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MISSING

The Canadian Engineer

ESTABLISHED 1893.

WITH WHICH IS INCORPORATED

THE CANADIAN MACHINE SHOP.

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

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TORONTO, CANADA, JUNE 7th, 1907.

CONTENTS OF THIS ISSUE.

REFORM IS IMPERATIVE.

Last month there arrived at Buffalo a train carrying twenty-eight bodies. They were the victims of the Southern Pacific Railway wreck at Honda. The cause of the disaster was a broken rail. Once again public indignation was aroused. Once more the daily press was furnished with good, sensational "railroad accident" copy. Manufacturers of steel rails and the railway companies have appointed a committee of experts to discuss the divergent views held on the subject of the broken rail.

For years this question has been a live topic in transportation circles. The rail manufacturers have blamed the railroads, and the railroad companies have blamed the manufacturers. While this enlightening controversy has raged, hundreds of human lives have been sacrificed. Cheap and nasty methods in railroad construction will not do. Too many issues are involved for any "skimping" work. On one road alone in the United States six hundred cases of broken rails were noted in two months. Every such break means the possibility of a wreck. It is thus a wonder that there have not been more derailments.

There was a time when the rails in the United States and Canada were rolled to the railroad engineers' specifications. Now, the rails are received, generally speaking, from one huge corporation. They are certainly not of such good quality as in the days gone by. It is all very well to make cheap rails. It suits these hustling days to manufacture them quickly. But rails cannot be made too cheaply and too quickly and yet retain quality.

As far as the average man can see, much of the evil rests with the rail factory. All concerns look to increased profits and dividends. But they should remember also that the good quality of their product is a very necessary item. It is the bounden duty of every factory to see that the rails they turn out are of the very best quality. The Almighty Dollar must not be the manufacturer's motto always. The annual toll of railroad accidents in Canada and the United States has reached about the limit.

It is time that engineers thoroughly investigated the causes of every accident, and endeavored to eradicate those causes. The public patience has been transformed almost to impatience. Reading of fatal railroad catastrophes every week is not conducive to the cultivation of public confidence in our steam transportation companies. It would be to the advantage of our big railroad companies to institute an investigation. One thing is certain, the appalling life loss caused by these accidents must be reduced. Until this is done it would be well that our much-vaunted progress in the science of transportation should not be made the subject of boasting.

TO BUILD OR NOT TO BUILD.

For fifty years the question of the Georgian Bay Canal has been discussed. As a hoary transportation topic, it almost rivals the English Channel tunnel. Compared with the latter enterprise, it demands far more serious consideration. The construction of this waterway would change the transportation map of Canada. In discussing the different actual and possible routes to the Atlantic seaboard, the United States Deep Waterways Commission of 1896 pointed out that it was the shortest route between terminals, and unquestionably was adapted to navigation of considerable capacity. Its consideration, they thought, was not justified at that time.

A detailed report as to the estimated cost of a twenty-one foot waterway from Georgian Bay to Montreal is to be presented to Parliament next session. It will be strictly an engineering report. Almost the whole length of the waterway—460 miles—has been mapped out, showing the necessary excavation work, the cost, location, and character of the structural work. The enterprise does not present very intricate engineering problems. The chief difficulty is the question of maintaining a supply of water across the height of land between Lake Nipissing and Trout Lake. This can be done, the engineers have determined, by conserving the flood waters of the lake and the tributary waters of the Ottawa River to maintain a continuous and adequate supply of water during the whole season of navigation without having to excavate from Trout Lake to the level of Lake Nipissing, which would have meant the expenditure of an enormous sum.

The proposed waterway would be continuous from Georgian Bay to Montreal, via the French River, Lake Nipissing and the Ottawa River. The Ottawa drains a total area of fifty-five thousand square miles. The survey has proved that it will be possible, at moderate cost, to reduce the flood level of the river and increase the low water level by a system of dams and control of tributary waters. The fluctuations between high and low water-marks vary from eleven and a half feet to twenty-five feet at various points.

The United States Government benefited the commerce of the Mississippi valley recently by an undertaking in connection with the Mississippi River similar to that proposed by the Georgian Bay Canal survey. The value of the water powers of the Ottawa River will be increased. If the proposed canal were completed, some five hundred thousand horse-power would be available along its course—almost equal to that of Niagara. By controlling the high and low water levels of the Ottawa River the low water level in Montreal harbor will be raised.

An increase of a foot in the depth of the Ottawa makes a difference of three inches in the depth of water in Montreal harbor. The cost of the undertaking would exceed probably one hundred million dollars. From the report to be presented to Parliament next session it will be seen that, from an engineering standpoint, the Georgian Bay Canal is undoubtedly a feasible scheme. The engineers will be found to have dealt with their report in a businesslike fashion, and to have demonstrated beyond question, from their point of view, that the waterway presents very few difficulties.

But the canal must be proved of value from a commercial standpoint. Montreal would be nearer Fort William and Duluth than Buffalo is, and from Chicago to Montreal the distance would be the same as the present distance from Chicago to Buffalo. From Fort William to Montreal, via the St. Lawrence, is 1,296 miles; via the Georgian Bay Canal it would be 882 miles, a saving of 414 miles. From Fort William to Liverpool, as against the Buffalo route, the saving would be 1,198 miles.

The saving in distance from Chicago to Liverpool would be 1,254 miles, and from Duluth to Liverpool, 1,213 miles. For such places as Kansas City, Omaha, Sioux City, and St. Paul—the centres of agricultural production in the Middle West—the projected Canadian waterway would mean very considerable savings in distance to Liverpool.

Six hundred thousand dollars have been spent by the Government in securing accurate data regarding this enterprise. This is certainly not an unnecessary expenditure of money, even in the event of it being found that one hundred million dollars is too big a price to pay for a Canadian waterway to the Atlantic. The engineering and commercial report at least should decide finally a question which has agitated transportation and commercial circles for more than half a century.

TRANSPORTATION AND THE MONO-RAIL.

In railroad spheres, the saving of fuel expenditure, increase of speed, and total absence of lateral oscillation are important items. These are a few of the advantages which Mr. Louis Brennan, C.B., inventor of the Brennan torpedo, claims for his mono-rail railroad. London advices state that the leaders of the English scientific world have acclaimed Mr. Brennan as worthy to rank high upon the roll of honor, which bears the names of Newton, and Watt, and Stephenson. If this be so, the new invention should cause, before very long, a revolution in steam transportation methods.

The invention has reached only the model stage. But there is many a slip between the real and the model. The gyroscope is used to overcome gravitation. One of the chief features, says the inventor, is that each vehicle is capable of maintaining its balance upon an ordinary rail, laid upon ties on the ground, whether it is standing still or moving in either direction, at any rate of speed, notwithstanding that the centre of gravity is several feet above the rail, and that wind pressure, shifting of load, centrifugal action or any combination of these forces may tend to upset it.

Automatic stability mechanism of extreme simplicity carried by the vehicle itself endows it with this power. The mechanism consists essentially of two fly-wheels rotated directly by electric motors in opposite directions at a very high velocity, and mounted so that their gyrostatic action and stored-up energy can be utilized. These fly-wheels are mounted on high-class bearings, and are placed in exhausted cases, so that both air and journal friction is reduced to a minimum, and consequently the power required to keep them in rapid motion is very small.

The stored-up energy in the fly-wheels, when revolving at full speed, is so great and the friction so small that if the driving current is cut off altogether they will run at sufficient velocity to impart stability to the vehicle for several hours, while it will take from two to three days before they come to rest. The stability mechanism occupies but little space, and is conveniently placed in the cab at one end of the vehicle. Its weight is also small, about five per cent. of the total load being considered an ample allowance for the first vehicle.

The road wheels are placed in a single row beneath the centre of the vehicles, instead of in two rows near the sides, as usual, and are carried on bogies or compound bogies, which are not only pivoted to provide for horizontal curves on the track, but for vertical ones also. By this means the vehicles can run upon curves of even less radius than the length of the vehicle itself, or on crooked rails or rails laid over uneven ground without danger of derailment.

The motive power may be either steam, petrol, oil, gas or electricity, as considered most suitable for local conditions. In the first instance, it has been decided to use a petrol electric generating set, carried by the vehicle itself, for the supply of current to the road wheel motors and to the stability mechanism. Such a vehicle will have the great advantage of being always ready for immediate use, the gyro wheels being kept constantly running by current from a small accumulator while the engine is at rest. In order that the vehicle may be able to ascend steep inclines the wheels are all power driven, and change gears are provided for use in hilly country. It is also possible to run free wheel down hill at great velocity, so that a good average rate of speed can be attained.

Mr. Brennan claims that great economy will result from making the vehicles wider in proportion to their length than on ordinary railways. Brakes capable of being operated by pneumatic or manual power are provided for all the wheels. The rail, which is of curved top, only requires to be the same weight as one of the rails on an ordinary line in order to carry the same load on the same number of wheels in each case. The ties also only require to give the same area of support to the vehicle.

Flying lines of railway, says Mr. Brennan, can be laid with great rapidity over uneven ground with slight expenditure of labor. Specially designed building vehicles, also designed on the mono-rail principle, equipped with electric gear for handling the rails, are kept at the rail head for the purpose. It is confidently anticipated that working in this manner it will be possible to keep up with an army on the march and supply them with all their requirements.

Bridges are of the simplest possible construction, a single wire hawser stretched across a ravine or river being all that is necessary for temporary work. These hawsers can be built up on the spot from separate wire rope strands, so that the transportation of them becomes an easy matter. Strange to say, the lateral swaying of the hawser does not disturb the balance of the vehicles, and the strongest winds will fail to blow them off. In other cases of bridge building a single row of piles, with a rail on top, suffices, or a single girder carrying the rail may be conveniently used.

The complete success of the invention almost seems to have been taken for granted. Successful experiments, a successful model, and the unanimous approbation and delight of the Royal Society are not necessarily sufficient endorsement of the commercial value of the railroad. It is difficult sometimes to decide whether we ought to trust a man until we prove him the thief, or to treat him as dishonest until we prove him otherwise. Similarly, one hardly knows whether to treat a model with scepticism until the real thing has proved itself a success. That members of the Royal Society think Mr. Brennan's name may be bracketed with those of Newton, Watt, and Stephenson is not extraordinary. Mr. Louis de Rougemont's marvellous natural history stories were accepted by some members of the same body. For some time De Rougemont lived in an atmosphere of scientific notoriety, but when it came to actual and practical demonstration, his discoveries in the natural history world were found to be mythical.

Mr. Brennan has completed his model. It has proved successful, but the far-seeing man will wait until a further and more practical demonstration has been made. It would appear that the law of gravitation is to be defied to some extent. In engineering enterprises it is necessary as far as possible to work with, and not against, nature. When you throw a ball into the air, the force you exert allows the sphere temporarily to defy gravitation. But finally the ball will fall to earth. And so with many inventions which attempt absolutely to defy nature's laws.

An invention considered from a strictly scientific standpoint most frequently assumes a very different aspect when commercial issues are involved. But theories have materialized into models; the models have been decried. Critics have been merciless. Yet in many instances these same inventions have triumphed, scientifically and commercially. It is always dangerous, of course, to prophesy failure, for, in the event of success, your fame as a prophet has passed forever. No one would condemn hastily Mr. Brennan's remarkable invention. But the average man will wait, certainly with interest, for future developments.

Sir Hiram Maxim, who has seen many of his inventions successfully evolve from models, is sceptical of this mono-rail system. He admits that a charming and highly scientific toy has been perfected. As to it being practicable to construct and operate a railroad by means of it, Sir Hiram is not in agrement. He is an authority on the gyroscope, and Lord Kelvin said recently that Sir Hiram was one of only three men in the world who really understood it.

"Mr. Brennan's proposal to construct a mono-rail "system," said Sir Hiram, "differs from other such "systems in that the rail is placed below the centre of "gravity instead of above it. I think his plan to keep "the carriages from tipping by the action of the gyro-"scope will be beset with a great many difficult pro-"blems, so difficult, in fact, as to make the whole "scheme absolutely impracticable. It is quite safe to "say that if Mr. Brennan's train was running east or "west, and there was a strong wind from the north, "the wind would exert considerable force on the train "in the same direction, and I think under those condi-"tions the plane of the gyroscope would gradually yield, "capsizing the train. Perhaps I can best illustrate "gyroscopic action by recalling the construction "thirty years ago by Sir Henry Bessemer of a ship "to take passengers across the British Channel, which "he proposed to keep in a horizontal position by the "use of large gyroscopes. Sir Henry had thought of "the gyroscope the same as other engineers, but there "was one engineer and mathematician of that time who "really understood the gyroscope. That was Professor "MacFarland Grey, who wrote, in the scientific press, "that gyroscopes in Sir Henry's ship would not work. "He was attacked for this by a large number of en-"gineers. However, when the ship was tried it be-"haved just as Professor Grey predicted. The gyro-"scopes had no effect at all in steadying the craft, and, "as the gyroscope failed to meet Sir Henry's expecta-"tions, so, without doubt, will it fail to meet Mr. "Brennan's if he ever undertakes to steady a full-sized "car on a mono-rail road."

Some of our readers will remember that in 1904 Otto Schlick invented what he called a gyrostat. A full-sized one was tested on a German torpedo boat on July 17th, 1906, with some moderate success. Last year a description of the gyrostat was published in a German paper. It showed facsimiles of tracings or indicator cards taken in tests at sea, showing how the vessel, rolling heavily—twenty-five degrees—in a cross sea, was steadied by starting the gyrostat until the movement of the vessel was reduced to less than one degree. The Hamburg-American steamship line have fitted one into one of their excursion steamers.

Mr. Brennan has been working on ideas that are not altogether new. Mr. Behr, a German inventor, has been a mono-rail enthusiast for many years. His system is not quite the same as that of the latest inventor. A trial track was laid in the Brussels Exhibition grounds, Belgium, and very satisfactory demonstrations given with a full-sized car, which attained a speed of 120 miles an hour. The Behr mono-rail is laid on a V-shaped trestle, with guide-rails half way down the trestle, which prevent derailment. The motors are carried on either side of the trestle, below the floor of the car. Between Manchester and Liverpool there is, perhaps, the greatest inter-urban business passenger traffic in the world; and Mr. Behr, beginning in 1899, interested business men in a scheme for a road that was to bring those two cities, thirty-two miles apart, within a trifle over fifteen minutes' travel of each other. A syndicate first failed to get the necessary bill through Parliament, and then, having obtained the bill, failed to finance the scheme, which is in abeyance. Since then Mr. Behr has been working for a bill providing for a line from London to Brighton, by which he claims the journey will be reduced from some two hours to thirty minutes. His strongest opposition has been the steam railroad, which already covers the ground. This illustrates that the mono-rail at least is feared as a competitor in transportation circles. But to the outsider it would seem that, were the mono-rail schemes as successful as have been their newspaper publicity, there should be no lack of capital to carry out the enterprises.

Certainly we owe a great deal to Mr. Brennan and other gentlemen who have devoted, and are devoting, their time to scientific research in engineering spheres. They should be assisted in every way. But nothing is gained by counting a model as a commercial revolutionizer, when it is really but a model. Doutbless Mr. Brennan himself, who is more of an expositor than an inventor in this case, does not aspire yet to be enrolled with Newton, Stephenson, and Watt. Sir Isaac Newton not only discovered natural laws, but reduced them to formulæ.

We live in practical days. Every scientific discovery, to be of value, must become of practical use. When Mr. Brennan demonstrates that his mono-rail railroad is anything near to being of material assistance to commercial progress, then will be the time to consider his name being bracketed with those who have contributed to national progress. Until then we are inclined rather to agree with Sir Hiram Maxim that there has been perfected in this particular instance "a charming and highly scientific toy."

WATERWORKS NUMBER.

The twenty-seventh annual convention of the American Waterworks Association will be held in Toronto—the first in Canada—from June 17th to 22nd. Much attention is being paid to waterworks development in the Dominion; and, although most of the members of the Convention belong to the United States, every city engineer, and all persons interested in waterworks development in Canada, should make a special effort to attend the sessions.

An opportunity is afforded the engineers of this country to get in touch with many men who have designed and are operating the largest waterworks plants on the continent, and the experiences and opinions that will be given will go a long way towards helping the developments that are about to take place in the Dominion.

A valuable adjunct to the Convention will be the exhibition of waterworks machinery and supplies. Many manufacturers of the United States and Canada will be represented, and if it were only for this alone the week in the "Convention City" would be well spent.

The following are a few of the papers and subjects that will be brought before the Convention:—

Some Notes on Rules, Ordinances and Court Rulings Covering the Operating of Water Plants; Gas Producer Plants for Pumping Water; Reynolds High vs. Low-duty Engines; The Deisel Oil Engine; The Electrically-driven Centrifugal Pumps at Buffalo; The Varying Conditions of Waterworks Plants and Their Relation to the Proper Rates to be Charged for Domestic and Public Supply; Lead Poisoning, Particularly as Affected by Electrolysis of Lead Pipes; Meters and Meter Systems; Cost of Meters in Rochester; Water Consumption, Waste and Meter Rates; Description of the Catskill Water Supply for New York; Tuberculation and the Flow of Water in Main; Cleaning Water Mains and the Effect on Flow; The Sanitary Protection of Surface Water Supplies; Successful Filtration of Waters of Low Turbidity and Color and Comparatively High Bacterial Contents by Artificial Addition of Turbidity; Typhoid Fever Cases in Pittsburgh, Pa., Some Interesting Statistics Pertaining to the Same from the Standpoint of a Public Water Supply.

Besides these, many other good things are in prospect, and there will certainly be enough material to make the meeting a most valuable as well as interesting one.

In view of this gathering the July 5th issue of the Canadian Engineer will be a "Waterworks Number," and will contain a copious report of the Convention. To make this issue of maximum interest to every Canadian waterworks and city engineer, the co-operation of everyone interested in this line of progress is necessary. Any data, accompanied by illustrations where possible, regarding plants already in operation, or plants under construction or projected, that are sent to us will be greatly appreciated, and full credit will be given for same. Mayhap you have had some experience in connection with waterworks that would be eminently interesting. If such is the case, place it before other engineers through the medium of this special number. Your experience on some special subject is probably just what another man is looking for, while his is what you are looking for.

MARKET CONDITIONS.

Montreal, June 6th, 1907.

English pig iron markets have taken another turn upwards and prices are now within a narrow margin of the record during the boom of last December. Best grades of Scotch metal are higher than ever. Shipments from Middlesboro' and Glasgow are exceptionally heavy and stocks in store are being depleted every day. German demand continues good and, notwithstanding the fact that the American market has been somewhat quieter during the past week, a good enquiry appears to be in evidence for English metal. As a matter of fact, a cargo of 5,000 tons has been engaged for the Chicago market within the week. Apparently the feeling in England continues strong, but from advices received the maintainance of the present position depends almost entirely upon the continuance of the existing demand from Germany and the United States. The home trade does not warrant higher prices.

In the United States, the buying movement in pig iron has been light for a week or two, but this is almost, if not entirely due to the fact, that purchasers have covered their immediate requirements and are not disposed to purchase for deliveries extending after the end of the present year. Numerous enquiries are being made for prices for 1908, but it would seem that this is rather with a view to sounding the market than with the idea of actually making purchases. Makers of iron in the Pittsburg and adjoining districts have received a demand from a large number of employees for an eight hour day and an advance in wages, the change to take effect on 1st July. It is claimed that the reduction in hours and advance in wages figures out to an increase of nearly 50 per cent. on the present cost of labor. If the demand is pressed and operations are limited or costs increased in consequence, it will result in a further strengthening of the market. Steel-making irons are very scarce and there is practically nothing for sale for the remainder of the present year. Many consumers consider that their position cannot be any worse later on and are delaying ordering in the hope of lower prices.

The local market is firm in price, but the situation has been relieved by the arrival of considerable quantities by ship and the distribution of this to customers.

Antimony.—There is very little going on and prices are steady. Quotations are 25½ to 26c.

Bar Iron and Steel.—There was no change in the market during the week. Quotations are: Bar iron, $2.20 per 100 pounds, best refined and horsehoe iron, $2.60, and forged iron, $2.45; mild steel, $2.25 per 100 pounds; sleigh shoe steel, $2.25 for 1 x ⅜-base; tire steel, $2.40 for 1 x ⅜-base; toe calk steel, $3.05; machine steel, iron finish, $2.40, base and reeled, $2.85.

Boiler Tubes.—Importers' contracts, in a number of cases, are about to run out, and as the present contracts were made at lower figures than now prevail, it is almost certain that prices will advance when new contracts are made. Quotations are: 2-inch, 8 to 8½c.; 2½-inch, 10¼ to 10¾c.; 3-inch, 12c.; 3½-inch, 15 to 15¼c.; 4-inch, 19¼ to 19½c.

Cement.—Canadian and American.—The market is very firm and demand is fully equal to supply. Canadian prices are $1.85 to $1.95 per barrel, in cotton bags, and $2.15 to $2.25 in wood, weights in both cases, 350 pounds. There are four bags of 87½ pounds each, net, to a barrel, and 10 cents must be added to the above prices for each bag. Bags in good condition are purchased at 10c. each. Where paper bags are wanted instead of cotton, the charge is 2½ cents for each, or 10 cents per barrel weight. American cement is steady at $1.10 per 350 pounds, basis Lehigh mills, conditions being the same as in the case of Canadian mills, save that when the cotton bags are returned in good condition, only 7½ cents is allowed for them.

Cement.—English and European.—English cement is unchanged at $1.80 to $1.90 per barrel in jute sacks of 82½ pounds each (including price of sacks), and $2.10 to $2.20 in wood, per 350 pounds, gross. Belgian cement is quoted at $1.75 to $1.90 per barrel, in wood. German is $2.52 to $2.55 per barrel of 400, for Dyckerhoff.

Copper.—The tone of the copper market is very firm. Quotations are: 26½ to 27c., Montreal.

Iron.—The local situation is changed only to the extent that supplies are now arriving and are being largely distributed, the result being that immediate necessities are being cared for. The situation is consequently much relieved. The trade here is enquiring for deliveries extending over the remainder of the year and fair sales are being made at slightly higher prices. Londonderry is still unobtainable for immediate shipment, while prices for the second half are on a basis of about $25 f.o.b., Montreal, for No. 1. Toronto prices are about $1.25 more. Summerlea iron is arriving, and is quoted at $24 f.o.b., cars, Montreal, for No. 2 selected, and $25 for No. 1. No. 1 Cleveland is quoted at $21.50 on cars, Montreal, and Clarence at $20.50 to $21. Carron is more or less nominal. There is a good demand, but considerable uncertainty as to price. No. 3 Carron is nominal at $24, special at $24.50, and No. 1 at $25.75.

Lead.—The market holds quite steady, and the tone is firm. Present quotations are $5.35 to $5.45 per 100 pounds.

Nails.—Demand for nails is keen, the quantity required being exceptional. Prices are $2.50 for cut, and wire, base prices.

Pipe.—Cast Iron.—The market is very firm and active. Water pipe is quoted as selling at from $37 to $38 per net ton at the foundry, and at about $38 to $39 Montreal, gas pipe being about $1 more.

Pipe.—Wrought.—Demand exceeds supply and prices are firm. Quotations for small lots, screwed and coupled are as follows: ¼-inch to ⅜-inch, $5.50 with 58 per cent. off for black and 43 per cent. off for galvanized; ½-inch, $8.50, with 67 per cent. off for black, and 57 per cent. off for galvanized. The discount on the following is 67 per cent. for black and 57 per cent. for galvanized; 1-inch, $16.50; 1¼-inch, $22.50; 1½-inch, $27; 2-inch, $36; 2-inch, $75.50, and 4-inch, $108.

Steel Shafting.—Dealers expect a very heavy advance in the price of cold rolled steel within the next few weeks. Demand is good, and sales have been quite satisfactory of late. Prices hold steady at 30 per cent. off the price list, but there seems to be an expectation that this discount will be reduced to perhaps 20 per cent.

Steel Plates.—Demand is good, and the market firm. Prices for small lots are $2.75 for 3-16 and ⅛, and $2.55 for ¼ and thicker.

Structural Steel.—Demand is generally reported to be active. Beams weighing 55 pounds per foot are quoted at 3c. per pound, and those upon which work, such as punching holes, has been done at 3½ to 4c., while columns with caps bring 4c. Heavy sections, weighing 35 pounds, and upwards are quoted by some at 2¾ to 3c., and light sections at 3 to 3¼c., plain.

Spikes.—Demand is good and prices are firm. Railway spikes are quoted at $2.75 per 100 pounds, base of 5½ x 9-16. Ship spikes are also in good demand, and prices are $3.15 for 100 lbs. base, 5½ x 10-inch, and ⅝ x 12-inch.

Tin.—The market shows strength. Prices are 46 to 46½c., in jobbing lots.

Tool Steel.—The situation is fairly active and firm. Base prices are as follows: Jessop's best unannealed, 14½c. per pound, annealed being 15½c., second grade 8½c., and high speed, "Ark," 60c., and "Novo," 65c.; Sanderson's special, 14c. for unannealed, 15c. for annealed, and 8½c. for second grade.

Zinc.—There is nothing new in the situation, and prices are quoted firm, at 7¼ to 7½c. here, in a jobbing way.

* * * *

Toronto, 6th June, 1907.

There are signs of relief to the scarcity of structural metal goods in this market and at other Ontario points. The sort of hasty congestion in pig iron stocks on the wharves of Montreal has hampered deliveries to the West. But pig is moving pretty steadily now at prices given below, although there cannot be said to be anything like a stock in Toronto. A welcome addition to the scant supply of boiler tubes has been made this week; the larger sizes are in fairly good stock, but the smaller still scarce.

