canada Atlantic during 1903 was: From Depot Harbor, 15,000,000 bushels; Midland, 14,000,000; Collingwood, 1,200,000; and Meaford, 5,000,000, a gain of 5,000,000 bushels over 1902. 45,000,000 bushels of grain were shipped through Canadian ports in 1902, compared with 184,000,000 via Buffalo. These figures pointed to the necessity of Canada making strenuous efforts to divert a share of this trade through Canadian ports. There were two ways of doing this; one by doubling the capacity of the Georgian Bay elevators, and reducing the grade and easing the curves of the railways to Montreal; the other way was to increase the capacity of the canals to accommodate the largest boats, on which another $100,000,000 must be spent if the canal system was to be an important factor in transportation. The Manitoba wheat production had increased in five years from 7,000,000 to 23,000,000 bushels, and at the present rate of increase, by 1913 the crop would be 242,000,000 bushels, exclusive of the yield farther west. These conclusions pointed to the possibility of there being four or five transcontinental lines during the present generation.

In the discussion which followed, J. Alex. Culverwell called attention to the additional transportation facilities which would be gained by the completion of the Trent Valley Canal. This could be done for five million dollars, making the total cost of the waterway nine millions, as compared with $100,000,000 to be spent on the Erie Canal. Out of the 200 miles from Midland to Lake Ontario, only 18 miles were actual canal. Freight could be handled more economically by the barge system in canals than by the large lake carriers. Germany had adopted barge canals for carrying ore to the shipping ports, as also had the United States from Buffalo to New York, therefore, the Trent Valley waterway should not be neglected, but should be completed without delay, and the public should be induced to realize the importance of this work in its relation to grain transportation.

J. F. Whitson read a biographical paper on the work of David Thompson, astronomer royal, 1784-1850, the first white man to navigate the Columbia river from its source to the Pacific, and who made many journeys across the North American continent. Thompson prepared many valuable maps as the result of twenty-eight years' surveying, but the importance of his work was not appreciated by the Government, and he died in poverty. Mr. Whitson thought it no wonder that boundaries were disputed when the work of early explorers and surveyors had received so little encouragement. T. Wilkie followed with some notes on the original survey of Hawkesbury Township, 105 years ago, and the reports of the council and board of examiners were presented by G. B. Kirkpatrick.

On February 25th, the report of the Committee on Engineering was brought in by E. G. Barrow. He also presented a paper on "Cement Concrete Sidewalks in Hamilton," which he strongly recommended, in the face of the increasing cost of wood and the necessity for a permanent material. In Hamilton, 96 miles of this walk has been laid in five years at a cost of 12.5 cents per sq. foot. Curbing cost 33 to 40 cents per lineal foot. The paper included some suggestions as to the position, the grade and the fall which sidewalks should have. The reports on exploration and polar research were taken as read, and A. R. Davis presented a useful paper on reciprocity between land surveyors' associations as to examinations.

In the afternoon, the Legislative Committee's report was presented by Major Sankey, a discussion following. It was stated that loose methods were observed in the filing of plans by certain railways. Under Dominion charters, engineers had the privilege of signing the plans. Under provincial charters, the plans have to be signed by surveyors. All plans should be signed by provincial surveyors, as some were submitted to the Railway Committee, which did not represent true surveys, and it was not in the public interest that such practices should continue. Some legislation was needed to prevent men leaving the employ of surveyors without reason or notice, the surveyor being out of pocket, and the public service suffering thereby. Major Sankey suggested that the Commissioner of Crown Lands be approached on the subject. He did not want a one-sided agreement, but there should be some penalty for men who desert surveying parties without reason. The report was adopted.

A resolution of regret on the death of John McAree was carried, and the retiring president was accorded a vote of thanks.

C. A. Jones, Petrolea, was elected president; J. W. Tyrrell, Hamilton, vice-president; Captain Killaly Gamble, secretary-treasurer; J. F. Whitson, and W. A. McLean, auditors. Two members of the council are to be elected by letter ballot, the nominations being P. S. Gibson, E. T. Wilkie, Thomas Fawcett, M. Gaviller, C. C. Fairchild, L. V. Rorke and James Robertson. The other members of the council are: Hon. E. J. Davis, Alex. Niven, A. J. Van Nostrand, G. B. Kirkpatrick, and Villiers Sankey.