Metal houses and machinery houses or agencies are all busy. Structural shapes in steel are still hard to get, and there are complaints of slow deliveries. Copper is in no great supply at unchanged prices; nor is there any great stock of lead, which is firm. A fairly good demand exists for tin; antimony is very weak; zinc unchanged.

Demand for freight space both by rail and water is strong. Shipowners tell us that there is occupation for all the tonnage available west-bound, the quantity of merchandise offering exceeding last year decidedly. At Montreal such heavy goods as pig iron, structural steel, wire, steel rails, are being taken in quantity for the far West, and a great deal of package freight as well. Both Hamilton and Toronto offer splendid cargo freights. And at Sydney the first cargo of rails under the recent contract between the Dominion Iron & Steel Company and the Montreal Transportation Company is being put on board the steamer "Glenmount" for Montreal and Fort William.

The railways have a great pressure upon them for freight accommodation, and the request for cars is greater than they can supply. This refers in particular to west-bound merchandise and household effects, but the demand in the West is equally clamorous.

We quote prices at Toronto as under :—

Antimony.—Very weak. Cookson's $22.50.

American Bessemer Sheet Steel.—14 gauge, 2.60; 17, 18, and 20 gauge, $2.80; 22 and 24 gauge, $2.90; 26 gauge, $3; 28 gauge, $3.25.

Bar Iron.—$2.30 from stock to the wholesale dealer.

Boiler Heads.—25c. per 100 pounds advance on boiler plate.

Boiler Plates.—¼-in. and heavier, $2.50.

Boiler Tubes.—Lap-welded steel, 2-in., $9.10; 2¼-in., $10.85; 2½-in., $12; 3-in., $13.50; 3½-in., $16.70; 4-in., $21 per 100 ft.

Cement.—Star brand, $1.95 per barrel, f.o.b., Kingston. National, $1.95 per barrel, Toronto, in car lots; retail price, $2.15.

Ingot Copper.—Quiet and unchanged. Toronto price, 26½c.

Lead.—Firmer and supply insufficient; $5.50 for pig.

Pig Iron.—Summerlee, No. 1, to arrive, $27; No. 2, $25.50, $26; Cleveland, No. 1, $23.50, $24; Clarence, No. 3, $24.

Steel Rails.—80-lb., $35 to $38 per ton.

Sheet Steel—Firm, 10 gauge, $2.70; 12 gauge, $2.80.

Tank Plate.—3-16-in., $2.65.

Tin.—Unchanged in price, 45c. for pig, very strong, and in fairly good demand.

Tool Steel.—Jowitt's special pink label, 10½c. per lb.

Wrought Steam and Water Pipe.—Trade prices per 100 pounds are: Black, ¼ and ⅜-in., $2.31; ½-in., $2.81; ¾-in., $3.80; 1-in., $5.45; 1¼-in., $7.43; 1½-in., $8.81; 2-in., $11.88; 2½-in., $19.50; 3-in., $25.50. Galvanized, ¼ and ⅜-in., $3.14; ½-in., $3.66; ¾-in., $4.95; 1-in., $7.10; 1¼-in., $9.68; 1½-in., $11.61; 2-in., $15.48; 3½-in., blk., $32; 4-in., $36.25.

Zinc.—Sheet zinc firm. Toronto, slab, $7; sheet, $8.

THE GAS ENGINE.

By R. A. Fraser.

It is a remarkable fact that the internal combustion engine combines within itself all the functions which in a steam plant call for a steam engine, boiler, feed pump, smoke stack, and the services of a man to operate it. Not only so, but when we stop to consider that the gasolene engine when applied to a motor cycle, the entire outfit weighing little over one hundred pounds, is capable of carrying a man weighing two hundred pounds for over one hundred miles on a consumption of one gallon of gasolene, we see the possibilities of this form of power as a means of cheap transportation. It must be evident to those of us who take an interest in matters mechanical that if mechanical flight is ever to be attained the gasolene engine promises to play an important part in the solution of this problem. It, therefore, behooves us to learn something of this power which has revolutionized transportation, and bids fair to revolutionize industrial life. The subject is an extensive one, and in order to deal with it in as concise a manner as possible I have thought it well to divide the paper under four general heads, namely:—

(a) Theory of operation,
(b) Fuels,
(c) Types of engines,
(d) Mechanical construction.

Theory of Operation.

It is a well-known fact that to the German inventor, Dr. Otto, is due the credit for developing the internal combustion engine as a commercial possibility, and despite the great advance made in gas engines since that time, the Otto cycle as first developed by Dr. Otto still stands. Of course, many experiments in gas engines were carried out before his time, but he was the first to appreciate the importance of a definite cycle of operation, and particularly the necessity of a definite exhaust phase, thus getting rid of the exhaust gases so as to produce a commercial and economical engine without utilizing outside means for scavenging the exhaust. It is a striking tribute to the efficiency of the gas engine that, while only one stroke out of four is the working stroke, or putting it another way, three parts of the engine's time is wasted, yet in the face of this fearful handicap the gas engine bids fair to beat all rivals in the economical generation of power.

The four operations which go to make up the cycle are:

(1) Suction,
(2) Compression,
(3) Ignition,
(4) Exhaust.

In the four-cycle engine, which is the type in most common use it takes four strokes of the piston, or two revolutions of the shaft, to complete the cycle, only one stroke being the working stroke, the remaining three strokes being taken care of by the momentum or energy stored up in the fly-wheels. Right at this point is where some confusion frequently arises in the minds of those not familiar with the operation of the gas engine, and where it is made to suffer in comparison with its rival, the steam engine, since in the case of the steam engine only two functions are carried out in the cylinder—the admission, and the exhaust of the steam, the preparation and admission of the fuel being provided for, apart from the engine, by the wasteful and dangerous agency of the steam boiler. It is really the failure to grasp the simplicity of the principle on which the internal combustion engine operates that we so commonly hear the statement, about as follows:—

"Well, gas engines are queer things anyway: when they run, you don't know why they run, and when they stop, you don't know why they stop." As a matter of fact, nothing could be more absurd than a statement of this nature, and in order to realize this, it is only necessary to recall the four factors which go to complete the cycle and, remembering these, to state that, provided an engine draws in a full and proper charge, and that charge is properly compressed, fully ignited, and freely exhausted, no matter how crude the design may be, how indifferent the materials, and how poor the workmanship, the engine will run and continue to run until one of the functions fails which go to make up the cycle. It is impossible to lay too much stress upon this aspect of the matter, as it lies at the very root of the subject, and a proper appreciation and understanding of this fact would save much mental research and often a good deal of physical exercise expended in a vain endeavor to start up an engine by turning over the fly-wheel, the engine having stopped and refusing to start, apparently for no good reason, but, as a matter of fact, through the failure of one of the functions of a cycle to carry out its part.

Starting with the piston at the top of the cylinder, as it descends a vacuum is created, causing the inlet valve to open automatically, admitting the mixture of gasolene and air. This mixture continues to flow in until the piston reaches the end of the first down-stroke. The inlet valve then closes automatically by the tension on the spring, thus confining the charge in the cylinder.

The return stroke, known as the compression stroke, is brought about by the momentum of the fly-wheel, and compresses the charge. This is essential, in order to obtain proper ignition of the charge and to obtain power and economy from the engine. In a general way, and within limits the higher the compression, the greater the power. The amount of compression, however, it is desirable to have is, of course, limited, as, if excessively high compression is carried, there is a tendency to ignite the charge prematurely, setting up severe stresses in the engine, causing it to work very irregularly.

In gasolene engines the larger the engine is the lower the compression will be.

The best accepted practice is to carry a moderate compression of from fifty to eighty pounds on gasolene up to as high as 175 lbs. on producer gas.

The faster the engine is running the higher the compression may be when using producer gas.

The third stroke in the cycle is the working stroke, obtained from the ignition, or explosion of the charge, or, put more correctly, due to the rapid expansion of the charge. It is important to note carefully the point at which the ignition of the charge should take place, so as to get the maximum power from the engine. At first glance, the natural inference would be that ignition should take place just as the crank passes the top centre, and when it is stated that the ignition must take place when the crank pin is about fifteen degrees behind the top centre the natural conclusion would be that the tendency would be to drive the engine in the opposite direction. In practice, however, this is not so, and to get the greatest power the igniter has to be tripped somewhere around this point. The explanation of this is that there is an interval between the time the igniter trips causing a spark at the point before the charge is fully ignited, and by tripping the igniter ahead of the crank the greatest force is given the piston just as it passes the top centre. I may point out that we frequently hear the internal combustion engine referred to as an explosion engine, and in speaking of the ignition of the charge we generally speak of it as an "explosion." Explosion engines were at one time in use, and some small ones are possibly still employed, but to speak of the internal combustion engine as an explosion engine is entirely erroneous, and the fact that ignition has to take place so early in order to obtain the full benefit of its force, proves that what actually does take place is rapid ignition and expansion. The distinction is, perhaps a fine one, but, as a matter of policy, especially in describing the engine to people who are not familiar with the operation and, naturally, somewhat suspicious of gasolene, it is well to avoid the use of the word "explosion" substituting ignition and speaking of the third operation as "the working stroke." The Fourth operation in the cycle is the exhaust stroke, the exhaust valve being mechanically opened at the end of the working stroke, and remaining open until the piston has reached the top, being carried up by the momentum stored up in the fly-wheel, driving out the burned products preparatory to drawing in a fresh charge, and thus completing the cycle.

Fuels.

In considering the fuels in general use in connection with the internal combustion engine, we may sub-divide this general head under three subsidiary heads:

(a) Classes of fuels,
(b) Heat value of fuels,
(c) Consumption of fuels.

The fuels in general use are, gasolene, kerosene, crude oil, illuminating gas, natural gas, producer gas and alcohol. Gasolene, which is the fuel in most common use, is obtained from distilling crude oil, and is classified under two heads,—known to the trade as "engine gasolene of 76 degrees" and "stove gasolene of 67 degrees." Chemically, gasolene is a compound of carbon and hydrogen, or a mixture of several similar compounds. This in a state of vapor or gas is mixed with air, consisting of one part oxygen and four parts of nitrogen. The hydrogen and carbon in the gasolene combine with the oxygen, forming carbon dioxide and water, leaving the inert nitrogen as before. Kerosene is also obtained from distilling crude oil and is a lower grade than gasolene. It differs from gasolene in so far that it is not explosive, and will not give off vapor when exposed to air as gasolene will, but on the other hand it can be readily vaporized. The advantages in the use of kerosene for an engine are that in some sections it is more easily obtained, it is usually cheaper, and it is always possible to get a lower rate of insurance where a kerosene engine is installed. The disadvantages of a kerosene engine are that the engine is somewhat more complicated, and in the hands of an inexperienced person there is a greater likelihood of the engine giving more or less trouble, as compared with a gasolene engine.

The use of crude oil has not, so far, become general, as it calls for a special type of engine. The failure of the early engineers to make this type of engine work was due to the fact that they did not compress the air enough before heating commenced by the fuel, and also to the mixing of air and fuel before entering the working cylinder. The mixed fuel and air could not safely be compressed to any high degree. Siemens made the first successful engine of this type, compressing the air and fuel separately, and injecting the fuel as the piston moved out. Diesel does the same thing: hence compression as high as four hundred pounds per square inch or more can be employed, and the temperature of compression is high enough to burn any kind of heavy oil of the crudest quality by self-ignition. The constant pressure of four hundred pounds, together with the liability of further sudden rise in pressure, coupled with the weakening effect on the metal, due to the high temperature, which varies within wide ranges tends to scare probable users, and make engineers go cautiously, as one or two disastrous accidents to engines using this fuel would indicate that handling this type is somewhat dangerous.

Illuminating gas, while an excellent fuel, is, of course, only available in cities and large towns, and natural gas, while it is, perhaps, the best of all fuels, is only found in certain sections of the country. Producer gas, which is coming to the front so rapidly in this country as a power gas, is obtained from the products of combustion of what is termed "pea anthracite coal, combined with the vapor from water, together with a certain quantity of air. A discussion of the operation and possibilities of the producer gas system would have to be made the subject of a paper by itself, and it is altogether too comprehensive to deal with within the scope of this paper. I would simply express my personal conviction that in this country we have only touched the fringe of the development of this form of power, and, while we have heard a great deal lately as to the advantages of Niagara power—particularly in this district—I wish to put myself on record as stating that I believe it will eventually be found impossible to compete with producer gas. It is important to note that there is no known fuel, not already in a gaseous form, that may not be converted into gas through the agency of the producer, and if we are to follow the experiments already being made in some of the older countries, it is only a question of time when the garbage gathered in the streets of our large cities, the waste products from many of our large industries, that at the present time is going to waste, or costing many thousands of dollars to get rid of, will be converted into useful energy for the distribution of power and light at a very low cost.

Regarding the use of alcohol as a means of generating power there is a good deal of matter appearing in print relating to the use of alcohol in internal combustion engines, and many of the statements contained therein are somewhat misleading, particularly in regard to the economy with which alcohol can be used. The heating gravity of wood alcohol (specific gravity .8163) is 8409 B.T.U. per pound. Of grain alcohol (sp. gr. .814) 19073 B.T.U. per pound and of Cuban alcohol (sp. gr. .824) 9584 B.T.U. Corresponding values for gasolene (sp. gr. .71) is 18296 B.T.U. per pound, and for kerosene (sp. gr. .807) is 18179 per pound. The Cuban alcohol referred to is manufactured from a cheap molasses which has hitherto been a waste product from the cane sugar mills in that country, and is sold in Havana at the low price of 10 cents per gallon. It is then apparent that an engine, in order to run on as small a quantity of grain alcohol, as of gasolene, would have to use the oil with nearly twice the efficiency. It is a fact that the gasolene or kerosene engine may be run on any of the alcohols above mentioned without much change, and the engine will give somewhat more power than on gasolene, but on the other hand the result will be disappointing because of the large quantity of alcohol consumed, this being, as might be expected, from the heat values referred to, nearly twice the quantity that would be consumed with gasolene. It will also be found that the engines are harder to start on alcohol, due to the greater difficulty in vaporizing, and it will be desirable to start the engine on gasolene, or to vaporize some of the alcohol, by previously heating it, in order to provide the necessary vapor for starting. It has been found that with alcohol much higher compression can be used in the engine without causing premature ignition, so that to get the best results from this fuel, engines have to be built specially to suit it. Experiments have shown that the best results are attained when compression of from ninety to one hundred pounds per square inch is used. The only objection, of course, to this high compression is the difficulty experienced in turning the engine over by hand, in order to start it. In an engine in all respects designed to operate on grain alcohol the consumption will be approximately fifty per cent. more alcohol by volume than gasolene.

Taking up the heat values of the different fuels in their order, they are about as follows:—Natural gas, 1000 B.T.U. per cubic foot; illuminating gas, 630 B.T.U.; producer gas, 125 to 150 B.T.U.; gasolene, 18,000 to 20,000 G.T.U. per pound. Kerosene, the same. Alcohol, 8,000 to 10,000 B.T.U. per pound.

It will be noted that gasolene has a lower heat value than natural gas, but will give more power from the same engine. This is due to the fact that the quantity of air necessary for complete combustion varies with the different fuels, and affects the horse-power developed.

Now regarding the consumption of fuels: in the case of gasolene the accepted consumption claimed by all reputable engine manufacturers is one pint per B.H.P. per hour under full load.

The approximate consumption of kerosene is ⅛ of a gallon per B.H.P. per hour under full load, this quantity being somewhat exceeded in the smaller sizes, and slightly less in the larger sizes.

In the case of illuminating gas, the accepted consumption is from 18 to 20 cubic feet per B.H.P. per hour under full load, and in the case of natural gas the consumption is from 12 to 13 cubic feet per B.H.P. per hour under full load.

With producer gas it is usual to guarantee a consumption of 1¼ pounds of pea anthracite coal per B.H.P. per hour when operating about the rated capacity of the engine.

Types of Engines.

At the present time when the relative merits of the different types of motors are being widely discussed, it may be useful to properly classify them.

Broadly considered, internal combustion engines are hot-air engines and divided naturally into two divisions—"the constant volume" and the "constant pressure" engine.

In the first, the heat is imparted to the air suddenly when the piston is practically at rest, and the air at constant volume being heated suddenly rises in temperature. As pointed out earlier in this paper, the resulting action is erroneously described as an explosion. All engines in which the air is compressed with the fuel, and fired when the piston is at rest on the dead centre, are "constant volume" engines.

These engines may be further divided into four and two cycle types, and these cover probably over ninety per cent. of the internal combustion engines in use to-day. The constant pressure engine was described earlier in this paper under the head of fuels, its use being limited to the type using the heavy or crude oils as fuel. The constant volume four-cycle and two-cycle types are those in general use, and either may be worked at constant pressure or constant volume. The factors which go to make up a cycle are the same in the case of the four-cycle and the two-cycle. The great difference lies in the method of charging and exhausting. In the four-cycle engine, one piston displaces the exhaust, draws in a fresh charge, compresses and works. In the two-cycle type, the exhaust is pushed out by the entering fresh charge, which comes in under pressure, the one side of the piston acting as a pump. The charge is then compressed and fired at a constant volume.

The two-cycle engine made in small sizes using the crank case as a receiver and the piston as a pump is the poorest attempt imaginable at a two-cycle engine. The little two-cycle engines so much in evidence, of course, have all the simplicity claimed for them, but they must not be taken as representative of the type. The chief drawback to the two-cycle engine—even when carefully and correctly designed, and unfortunately that is not very often—is that there is not enough time at the exhausting and charging periods to perform these operations properly. The two-cycle engine reduced to its scientific conclusion should only have the charge drawn into the cylinder after the exhaust has either been completely withdrawn or discharged, but, as pointed out, in the present types these operations frequently overlap, resulting in erratic operation and excessive consumption of fuel.

Mechanical Construction.

In taking up briefly the last head, namely the mechanical construction of the engine, it may be pointed out that up to a certain point the gasolene engine closely resembles the steam engine, in so far that the energy is transmitted to the shaft through a piston operating in a cylinder. There, however, the resemblance ceases, as what would pass muster in steam practice would be fatal in a gas engine. In one respect the gas engine may be said to resemble a quick-firing gun, in so far that the initial pressure and temperature is very high. In all well-designed engines, the tendency is to keep the compression as low as possible, consistent with economy. The maximum pressure at ignition should not exceed three hundred pounds, equivalent to about twenty-seven hundred degrees "Far." Many engines on the market carry pressures of four hundred pounds and over, and just what this means is best illustrated by an example. Taking a cylinder, four inches in diameter, at three hundred pounds, the total pressure at the moment of ignition, is about thirty-seven hundred and fifty pounds. Now if the ignition pressure be increased to four hundred pounds, the ignition pressure amounts to five thousand pounds, representing an increase of over thirty per cent., all tending to increase the wear and tear on the engine. In a general way, it may be stated, that within limits the higher the initial pressure the greater the horse-power developed. This is a point that is very misleading to the layman in making comparisons, as to the horse-power developed by engines of different makes, whereas a moment's reflection will convince one that the rating of an engine may be materially raised by using high compression and correspondingly high temperature, "but it must also be evident that such an engine is much less likely to prove satisfactory and serviceable than an engine with low compression and low temperature. I have just remarked that what would pass muster in steam practice would fail completely in a gas engine. You will appreciate the fact that the cylinder of a gas engine, in order to stand the high pressure and resist the high temperatures which fluctuate within a wide range, call for a special grade of close-grained iron: not only so, but, as the efficiency of the engine absolutely depends on the compression being maintained, you will see that it calls for the accurate machining and fitting of both the cylinder, piston and rings. Coupled with this: the cylinder has to be water-jacketed, causing the cylinder castings to be expensive to mold, and, as frequently happens, a cylinder may be all machined and the engine on the test floor before any defect is found, perhaps simply a small leak between the water-jacket and the cylinder, due to spongy metal, or some other cause, the result being that the cylinder has to be thrown away and a new one substituted. These experiences are almost unknown in steam practice, and answer in part the question so often asked as to why a gas engine is so much more expensive than a steam engine of the same horse-power.

Valves.

The valves in an internal combustion engine are important and come in for a good deal of consideration. These consist simply of an inlet and exhaust valve, and the accepted practice is to make these of the "poppet" type, either making them from drop forgings, or preferably of nickel steel.

The invariable practice is to operate the exhaust valve mechanically. The inlet valve may be either mechanically operated, or of the automatic type, opening by the vacuum created in the cylinder as the piston descends. There has been, and there is still a good deal of controversy as to the merits of the mechanically operated, and the automatic admission valve. It may be said at once that both types have merits, the automatic type certainly has the merit of great simplicity, requiring no mechanism of any kind to operate it, and this type has been consistently used by some of the best known and largest engine manufacturers with uniform success. Incidentally, one of the largest European manufacturers, realizing that both types have merits of their own, have devised a compromise in an effort to utilize the advantages of each type, and the results are said to be eminently satisfactory.

Vaporizer.

The systems by which the liquid fuels are led to the engine are two, known as the "gravity feed" system, where the fuel tank is located above the engine, and flows to the vaporizing device by gravity: the other is the "pump feed" system, where the fuel tank is placed below the level of the engine, and may be located at some distance away, the liquid being pumped to the vaporizer by a small pump run by the engine, the surplus returning to the tank by gravity. The gravity feed system, for stationary service particularly, has been discarded by all reputable makers, and is condemned by the Fire Underwriters as dangerous, and rightly so, since, as a matter of fact, practically the only merit in the system was its cheapness.

The devices for converting the liquid fuel into gas are legion, and are known as "vaporizers," "carburetors," etc. For stationary work, the vaporizer is in general use, as it is remarkably simple, and devoid of mechanism of any kind. For automobile and marine service, the accepted type is that known as the "float-feed carburetor." The principle of operation is essentially simple, but the latest types have become more or less complicated, due to an effort to devise a carburetor adapted for a variable speed motor which will respond instantly and maintain a constant mixture under wide ranges of speed and load.

Governors.

The systems of governing in general use are practically two, known as the "throttling" and the "hit and miss" systems. In the throttling system, the governor automatically regulates the amount of mixture admitted to the cylinder, that is the more the load the more the mixture, the less the load, the less the mixture. In the "hit and miss system" the governor automatically controls the number of explosions, or impulses, each impulse being of the same intensity, that is the more the load the more the number of impulses, the less the load, the less the number of impulses. The throttling system is used on all engines for electric lighting service, as with this system very close regulation can be attained—as a matter of fact, within two per cent. at full load. The system, however, is not economical on light loads. On the other hand, the "hit and miss" governor, while not giving such close regulation, is preferable, owing to its higher efficiency on light loads, and is the system in general use for all other purposes, except those where very close regulation is called for. In the case of the throttling governor, the method of operation is comparatively simple, consisting of either a slide valve or a throttle valve placed between the vaporizer and the cylinder, and controlled by the governor. In the case of the "hit and miss" system, the methods and devices are legion. Some govern the fuel supply, some cut off the electric current, and in some types particularly horizontal, all operations are stopped by the governor controlling the second motion shaft. Probably the simplest and most effective method is that whereby the governor simply holds the exhaust valve open, with the result that there is no vacuum created to open the inlet valve, and no compression to add to the load on the engine, so that, under light load, the engine runs freely, and with the minimum amount of friction.

(To be Continued.)

POWER PLANT OF THE OTTAWA ELECTRIC RAILWAY.

W. L. McLaren.

The Ottawa Electric Railway Company was organized in eighteen ninety-one by Messrs. Thos. Ahearn and Warren Y. Soper, who are to-day respectively president and a director of the company. Mr. Ahearn started life as a telegraph messenger at $8,00 per month, and Mr. Soper as a cash boy at $8.33 per month, they were friends, and both began the study of electricity with whole-souled effort, and climbed the ladder step by step. When the Bell Telephone Company welcomely invaded Ottawa, Mr. Ahearn was made local manager. At this time Mr. Soper had risen to the position of Ottawa manager of the Dominion Telegraph Company. In 1882 they entered into a partnership as electrical engineers and contractors, and their business soon assumed immense proportions. They built the long-distance line from Quebec to Pembroke, via Montreal and Ottawa, and the land lines of the Commercial Cable Company in Nova Scotia. They also equipped the lines of the C. P. R. Telegraph Company from ocean to ocean.

Fig. 1.—Chaudiere Falls on the Ottawa River, from the Ontario Side.

The Power Plant.

The power plant consists of three parts, namely, the Street Railway Power House proper, with storage battery in connection, an auxiliary generator in the Ottawa Electric Company's steam station, and an alternating current machine used for lighting the company's buildings, park lines, etc. In addition there is a motor generator to be used as an auxiliary at any time when it may be necessary to shut down the power house proper. The power house, flume and tail race are most substantially built of iron and concrete, the foundation being the solid rock. The machinery floor is also of concrete, arched over the tail race, and supported by iron columns.

The plant consists of six 48-inch Victor water wheels (Fig. 2), all keyed upon the one horizontal shaft and arranged in three pairs, each pair discharging in one draught tube. The regulating gates all open and close together and cannot be operated singly. The capacity of the wheels is about 350 horse-power each or 2,100 effective horse-power, which is also approximately the capacity of the electric generator when working at its rated overload.

Any surplus power generated is taken up by the large storage battery in an adjoining building, which also makes up any deficiency, thus enabling the water-power plant to be run at the usual rate and avoiding shocks or strains, due to sudden opening or closing of the gates. This storage battery was installed in 1902, and is housed in an adjoining brick and concrete building. The battery consists of 288 tanks or cells, capable, as it stands, of giving out 1,000 amperes at 600 volts for one hour, or about 800 horse-power. In momentary discharges such as are called for in sudden increases in railway load, and which last for short periods only, it will supply 1,200 horse-power, while for continuous eight-hour periods it will give, without injury to the battery, 800 horse-power. This battery is shown at Fig. 3. The battery is, therefore, capable of operating snow sweepers or the few cars which it might be necessary to run between the hours of midnight and morning, at times when the water-power plant is shut down for inspection or for minor repairs. A most important feature of this part of the plant is that for maintaining a constant voltage on the line, it reduces the amount of current required to operate a car by about 40 per cent., thus in effect increasing the capacity of the station as a whole, and also the capacity of the feeding system. This part of the company's plant is well proportioned, in good working order throughout, more than ample for the work it now has to do and able to handle an increase of 50 per cent. in car service.

Installed in the Ottawa Electric Company's (the company which supplies Ottawa with light) steam power house is a four-pole Westinghouse belt-driven generator, which is held in reserve to run the power plant (Railway Company's) proper at a slower speed. This machine has been newly re-wound, and has a capacity of 750 horse-power, the power to run it is obtained from the steam plant of the Ottawa Electric Company, and is paid for on a basis of power supplied. There is also a two-phase 2,200 volt alternating current ma-

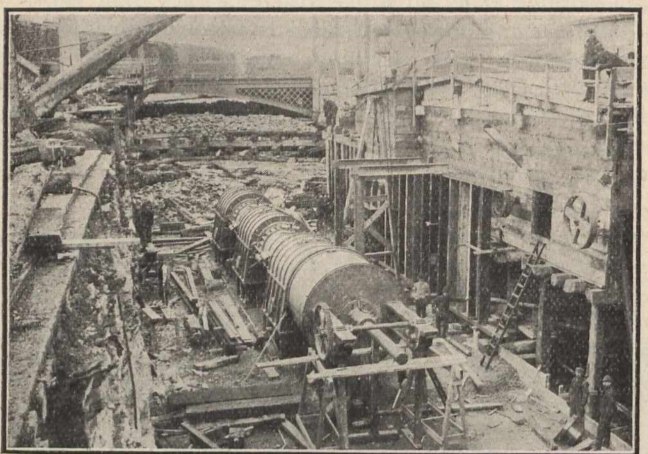


Fig. 2.—Water Wheels Being Installed.

chine with exciter and switchboard, driven by two 60-inch water wheels, which lights all the company's car shops and offices as well as parks, as before stated.

The 1,400 horse-power motor generator will carry an overload of 50 per cent., and is of sufficient capacity to handle the ordinary traffic of the railway, and in conjunction with the generator in the Ottawa Electric Company's steam plant it can handle the maximum traffic at any time.

From the above it will be seen that except for the 750 horse-power auxiliary in the Ottawa Electric Company's steam station the railway is dependent for continuous service upon either their own water-power plant, or upon pur-

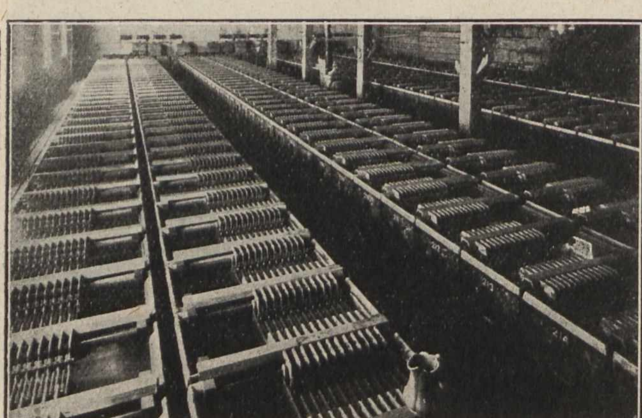


Fig. 3.—Storage Batteries of the Ottawa Electric Railway Company.

chased power developed by water at Chaudiere. They may, therefore, be considered as exposed to the trouble arising from anchor ice or low water to which all Chaudiere power users are subject. Being the owners of two power lots and having acquired the power rights which belong to a third, they now have rights to 3/19 of the water available for power on the Ontario side of the river.

At ordinary water stages the power controlled will meet the company's requirements for some time to come. At low water periods, or while anchor ice is running the water-power plant cannot be relied upon to maintain a full service to-day. That this is the company's experience is evidenced by the above mentioned auxiliary additions which they have made to their plant.

The Victor turbines are direct-connected to the main unit, which is a 1200 Kw. D. C. Westinghouse generator,

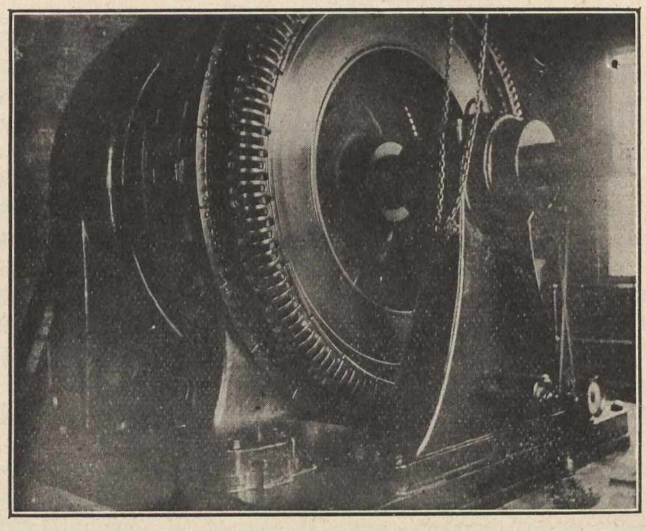


Fig. 4.—1,200 Kw. D. C. Westinghouse Generator.

600 volts, 2,100 amperes running at 108 r.p.m. (Fig. 4.) Fig. 1, the Chaudiere Falls to which the power plant owes its existence.

In 1899 the half of the City of Ottawa was consumed by fire, which destroyed the power plant of the Ottawa Electric Railway Company, the main room of which is shown at Fig. 5, which also serves to illustrate the change in electrical apparatus since that time.

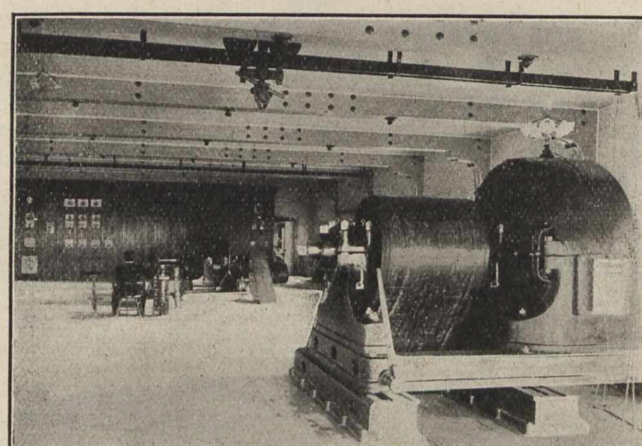


Fig. 5.—Power House Destroyed by Fire in 1899.

Many thanks are due to Mr. James D. Fraser and Capt. J. E. Hutcheson, respectively, secretary-treasure and superintendent of the Ottawa Electric Railway Company, for the facts here presented.

POWER IN THE UNITED STATES.

Some interesting figures relating to the development of power used in manufacturing industries in the United States have recently been published by the Census Office. It appears that in 1870 the total power employed in the United States was 2,346,000 h.p.; in ten years it had increased 45 per cent. to 3,411,000 h.p.; by 1890 it had advanced 75 per cent. to 5,955,000; and by the end of the century it was 10,410,000, a further increase of 75 per cent. Last year the aggregate was 14,465,000, or an advance of 39 per cent. Before 1890 the main sources of power were steam and water, but since that time gas and electric power have made enormous strides, electric power now supplying a total of 1,138,000 h.p. It is interesting to note that thirty-five years ago water power accounted for nearly one-half of the total, while now it is represented by only 11.5 per cent.

MINERAL RESOURCES OF NEW ZEALAND.†

PART II.—SUGGESTIONS.

Before considering suggestions for the development of the quartz-mining industry, it will be best, perhaps, to establish the nature of the results which it is desired to achieve. The Russian Government, it is said, work the mines of Siberia with convict labor to provide the means for the furtherance of class ambitions and the support of an autocracy. For them, undoubtedly, large annual value of output is the principal consideration. But it is not to obtain such ends that the people of New Zealand are prepared with special legislation and subsidies. What they desire is the exploitation of their minerals in such a way as to secure the maximum prosperity of all concerned. Now, prosperity without health is not worth the seeking; and if a high position among gold-producing countries can only be secured or maintained at the cost of the bodily ruin of the men employed in the work, then the sooner New Zealand reaches the bottom of the list the better.

There is no special sanctity attaching to the mining of lodes. It may be argued that gold-mining in particular has certain claims to respect above all others, for its product cannot be destroyed, but passes from hand to hand indefinitely, unlike, say, the wheat of the farmer, which is reaped and eaten and lost. This is fallacious however—the corn is not lost. Although as corn it no longer exists, yet as flour or bread it is consumed by the artisan or laborer, and the results of its consumption appear in some other form. So that the mining of metals, even of gold, is only one industry among many, and unless it can furnish healthy, steady, and remunerative employment for our citizens it is unworthy, even in the slightest degree, of national encouragement.

No observant man can fail to have noticed the comparative youth of the superannuated quartz-miner. Fifteen years would seem to be about the average length of an underground career—twenty years would be exceptional.* This is not intended to convey that the miner necessarily dies at the end of this time, or even that he is permanently confined to his bed. But neither must it be taken that although unfitted for mining he is still able to do a day's work "on top," for, on the contrary, a climb up a fairly steep flight of stairs is beyond him; any continuous work, of course, also; nay, even a hearty laugh will turn to a body-racking fit of coughing. In his own parlance, he is "cooked." Every man of forty or so that one sees in a mining district halting and fighting for breath on a gentle rise, or staggering under a burden of which a strong fourteen-year old boy would make light, is an indictment against the quartz-mining industry as at present conducted. This matter is more fully discussed under "Silicosis."

A.—Suggestions for the Consideration of the Legislature and the People of New Zealand.

Some of the legislation which follows may seem somewhat startling at first sight; but it must be remembered that New Zealand enjoys possibilities denied to many other countries, owing to the wisdom of the legislators in the past and the soundness of the principle on which they based their legal code. That principle is, "The land with all it contains is the property of the people."

Location and Exploitation of Lodes.

It is suggested;—

(1.) That there be established, by the allocation of an adequate sum from loans or revenues, as may be deemed advisable, a fund (hereinafter called the "Minerals Fund"), from which will be paid all expenses incurred in the undertakings subsequently detailed, and into which will be paid all moneys returning from such undertakings.

(2.) That further subsidies be granted to works of a prospecting nature already proceeding only if equitable arrangements can be arrived at between the Minister of Mines on the one hand and the County Council, miners' association, etc., concerned on the other hand, by which the Minerals Fund will receive a direct return from the profits won from any lodes which such operations may succeed in locating.

(3.) That, with the exception of claims affected by the preceding clause, no further grants of quartz-claims be made to applicants under the present Mining Acts.

(4.) That, on receiving notice of the discovery of a mineral deposit of possible value, the Minister order a report to be made as to the correctness of the informant's statements, and that, if such report prove satisfactory, testing operations, such as boring, winze-sinking on the reef, or driving to meet it at a lower level, as deemed best, shall be carried out.

(5.) That if the value of the mineral contents be sufficiently great to warrant exploitation, the Minister call for tenders for a long-term lease of the property, with all necessary water and timber rights, the tender to take the form of sufficient in cash to pay out-of-pocket expenses and a proportion of the shares (fully paid) of the limited liability company which will be formed by the tenderers to work the property.

(6.) That the person who reported the discovery to the Minister be regarded as the discoverer, and that he be rewarded as indicated in following pages.

(7.) That as regards lodes in properties previously taken up but now abandoned, the person reporting the find be not necessarily regarded as the discoverer, but that in the event of more than one person supplying information within three months of the date of the first report the Minister decide in what proportion the credit of the discovery is due to each of the applicants, the expenses incurred in the inquiry being paid out of the reward finally granted.

(8.) That a practical mineralogist be appointed to each part of the Geological Survey, and that it be an instruction that he confine his labors exclusively to the search for and estimation of minerals of an economic value.

(9.) That there be established in all country schools above a certain size, and in such town schools as may be deemed advisable, a small collection of minerals,* that the children be permitted to handle them at will, and that prizes be offered annually for collections locally made.

The foregoing suggestions aim at the creation of a New Zealand Minerals Development State Syndicate, of which every elector will be a shareholder, with a voice in the management of affairs. This syndicate will float properties, and will hold shares in the properties when floated, but it will not itself run the mines which are opened. Thus the weaknesses which are—in the minds of many people—inevitable to State-operated enterprises need not be apprehended.

The mineral wealth of this country is the heritage of her people as a whole, and it therefore follows that the as-yet-undiscovered reefs of South Westland are as much the property of the Hawke's Bay farmer as of the Greymouth merchant or the Okarito settler. This point is sometimes obscured in the minds of County Councils, miners' associations, and others who make applications for subsidies wherewith to carry on prospecting operations.

Now, the early pioneer had infinitely more at stake than the miner and settler of the present day, for he was risking—in many cases he actually lost—his life. At the very least, he faced much personal discomfort exploring, as he was in a country which no other class had cared to attack. It was only reasonable, then, that this way should

†Prize Essay in New Zealand Mines Record.

*Steady work is implied, such as would be incumbent on a man with a family to keep. Single men often go into the bush in summertime, or save up a little money and go for a trip. Five years' constant employment on machine drills is more than most men could stand.

*Enumerated later.

be made as smooth as possible for him—that, for example, he should be allowed to carry away practically all the profits from the claim freely granted to him; that he should be allowed a residence-site rent-free; and that roads, water-races, etc., should be constructed for his especial benefit. But the modern man who elects to make his home in an already partially settled district has no such title to generous treatment, for he is enjoying all the privileges of his compatriots. He looks for all the concomitants of citizenship, and he must expect to pay just as much as any other taxpayer, and to receive just as much and no more from the public purse. It is true that if he takes up a claim he risks his time and some capital, but so does a blacksmith who opens a shoeing-forge, or a doctor who sets up his brass plate. Yet neither the farrier nor the doctor makes such outrageous demands as the man who settles in what he believes to be auriferous country.

The Minister of Mines annually receives a large number of communications asking for subsidies for the prospecting of mineral deposits, the idea of the writers in each case being that in the event of the ground proving workable they themselves, in virtue of living in the neighborhood, would be in a favorable position for pegging out claims. They would then proceed to exploit their "property," and would resent loudly as a check on commercial enterprise legislation calculated to make them disgorge any proportion, however small, of their profits. It would be equally logical for the writer to call for a public subscription at the rate of a penny per head for his exclusive benefit. He would undoubtedly spend the income derived from the investment of the money thus collected in clothes, food, etc., and so his fellow-citizens would indirectly benefit. The general public would not feel this slight impost, and the writer would be placed above the reach of want. It is not to be supposed, however, that any such proposal would be entertained by his sordid fellow-countrymen.

The Blackwater Miners' Association applied last year for a subsidy of £200, which they agreed to pay out as half-wages to six or eight men. When the £200 had been spent a reef was discovered, and this was sold at once to a private citizen for £2,000. There is no need for the writer to comment on this at any length.

There is no justification for paying public moneys, however trifling, for the proving of mining possibilities unless some considerable portion of the proceeds is paid directly to the State, and hence will go towards the alleviation of national taxation or the extinction of national debt. Had a private citizen paid the £200 subsidy mentioned above, he would certainly have expected £1,000 out of the purchase-price. He would probably have made considerably more, for the operator who bought the property sold out soon after at a very much higher figure to an English mining company. Capital incurring risk is as much entitled to dividend when State-owned as when the property of private individuals.

It may be argued that the refusal to grant any further quartz claims will kill private enterprise. As regards that branch of private enterprise known as "trafficking in options," the charge is undoubtedly a true one.

The Lot of the Prospector Under Present Conditions.

Let us consider the reward obtained by the fortunate man who makes a discovery of possible importance.

He returns from the bush highly excited and full of confidence in the value of his find. He brings with him a number of samples, which he causes to be assayed. Being picked stone they usually show fairly high results. The heavier part of his task still remains to be done, however, for he has yet to induce others to believe what he himself knows to be the truth. He finds that the people whom he approaches for financial support may be divided into three classes,—viz., (1) Those "who have been had before," (2) those "who don't mean to be had if they can help it," and (3) those "who mean to get a bit of their own back." He may go farther afield; but, of course, among those to whom he is unknown he fares no better. He has many disappointments, and one cannot wonder if with each rebuff his story grows until the original pennyweights of value become ounces, and the inches of width become feet, until in fact the whole thing is too much for any one to swallow. Sometimes he desists long before this point is reached and retires into obscurity, there to await the advent of a "boom," or—what is in his estimation equally probable—of a mining speculator with honesty, intelligence, and money.

If, on the other hand, he succeeds in finding a backer he is usually but little the wealthier, for often the trained men of business with whom he is dealing prove altogether too clever for him, and he loses everything.

The Lot of the Prospector Under the Scheme Proposed.

At the least he will be sure of a fair and speedy hearing. The course adopted will be somewhat as follows:—The Minister on receiving the report of a find will cause an investigation to be made as to this man's bona fides. A mere inquiry from a local J.P. or other responsible person will establish whether or not the prospector is the sort of man who would tell a series of falsehoods to make a few shillings. Being satisfied on this point, the Minister will dlirect some competent person to accompany the prospector to his reef and take a sufficient number of samples for assay purposes. The official could be either a member of the staff of the Department or a reputable engineer specially engaged. For the time spent in accompanying the expert to the ground, sampling the face, and returning to the township, the prospector might receive pay at the rate of twice the wage ruling in the district for casual labor. The expert will draw up a short report stating briefly the results of the assays and whether he considers the reef worthy of further test. Upon this the Minister will act, and the result of the boring or other operations carried out under the direction of a qualified engineer will be either that the property is shown to be worthless for flotation purposes, or that it is sufficiently promising to be what is called a "surface show."

Plans for the district will then be prepared, an estimate made of the cost of the necessary roads, water-races, etc., a report procured as to the quantity of water and mining timber available, and a lease of the property will be offered for public tender. The price will be so-much in cash and so-much in shares, and the Minister will allot a due proportion of either or both to the prospector, taking into consideration in fixing the amounts to be paid the labour the discoverer had expended and the price paid by the shareholders of the company to be formed. It would simplify matters and promote the confidence of investors if the Minister would undertake to pool his shares for, say, twelve months.

Company-promoting.

Almost anything can be forgiven a new mining proposition if only it is floated when the market is in a favorable condition. It is of no moment to the ordinary promoter what the prospects of the property may really be—he is a promoter, not a holder for dividend. At any rate, he does not intend to be a shareholder longer than he can help. Having fixed up the articles of association and obtained a certificate from the Registrar, he publishes a prospectus concocted from the following ingredients:—

(1.) Two or three reports from mining experts who may or may not know something about mining, who have visited the property—whatever that may mean—and who have not too recently incurred public disfavor. These gentlemen usually have to look to a successful flotation to pay their fees.

(2.) Particulars of the area and situation of the lease. This includes an enlarged copy of a published map of the district with a little second-hand geological information

(3.) Results of assays made by reputable and competent men on samples of stone which are said to have come from the property. Even if they are what they purport to be, in the absence of systematic sampling they cannot be expected to represent the value of the reef, even at the outcrop.

(4.) Vague information as to water-power, transport facilities, timber, etc.†

†The "reports to operators," mentioned under "Copper," belong to a different class altogether. They are written for the edification of a keen man of business. The reports which are to be found in a prospectus are aimed at the British public.

Very often the shares are underwritten—that is to say, friends of the promoter and others whom they introduce promise to take up a certain proportion of the scrip for which the public may fail to apply. (If a legal agreement is entered into in this connection particulars must appear in the prospectus.) For this underwriting a commission of from 10 to 25 per cent. is paid, more or less of it in cash. The people who find the underwriters also receive a small commission of 2 to 5 per cent. in cash or shares for their trouble.

The prospectus is laid before the public. Not only is it advertised in well-known newspapers, but copies are mailed to all promising people. (The compilation of lists of such people also brings in its own modest reward.) The recipient, or the reader, does not ask himself, "Does the property look like a probable dividend-payer?" but "Is the whole thing of such a nature, and is the flotation so well-timed that the shares will probably stand at a premium?" and he acts as his judgment directs. If stock is allotted to him, he pays the calls as they come due until a favorable moment comes for unloading. According as the market fluctuates he will buy in and sell out again. Sometimes he finds himself saddled with shares of which he can only dispose at a serious loss, but he trusts to the future to recoup himself. He is essentially a gambler not an investor.

Meanwhile the Sem Vergonha Mining Company (Limited), has commenced operations. A salaried official has visited the property and has found the outcrop still in position. Some specimen stone overlooked by previous inquirers is taken and assayed. The good news is cabled to England, and favorable comments are made in the public press. The ordinary citizen, who has learnt a certain amount of caution from ill-success in previous speculation, now reads in his favorite newspaper something like the following:—"The Sem Vergonha Mining Company, (Limited), whose shares (10s. paid) are now standing at a slight premium, are nevertheless a good investment at the price, so promising are the reports received recently from the company's representatives on the ground. Further assays have proved the reef to be uniformly rich." The real investors—the men who are out after dividends—now buy in. It is their money that pays the wages of the promoter—who now retires with as little commotion as possible—and the tribe of hungry men behind him. Too often it is found that an increase of capital, a reconstruction, or a debenture-issue is necessary to provide a bare sufficiency of working-capital. It is true that an allottee may sue the promoter, pleading that he has been misled by false statements in the prospectus; but usually the final sufferers have bought in some time after flotation, and even if they were among the original shareholders they either have not the money to spare for legal expenses or do not consider it politic to send good money after bad.

It must be admitted that the above remarks do not generally apply to locally capitalized concerns, nor to properties which are floated, after a reasonable amount of development-work has been done, by a development syndicate or by a reputable firm of mining engineers; but they are most certainly justified as regards the great bulk of the mining investments offered to the public, and it is by such that much capital is absorbed, to the detriment of legitimate propositions.

One would think that the exposé in connection with the Whittaker Wright and the Hooley companies would have educated the British investor, and some effect certainly is produced. For months after the revelations in the law-courts or at the Old Bailey the market is dull. This may partly explain why really good surface-shows very often go a-begging.

The work of the private development syndicate is handicapped by the fact that its employees, though faithful and competent, are hurried, and have no special knowledge of the country on which they are reporting. They have to trust a good deal to hearsay, and do not understand the genius of the people with whom they are dealing. Moreover, since development syndicates exist by and for the flotation of mining properties, they are expected to furnish reports as favorable as possible. They are employed to a great extent in collecting and collating information obtainable by a much cheaper man, and they have to make special, lengthy, and costly journeys.

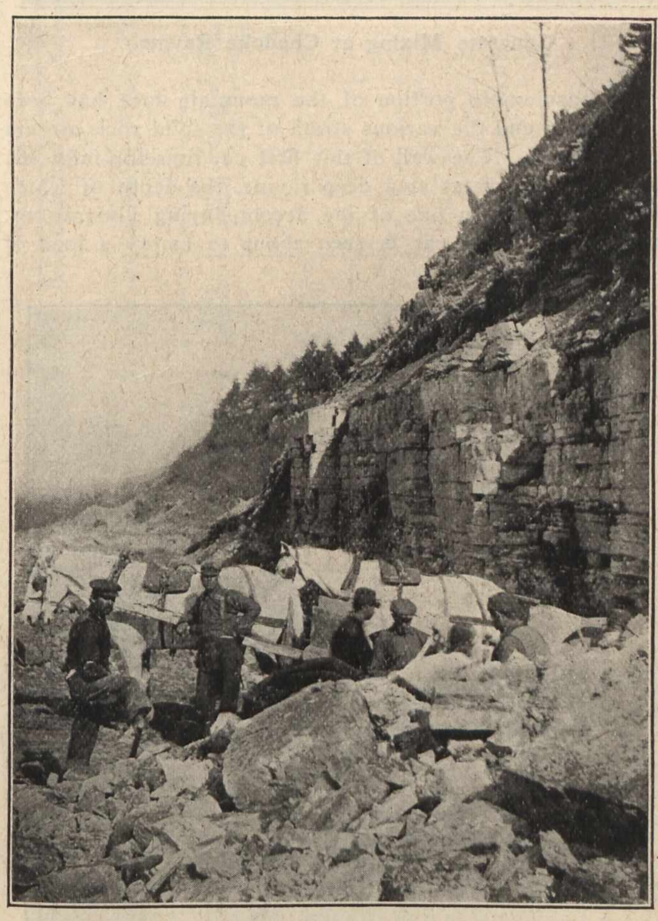
So long as profits continue to be made in various callings and professions, there will be unemployed capital in the hands of people whose temperament inclines them towards mining ventures. The idea of the suggestions made in this essay is to offer these people something better than the totally undeveloped property, with watered capital and shares standing at a premium, to which they are accustomed.

(To be Continued).

THE BUILDING OF THE HAMILTON-BRANTFORD ELECTRIC RAILWAY.*

Work on the Hamilton and Brantford Electric Railway is being rapidly pushed to completion. Over 350 men are now working on the grades and cuts on the Hamilton mountain, and every effort is being made to have the work finished as soon as possible.