The annual dinner was held at McConkey's on the 24th, W. R. Aylsworth presiding. Speeches were made by the Hon. E. J. Davis, Commissioner of Crown Lands; Col. Otter, E. D. Armour, Prof. Galbraith, Principal Manley, and others. There was a good attendance.

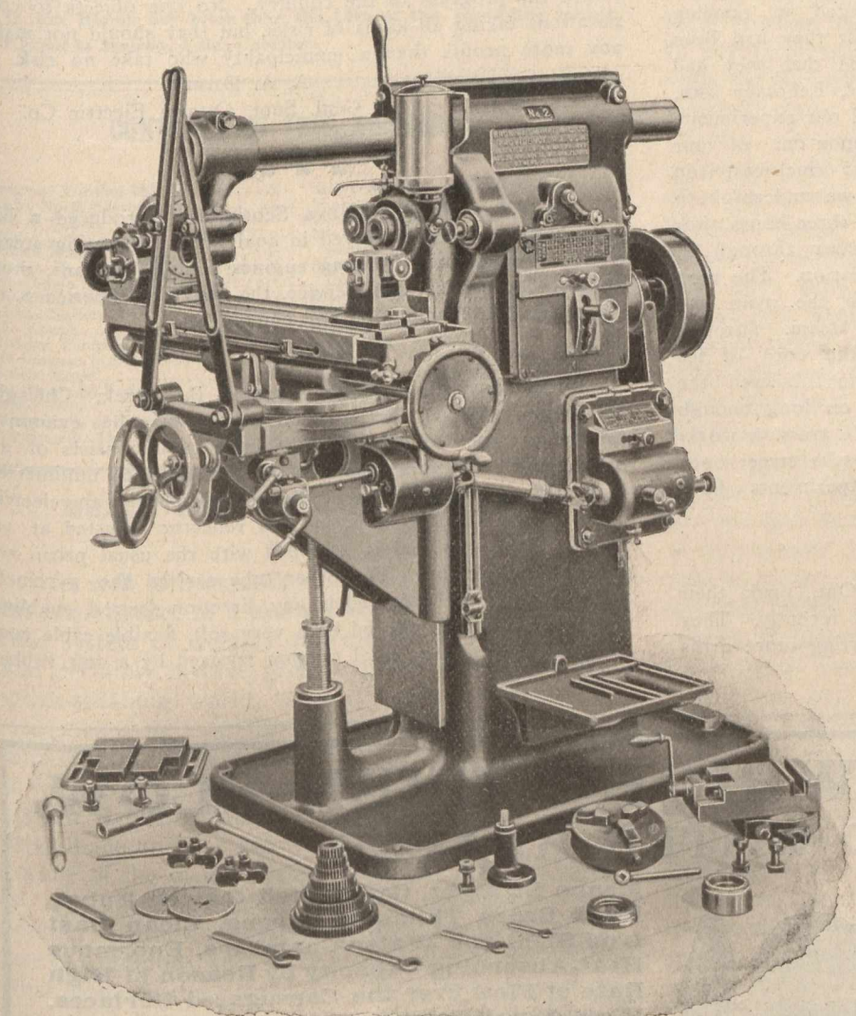
The following are the results of the annual examination before the Board of Ontario Land Surveyors: Final—J. W. Fitzgerald, Peterboro; W. J. Blair, Berlin, J. H. Smith,

Pembroke; Messrs. Fitzgerald and Blair have been sworn in. Mr. Smith will be sworn in on the expiry of his article of apprenticeship. Preliminary examination for apprenticeship —T. G. Code, Alvinston; E. P. Bowman, West Montrose; W. Raywood Smith, London; W. H. Holland, Toronto.

MOTOR DRIVEN MILLING MACHINES.

The difficulties that have arisen in the application of the motor drive to machine tools not designed with this in view are probably familiar to our readers, who will be interested in the constant belt speed milling machine, described herewith, as being adapted to the application of this drive, and they will also be interested in the other mechanical features of this machine.