Particularly interesting is the grading up the mountain. Here the line will run in a deep chasm, that has been blasted



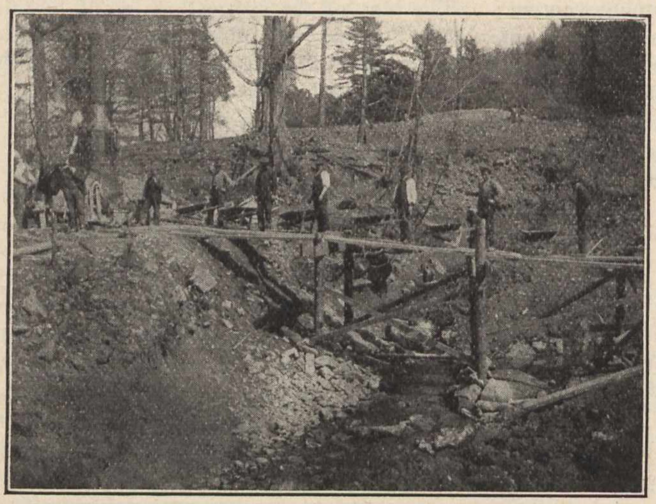
Cutting the Way at the Summit.

out with dynamite, leaving the high stone walls on either side. One noticeable feature of this grade is that it is almost perfectly straight until it reaches the top, and then the line takes a turn between the almost vertical stone walls. In places, of course, it has only been necessary to level the slope the width of the right-of-way, which part of the work is not at all difficult.

At the Chedoke ravine a bridge is under construction, the foundations of which are of concrete. A large steam cement mixer is used, and the water is taken from the creek running through the ravine, which at the point where the bridge crosses is about 10 feet wide. After leaving the Chedoke ravine the actual grade commences, and here a big steam shovel is cutting the right-of-way, the grade being 2¼ per cent. A second ravine on this section of the road has been

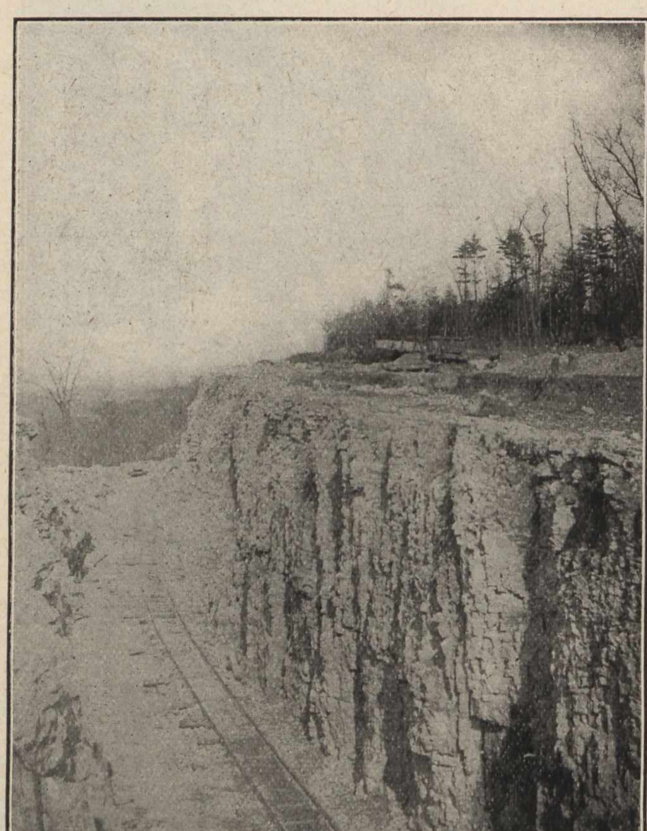
*We are indebted to the "Hamilton Spectator" for the illustrations and data contained herein.

filled in. For a short distance from this ravine the road-bed is fairly level, and then comes the hardest work that is being done. From this point on the road is practically cut through the solid rock, much of which has to be blasted. There are two cuts up the mountain, one about 15 ft. deep and the other about 30 ft. deep.



Concrete Mixing at Chedoke Ravine.

A considerable portion of the mountain face has been blown away, and the various strata of the solid rock present different hues. The wall of this first cut runs for fully 100 yards, and terminates at a deep ravine, the depth of which can be judged from one of the accompanying illustrations, where a small hand-car is seen about to empty a load of



Looking Ahead into the Dundas Valley.

stone down the decline. There is no obstruction on the outside of the right-of-way at this cut, and passengers in the cars will be enabled to have a splendid view of the Dundas Valley.

The second cut at the summit, however, is more interesting. Here the line has been cut through solid rock, and is shut in on both sides by walls 20 ft. high. This is the point at which the line takes a curve, and heads in the direction of Ancaster.

It is not anticipated that the line will be entirely completed by July 1st, which is the date set for its completion, but it is believed that the greater portion of the work will be

Carting Away Material for Filling In.

done, and the cars will be run up the mountain, and as much further as possible.

MINERAL PRODUCTS OF JAPAN.

The exports of the principal mineral products of Japan report last year, says the Yokohama Chamber of Commerce, were valued at $16,980,596, and the imports at $19,081,406. Compared with the previous year the exports show an increase of 38 per cent., while the imports show a falling off of 31 per cent.

Crude and refined copper was exported to the value of $12,552,477, an increase of over 50 per cent. since the year preceding the war. Copper wire and other manufactured articles were exported to the value of $12,752,629.

The export of coal amounted to 2,402,354 tons, valued at $8,143,536, the latter showing an increase of 14 per cent. compared with last year, but a decrease of 15 per cent. compared with 1903.

The total amount of mineral output for 1906 was valued at $48.930,684, which is an increase of 33 per cent. compared with that of the year preceding. The following table will give some idea concerning the same :

Gold	$1,861,063
Silver	1,575,781
Copper	12,875,770
Lead	233.694
Bronze	1,281
Antimony	246,839
Quicksilver	350
Iron	1,405,160

A NEW USE FOR COBALT.

Heretofore the only use of cobalt has been for the coloring of glass, enamels, and porcelains. It produces the purest and most beautiful of all the fast blues. For this purpose only some 150 tons of cobalt was used annually. It has all the properties of nickel for nickel-plating and hardening steel, but it is too expensive for this use. Formerly cobalt was not used as a metal at all, its use being in the form of glass, made by melting together quartz, the oxide of cobalt and carbonate of potash. Now, however, it has been discovered that cobalt is useful in the manufacture of storage batteries, and deposits of it are being eagerly sought for.

SYSTEM IN INDUSTRIAL ESTABLISHMENTS.

By A. J. Lavoie.

Article XIV.

Pay-Roll Record (Continued).

Upon completion of the pay envelope receipts, form No. 1,004, from the duplicate semi-monthly pay-roll record, form No. 1,002, if several sheets of this latter form have been prepared for each department, one form only should be prepared, giving a summary of the information contained on the other sheets. In making out this latter form the non-productive and productive labor should be kept separate. If the establishment is divided into a number of departments it then becomes necessary to have one sheet containing a summary of what is contained on the sheets of each department; the totals on the department sheets need only be recorded on this form. This summary should be made in duplicate, the original bearing the signatures of persons mentioned on said form. After being completed this form is sent to the general auditor's office, where it is filed.

The duplicates of the departmental summaries are kept by the time-keeping department, where they are bound with wire staples to each departmental pay-roll record sheet, and filed according to date and department name and number.

The duplicate copy of the general summary is forwarded to the cost division in department No. 4, and the various items are taken from it, and entered against the respective division in each department, after which it is filed with similar copies according to date. This ends the pay-roll record until the annual inventory is taken, at which time this general summary is referred to for the purpose of making the annual report.

The Machine Shop.

In giving a detail of the system used in the machine shop, it may be divided under the following headings:

1. The importance of written orders.
2. Drawings.
3. Instruction cards.
4. Labor and Job cards.
5. Machinery.
6. The Tool-room.
7. Material.
8. Marking Table.
9. Finished parts.
10. Tests and reports.
11. Inspection and reports.
12. Assembling.
13. Final tests and reports.
14. Final inspection and reports.
15. Storing finished work.
16. Cost records and reports.

DETAILED LABOR and MACHINE COST-CARD

A. J. LAVOIE'S SYSTEM FORM NO. 122

NUMBER OF HOURS FOR EACH OPERATION

OPERATIONS	DAY WORK	OVER-TIME	BONUS	TOTAL
Total Hours for Above Operations				

Employe's Check No.	Rate per Hour		
Machine Number	Rate per Hour		
Burden Number	Rate per Hour		
Labor, Machine and Burden Cost per Hour . . .			
Labor, Machine and Burden Total Cost . . .			
Labor, Machine and Burden Cost of one Article			

Size of form, 3 in. x 5 in. exact size.
Color of printing to be the same as the other side of the form, wherever it may be used.

WORK MUST BE INSPECTED BEFORE IT LEAVES THE MACHINE OR BENCH

JOB NO.	*Drawing No.*	*List No.*	*Pattern No.*	*Production List No.*	*Material*
Name of Article			*Nos. of Articles Req.*		*Weight of One*

DATE	OPERATIONS	Number of Pieces Started	Number of Pieces Completed	Time Allowed	Time Taken	Sub-Foreman Ap'val	Ins-pector Ap'val

Employe's Check No.	*Machine Number*	*General Foreman's Approval*

A. J. LAVOIE'S SYSTEM FORM NO. 121. MACHINE SHOP DEPT NO. 5. JOB CARD

Size of form, 3 in. x 5 in. exact size.
Printed Red on 20 lb. White Color Bond Paper. Padded on top, cardboard back, ⅜ in. thick.

The Importance of Written Orders.

No department should take a verbal order from anyone, each order should be written and signed by the proper person, and unless signed it should not be accepted.

Upon receipt of the Production Office requisition, Form No. 29, (the manner in which this order should be prepared and issued has already been dealt with in Article VI. and VII.) the machine shop is now in a position to proceed with the work.

Drawings.

If the Production Office requisition calls for work that has been standardized, or similar to some that has already been done, drawings should be on file in the blue-print cabinet of the shop. If prints have been lost, or it is found necessary to replace them the method shown on chart No. 61 (Article No. VIII.) is to be followed. One blue-print from each drawing should be sent to the respective departments through which the work will pass, and the deliverer should receive a receipt for the same.

Instruction Card.

The preparation of form No. 11-12, together with advantages derived from the use of same, and the mode of issuing are dealt with in Article No. 111.

Labor.

All job cards, form No. 121-122, are prepared by the clerk in the general foreman's office, which clerk also has charge of the stores and tool-room ; in fact he does all the clerical work of the department. Upon receipt of Production Office requisition, form No. 29, the clerk will at once make out the job cards, form No. 121-122 in duplicate, at the same time consulting the instruction card, form No. 11-12, if any have been prepared. He will enter on the job card the instruction card number and, after consulting the foreman, will determine upon the mechanic who is to perform the work. He will then enter the workman's check number on the job card and place the original in a filing cabinet for that purpose, against the workman's check number. The duplicate job card is to be indexed in numerical order, under job number, and according to drawing number.

If no estimates have been prepared and no instruction cards issued, the foreman should select the mechanic and the machine to do the work, and instruct his clerk to specify the order in which the operations are to be done.

After the job cards have been prepared the next question is the instructing of the workman as to the work he is to do. Experience has shown that it is good practice to appoint some one to take care of mechanics' supplies, job cards, drawings, material, etc., as this relieves a high salaried foreman of detail and routine work, placing at his command valuable time in which he may go amongst his men giving personal attention to their requirements and advising them as to expeditious methods of getting out the work.

It has been found a good plan to relegate this work to an apprentice during his first year. In this way the beginner in the shop quickly becomes familiar with the names of tools, the various materials, the purpose of drawings, and gets an insight into the detail, and at the same time a comprehensive understanding of the trade he is learning. When he goes to the bench, or has to handle the material and machinery he will have a keener perception of his duties and a higher sense of responsibility than he would have done had he spent the first six months or year of his apprenticeship running errands, melting babbitt, and sweeping the shop floor, which duties are commonly given the apprentice to do in the average machine shop during the first year. It is not to be wondered at that there is a great demand for skilled artizans when the foundation of an apprentice's training is laid in this way.

When a workman is about to complete a job he calls an apprentice, gives him two of his checks, of which he has a number, and the apprentice carries these to the clerk in the foreman's office, who will take from his file the original job card allotted to the workman in question, and gives it to the apprentice, receiving as a receipt for same the workman's checks, of which one is deposited in the place previously occupied by the job card, and the other placed in the file in numerical order according to job number, until such time as the job card, form No. 121-122 is returned to the office.

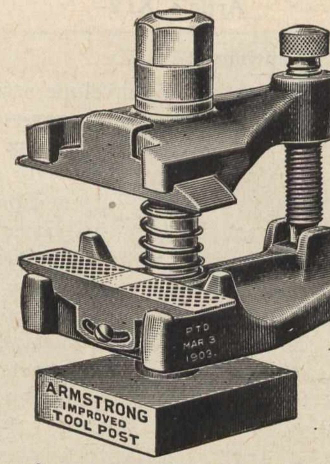
Upon receipt of the job card the apprentice will ask for the blue-print indicated on same, and in exchange will give another of the workman's checks, which is kept in the office until the blue-print is returned. The apprentice will then carry the job card and blue-print to the workman who, after looking over the same will give the apprentice a memorandum of the tools he requires, at the same time giving him as many checks as there are tools on the list. These checks are kept in the tool-room as receipts until the tools are returned, when they are returned to the workman. By means of these checks a record as to the whereabouts of the job cards, drawings and tools is always at hand.

(To be continued.)

W. P. Hansen, Lethbridge, will build a saw mill on the Belly River, at a cost of $50,000.

A NEW TOOL POST.

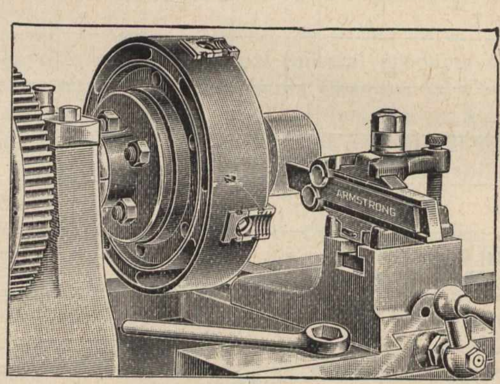
The improved tool post herewith illustrated combines in itself the strength and holding power of the strap, and steel tool clamp, and has the convenience of the open side and ordinary set-screw tool post. The design is clearly shown



Armstrong New Tool Post.

in the cuts. The body parts and jaws are of drop-forged steel, hardened; the other parts being of bar steel.

It is claimed that this post is much stronger and stiffer than the ordinary tool post, and on this account it will not slip or chatter, consequently doing more accurate work, and since there is no side projection it is possible to work very close to the chuck. It has considerable range of adjustment



without loss of holding power as the jaws are so arranged that they will adjust themselves on parallel lines, and the open side allows of rapid change or adjustment of tools. The jaws will not tear the shank of the tool, and, therefore, it is specially adapted for use with tool-holders. By means of a pair of V-blocks fitted to this Tool Post boring bars and similar tools of various diameters can be conveniently held as shown in above illustration.

THE FIRST AIR-BRAKE TRIAL.

The air-brake was ushered into actual use in most dramatic fashion. The trial trip occurred in April, 1869. The train selected was the Steubenville accommodation, running between Pittsburg and Steubenville, O. When the train was going at full speed, suddenly as he came around a sharp curve the engineer saw a stalled waggon in the middle of the track dead ahead. With hand brakes only, nothing could have prevented a terrible smash-up. The formal time for the trial of the air-brake had not come, but the brake was there, and in desperation, not believing for a moment that the thing could possibly avail, the engineer threw on the air. But it did avail. The observers in the rear were almost catapulted out of their seats by the shock of the sudden stop. But when they saw the engine fairly poking its nose into the waggon-bed, so narrow had been the margin between safety and disaster, they forgot all about their shock and stood in awed silence. The air-brake had come into its own.—" Everybody's Magazine."

COMPARATIVE COST OF ENERGY IN DIFFERENT FUELS.*

By Charles E. Lucke.

Different kinds of fuel contain different amounts of energy per pound—that is to say, they have different heating powers. In comparing, therefore, the value of fuels for power purposes there must be taken into consideration two facts—the market price of the fuel and the amount of heat which will be liberated when it is burned.

Anthracite coal in the neighborhood of New York can be bought in small sizes, large quantities for power purposes at about $2.50 per ton. This coal will contain about 12,500 B. t. u. per pound. This is equivalent to about 10,000,000 heat units per dollar. Large sizes, such as egg coal, containing about 14,000 B. t. u. per pound can be bought in large quantities for about $6.25 per ton, which is equivalent to 4,500,000 B. t. u. per dollar. Other grades of anthracite coal and the various grades and qualities of bituminous coal will lie between these two limits of cost.

Table I. Cost of Energy in Fuels.

Kind of fuel.	Cost of fuel.	British thermal units. (B. T. U.)	Number of B. T. U. bought for $1.
S. anth'cite.	$2.50 per ton......	12,500 per lb. ..	10,000,000
L. anth'cite.	6.25 per ton......	14,000 per lb. ...	4,500,000
Illum't'g gas	1.00 per 1,000 cu.ft.	550 per cu. ft.	550,000
Natural gas	.10 per 1,000 cu.ft.	1,000 per cu. ft.	10,000,000
Crude oil ..	.04 per gallon....	20,000 per lb. ..	3,650,000
Kerosene ...	.10 per gallon....	20,000 per lb. ..	1,200,000
Do . .	.30 per gallon....	20,000 per lb. ..	400,000
Gasoline . .	.10 per gallon....	20,000 per lb. ..	1,200,000
Do . .	.30 per gallon....	20,000 per lb. ..	400,000
Gr. alcohol	.30 per gallon....	12,000 per lb. ..	270,000
Do . . .	.40 per gallon....	12,000 per lb. ..	200,000

Illuminating gas in New York costs $1 per 1,000 cubic feet, which is equivalent to about 500,000 heat units per dollar. Natural gas in the Middle States is sold for 10 cents per 1,000 cubic feet and upward. This fuel at the minimum price will furnish about 10,000,000 heat units for a dollar.

Crude oil sells in the East at a minimum price of 4 cents a gallon, which is equivalent to about 4,000,000 heat units per dollar. Gasoline sells at a minimum price of 10 cents per gallon, which is equivalent to about 1,200,000 heat units per dollar. Kerosene sells from 10 to 30 cents per gallon, which is equivalent to 1,200,000 and 400,000 heat units per dollar, respectively.

Grain alcohol, such as has been freed from tax under the recent legislation, will sell for an unknown price; but for the purpose of comparison, assuming 30 cents a gallon as a minimum, it will give 270,000 heat units per dollar.

Gasoline, kerosene, crude oils, and, in fact, all of the distillates have about the same amount of heat per pound; therefore, at the same price per gallon, ignoring the slight difference in density, they would deliver to the consumer about the same amount of heat per dollar, whereas the other liquid fuel, alcohol, if sold at an equal price, would give the consumer only about three-fifths the amount of heat for the same money.

From the figures above given it appears that the cost of heat energy contained in the above fuels, at the fair market prices given, varies widely, lying between 200,000 heat units per dollar and 10,000,000 heat units per dollar. It is possible to buy eight times as much energy for a given amount of money in the form of cheap coal as in the form of low-priced gasoline, or twenty-five times as much as in the form of high-priced gasoline or kerosene. This being true, it might seem to a casual observer as rather strange that gasoline should be used at all, and the fact that it is used in competition with fuel of one-eighth to one-twentyfifth its cost shows clearly that either the gasoline engine has some characteristics not possessed by an engineer or plant using coal, which makes it able to do things the other cannot do, or that more of the heat it contains can be transformed into energy for useful work. Both of these things are true.

Thermal Efficiency.

If all the heat energy in fuel were transformed into work with no losses whatever in the mechanism, the machinery would be said to have a thermal efficiency of 100 per cent. and it would require 2,545 heat units an hour to maintain an output of 1 horse-power. If half of the energy in the fuel were lost in the machinery, its thermal efficiency would be said to be 50 per cent., and there would be required 5,000 heat units an hour. If only 1 per cent. of the heat energy in the fuel were transformed into useful work, the efficiency of the machinery or power plant would be said to be 1 per cent., and there would be required 254,500 heat units an hour to maintain 1 horse-power.

Table II. Fuel Cost of Power.

Fuel and type of plant.	Fuel required per H.P. per hour.	British thermal units required per H.P. hour.	Thermal efficiency. Per cent.	Cost of fuel.	Cost of fuel per H.P. per hour. Cents.
Anthracite coal:					
Large steam plant	2 lbs...	25,000	10	$2.50 per ton	0.25
Do	2 lbs...	25,000	10	6.25 per ton	.57
Small steam plant	7 lbs...	100,000	2½	2.50 per ton	1.00
Do	7 lbs...	100,000	2½	6.25 per ton	2.20
Producer gas plant	1¼ lbs.	14,000	18	2.50 per ton	.14
Do	1¼ lbs.	14,000	18	6.25 per ton	.31
Do	2 lbs...	25,000	10	2.50 per ton	.25
Do	2 lbs...	25,000	10	6.25 per ton	.57
Illuminating gas . .	24 cu. ft.	12,000	20	1.00 per 1,000 cu. ft.	2.20
Crude oil	1.4 pints.	25,000	10	.04 per gallon ..	.68
Gasoline	1.1 pints.	13,400	19	.15 per gallon ..	1.70
Do	1.1 pints.	13,400	19	.30 per gallon ..	3.40
Alcohol		......	*19	.30 per gallon . .	5.00
Do		....	*19	.40 per gallon ..	6.70

* Efficiency of alcohol is assumed to be the same as that of gasoline for identical conditions of use.

Steam-power plants are built to-day to do every conceivable sort of work, and range in size from 1 horse-power to 100,000 horse-power. For purposes of comparison neither the largest nor the smallest should be used, nor the best performance nor the worst performance of these plants, but a figure representing a fair average for the conditions named should be taken.

Large steam plants in their daily work seldom use less than 2 pounds of poor coal an hour for each useful horse-power (known as the brake horse-power), which is equivalent to about 25,000 B. t. u. an hour, and which corresponds to about 10 per cent. thermal efficiency. Small steam plants working intermittently, such as hoisting engines, may use as high as 7 pounds of coal per brake horse-power, which is equivalent to about 100,000 heat units per brake horse-power-

*From a Bulletin of the United States Department of Agriculture.

hour, or 2.5 per cent. thermal efficiency. Some plants will do better than the above with proper conditions, and some may do worse, but in general it may be said that the performances of steam plants lie between the limits of 2.5 and 10 per cent. thermal efficiency.

Plants consisting of gas producers for transforming coal into gas for use in gas engines have in general a much higher thermal efficiency than steam plants doing the same work. They are, however, not built quite so small as steam plants, the smallest being about 25 horse-power, and in general they have not been built so large, the largest being only a few thousand horse-power. Their efficiency, however, does not vary so much as is the case with steam plants. It may be fair to say that under the same conditions as previously outlined these plants will use 1.25 to 2 pounds of coal of fair or poor quality per brake horse-power-hour, which gives a thermal efficiency ranging from 18 to 10 per cent. These plants can be made to do much better than this, and perhaps may do worse, although the variation is not nearly so great as for steam plants.

Gas engines operating on natural gas or on illuminating gas from city mains will, on fluctuation of load with the regular work, average about 12,000 heat units per brake horse-power-hour, or 20 per cent. thermal efficiency. Explosion engines operating on crude oil will average about 25,000 heat units per brake horse-power-hour, which is equivalent to about 10 per cent. thermal efficiency. Explosion engines using gasoline should operate at a thermal efficiency of about 19 per cent. under similar operating conditions.

The efficiency of an alcohol engine may be assumed at this time to be unknown, but as alcohol can be burned in engines designed for gasoline, it may be assumed that such an engine will have with alcohol fuel the same thermal efficiency as with gasoline, to wit, 19 per cent. for fair working conditions.

From the above brief discussion of the efficiency of different methods of power generation from different fuels it appears that quite a range is possible, though not so great a range as exists in the case of cost of fuel energy. Efficiency is seen to lie somewhere between 2½ and 20 per cent. for all the fuels under working conditions. It is known that actual thermal efficiency under bad conditions may be less than 1 per cent., and under the best conditions as high as 40 per cent. but these are rare and unusual cases.

The range given is sufficient to indicate that a highly efficient method may make the fuel cost per unit of power less with quite expensive fuel than it would be with cheaper fuel used in a less efficient machine. It is also perfectly clear that without proper information on the efficiency of the machine or the efficiency of the plant it is impossible to tell what the cost of fuel per horse-power-hour will be, even though the price of the fuel per ton or per gallon be known. From the figures given on the cost of fuel and a fair average for plant efficiency the cost of fuel per horsepower-hour is computed as given in the preceding tables.

ELECTRIC RAILWAY STATISTICS OF CANADA.

According to the annual report of the Department of Railways and Canals of Canada, there were in operation at the close of the fiscal year ended June 30, 1906, 814 miles of electric railway, 195 miles being double-tracked. The paid-up capital amounted to $63,857,070. The gross earnings aggregated $10,966,872, an increase of $1,609,747, and the working expenses $6,675,038, an increase of $756,844, leaving the net earnings $4,291,834, an increase of $852,903. The number of passengers carried was 237,655,074, an increase of 34,187,757, and the freight carried amounted to 506,024 tons, a decrease of 4,326 tons. The car mileage was 56,618,836 an increase of 4,659,735 miles. The accident returns show a total of 47 persons killed during the year, and 1,653 persons injured. Power was supplied in 15 cases by water, and in 41 cases by steam. Ontario has 441 miles, Quebec, 198, New Brunswick, 16, Nova Scotia, 54, Manitoba, 32, and British Columbia, 72 miles. Returns were received from forty-seven companies.

THE ANCHOR ARMS OF THE QUEBEC BRIDGE.

The bridge in course of construction across the St. Lawrence river, near Quebec, is 2,800 feet long between centers of anchorages, and will have a total width of 82 feet. It is designed to carry two railroad tracks, two highways, and two electric car tracks on a single deck about 160 feet high above extreme low water. The 1,800 feet cantilever span across the channel is flanked by two 500 feet anchor arm spans, each of which weighs about 12,500,000 lbs.

The erection of the south anchor arm on fixed falsework was completed last summer. Some of the details are entirely novel, and all are of interest on account of their dimensions, many of them unprecedented.

Work on them has been in almost constant progress for about four years, and they have been made to conform to a rigid analysis of conditions, to elaborate computations, and to the requirements of the highest grade of shop work. They have also been adapted to the greatest safety, facility, and rapidity of field erection, and have been proportioned to secure the greatest rigidity in the structure consistent with economical weight. Indeterminate stresses have been avoided, and members are proportioned strictly according to the actual service which they will perform under assumed maximum conditions. The great capacity and unprecedented dimensions of the bridge have therefore involved such high stresses in large members that the latter have exceeded all previous limits for shop built pieces ; it has been necessary to provide unusual sections, some of them very massive and some of them limited only by the restrictions of transportation and by the maxima of commercial manufacture of steel plates and sections employed.

The main trusses are in vertical planes 67 feet apart, the top and bottom chords are segments of parbolic curves, intended to combine a graceful outline with theoretical requirements for depth. They carry the single-deck floor on a 1 per cent. grade up from the level of the bottom chord at the anchorage to a point 120 feet above the top of the main pier. The depth of the trusses increases from about 97 feet on the centers at the anchorage to 315 feet at the main pier. They are divided into five 100-feet main panels, or ten 50-feet sub-panels, each main panel being subdivided in two 50-feet panels. Alternate sub-panels have horizontal struts and counter diagonal struts stiffening the main web members. An important feature of the design is the use of separate pins at each main panel point top and bottom for the connections of chords and tension diagonals with the vertical posts. This arrangement greatly reduces the bending moments and consequently reduces the sizes of the pins, and facilitates assembling the members during field erection.

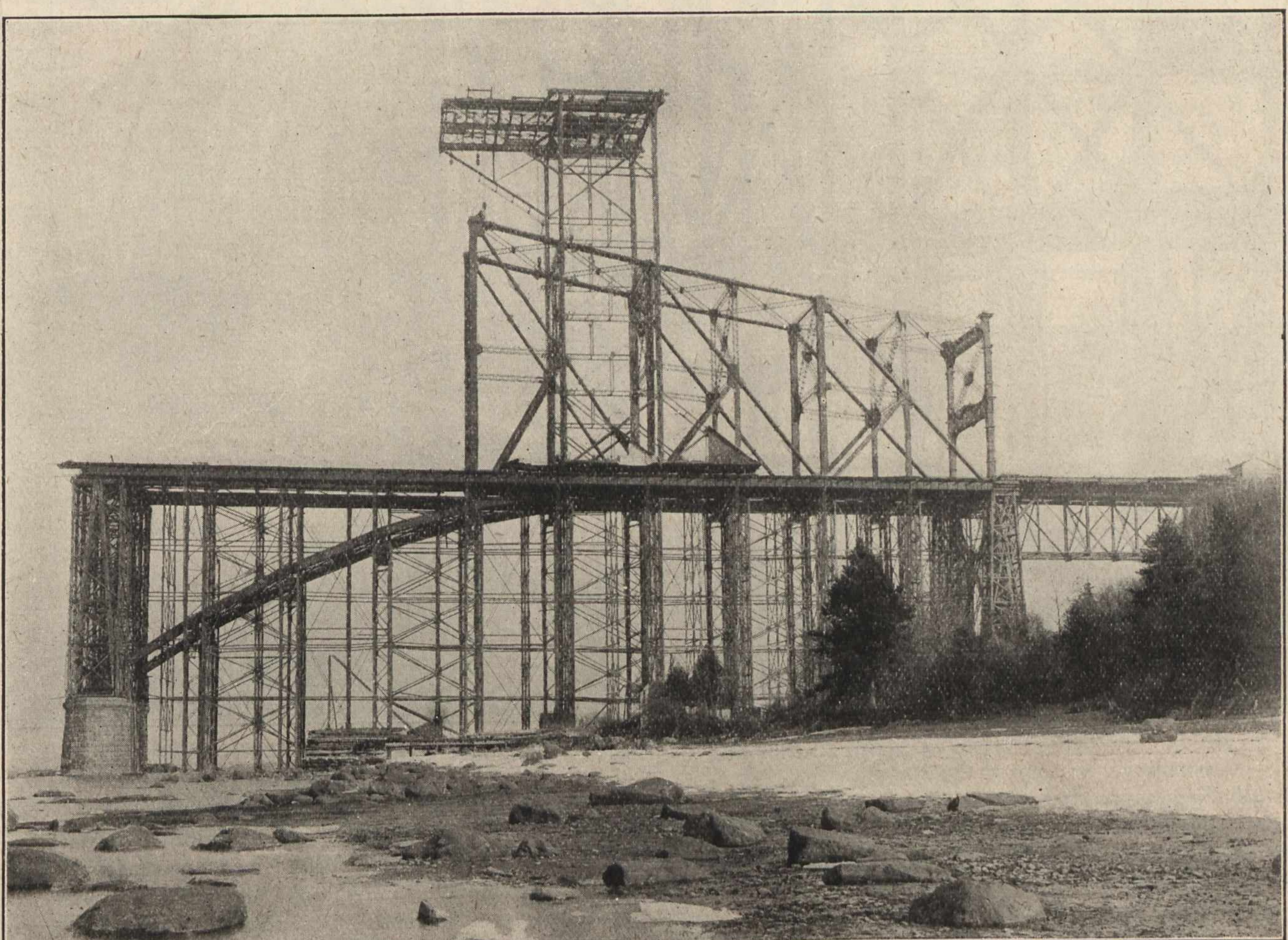
The trusses have lateral bracing in the planes of the top and bottom chords and in the floor system. The top lateral system is composed of transverse struts and X-braces in every panel, all riveted between horizontal connection plates at the tops of the vertical posts. The struts have rectangular cross-sections made with four angles latticed on all sides. The X-braces have I-shaped cross-sections, made with two pairs of angles back to back, latticed, one brace being cut to clear the other at the intersection, where both are field-riveted betwen top and bottom flange cover plates. The lower lateral system consists of transverse struts and X-braces in each panel ; the former are pairs of built channels with vertical webs, flanges turned in and latticed ; the latter have each flange built of two angles and one cover plate, 26 inches wide, the two flanges connected by latticing in two vertical planes, the connections corresponding with those of the top laterals. The floor system consists of floor-beams at panel points, supporting twelve lines of web-connected stringers, all braced together with zigzag angles in the planes of their top and bottom flanges.

Tranverse swaybracing is provided in their planes of all the vertical posts, and is arranged in one or two panels above the roadway, and one or two panels below it. The horizontal struts and X-braces all have rectangular cross-sections built of four angles latticed on all sides ; they are field riveted at their intersections and at the ends between wide and heavy jaw plates, which also serve as splice plates for the vertical posts and have their edges curved to give a pleasing effect to the structure. Those above the roadway have uniform cross-sections made of four 4 x 4 inch angles. Below the roadway the trussed floor beams form part of the X-brace members in the upper panels, and those in the lower panels have I-shaped cross-sections made with two pairs of angles back to back, latticed.

All chord members are made in single panel lengths, varying from 50 feet on centers at the anchorage to over 60 feet at the pier, where they are most steeply inclined. The top chord proper is composed entirely of 15-inch eyebars from 1½ to 2 1-16 inches in thickness. The bottom chord has a rectangular cross-section about 4½ feet deep and 5½ feet wide over all, made of four built channels having their flanges latticed with angle bars. The direction of the bottom chord changes at the pin centres ; to facilitate erection, a short section of the adjacent chord is shop riveted to each following chord piece to provide a field splice clear of the panel point beyond it on the river side. All vertical posts except the main posts over the pier are made of two engage the main pins. All of the chord pins, except those at the top and bottom of the main vertical post are 12 inches in diameter, and have maximum lengths of over 10 feet.

In order to secure a more pleasing appearance in side elevation, the line of the top chord is produced, from the top of the end inclined tie to the centre of the anchorage pier, by means of false members which intersect an ornamental portal. All of these members are built of light angles, latticed, since they do not carry any dead or live load stress.

The dead load of the bridge is so great that the cantilever will always produce an upward resultant at the shore end of the anchor truss ; the vertical anchorage bars there will always be under tension, varying with the live load ; and the anchor piers will not receive any weight from the bridge, all of it being concentrated on the pedestals of the main pier. There will, however, be a heavy wind stress transmitted to the anchor piers that will have a considerable vertical resultant. This stress is delivered by the lateral systems to the end floorbeams, and thence is transferred through the tower-like vertical members to the top of the



South Anchor Arm Under Construction.

built channels in the planes of the trusses with their flanges latticed, and are field spliced at one or two points. The sub-posts intersecting the tension diagonals are provided with pairs of extended flange plates to receive the latter members on separate pins at each side of the vertical posts. The main vertical post is made up of four built I-beams having 48-inch webs, 8 x 6 inch flange angles, and 7 x ¾ inch inside flange reinforcement plates.

The tension diagonals are made of two lengths of 15-inch eyebars extending together across two panels and connected as already stated to separate pins on opposite sides of the intersecting vertical posts. The diagonal nearest the main pier is a compression member calculated for compression as well as tension. It requires a net cross section of 144 square inches, which is made of four 6 x 6 x 31.8-lb. angles, and four 44 x 11-16 inch web plates. The short vertical and horizontal struts in alternate panels, and the sub-vertical posts reaching from the intersections of the vertical and diagonal members to the top chords to support the latter are made of four angles latticed on four sides and have riveted connections except at the top chord, where they piers, where it is taken by the anchor eyebars and distributed through the pier masonry.

The main chord pins are fitted with a clearance of 3-64 inch and 1-16 inch clearance is allowed for each eyebar in packing. All the riveted splices and main connections have field rivet holes drilled to cast iron templates, and all splice plates are shop fitted and matchmarked. Great care has been taken in checking the drawings and inspecting the shop work ; this has resulted in such accuracy that the south anchor arm already erected has been assembled in the field without difficulty and without fitting or alterations.

All material used is open hearth steel, soft or medium, and is sub-punched and reamed for all riveted work. The 15-inch eyebars have heads 36 inches in diameter and not more than ⅛-inch thicker than the body of the bar. They are upset in three heats and finished under a 12,000 lb. steam hammer ; their annealing is done in about 12 hours in wood furnace. Several full-size tests have been made ; the bars have developed a total ultimate strength of about 58,000 lbs. per square inch and an elongation of 20 per cent. in a measured distance of 18 feet. These results correspond very well with an average of 66,000 lb. ultimate strength, 36,000 lb. elastic limit, and 25 per cent. elongation in small test specimens. None of the bars tested to destruction were broken in the head, and it is believed that great uniformity has been secured in their manufacture.

The vertical posts are shop riveted in lengths of from 45 to 77 feet, and field connections are made with main pins up to 24 inch diameter, and with 500,000 ⅞-inch and 1 inch field driven rivets, and 10,000 turned bolts.

It is interesting to note that in the 1,710 feet spans of the Forth Bridge, which is entirely of riveted construction

View of South Anchor and Cantilever Arm Under Construc tion.

with tubular compression members 12 feet in diameter, built up piecemeal in position, there is 9½ lb. dead load for every pound of live load, while in this longer pin-connected span with shop built members the proportion of dead to live load is only 4⅓ : 1.

The south cantilever arm containing 10 panels was erected last year to the point where the south end of the suspended span will be connected.

The photographs show the erection traveller in position, the traveller track for the cantilever arm being carried on temporary floor beams suspended from the lower chord pins which project for that purpose.

The bridge is being built by the Phoenix Bridge Company, Phoenixville, Pa., for the Quebec Bridge and Railway Company, under the direction of Mr. E. A. Hoare, the company's chief engineer.

THE ENGINEER, HIS SCOPE AND QUALIFICATIONS.*

By John Hays Hammond.

This is the era of the engineer. To her supremacy in the industrial art, rather than to the triumphs of diplomacy and of war, America owes her recognized position in the forerank of the nations of the world. Therefore, it is not an idle boast to claim for the engineering profession a large, if not, indeed, the chief part in this attainment. Not only in the development of new spheres of activity, but among the pioneers of civilization itself, the engineer has been ever in the van. First, as the mining engineer in quest of gold, and then followed his confreres, the civil, the mechanical, and the electrical engineers in turn.

Though, as I have said, the engineering profession has done much to promote the welfare of mankind, there has been, I think, a wholly inadequate appreciation of its services.

I do not wish to lay myself open to the imputation of commercialism by intimating that success can be best reckoned in dollars and cents. But nevertheless, I do confess my conviction that money is an important consideration in the measure of accomplishment. I hasten to disclaim, however, any intention to disparage the admirable work done by engineers sometimes in a position where the guerdon lies not in the pecuniary recompense, but in the winning of fame, which is, indeed, more precious than any other testimonial of success. Notwithstanding this reservation, I believe that we owe it to our profession to insist upon a fair monetary compensation for our service as engineers.

In common with that of the wage-earner, the remuneration of the engineer is determined largely by the law of supply and demand. Until within the past few years there has been a superabundance of engineers, and the shrewd business man has not been slow to take advantage of the situation to cut down salaries and fees. To prevent the recurrence of this condition and the consequent professional congestion—if I may use the term—I advocate the extension of the scope of the engineer. I would have him invade the sphere now monopolized by the employer and the capitalist, and eventually become, in fact, himself the master, for I cannot see wherein a technical education per se should deprive a man of business aptitude.

Contrariwise, it is not unreasonable to believe that a man equipped with technical education, supplemented by experience and a knowledge of business methods, is far better able to promote and to manage industrial enterprises than the so-called practical man of business. A business

* The California Journal of Technology.

man who has the requisite technical knowledge to become his own engineer has as great an advantage over the non-technical business man as has one speaking a certain foreign language over his less fortunate competitor, who must obtain the services of an interpreter in the conduct of negotiations in that tongue.

In other words, where the engineer himself has the direction of the financial, the commercial and the technical departments of an industrial enterprise, there is a prevention of what I might call the lost motion that obtains under the present system.

Following the procedure indicated, not only would there be greater opportunities for the engineer, but there would also be introduced into the financial management of industrial enterprises a conservatism and an honesty of purpose which unfortunately does not always now obtain.

This suggestion may seem somewhat visionary to those who have followed the conventional lines of the past; but, having observed the success that has rewarded the efforts of the mining engineer in this direction, I am emphatic in advocating the extension of the principle to all branches of engineering.

Until recently the mining engineer has also submissively borne the employer's yoke, and accepted whatever compensation was vouchsafed to him by the not always liberally disposed capitalist. Latterly a new era has dawned.

The mining engineer has at last struck for more equitable treatment, and as a result is now able to look forward to become eventually a partner, rather than to continue indefinitely as an employee in the enterprise under his direction.

This he expects to accomplish by serving at first his apprenticeship strictly in the position of an engineer, and by subsequently rendering his professional services for an interest in the profits of the business.

Obviously, all engineers do not possess the qualifications requisite for commercial success. But they will not, I believe, be found more generally lacking in these essentials than is the average man of affairs. You quite naturally might ask how this plan meets the views of the employer. Does he regard it as antagonistic to his interests and to be resisted by him? Having in mind the experience of the mining engineer, I answer decidedly not, but, on the contrary, that the plan is one which strongly commends itself to the employer, for the reason that such a business arrangement not only assures the loyal co-operation of the engineer, but secures his undivided and constant endeavors in furtherance of what thus becomes the mutual interest of the employer and engineer. This phase of your professional opportunity is, in my judgment, of paramount importance, and I commend its favorable consideration to those to-day embarking on their career. Verbum sap.

The question is often asked, What are the essentials of professional success, and whether a special aptitude in mathematics, mechanics, or other branches should not ensure a successful career? To this question I have always replied that, while those who have exceptional ability in the mastery of the studies of the curriculum are greatly favored, and while, further, a technical education is in itself indispensable, I would nevertheless rate these qualifications far lower in the scale of relative importance than the individual character of the engineer.

First, then, and above all other considerations, I would place the possession of character. An honest, clean-cut, straightforward, conscientious young fellow, ambitious, persevering, and last, but by no means least, level-headed, would, to my judgment, possess seventy-five per cent. of the essentials of success; while in relative importance I would not attach more than twenty-five per cent. to the possession of a technical education. And I say this without in any degree depreciating the inestimable value of a technical education.

Without character the monument of the engineer would be as unstable as an edifice where the mortar is deficient in lime. Therefore, I urge you to persevere in the development of character in its widest sense, and especially ever to be jealous of your reputation for integrity.

Where ye feel your honor grip,
Let that aye be your border.

There are two critical epochs in a man's career. First, when he graduates and starts on his life's work. A start in the right direction is all-important. The Germans have a proverb illustrative of this:—

Gut begonnen:
Halb gewonnen.

One of the greatest enemies of success, as you have been told times innumerable (but this fact should not deter me from repeating it) is conceit—that kind of conceit which manifests itself in what is aptly, if not elegantly, called "the big head." It is not the dolichocephalous nor the brachycephalous kind, referred to by phrenologists, for, in spite of the paradox, it comes rather under the category of the "pinhead." Whatever the shape may be, a small quantity and inferior quality of brain matter is characteristic of the disease.

There are many "big heads" graduated from college every year, but when the disease is not eradicated or checked, the victims are soon "sized up" by the discriminating public and forthwith relegated to the category of mediocrity, and thenceforth are but laggards, soon lost sight of in the race of life.

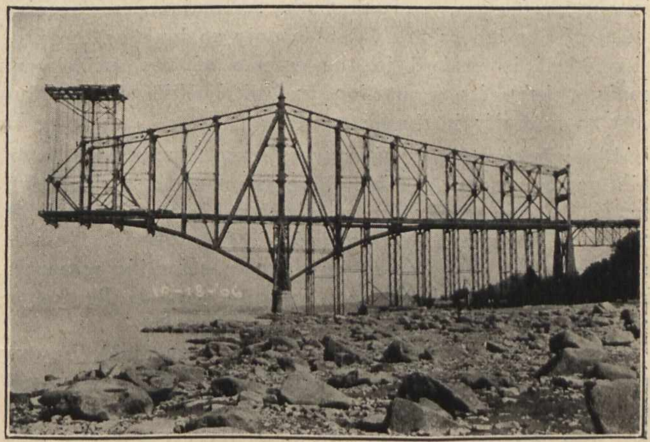
The disease is sometimes also latent, and does not develop in a dangerous, nor even to an obnoxious, degree until later in life—usually at the time of some transient success, commonly of the financial kind, whereupon it often develops with extraordinary rapidity. This is the second critical epoch.

It was the inimitable "Touchstone" who said: "Call me not fool till Heaven has sent me Fortune."

The "big head" that has attained this temporary, or more likely merely fancied, success has reached the highest point of his self-conceded glory, and, like Lucifer, falls, never to rise again. For the rest of mankind it is a very fortunate effacement.

This disease is fortunately rare among the graduates of scientific schools, for there the subjects taught provide in themselves correctives of conceit.

You may rely upon it that the demeanor of the successful man is the absolute index of his mind and character. The really great man who achieves genuine success is of all men the most modest as to his accomplishment. He has, of course, which is proper and desirable, a self-respect, and also pride in his achievements, but he is not the least conscious that this success has been due to any greatness



Quebec Bridge.—South Cantilever Arm.

on his part, ascribing it rather to that kind of genius that is synonymous with honesty of purpose and indefatigable endeavor.

The truly great man knows how insignificant are his achievements compared with the work before him, and would say, as did Cecil Rhodes on his deathbed—a truly great man, and one of the most modest whom I have known—"So little done, so much to do."

After safely escaping the crisis referred to, keep on raising the monument of your success. The higher the monument, the broader must be the base, for you will find it indispensable as you are brought in contact with men of greater importance in your day's work to possess a wide knowledge of many subjects that cannot be included in the curriculum of the technical schools.

You should, therefore, complement your technical education by a study of the humanities, since you shall find the possession of a capacious rather than a subtle mind to be of incomparable advantage.

Finally, if you have "taken the current when it serves you," you will obtain that success which will not only prove a gratification to yourself, but a source of pride to your ever-solicitous Alma Mater. But should untoward circumstances intervene to frustrate your endeavors, you will at least find solace in the reflection, "'Tis not in mortals to command success, but we'll do more, Sempronius, we'll deserve it"; or, perhaps, expressed in the sententious, if uncouth, language of the cowboy: "Life ain't in holding a good hand, but in playing a poor hand well."

Now, as to your duties: You have obligations not only to your profession, but to the community in which you live. Fortunately for yourselves and your fellowmen, you do not belong to that pitiable and yet despicable class of idle rich that are born to lead a life of indolent contentment, an existence worse than negative, inasmuch as its example is enervating and demoralizing.

Our condemnation of idleness must not involve our approbation of that spirit of hyperstrenuousness that has obsessed not only our days of toil, but our hours of recreation as well. But that is another story.

We professional men are so much occupied with our technical work that we are inclined to neglect the political and social affairs of the community in which we live, as well as the larger political and social problems of our country. We are not actuated by higher motives, our own self-interests at least should impel us to concern ourselves with these matters, since upon the well-being of the body politic and the welfare of the country in general depends the status of our own vocation.

As engineers, individually and collectively, we should set a high moral standard, not only in our professional ethics, but in our civic relations as well. Moreover, we should not be satisfied with the mere example of negative honesty in our lives, but we should be aggressive against all forms of corruption, especially, of course, in our professional field, where our confreres should be held strictly to account for all transactions that tend to discredit our profession. For we must constantly keep in mind the fact that it is our profession, and that the encomiums we receive because of our labors are valuable only so long as the profession itself is exalted in the esteem of our fellowmen. Therefore, keep its reputation unsullied while doing your utmost to magnify its importance.

Although there are, of course, some black sheep even within our engineering fold, there is, nevertheless, among scientific men generally, an unquestionable predilection for rectitude to an extent that is, indeed, sui generis. This is due to the many years spent by them in scientific research, which inculcates a veritable zeal for truth, even to the degree of what Huxley calls a "fanaticism for veracity."

While we must be exacting, as I have said, in our demand for high-grade professional morality, we must not forget that it is also our duty to encourage and to sustain those who are striving to win new laurels for our profession.

The unintelligent, unjust, and sometimes, indeed, dishonest criticism of the work being done on the Panama Canal comes to my mind in this connection.

We engineers can sympathize with our confreres who, despite the importunate demands for greater haste, insist upon a thorough study of the problems presented before beginning operations which otherwise might jeopardize the ultimate success of this, the greatest engineering work yet attempted by man.

There is a deplorable prevalence in these times of a class in the community to whom President Roosevelt referred as "muck-rakers." These men constantly scoff at public virtue, and feel an ill-concealed gratification in the discovery of scandals affecting men of prominence, especially in Governmental positions.

These degenerates should be treated as social abominations, for they are closely allied to the dangerous class of Anarchists and Nihilists, who are allowed to breed and to hatch nefarious plots with perfect impunity within the borders of our unwisely tolerant country.

Let us rather incline to idealism and to become hero-worshippers than to yield to the tendency to be hyper-critical, or to run the risk of being tainted with "muck-rakism." It is so much easier to criticize and to point out the defects than it is to conceive and to elaborate undertakings of importance. As Bacon says: "There are no reports more readily believed than those that disparage genius and soothe the envy of conscious mediocrity." Reform is now the popular theme of our statesmen, and the ban of public opinion is fortunately emphatically against dishonest methods in business as well as in public life.

We should, of course, give our hearty support to these measures of reform, but let us do it deliberately, moderately, and persistently, rather than by hysterical, paroxysmal, and short-lived efforts.

With this final admonition I leave you:

> This above all: To thine own self be true,
> And it must follow, as the night the day,
> Thou canst not then be false to any man.

UNION STATION PROPOSED FOR TORONTO.

Plans have now been completed by the Grand Trunk and Canadian Pacific Railways for the new union station to be constructed at Toronto, the illustrations and descriptions of which have kindly been sent us by Mr. R. S. Logan, Assistant to the Second Vice-President of the Grand Trunk Railway. A tract of land has been secured on Front Street West, near the present depot, for the building of the new station. This site is bounded on the north by Front Street, west by York Street, and on the south by Esplanade Street, which street, when the station is built, will be closed from the west side of Yonge Street. On the general lay out plan the southerly boundary of the new portion of the land is shown by the dotted lines. It is estimated that this station, including the land, will cost about $2,000,000 .

The proposed passenger train station building, including baggage buildings and service plant, are to be erected on the southerly side of Front Street, between York and Bay Street, and will occupy the entire frontage between these streets. the express building now existing west of York Street will be retained for the express service of the Grand Trunk, and a new express building of similar dimensions and with the same general relation to the passenger building will be erected east of Bay Street for the express service of the Canadian Pacific. The northerly line of the passenger buildings is to be generally 65 ft. from the southerly line of Front Street, leaving a plaza of this width for carriage and foot walk purposes. The station building is generally 100 ft. wide, and between the building and the tracks there is a concourse 90 ft. wide for the general circulation of passengers.