As to the motor drive, it will be readily apparent that, with a constant drive for the machine itself, the simplest constant speed type of motor of any standard make can be applied and the full efficiency be at all times available. The milling machine is one recently placed upon the market by the Brown & Sharpe Mfg. Co. It presents many features that show a radical departure from the well known milling machine construction. The difficulties inherent in the usual cone drive and a table feed dependent upon the variable spindle drive are entirely eliminated. The main drive is direct from the countershaft to the machine pulley by a belt that runs at a constant speed and provides for the use of the same size pulley on both the machine and counter-shaft, thus giving a much greater belt contact and driving lever-



age than can be obtained with the usual cone drive. All spindle speed changes are provided for in the machine, the changes being obtained by means of gearing. Spindle gearing has a ratio varying from zero to 20 to 1.

Referring to the illustration, directly to the left of the main driving pulley will be seen a plate with two adjusting levers and an index slide between them. The index slide determines the combination of gearing between the driving pulley and spindle. The lower lever carries the intermediate and engages the gears after they have been set; the upper lever gives two series of speeds, one fast and one slow, which, together with the back gears, give 16 changes of spindle speed varying from 15 to 376 revolutions per minute in either direction. The back gears are operated by a lever in the usual way; the locking pins that engage the spindle sleeve, replacing the cone head, are operated automatically by the movement of the lever controlling the back gears.

The table feeding mechanism is an important feature. The mechanism is new in design, and gives a wide range of feeds that fully covers all requirements of modern milling practice. The gearing is all spur gears with properly proportioned bearings, thus reducing the loss of power by friction and insuring an unusually high efficiency. The feed changes are obtained by the simple movement of a lever and index slide. The drive is from the machine pulley shaft by chain and sprocket wheels, and as this shaft runs at a constant speed, it is possible to obtain a table feed that is independent of the spindle speed, thus giving a fixed rate of correct feeds in inches per minute, in relation to the spindle speeds, for all diameters of cutters. The range of feed obtainable with this mechanism varies from ½-in. to 6-in. per minute, which gives for small mills a range from .001-in. to .016-in. and for large mills .033-in. to .400-in. per revolution of spindle. Another feature of importance is that the table feeds and spindle speeds are in geometrical progression, which is recognized by the leading engineers as the most satisfactory for this class of machine tools.

THAWING WATER PIPES BY ELECTRICITY.

Unusual trouble from the freezing of water mains and service pipes has been reported from many cities and towns, both in Canada and the United States, and the Canadian Engineer has had enquiries from both sides of the line as to a method of thawing pipes by electricity briefly described in our issue of February, 1903. As the Ottawa Electric Co. has frequently come to the relief of the Capital City, which has suffered much during the past winter from the severe frost we give below details of the method employed there, as kindly furnished by A. A. Dion, general superintendent, in reply to our enquiries:

"Regarding the thawing of pipes by electricity, I think we were the first in Canada to do it, though I believe it had been done at one place in the United States before, that was four years ago. This year the cold has been so severe that the city has not been able to cope with the trouble of frozen pipes with the ordinary means at hand, such as steam boilers mounted on sleighs, etc. If the freezing has extended into the street they can do little and that only at a great expense. The City Engineer having asked for our assistance, we rigged one of the company's express sleighs for the purpose. Four transformers of 5,000 watts each were put in this sleigh and connected two in series on their primary side. The secondary connections were such that when the transformers were attached to the line wires by means of small flexible rubber covered cable, each transformer got half the primary voltage for which it was made, and the secondary voltage was about 25 volts. The normal current capacity of the secondaries as connected was 400 amperes. We also had a rheostat in series with the primary cables and an ammeter. A board about 6 ft. long was set upright in the sleigh, on this a shelf was attached for the ammeter and a cross piece at the top

carried two primary cutouts, to which were attached the cables to line wires. Two coils of No. 0000 insulated cable, each about 200 ft. long, were carried for secondary connections. One connection from the secondary of the transformers was made to the lead pipe inside the building where water was stopped. This connection was made by means of a brass clamp which surrounded the lead pipe without injuring it, and afforded sufficient surface to pass a large current to the lead pipe without burning it. The other secondary lead was taken to the next house or to the nearest hydrant. Care was taken to connect to the lead pipe below the point where the pipe was empty because the empty pipe would heat too much with some currents which were used. The currents varied from about 90 amperes to about 275, and the time occupied before water would flow varied from four minutes to three hours. Usually if there is any chance of success, results will be seen in a very few minutes. In some cases we could not get enough current through to produce any satisfactory results. This was attributed to bad joints in the pipes causing unusual resistance. Three men went with the outfit, one driver and two linemen."