The track layout consists of nine through tracks and two stub tracks, so arranged that there are five platforms for passengers and two platforms for the exclusive trucking of baggage and express matter. The station tracks are connected up at each end with an interlocking switching system so that they properly join the four main tracks on the east and the two main tracks on the west, generally with double-track leads, to give the greatest facility to the train movements. The passenger platforms will be 1,400 ft. long, this distance being sufficient for the longest trains, though it may be increased if found necessary. They are about 20 ft. wide throughout.

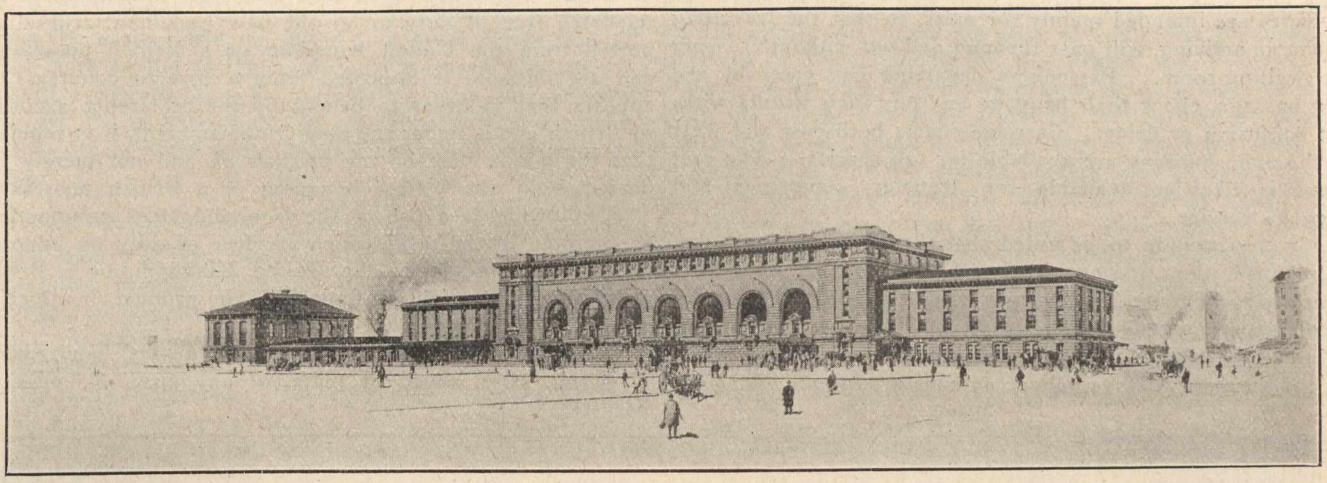
The new tracks at a point opposite the centre of the station will be 4 ft. higher than the present tracks, and the platforms are designed to be 8 in. above the top of the rail. This gives a difference of level of about 5 ft. between the grade of the platform and the grade of Front Street, which difference is overcome by three steps at the waiting room entrance and inclined surfaces transversely on the concourse between the tracks and the station, and on the plaza between the station and Front Street. None of the inclined surfaces exceed a slope of ⅜-in. per foot. The passages for exit are without any steps whatever. By this arrangement the station and platforms are, in effect, level with the street, a condition which permits of the best possible treatment of any type of a railroad station.

In order to accomplish this it has been found necessary to provide for the removal of the present York Street overhead bridge and to substitute for it an overhead bridge just east of Bay Street. It is also suggested that this latter bridge can be made to take care of the traffic at the Yonge Street grade crossing, so that the necessity of a bridge at the latter street can be avoided. Foot bridges at any necessary point of crossing can be built without interfering with the raising of the tracks.

In order that it may not be necessary for any passenger to go upon any track at grade, and to make the station absolutely safe and fully up to modern methods and requirements, a subway 50 ft. wide is provided opposite the centre of the station, so that any platform may be reached by means of easy stairways with landings. The total height of stairways for this purpose is about 10 ft. This method allows all trains to come to a stop directly opposite the centre of the station, thus making the least distance for passengers to walk to and from the station and trains.

The baggage and express trucks are to be kept as much as possible on special trucking platforms, 10 ft. wide, which extend the whole length of the station, and which are adjacent to four of the nine through tracks. On these four tracks it is intended that trains having the bulk of express and baggage matter will be run. The baggage and express trucks cross the track area by subways beneath the tracks and leading to the basement of the baggage and express buildings. The trucks will be raised and lowered between the subways and the platforms by means of electric elevators. There are three of these cross subways, one leading to the baggage-room, one to the express building at the east end, and one to the express building at the west end of the station.

A train-shed roof will cover the main portion of the platforms and the concourse. It will be 800 ft. long by 315 ft. wide, covering about six acres. The main structure will be in three spans and there will be a connecting roof between the train-shed and the station building. This roof will be a steel structure and will be lighted and ventilated.



Front Elevation.

At each end of the station concourse are spaces for a carriage court, for the accommodation of cabs, carriages, and baggage transfer wagons, so that it will not be necessary to pass through the station building to get a carriage.

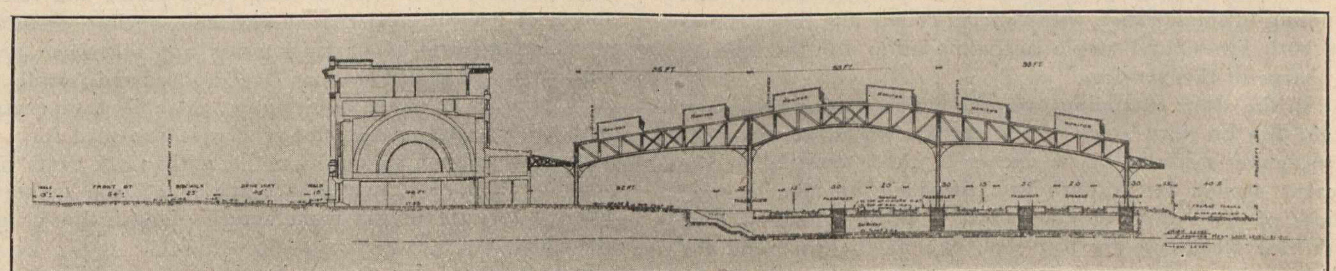
At the extreme easterly end of the station a service building is provided for supplying all heat, light, steam, hot water, compressed air, refrigeration, etc., for the use of the station building and trains.

The general layout of the station yards and grounds, including the approach tracks, does not interfere in any way with the present freight yards of either railroad company.

The station building is planned primarily with a view to convenience and spaciousness, and consists of a main central building with two service wings. In the main building, on a level with the tracks, is located the general waiting room containing 17,242 square feet, which is 5,000 square feet larger in area than the Grand Central Station of New York City, or the present station in Toronto. Access to the waiting room is obtained directly by three spacious openings containing nine doors each directly from the plaza, or Front Street. Egress to the trains is obtained by three similar openings, containing each nine doors, leading to the concourse.

Ticket, telegraph and telephone booth, information bureau, news stands, ample parcel room and other conveniences are provided along the four sides of the waiting-room, where they are easily accessible and visible.

A broad passage at the east end leads directly to the baggage-room, which is located in the east service wing. The area of this room, including the basement and first floor, is 28,000 sq. ft., or 15,000 sq. ft. larger than the present baggage



Cross Section Through Centre of Main Waiting Room and Passenger Subway, Showing Construction of Train Shed.

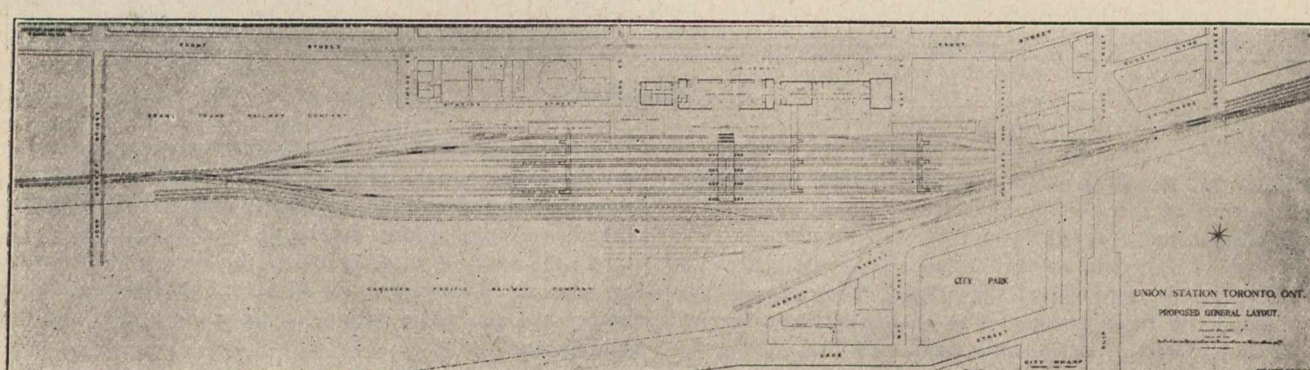
room, and 6,000 sq. ft. larger than the baggage-room at the Grand Central Station of New York, which is one of the largest in the United States. A similar passage at the west end of the waiting-room leads directly to the west service wing, in which are located waiting-rooms for men and women, each provided with ample toilet accommodations, the women having in addition retiring rooms. Barber shop, boot blacks, and other conveniences, together with a well-equipped, spacious lunch counter, are likewise provided in this section of the building.

Spacious passages running north and south are placed at each end of the waiting-room, between the waiting-room and the baggage-room on the east, and between the waiting-room and service wing just mentioned on the west. These passages are intended mainly for exits, so that the travelling public, in arriving, will pass through and out without crossing the waiting-room. Passengers departing can enter by the east passage, check their baggage and buy their tickets without confusion or delay. Carriage courts both east and west of the main building are available for cab service. The east court is likewise available for transfer companies and baggage service.

It is especially to be noted that the main waiting-room, as planned, cannot conveniently be used as a thoroughfare, which will increase its efficiency and comfort. This main waiting-room extends to a height of three storeys, and is lighted by 14 large windows, seven on the north and seven on the south. A large gallery extends around all four sides of the room at the height of the second story of the service wings, the north gallery giving access to a series of roomy offices for the use of the employees directly in charge of the station traffic. On this floor in the west wing is a large dining room, serving rooms, kitchen and all accessories. In the east wing is a large hall for the segregation and handling of immigrants, with retiring-rooms and toilet rooms for both sexes, and ample accommodation for the officers in charge of this service.

In the story extending over the entire waiting-room and in the top or third story of the service wings, accommodations, about 6,000 sq. ft. in excess of those existing in the present station in Toronto are provided for the general offices of both railroad companies. Two staircases, each with two elevators, are provided, one at the east and the other at the west end of the main waiting-room, giving access to the galleries, offices and other service.

The architectural treatment of the exterior is designed with a view of obtaining a monumental effect in a simple, dignified and reposeful manner; of expressing clearly on the exterior the function of each part of the building on the interior. Thus, the main waiting-room is clearly suggested by the large windows and the solid basement treatment, the wings indicating clearly the subordinate function which they have to perform; so likewise the baggage and service buildings. The treatment will be maintained on the interior of the building on the same lines. The style of architecture is classic, and though inspired as to detail from the fine examples of the eighteenth century, is treated so as to be distinctly modern in its expression and to clearly indicate the purpose of the building as a whole, and of each part of the building as well. It is intended to build the exterior of some light stone.



General Layout.

ENGINEERING NEWS FROM GREAT BRITAIN.

(From Our Own Correspondent.)

New Canadian Tariff. London, May 23rd.

There are certain questions in the House of Commons to which the responsible ministers of the Government do not answer orally, and the tendency of such answers which are printed and circulated amongst the members, is to become buried amidst a mass of other matters and sometimes never come to light. I have received one such question and answer, and give it below. The President of the Board of Trade was asked what iron and steel manufactures are imported free of duty under the new Canadian tariff if imported from the United Kingdom or a British possession, and are dutiable if imported from a foreign country. It appears that in order to benefit by the preference accorded to British goods under the new Canadian tariff, it is requisite that the goods shall be the product of, and not merely imported from, the United Kingdom or a British possession. The following is a list of the iron and steel manufactures enumerated in the tariff which are free of duty on importation of the product of the United Kingdom, or a British possession, but which are dutiable if the product of a foreign country. :

Rolled iron or steel and cast steel, in bars, bands, hoop, scroll, strip, sheet, or plate, of any size, thickness, or width, galvanised, or coated with any material or not, and steel blanks for the manufacture of milling cutters, when of greater value than 3½ cents per pound ;

Rolled iron or steel sheets and strips, polished or not, number 14 gauge and thinner, not otherwise provided for, Canada plates, Russian iron, terne plates and rolled sheets of iron or steel coated with zinc, spelter, or other metal, of all widths or thicknesses not otherwise provided for, and rolled iron or steel hoop, band, scroll, or strip, number 14 gauge and thinner, galvanised, or coated with other metal or not, not otherwise provided for.

Seamless steel tubing, valued at not less than 3½ cents per pound, rolled or drawn square tubing of iron or steel, adapted for use in the manufacture of agricultural implements ;

Steel balls, adapted for use on bearings of machinery and vehicles. Wire, crucible cast steel, valued at not less than six cents per pound.

New Mono-rail System.

Quite the sensation of the hour is the invention of a new mono-railway system by Mr. Louis Brennan, C.B., who is also, I believe, famous in connection with torpedoes. The permanent way may consist either of a circular section rail attached to sleepers, or it need only be a stout steel rope stretched taut. The chief point about the car is the application of gyroscopic action in its propulsion, or rather to maintain equilibrium, for as the car is only carried on a bogie at each end, the centre of gravity is very high. Each pair of wheels is driven direct through gearing from electric motors mounted on the bogies ; the latter being driven, in the model, by accumulators. To maintain the stable condition of the car two gyroscopes are used at each end of the car, which work in a vertical plane and run in opposite directions. Each individual pair of gyroscopes of course, are connected together so as to ensure equal peripheral speed. These are motor-driven at a speed varying between 7,000 to 8,000 revolutions. The model which has been built has shown rare extraordinary performances with loads up to 20 tons, an incline of 1 in 5 being successfully negotiated. One of the pet fancies of the inventor is the utility of the system for military purposes, and there would certainly appear to be field for it here. A full size vehicle, which will have a length of 12 feet is under construction, and will be driven by a 100 h.p. petrol motor directly coupled to a motor. The gyroscopes in this case will have a diameter of 2 feet 9 ins., and will run at about 2,500 revolutions per minute. The inventor has hopes of introducing variable speed gears and free wheel eventually. Another use to which Mr. Brennan believes the system will be suited is for the conduction of pioneer lines in the Colonies, making it possible to give a means of communication at a minimum cost, and thereby giving settlers an opportunity of reaching the markets with their produce at much lower rates than would otherwise be possible.

Electric Power in London.

Last month I mentioned that the proposals to supply electric power in bulk in London were in a state of suspended animation. The present position is one of considerable animation. A sub-committee of the new County Council has recommended considerable modifications of the proposals made by its predecessors. These have been passed by the Council, but the effect has been a storm of criticism which has extended to the House of Commons, and bids fair to continue for a while. The intention of the late Council to work the undertaking as a municipal enterprise, to purchase all the existing municipal works, and later on to acquire those of the companies as well, has been completely thrown over, and in its stead is a resolution to lease all the powers of the bill to private enterprise. But the progressive party, which has just been defeated at the County Council election, has considerable influence in the House of Commons, and the debate upon the second reading of the County Council Bill has already occupied one evening and stands adjourned. The London Liberal members are pressing the Government for an assurance that no contract shall be entered into with private enterprise without the full terms being presented for Parliamentary discussion, a course of action which has some advantages, but many disadvantages. In the meantime, the delay which is taking place is gradually precluding the possibility of any definite result being arrived at this season. But then there are many here who do not believe there is the pressing need in London for extra electric supply facilities.

Railway Mechanical Engineering.

The new president of the Institution of Mechanical Engineers devoted his address a few weeks ago to that part of the mechanical engineering of railways which is represented by rolling stock and machinery. He regarded the requirements of modern travelling as necessitating modifications of both engine and coach designs which were difficult to secure owing to our limited gauge, and he half regretted that our standard gauge of 4 feet 8½ inches has survived as such. In fact, he showed a prediction for a 5 feet 6-inch gauge. Dealing with the efforts to procure a power supply of water for locomotive boilers, the president referred to the efforts that have been made to introduce means of purification. Many efforts have been made with more or less success to introduce compounding, but there seemed to be one requirement that had not been fully accomplished, viz., to get the full effect out of the steam. It would appear that this might be improved if some method of condensation could be applied, and with the facilities now existing on many railways for picking up water it might be possible to apply a condenser, and so assist in front of the piston by obtaining at least a partial vacuum, and then pumping the condensed steam back into the boiler at high temperature. The following remarks upon electric traction are worth quoting: "In the case of passenger traffic there can be no doubt that for frequent trains, for not too long distances and for frequent stops and high speeds, electricity is extremely useful and desirable. As regards goods and mineral traffic, I cannot help thinking that the dealing with this problem will find it worth consideration in the highest degree to solve the question of regenerative control. In hilly mining districts if it were possible to use the gravity and momentum of the down train to generate current for the up traffic, and that at a reasonable cost, then it ought to make an enormous difference in the possibilities of electric traction for such purposes."

New Dock on the Clyde.

An important engineering work is in progress on the Clyde in the construction of the new Clydebank Dock, near Glasgow. The work is part of the scheme of the Clydebank Navigation Trustees, and although the new facilities are not yet absolutely completed, yet they are sufficiently advanced to admit of their opening by the Prince and Princess of Wales. I shall be in a position later to fully describe this work, but in the meantime a general outline may be given. The width of the entrance to the dock is 200 feet; there is an outer basin 600 feet square leading into an inner basin some 500 yards long. At low tide there will be a depth of 25 feet, and at high tide 36½ feet. Inside there will be berths for 16 vessels. A leading feature of the equipment is the electrical plant, especially the cranes, hoists, winches, etc., into which many novelties have been introduced and used for the first time. There are four coal hoists, 36 cranes, transporters, etc., and a separate power house has been erected for supplying the necessary electrical energy.

The Irish International Exhibition.

One of the main features of this Exhibition at Cork is the Canadian pavilion. There is a good deal of engineering interest to report from here, but so far things are not in a very forward state.

Flying Machines.

The possibility of a really practical design of flying machine always keeps this subject interesting, although commercially, their application had best not be discussed. Major B. F. S. Baden-Powell, however, who is taking much interest in the matter over here, believes that with the progress that has been made of late in the problems of balancing and landing, there is a great probability that aerial navigation will be in fact accomplished within a very few years. The following table gives important facts of recent progress as to the power, speed and surface necessary to raise a given weight off the ground:

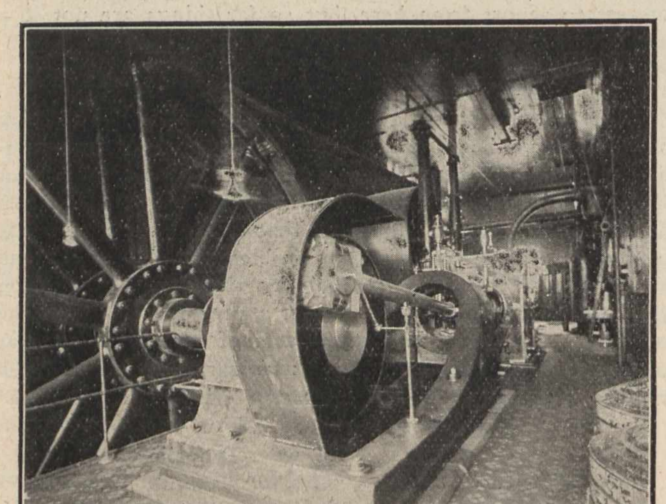
	Span	Area	Total weight with operator	Engine	Propeller Diameter	Propeller Revs. per minute	Speed attained on ground	Speed attained in air
	ft.	sq. ft.	lbs.	h.p.	ft.			
Wright	40	480	925	24	2	—	—	38-40
Santos Dumont (1)	39	560	550	50	6	1,000	24½	22-26
Santos Dumont (2)	36½	146	500	50	6½	—	25	—
Bleriot	25½	140	600	24	5¼	—	—	—
Delagange	32	645	638	50	6.9	1,500	—	.15
Veria	—	215	605	—	7¼	—	—	—

The fast steamship line between Blacksod Bay, Ireland, and Halifax, is having plentiful publicity. The possibilities of the Canadian Atlantic route, perhaps, are not fully appreciated. The Canadian steamship companies should take a larger proportion of the traffic which the New York steamships now handle. The present scheme looks very well in print. And so, for many years, has the English channel tunnel project. There is room for improvement in the Canadian Atlantic steamship service. The establishment of the new route would cost many millions of dollars. The Governments of Canada and Britain would be asked to subsidize it heavily. And then the public would discuss whether up-to-date improvements to existing routes could not be made to suffice.

THE ELECTRIFICATION OF A LARGE FLOUR MILL.

The Winnipeg plant of the Ogilvie Flour Mills Co., is now being operated by electricity supplied by the Winnipeg Street Railway Company. The installation was completed last fall, and with the exception of a few days during the past winter and once for a few hours this spring, has been running continuously. The delays were not due to any fault in the installation but because of the failure of the water supply at Lac du Bonnet, the generating station of the street railway company. As the steam plant has not been removed from the mills, it being retained for emergencies, the two installations afford an excellent comparison of the relative merits of the systems.

There were several reasons which led to the milling company adopting electricity for power purposes. For some time past there has been difficulty in securing an edequate fuel supply at reasonable figures. The first steam installation used wood for fuel, and for several years there was no difficulty in securing a supply. As the country about Winnipeg filled up with settlers, the wood lots were pushed farther back and prices advanced. The milling company then changed over to lignite coal, drawing supplies from the extensive fields of south-eastern Saskatchewan. This source, too, was not altogether satisfactory, as during periods of heavy snowfall a blockade of several days duration sometimes occurred, and as heavy stock could not be carried, a temporary shut-down sometimes occurred. Finally the Winnipeg Electric Street Railway Company completed its hydro-electric plant on the Winnipeg river, and was in a position to quote a suitable price and to guarantee a permanent supply of electrical energy.



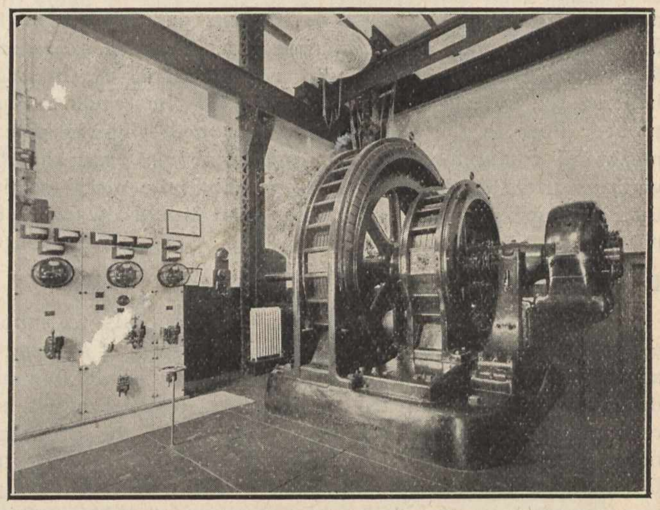
Old Engine Room, Ogilvie Flour Mills Company.

The accompanying cuts give a good idea of the steam and electric installations. A single synchronous motor of 1,100 horse-power is all that is required to drive the plant. It receives the current at 2,200 volts direct from the switchboard at the Winnipeg distributing station of the power company. On the same shaft is an induction motor of 600 horse power, used for starting the larger motor. As soon as the two synchronize the smaller motor is cut out. The small d.c. motor generator is carried on a bracket to the right of the induction motor, and supplies a current at 125 volts and 144 kilowatts. Another small motor has been put in to run the bucket elevators of the loading equipment, and is only used when the plant is idle. It is an induction motor of 150 horse-power.

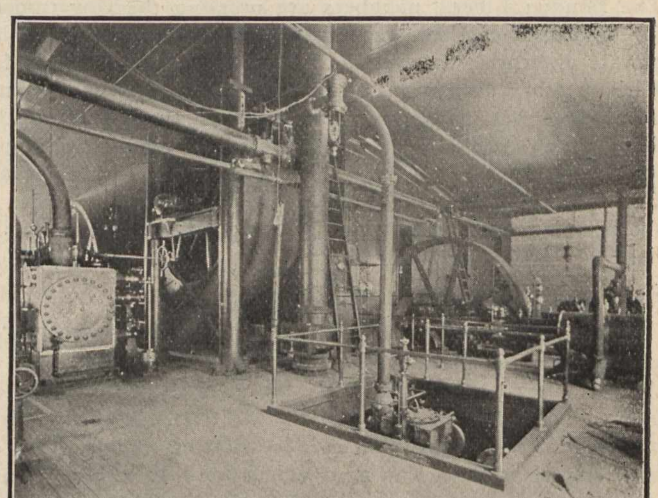
The base of the motor, which is 10 x 13 feet, rests on a cube of solid concrete, fourteen feet in thickness, and in practice has been found to run with a minimum of vibration. The switchboard containing four panels is shown to the left of the motors. The receiving panel, which is duplicated at the distributing station, carries a Thomson poly-phase wattmeter, a voltmeter, ammeter, and kilowatt meter. A second panel is used for the lighting system, and for the small motors throughout the building. It has a similar equipment and carries an automatic oil switch. The other two panels are for the starting motor and the elevator motor.

In the basement are the step-down transformers, one bank of which supplies the 110 volt lighting current, and a second for the 550 volt current for the small motors in the machine shop and elsewhere. The whole space occupied by the electrical installation is a room 30 feet square. The cement floor is brown, the walls white, and the steel columns carrying the electric travelling crane a dull black.

In comparison with the above plant, the old engine room suffers materially. It was 75 x 28 feet, and there were 11 large boilers in another division. The main engine shown was a 1,200 horse-power, tandem, compound, condensing. The fly-wheel was 22 feet in diameter with a face of 74 inches. The belt was 72 inches in width, and 125 feet long. In addition there was a smaller engine for the elevating plant and several for the pumps. The boilers are now dead, with the exception of two which are kept up to supply the heating system and the oatmeal kiln of the mill which lies immediately across the street from the flour mill. The saving in labor has been pronounced, the engine-room staff having been cut down from thirteen men to two, who look after the oiling and similar details. It is expected that the old engine will be removed in the near future though at present it is kept up for emergencies. The change can be made in a comparatively short time, in fact as soon as the steam pressure can be raised.



Motor Room, Ogilvie Flour Mills Company.



Small Engine and Pump Pit. Cylinder Head of Large Engine on Left.

The importation of railway material in China, says Mr. F. B. Suttor, the New South Wales Commissioner in that country, is increasing, and last year was valued at $144,132,892. Europe, Great Britain and Japan furnished the great bulk of it; the United States is credited with $33,277,684; Australia, $32,241,348; Canada, $215,741. The Australian importations would be railway ties and timber for railway work.

MODERN FIRE RESISTING CONSTRUCTION.

Year by year, steadily if slowly, the business public is becoming aroused to the need of an improved class of buildings for commercial and manufacturers' use. And the destruction of inferior buildings by fire and the warnings of underwriters are having the effect of constraining proprietors to conform to standards of construction which the experience of builders and the research of insurance organizations show to be really economical. In the chief cities of the United States a great change has been wrought in this direction. And Canadian cities are showing themselves alive to the desirability of modern fire-resisting buildings.

Taking Toronto as an example, half a dozen instances may be cited. The six storey addition to the T. Eaton Department store at James and Yonge Streets is a fair example of substantial fire proof work, already shown in the foundation and steel frame-work and to be demonstrated yet more fully in the walls, flooring, and fitting.

Another handsome specimen is rising to the height of seven stories on the corner of Wellington and Bay Streets. This is being put up for the Scottish firm of Ogilvie & Co. Steel and concrete are the chief materials; the system is one of fire-proofing throughout. Steel uprights and interlacing beams, concrete floors, the protection of iron columns by means of concrete lining, and the employment wherever possible of fire-resisting materials and the minimizing of openings for flame characterize the structure.

Warned by example of the danger to the lives of their horses, and the risk of destruction to inflammable materials that exist in possible fires in extensive stables, the Dominion Transport Company adopts, in its new building rising on Wellington Street near John, the expanded metal system of steel and reinforced concrete construction. Yet another instance of the progress of the age in safety materials is found in the Hislop Garage on Shuter Street, where moulded concrete is used for the walls, and steel construction for interior frame work. The Jarvis moulds are here employed for reinforcing the metal. These buildings already show careful adherence to modern safe building methods on the part of the firm which has them in hand, the Expanded Metal and Fire Proofing Co., Limited.

Another good structure approaching completion is the Traders Bank branch building at Yonge and Bloor, substantially constructed of stone, cement, and steel, with fire-proof interior. Lastly there deserves mention the Alexandra Theatre on King Street West, which is of extraordinary strength and of high quality as to safety of design and immunity from serious damage by fire. Indeed there is scarcely any combustible matter in it. The floors are of concrete and expanded metal; the stairs of iron; the interior fittings, such as partitions and ceilings, of steel and cement. "There is nothing to burn," said a man who had been shown through it, "except the ¾ inch maple flooring, and parts of the front, the foyer, entrances and waiting rooms. In these, all that will burn is the trim of the doors and windows."

ELECTRIC HOISTS.

The Yale and Towne Company, of New York, have placed on the market an electric hoist suitable for almost every purpose. Those shown in the illustrations are specially adapted for use in power houses, and are designed to meet all the demands that may be made upon them. Fig. 1 is a detailed illustration of a high voltage equipment designed for the handling of coal and ashes, used in the plant of the Nashville Railway and Light Company. The voltage on this line often reaches 650, while at times it drops considerably below 575.

This particular machine has to stand a very severe heat, since it must operate very close to the front of the boilers when delivering coal and removing ashes. The operator's cage, is so arranged that he can manipulate the trolley and hoist, and at the same time dump the bucket from the cage. This arrangement enables an ordinary laborer to handle considerable material in the course of a day. As shown the machine is suspended from overhead girders, so that it requires no floor space or cleared passages, and is entirely out of the way.

The hoist is equipped with a 3-horse-power motor and the trolley with a ¾-horse-power motor. The lifting speed with the ordinary load of 2,000 lbs. is from 20 to 25 ft. per minute, and the traversing speed is 350 ft. per minute on straight track, as a maximum. The current is conducted to the trolley and hoist through the bar copper wires alongside the track. It should be noted that the position of the rheostat is such that the heat radiated from the resistance elements is quickly dissipated through the ventilated casing. This precludes injury to the motor or hoisting gear through heating. The easy accessibility of the controller contacts,

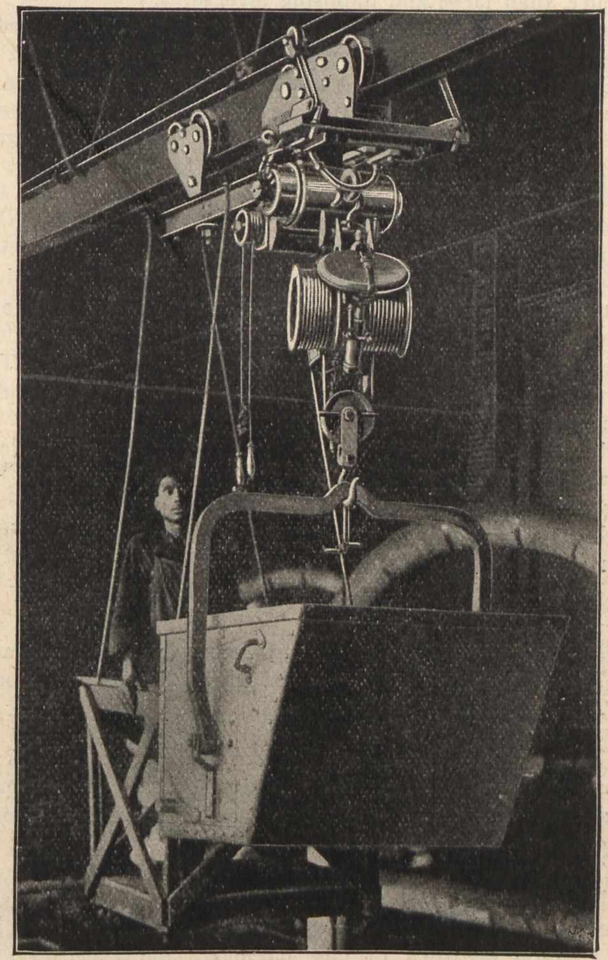


Fig. 1.

Portable Electric Hoist Hooked in Motor-Driven Trolley, For Handling Coal and Ashes.

the commutator and brush holders also deserves attention. at the same time each part is thoroughly enclosed so that the hoist can work in hot, dusty or damp places. The machine is capable of traversing curves of 10 ft. radius or larger. The overhead track may contain switches and consequent lateral tracks, so that a large area may be covered. This track may consist of a few feet or several thousand feet, enabling the material to be very economically handled for a great distance.

These machines are built in capacities from one to fifteen tons, and as they have single top hooks, they may be attached to any kind of stationary support. The hoists may be controlled from an operator's cage, or by pendant cords from the floor, and may be installed or operated by any intelligent laborer. They are thoroughly enclosed, making them suitable for use in hot or dusty places, and also when exposed to the weather. They may be further equipped with solenoid attachments for control from a distant point. The trolleys may be constructed for running on the lower flanges of standard I-beam track, or on the top flanges of two parallel girders.

BOOK REVIEWS.

Publications reviewed under this heading may be secured in Canada from the Smith Publishing Company, 62 Church Street, Toronto, who are the publishers in this country of the books published by The Norman W. Henley Publishing Company, of New York.

The Anatomy of Bridgework.—By William H. Sharpe, Assoc. M., Inst. C.E., E. & F. N. Spon, Limited, London. pp. 190, 6s. net.

This compact little treatise on bridgework construction deals mostly with wrought iron bridges of quite small dimensions; but it is these which most commonly give trouble, both because the effects of impact are in such cases most severely felt, and possibly because the smaller classes of bridges are very generally designed by men of less experience, than large and imposing structures.

An endeavor has been made to secure some kind of order in dealing with the subject, but it has been found difficult to avoid a somewhat disjointed treatment, inseparable, perhaps, from the nature of the matter. All the cases quoted have come under the author's personal notice, making it a practical little book, and a ready reference for an engineer, as it cannot but be useful since it gives the results of the behavior of bridges, whether new or old, that have come under observation; and in this way keeps together the designing of bridges and their after-maintenance. The author points out that much may be learned from the study of defects and failures, even though they be of such a character, that no experienced designer would now furnish like examples. The introductory portions of the work deal with girder bearings, main girders and bridge floors, followed by chapters on bracing, riveted connections and high stresses, with much valuable information on deformations and deflections, defects, and how remedied, etc.

In the concluding chapters he deals with the various forms of bridges and their relative merits.

* * * *

Engineering Work in Towns and Small Cities.—By Ernest McCullough; M. West. Soc., Eng. Technical Book Agency, Chicago, U.S.A., pp. 471.

This is a book written for two classes of officials in towns and cities, having a population of less than twenty thousand inhabitants, though it may be found useful in some larger places.

The first class for which it is intended, are elected officials, and those who have had no technical education. The second class is composed of engineers and surveyors holding the position of town or city engineer, and especially for those who have had little or no experience in municipal engineering.

The book has been divided somewhat to meet the requirements of the two classes. Although some chapters will appeal to both. Chapters on bibliography and on the filing of fragmentary literature, will appeal to both. Chapters on field and office work, and engineering data will hardly be appreciated by the non-technical reader.

The book is a manual of municipal engineering, and is the accumulation of many years' experience in this kind of work, and the author has put in convenient form, odds and ends of professional knowledge which may be appreciated by the men whom it will benefit.

The book is strictly practical, and contains first hand information,—supplemented with selected matter from good authorities. The book hinges about engineering work, and therefore about the engineer. The author in the opening chapter gives a brief account of the different classes of men engaged in municipal work in towns and small cities, and the information most helpful to each. The comprehensiveness of this work can be better obtained perhaps from the subjects of the various chapters which are as follows:—The City Engineer and his Duties; Roads and Streets; Walks Curbs and Gutters; Street Pavements; Sanitation; Drainage; Sewerage; Water Supply; Concrete; Building Department; Contracts and Specifications; Office Systems; City Engineers' Records; Field Work; and Engineering Data. It also contains appendices on Machines for Mixing Concrete; Trenching Machines; Bibliography; Trade Literature, and Specification Index.

* * * *

Practical Mechanics.—By James Powell, Chief Draughtsman Grand Trunk Railway, Montreal. pp. 54.

This is the name of a little book, just received by the Canadian Engineer, from the author. The preface explains the object of the book in the following words:—"This work has been written and compiled with the object of laying a foundation and preparing the way for a better education and technical knowledge for apprentices and others in engineering shops, and has been based on what will actually be needed, and should be followed in conjunction with a course of mechanical drawing."

The book has been printed for the use of apprentices on the G.T.R. system, and many others outside who may desire to take it up. It has been made as simple as possible, dealing only with practical questions which come up in everyday work, and is followed out on the Grand Trunk Railway System along with a course in Mechanical Drawing, under instructors.

* * * *

Notes on Construction in Mild Steel.—By Henry Fidler, M. Inst. C.E., London. New York and Bombay: Longmans, Green & Co. 6½ x 9½, pp. 448; $5.

This volume is one of the well-known "Longman's Civil Engineering Series." It has been arranged for the use of junior draftsmen in the architectural and engineering professions, and the author has kept his subject, as set forth in the title, steadily in view. He has not attempted to treat the subject from the viewpoint of applied mechanics, and has given theories of construction, calculation for buildings or engineering structures only where they are absolutely necessary in connection with the subject under discussion. He assumes that the reader has a thorough knowledge of the theory of construction, and that he also has some idea as to the determination of stresses in the structures with which he has to deal. The book is divided into seven sections as follows: Chapter I. deals with the characteristics and manufacture of mild steel; Chapter II., with the various sections; Chapter III., with applications of rivetted girder work; Chapter IV., on the design of columns and struts; Chapter V., roof construction; Chapter VI., the use of mild steel and iron in marine engineering, and Chapter VII., with protection from corrosion of constructional steel work.

The education of the designer, says the author, is not complete even when to a sound knowledge of theory he has added the experience of the practical aspects of the design. He should, as opportunity affords, trace the previous history of the material he has been dealing with. He should place himself in touch as far as he can with the centres of the steel-making industry, the blast furnace, the cinder heap, the "sow" and her "pigs," the dazzling radiance of the molten metal in the open hearth or the converter, the methods (to say nothing of the risks and anxieties) of the steel founder, the ruddy atmosphere of the annealing furnace, and the spectral shapes of castings, refracted by the waving and glowing gases as they undergo the ordeal which relieves internal stress and makes them ductile and tough, the ingot, the soaking pit, the clangor, and hiss, and roar of the rolling mills. The scene changes, and he will follow the completed sections and shapes to the platers' yard, the templet-makers' machine and smiths' shops, the pickling or galvanizing tanks, and watch the processes whereby drilling machine, punching machine, riveting machine, pneumatic hammer, with its incessant rattle, cold saw, with its halo of sparks, hydraulic press, and the like, shape and fashion his material into the form he has evolved on paper; and, perhaps, he then becomes conscious, as the offspring of his thought grows into visible bodily shape before his eyes, that there are certain details in his design which he will take care to improve on a future occasion.

Again the scene changes. The riveted sections of steel work, the castings, the cases of bolts and nuts, the bags of rivets, have all left the contractor's yard, some by rail, some perchance by sea, and then the multitudinous practical requirements which surround the erection of constructional steel work becomes evident, whether the structure be some bridge of great span over a ravine or rapid river, a skeleton steel "skyscraper," many stories high, a large caisson or lock gate for a dock entrance, or whether it be the simpler and humbler forms of builders' ironwork and the erection of a few simple columns, girders or roof principals. The volume does not touch on the question of reinforced concrete of any kind, in which so much mild steel is being used at the present time. This subject is one covering a considerable area, and can only be dealt with in a separate volume. The author has also left undealt with the question of the protection of steel structures from fire. This is a subject that might reasonably be included in a work on reinforced concrete.

Numerous illustrations are given, showing various connections that may be made with structural steel sections, which should prove very valuable to the student in this line of engineering.

* * * *

Symmetrical Masonry Arches.—By Malverd A. Howe, M. Am. Soc., C.E., Professor of Civil Engineering, Rose Polytechnic Institute. New York: John Wiley & Sons, 6 x 9, pp. 170. $2.50.

This book is based on the elastic theory, and presents the method to be employed in designing masonry arches, including natural stone, plain-concrete, and reinforced-concrete arches. Masonry arches are constructed of material that is more or less uncertain in character, and on this account the use of rigid or comprehensive formulas is not at all necessary. The formulas and methods given by the author are only approximate, but accurate enough for the subject in hand.

The major part of the work gives solutions, of examples, and these solutions are given in such detail that they may be easily followed by the undergraduate or engineer who cannot afford the time to go through the theory of arches comprehensively.

A longer method than is necessary has been used in solving the first two examples, this being done in order to show clearly the several processes and checks. A very simple solution of the formula for the horizontal thrusts and bending moments for the supports is given in the third example. The author says that although there are discrepancies in the numerical and graphical work, these are of no practical importance, since the results are much nearer exact than any masonry structure can be built, in fulfilling conditions upon which calculations are based.

General data for over five hundred arch bridges have been given in tabular form, with references to periodicals, etc., where more extensive descriptions may be found. The book is well illustrated throughout.

* * * *

Sanitary Engineering, with respect to Water Supply and Sewage Disposal.—By L. F. Vernon-Harcourt, M.A. M. Inst. C.E., London, New York, and Bombay: Longmans, Green & Co., 6½ x 9½ pp. 419. $4.50.

This is another of Longmans' "Civil Engineering Series," and is practically an expansion of a former work, "Civil Engineering as Applied in Construction," by the same author. The work deals especially with water supply and sewage disposal. It is written in a very concise manner, but at the same time is most comprehensive.

The first section takes up practically every question that might arise in connection with the supply of pure water. Commencing with the various sources of water supply, it includes wells, reservoirs, dams, conveyances, storage of supply, purification, and distribution.

The section dealing with sewage disposal is equally comprehensive giving consideration to house drainage, disposal of refuse, sewerage clarification, utilization and purification of sewage on land; chemical, electrolytic, and bacterial purification, etc. These two subjects form the basis of sanitary science, and on this account it is well that they have been included in one volume. The author has couched his writing in as non-technical a manner as possible, so that the work should possess no little interest for the public generally, as well as for the trained engineer.

In dealing with the strength of dams Professor Vernon-Harcourt shows that the current theory of the stability of dams is both theoretically and experimentally erroneous, and that theory shows that the vertical and not the horizontal sections are the critical ones. Many actual illustrations are given to show that this finding is correct.

Almost every phase of water supply and sewage disposal is dealt with, and numerous examples are cited where the various methods set forth have been adopted. This is a work that should prove a most valuable addition to the library of every municipal engineer, in fact of every engineer who is interested in the supply of pure water to towns and cities, together with sewage systems.

TRADE ENQUIRIES.

The following enquiries relating to Canadian trade have been received at the Canadian Government Office, 17 Victoria Street, London, S.W.:—

A North of England firm of wire and hemp rope manufacturers is seeking to extend its Canadian connections and asks to be referred to buyers of such goods.

A London firm of motor car agents is desirous of getting into touch with Canadian buyers of scout cars, industrial motors, vans, lorries, etc.

Inquiry is made by a North of England company, manufacturing electrical cables and accessories of all kinds, regarding opening up a business in Canada.

An English firm manufacturing steam portable engines, semi-portable engines, traction engines, road locomotives and rollers, steam motor lorries and tractors, desires to hear from parties in Canada contemplating the purchase of any of the above.

A Liverpool firm of large exporters who are specially interested in the tin plate, metal and coal trades wishes to be referred to likely buyers in Western Canada.

A Lancashire firm is open to act as agents in the United Kingdom for Canadian firms exporting molybdenum and molybdenite and other similar classes of ores.

An Ontario firm of manufacturers of steam specialities for engineers, lubricating devices and other metal work wishes to receive catalogues and price lists from English firms manufacturing gas producing plants, including engines ranging from fifty to a hundred horse-power.

From the City Trade Branch, 73 Basinghall Street, London, E.C.:—

A London firm of merchants wishes to correspond with Canadian producers of asbestos fibre and paper, seeking representation in England.

PERSONAL.

Mr. E. A. James, formerly manager of the Canadian Northern Railway, with headquarters at Winnipeg, has retired from active life, and will become a permanent resident of Victoria.

Mr. R. S. Lea, consulting engineer, of Montreal, has been recently appointed a member of the board of consulting engineers to investigate and report upon a new water supply for the city of Winnipeg. They will investigate the present supply, the purification of the water of the Red River, and the gravity supply from Shore Lake, which is situated about ninety miles east of the city.

Mr. Lea, who was Professor of Civil Engineering in McGill University for several years has had wide practical experience in hydraulic and sanitary work, and was for some time consulting engineer to the Board of Health of the Province of Quebec. In dealing with the question of the Winnipeg water supply, Mr. Lea will be associated with Messrs. Allen Hazen and James H. Fuertes, of New York, two of the foremost hydraulic and sanitary engineers in the United States, and J. E. Schwitzer, assisting chief engineer of the Canadian Pacific Railway at Winnipeg.

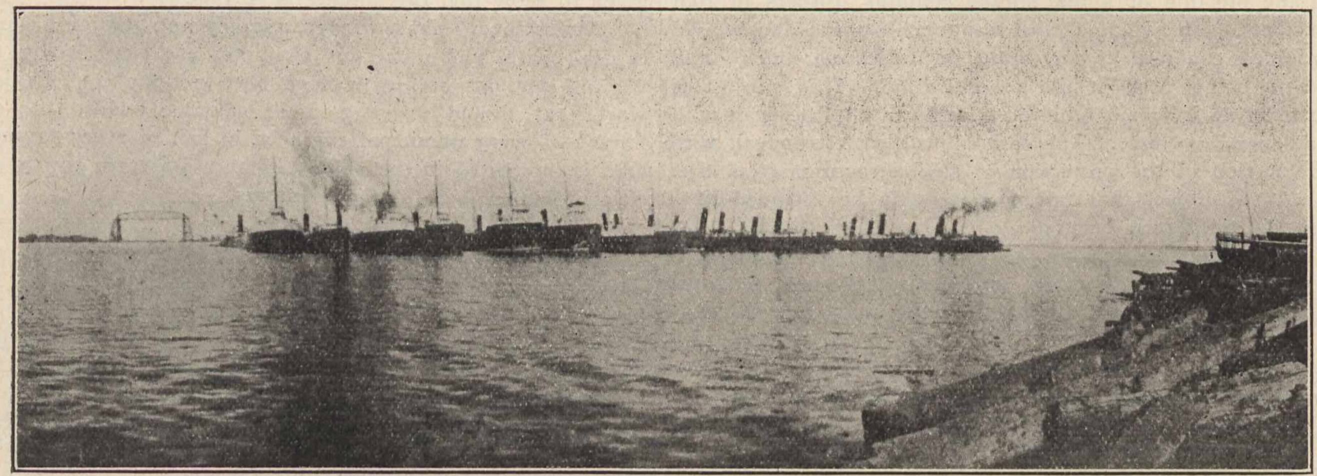
THE AERIAL FERRY BRIDGE OF DULUTH, MINNESOTA.

By B. C. Cundy.

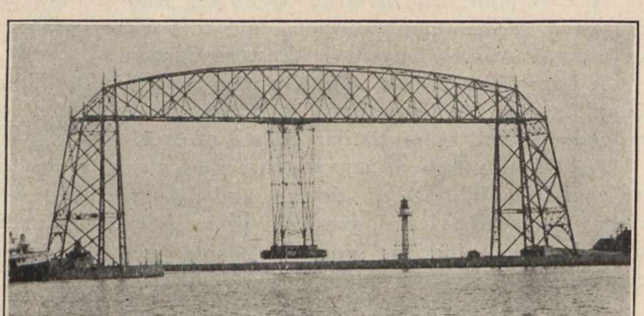
The Aerial Ferry Bridge, of Duluth, is the only one of its kind in the world, and is a masterpiece of engineering and electrical skill.

To fully understand the need of this "bridge," one must first know something of the conditions which called for it, and also something of Duluth itself.

Duluth, "The Zenith City," needs no eulogy, since it is well-known by almost every one. At one period (the exact time of which is not known) the Great Lakes were many hundreds of feet higher than at present. Just when the waters decreased we do not know (we do know that they are still decreasing), but in doing so, they left a narrow strip of land jutting out from Duluth, called Minnesota Point. Previous to 1871, Duluth had no good harbor, her shipping had to be from the lake, her docking must be from piers, or natural warfage of rock, and it may be in the memory of some seeing a picture of Duluth, where a ship was tied to a tree on the shore. This manner of docking prevented ships from remaining long at Duluth, and in case of storm they were obliged to put out into the lake for fear of being wrecked on the rocks of the shore. In 1871 the idea was conceived of cutting a canal across Minnesota Point, and thus afford the shipping interest one of the finest and safest harbors. Later the United States Government adopted this canal, in 1901 it was widened from two hundred and forty feet to three hundred feet, and named "The Duluth Ship Canal," through which now passes annually about the same commercial tonnage that is carried through the famous Suez Canal. The cutting of this canal, converted Minnesota Point into an island, and the city accepted the responsibility of providing the inhabitants with means of communication with the main land, from 1871 to 1897 a row boat ferry was maintained, but during the year 1893-4, commonly known as the "hard times," it became popular as a summer camping ground, later on summer cottages were built. It was, therefore, impossible to accommodate this increase with the row boat ferry, and a steam ferry was put in use and continued to serve the people until 1905. But the "Point" continued to grow, becoming more and more popular creating an imperative demand from the resident for better, quicker and safer transportation. The city also desired something cheaper, the steam ferry was costing them about eleven thousand yearly. The city engineer had presented to him plans for a draw-bridge, lift-bridge, and a roller bridge, but all failed to meet with the approval of the United States War Department, which demanded a method in no way impeding, or interfering with the commercial shipping interests passing through the canal. The suspended car transfer bridge at Rouen, France, was then brought to the notice of



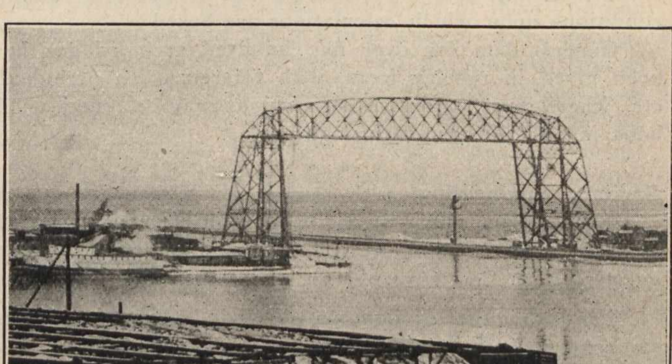
Congestion of Freighters in Duluth Harbor.