We have just received the following interesting report from Harry A. Lord, superintendent of waterworks, Ogdensburg, N.Y., where 4,000 feet of water and gas pipes were reported to be frozen between the 15th and 20th of Feb. Ogdensburg was one of the places from which enquiries came to the Canadian Engineer: "Upon receipt of your esteemed favor of the 18th inst., written in reply to my telegram, I telephoned to the Superintendent of Waterworks, at Ottawa, Ont., regarding their method of thawing water pipes with electricity. I was informed by the superintendent that the local electric company was engaged in thawing house service pipes with electricity, but that they had been unsuccessful in thawing mains. He stated that they had made several attempts, but up to that time, February 20th, they had not succeeded. We have continued our experiments in Ogdensburg and have been working upon one of our streets, where a stretch of about 1,800 feet of 6-inch cast iron main was frozen solid. The first section we undertook to open up was 700 feet in length, and in about three hours after the current had been turned on, we had water through it, leaving the hydrant open to maintain circulation. The next section was about 500 feet to a point where the main had been cut open in an attempt to thaw it with steam. Through this opening we were enabled to extract the core of ice which came along with the current, and thus obviated the necessity of keeping the electrical current on long enough to warm the water and thaw out the ice. We are now working on the last section, and expect to have the street open in a few hours. I beg to report that experiments have proven highly successful."

The Madoc Mining Co., Black Creek, Ont., made their first shipment of pyrites to Cleveland, Ohio, recently. They have put in an extra boiler, and intend starting more drills and cross-cuts.

NOVA SCOTIA ENGINES IN AUSTRALIA.

D. H. Ross, Melbourne, commercial agent for Victoria, South and West Australia and Tasmania, writes to his father at Amherst, N.S., as follows: "At the power house of the Perth Electric Tram Company, I was pleased to observe two 300-h.p. engines, manufactured by the Robb Engineering Co., of Amherst, Nova Scotia. These engines (Nos. 472, 473), have been working almost continuously eighteen and one-half hours daily, for over three years. The engineer in charge intimated the excellence of their work. The general manager and engineer of this railway is H. J. Somerset, formerly of Winnipeg, Man. He is also engineer of the Kalgoorlie Tram Company, and the chief authority on electric traction in Western Australia."

PREJUDICE AGAINST COMPANIES.

Editor, Canadian Engineer:—

SIR,—Your late article on "Municipal Plants" struck me as being somewhat unfair to companies. No doubt some corporations have invited that kind of criticism, but a great many companies have suffered severely from the prejudice in the public mind against all private enterprise, which is being fostered so much throughout Ontario by the press and otherwise, to the evident discouragement of capital. It is all very well for municipal undertakings to follow where private enterprise has shown the way, but municipalities never originate anything. If you discourage private initiative you must retard the progress of the country. No one objects to corporations taking all kinds of risks, but they should not make any more profits than a municipality who take no risk.

A. A. DION,
Genl. Supt. Ottawa Electric Co.

Ottawa, Feb. 22nd, 1904.

The Government of Nova Scotia has introduced a bill providing that men employed in coal mines, operating steam plants, man engines, hoisting engines, ventilating fans, must either hold certificates of service, the result of experience, or must pass an examination for competency.

By an invention of Dr. Fenton B. Turck, Chicago, the human stomach and internal organs may be examined for the presence of disease. The instrument consists of an optical and a carrying tube side by side, fourteen millimetres in width. Beyond the tip of the optical tube is an electric lamp, above which is a prism and reflector adjusted at an angle. The outer end is provided with the usual prism set before the objective. The other tube carries the gyromcle cable, which may be curved in any direction desired, enabling the pylorus to be explored by a very soft, flexible cable covered at the end with wool tampon encased by a soft rubber finger cot.