Duluth's Aerial Ferry Bridge.

the city engineer in 1899, who thinking well of it got out plans adapting the general scheme to the requirements of the "Duluth ship canal." This was favorably received both by the city of Duluth, and the United States War Department. The State Legislature sanctioned a bond for the estimated cost of $100,000 to commence erection in 1901.

The foundations contain 730 tons of concrete, in 8 piers, extending below the water level of the lake. After the piers were built, and various delays occurred, a contract was finally entered into (February, 1904) with the Modern Steel Structural Company, of Waukesha, Wisconsin, for a riveted steel tower, the ferry car to be supported by an inverted steel tower, 24 anchor bolts 2 inches in diameter fastened by means of large washers to the bottom of the pier hold the towers in position. The bridge has a clear height above the ordinary level of Lake Superior of 135 feet. This height was fixed by the "Lake Carriers' Association," thus permitting the highest mast to pass under. The truss at the centre is 51 feet, making the highest part of the bridge 186 feet above the water. The width centre to centre of trusses, is 34 feet



Duluth's Aerial Ferry Bridge.

and the clear span is 393.75 feet. The car platform is 34 x 50 feet, and contains in addition to space for a street car and two waggons, two enclosed and glazed cabins, each 7 x 30 feet. The bottom of the car is elevated above the Government piers 6 feet, so that when the car is at rest, the whole length is over land, in no way obstructing navigation. The bridge contains 700 tons of steel and over 100,000 rivets. The car will carry at one time 125,000 pounds, which is equal to a loaded double truck street car, two loaded wagons with teams and 350 passengers. The motive power of this ferry car is electricity, current being supplied from two separate sources, the switch being under the control of the motorman, so that in case one fails, the other can be turned on immediately. Adequate hand-power equipment is also provided, which can be used if the electric power fails altogether. The passage across the canal is made in a little over a minute.

Two 40 horse-power motors, placed under the floor of the car, actuate two drums, 9 feet in diameter, on which are wound one-inch cables, extending to the truss, over 9 foot idler wheels, through the inside of the lower chords to the towers, where they are fastened, producing the motion of the car, which is very easy. The car moving so smoothly that one is hardly aware of motion at all. The track to carry the car and hangers, is ingeniously arranged, being enclosed on three sides within the box section of the lower chord, so that it cannot become coated with ice or sleet in winter, there are four rails, within the two bottom chords, two in each, with 32 wheels arranged in pairs, 8 in each pair, which carry the truck. The cost of the steam ferry was about eleven thousand dollars annually, the cost of the Aerial ferry bridge is eight thousand dollars, and as well as being cheaper, gives better service. Duluth has the distinction of having a structure not duplicated anywhere.

A few figures from the report of 1904, will show why this canal was so necessary, and why the bridge must not interfere with ship traffic, tons passing through canal, 4,037,608 entered, 7,113,297 departed, total 11,150,905 passed through; vessels entering, 3,426; departing, 3,147; total, 6,573; navigation season 217 days, which practically puts Duluth Superior harbor next to New York. On April 9th, 1905, 33,000 persons were carried on the bridge, 29,500 from noon to 7.15 p.m., 7,781 in one hour; 18 horse-power is required for one trip.

NEW INCORPORATIONS.

Dominion.—The Provincial Construction Co., Montreal, $20,000; J. B. Pauze, H. Beauregard, F. Trudeau, P. Trudeau, Z. Beauchamp, Montreal.

The S. Coté Motor Co., Montreal, $20,000. S. Coté, A. Meunier, D. Genereux, H. O'Donouhue, R. L. Prieur, Montreal.

Pacific Coal Mines, Toronto, $6,000,000. J. S. Lovell, W. Bain, R. Gowans, E. W. McNeill, H. Chambers, C. H. Black, Toronto.

Structural Steel Co., Montreal, $500,000. P. Johnson, W. G. McIntyre, R. C. McMichael, D. J. Angus, F. G. Bush, Montreal.

The Wilson Automobile Co., Ottawa, $145,000. B. S. Wilson, H. R. Wilson, Montreal; W. W. Wilson, S. H. McKay, Ottawa.

McCoy and Wilford, Lindsay, Ont., $49,000. P. McCoy, Kingston; F. R. Wilford, G. H. Hopkins, F. A. Walters, Lindsay.

The Northern Oil and Gas Co., Montreal, $99,000. J. M. Fortier, L. M. Fortier, J. A. Mann, Montreal; S. B. Ridenour, Lima, Ohio.

The Gordon Development Co., Ottawa, $499,900. C. H Clendenning, H. S. Conn, R. V. Sinclair, J. Thompson, A. McFarlane, Ottawa.

The Imperial Supply Co., Montreal, $100,000. H. H. Bradfield, Morrisburg; W. R. Duckworth, H. G. Myers, C. A. Myers, Montreal.

The Turtle Lake Mining Co., Ottawa, $250,000. M. Quinn, J. C. Bartram, J. A. Parent, P. Doorley, Ottawa; L. A. Gendron, Hull.

J. W. Harris Manufacturing Co., Montreal, $1,000,000. T. Craig, W. B. Powell, W. H. C. Mussen, F. D. Monk, J. W. Harris, Montreal.

Standard Fitting and Valve Co., Guelph, $100,000. H. L. Wells, R. B. Hunter, T. Hunter, G. C. Webb, Fulton, N. Y.; A. H. Lomer, Montreal.

The Caguas Tramway Co., Montreal, $250,000. F. W. G. Johnson, E. Schmidt, F. A. Genereux, A. Merrill, J. A. Dupuy, L. P. Pinsoneault, Montreal.

Battle Island Transportation Co., Montreal, $18,000. G. Aird, G. W. Aird, E. S. Platt, Troy, N. Y.; J. M. Taylor, Guelph; G. D. Forbes, Hespeler, Ont.

Westinghouse, Church, Kerr and Company, of Canada, Montreal, $2,500,000. P. Davidson, A. Wainright, A. Bissett, C. F. Larkin, O. Cousineau, Montreal.

Ontario.—Norton Telephone Manufacturing Co., Toronto, $40,000. J. E. Day, J. M. Ferguson, E. V. O'Sullivan, A. W. Bixel, Toronto.

Tehkummah Oil Co., Toronto, $40,000. A. C. Bedford-Jones, F. H. Lytle, Toronto.

Rogers Electric Co., Toronto, $50,000. J. Rogers, W. R. P. Parker, G. M. Clark, J. A. McEvoy, G. Russell, Toronto.

Cobalt Eldorado Mines Co., Toronto, $2,000,000. J. E. Day, J. M. Ferguson, A. W. Bixel, E. V. O'Sullivan, Toronto.

Parry Sound Transportation Co., Toronto, $150,000. J. B. Miller, F. B. Polson, W. B. Tindall, R. I. Clarkson, Toronto.

Higbee Mines, Toronto, $40,000. N. Higbee, W. Pinkerton, J. F. Connolly, T. W. Murray, G. I. Riddell, Toronto.

Haileybury Bucke Cobalt Co., Toronto, $40,000. J. E. Day, J. M. Ferguson, E. V. O'Sullivan, A. W. Bixel, Toronto.

The Auld Silver Mines, North Bay, $500,000. R. Y. Angus, T. R. Burt, J. J. Martin, W. Martin, I. H. Wright, North Bay.

North Star Larder Lake Mining Co., Toronto, $1,000,000. J. E. Day, J. M. Ferguson, E. V. O'Sullivan, A. W. Bixel, Toronto.

Ore Reduction Co., Toronto, $250,000. R. E. Kemerer, E. S. Francis, W. R. P. Parker, G. M. Clark, J. A. McEvay, G. Russell, Toronto.

Concrete Engineering and Construction Co., Toronto, $40,000. J. V. Gray, Detroit; A. F. Wells, R. D. Moorhead, R. H. Paterson, Toronto.

The British Dominion Mines, Toronto, $1,000,000. H. S. Pritchard, J. C. Burgess, F. Watt, Toronto; J. Ferguson, J. Dixon, North Bay.

National Refining Co., Toronto, $20,000. W. M. McTavish, R. A. McTavish, R. J. Dunlop, Toronto.

Dominion Exploration and Development Co., Toronto, $1,000,000. R. J. Tough, R. D. Moorhead, R. H. Paterson, D. C. Raymond, J. G. McMillan, Toronto.

The International Snow Plow Manufacturing Co., Stratford, $250,000. J. Rankin, Seaforth; J. M. Dennison, J. W. Mowbray, W. J. Hackwell, W. Dyer, Stratford.

Port Hope Telephone Co., Clarke, $10,000. G. W. Jones, G. Payne, S. R. Jones, Clarke; W. H. Burley, A. P. Polard, E. H. Dickinson, W. H. B. Dickinson, Hope Township.

Beamsville Larder Lake Prospecting Co., Beamsville, $100,000. S. B. Bisbee, R. H. Davey, C. A. D. Fairfield, H. V. Robins, Beamsville; I. Bucknall, Haileybury.

Canuck Silver Mines, Toronto, $1,000,000. A. F. Lobb, A. D. Wilson, Toronto; G. A. Loney, Sudbury; G. F. Thompson, Ottawa; R. E. Goodrich, New Britain, Conn.

Lehigh Cobalt Silver Mines, Toronto, $1,000,000. E. A. S. Shimer, E. B. Byington, Allentown, Pa.; G. Grant, M. F. Pumaville, A. L. Bitzer, Toronto.

Ontario Steel Tubular Axle Co., Belleville, $20,000. H. P. Thomas, R. E. Colling, J. S. McKeown, W. J. Thomson, J. W. Boyd, J. C. Panter, Belleville.

Wahcondah Steamship Co., Hamilton, $100,000. W. G. Walton, F. A. Magee, F. H. Whitton, J. Milne, J. P. Studman, C. E. Doolittle, R. O. MacKay, Hamilton.

The Neepawah Steamship Co., Hamilton, $100,000. W. G. Walton, F. A. Magee, F. H. Whitton, J. Milne, J. P. Studman, C. E. Doolittle, R. O. MacKay, Hamilton.

The Soo Larder Lake Exploration Co., Sault Ste. Marie, $150,000; D. I. Miller, A. D. McNabb, G. Dawson, B. J. Bothwell, A. F. Smith, J. Dawson, A. R. Johnson, Sault Ste. Marie.

The St. Marys-Medina Telephone Co., St. Marys, $40,000. W. J. Atkinson, E. McKim, J. Kirk, J. W. Stewart, East Nissouri, Ont.; W. F. Brown, J. Pool, J. B. Thompson, W. A. McIntyre, St. Marys, Ont.

New Brunswick.—The Canadian Mineral Co., Fredericton, $20,000. R. M. Graves, W. Miller, Elizabeth, N. J.; F. A. Young, St. John; S. Holt, Jersey City, N. J.

Northfield Coal Co., Fredericton, $20,000. J. Barnes, E. D. Barnes, Buctouche; C. J. Asman, Hillsborough; J. M. Kennedy, Adamsville; E. P. Barnhill, St. John.

Manitoba.—Mineral King Nickel Co., Winnipeg, $100,000. A. Haggart, H. W. Whitla, A. Sullivan, A. K. Cates, E. J. Tarr, Winnipeg.

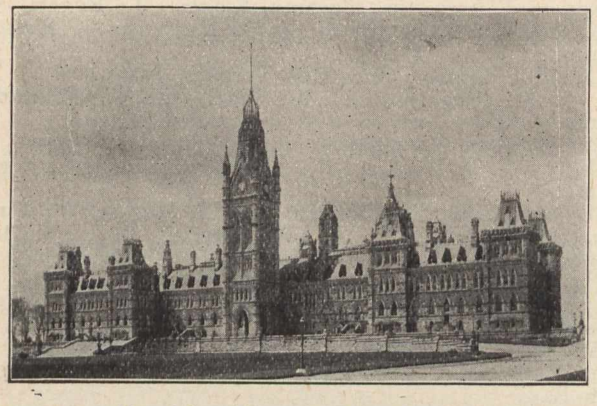
Manitoba Linseed Oil Mills, Winnipeg, $200,000. K. B. Stoddart, J. Carr, R. W. Paterson, J. C. Hicks, J. A. Machray, Winnipeg.

The Perfection Concrete Co., Winnipeg, $100,000. J. Robinson, H. F. Osler, J. H. Turnbull, H. P. Rugh, C. V. Alloway, Winnipeg.

Royal Manufacturing Co., Winnipeg, $100,000. H. T. Helgeson, Regina; C. S. Whiteworth, Cedar Falls, Iowa; J. R. Norris, Winnipeg.

Western Pavers, Winnipeg, $40,000. C. Curtis, Winnipeg; H. B. Smith, J. A. Nelson, E. S. McGowan, A. Emblom, Minneapolis, Minn.

INTERNATIONAL PATENT RECORD

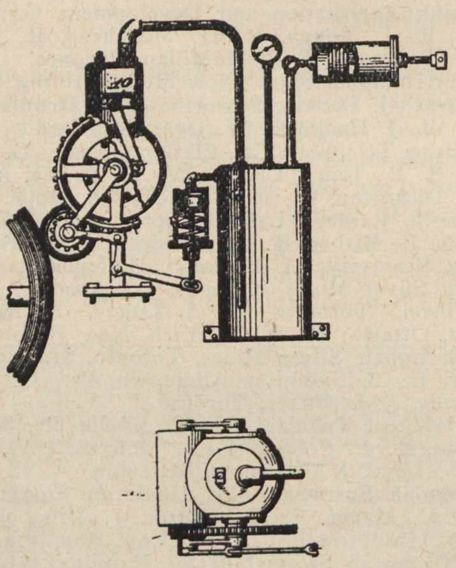


Dominion Houses of Parliament.

CANADIAN PATENTS.

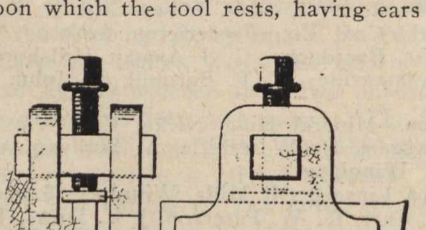
Specially compiled by Messrs. Fetherstonhaugh, Dennison and Blackmore Patent Attorneys. Star Bldg., 18 King St. W., Toronto; Montreal and Ottawa.

Air Brakes for Automobiles.—Fredric Kalisch.—101,949.— A small air-compressor and storage tank is arranged in an automobile. The air-compressor is driven through a small friction pulley riding on the flywheel of the engine, and geared to said pump and adapted to be swung clear of the flywheel. A small cylinder containing a spring-held piston is connected to the air tank so that when the pressure rises to a certain point the pump will be automatically stopped and will start again immediately on the reduction of the pressure. A suitable brake cylinder is connected to the tank.



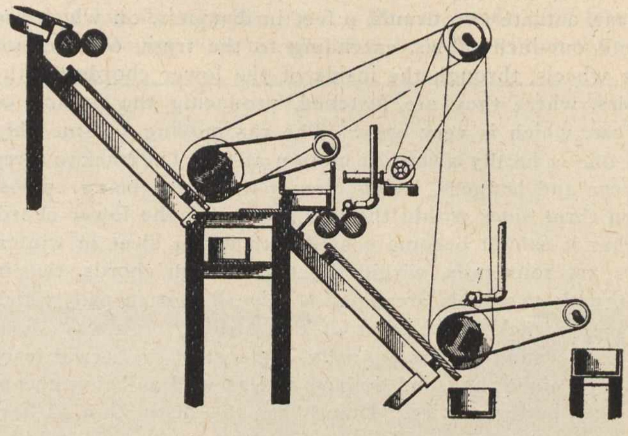
101,949.

Tool Holder for Lathes.—John Bertram and Sons Co.—102,282.—1907.—This is a simple tool holder which will enable the tool to be very quickly and easily adjusted, and it consists of a base upon which the tool rests, having ears projecting upwardly from the sides, said ears being mortised to receive a shifting cross-bar. The cross-bar has a suitable threaded orifice through which the set-screw extends, and the said bar may be shifted laterally to bring the set-screw over any portion of the width of the tool desired.



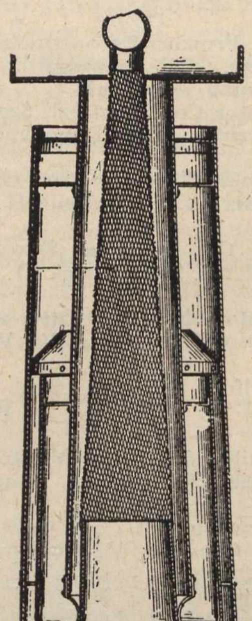
102,282.

Method of Recovering Copper.—T. J. Lovett.—102,220.— The invention consists of a combined dry and wet process of concentrating and collecting the non-magnetic sulphide and contained values in low-grade chalcopyrite ores carrying a material percentage of magnetic iron. The ore is first crushed in a dry state to reduce the sulphide and iron and dislodge the sulphide powder and passing over an incline the iron particles are magnetically separated. The dry iron particles are then vibrated to dislodge all the adhering sulphide powder, and are then subjected in a wet state to a further crushing, and removing the iron particles magnetically. The remaining portion of the mass is collected and the sulphide concentrates saved from the re-crushed mass.



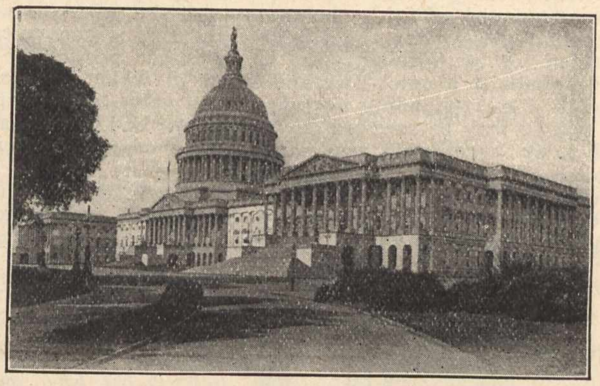
102,220.

Spark Arrester.—H. L. Lapham.—102,143.—A screen is arranged in the form of a cone within the stack and having a deflecting hood secured to the top of said cone and supported above the top of the stack so that the sparks in their upward travel will be deflected downwardly outside of the stack. An outer casing surrounds the deflecting hood and a baffle plate is inserted below the deflector to turn the smoke, which may pass around the baffle hood upwardly, and allow the deadened spark to drop into the lower portion of said enclosing casing.



102,143.

Work on the McGregor-Gourlay Company's new plant at Galt is progressing rapidly. The large Pattern Storage is complete, and the bricklayers are now working on the moulding shop. A large three storey pattern shop is to be erected, for which Messrs. Sibley and Miller will do the mason work.

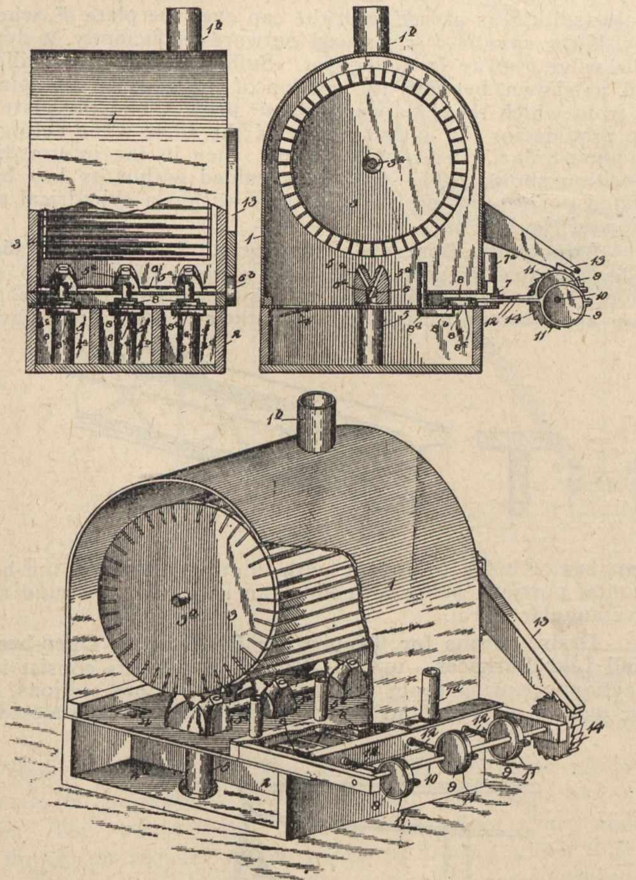


Capitol, Washington, U. S. A.

UNITED STATES PATENTS.

Copies of these patents can be obtained by sending ten cents in stamps to Messrs Siggers and Siggers, Patent Attorneys, 918 F. Street, N.W., Washington, D.C., U.S.A.

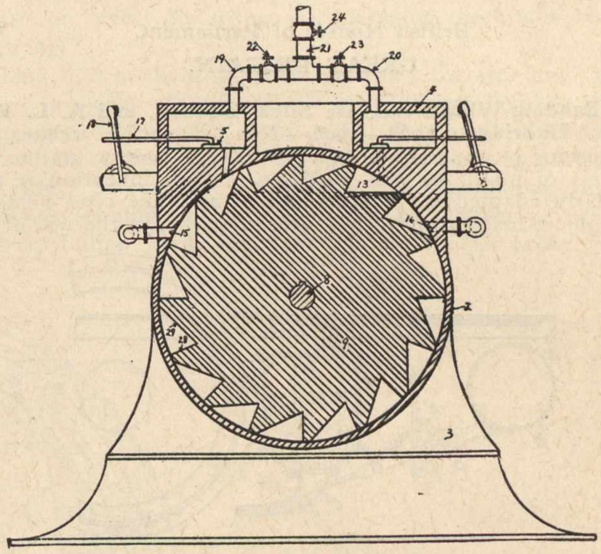
Turbine-Engine.—Richard Toennes, Boonville, Mo.—849,942.—1907.—This invention pertains to improvements in what may be termed "turbine-engines." The motive fluid herein employed may be and is preferably oil thrown in a stream or streams upon a turbine-wheel fixed to the engine or driving-shaft by the action of steam exerting or delivering its pressure upon the body of oil or other motive fluid. The invention has for its object to provide for facility and efficiency in the action of the parts and to carry out ends in a simple and expeditious manner.



849,942.

It comprises a turbine-wheel, liquid or oil containing chambers arranged below said wheel, a plurality of nozzled pipes depending within, and effective for the delivery of the contents of said chambers upon said wheel, a ported plug arranged within, and common to all of said nozzled pipes and extending to the outside of the engine-casing, means for actuating said plug, a steam-chest equipped with inlet and exhaust valves, arranged with relation to said chamber, a shaft bearing a number of eccentrics whose points of connection with said shaft are at relatively varying radii of said eccentrics, said eccentrics having pitmen connection with said valves, and means for actuating said latter shaft from the wheel-shaft.

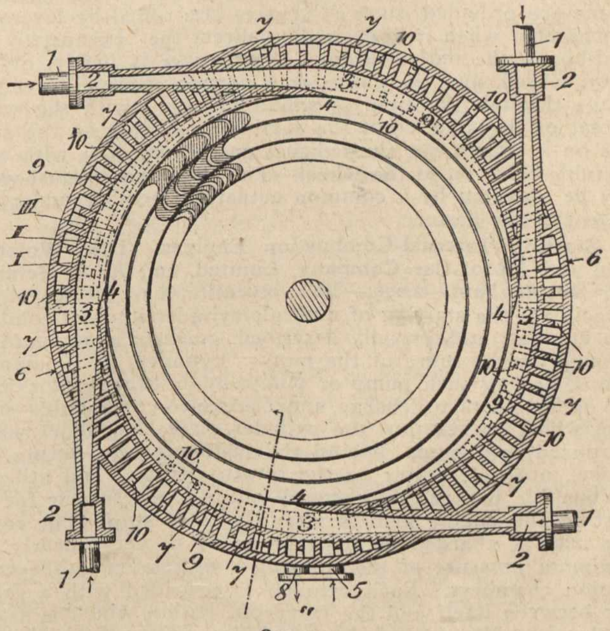
Steam-Turbine.—John Beishlag, of National Soldiers Home, Tennessee.—849,455.—1907.—This invention has relation to turbine-engines designed and adapted to be operated by steam, and has for its object the provision of a turbine-engine consisting of but few parts, of simple and compact form, in which the utilization of steam is greatly augmented and the waste of the same reduced to a minimum. This invention consists in the provision of a steam-turbine engine in which the wheel and the buckets on its periphery are formed, preferably, by casting, of a single piece of metal. This invention further consists in the provision of a steam-turbine engine having a single wheel formed with buckets on its periphery in duplicate, each series of buckets being so constructed that admission of steam to one set will revolve the wheel in an opposite direction from that produced by the admission of steam to the other series of buckets on the same wheel. This invention still further consists in the pro-



849,455.

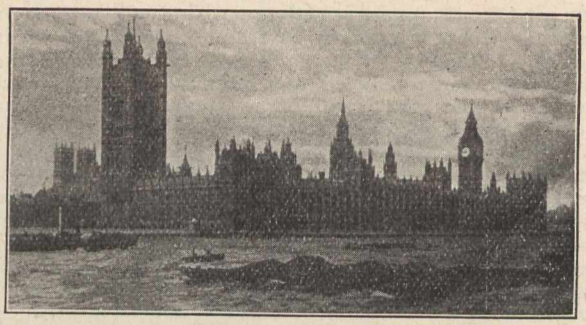
vision of a steam-turbine engine having two series of buckets oppositely situated upon the periphery of its wheel and means for controlling the admission of steam to either of the series of buckets, as desired, and thereby operating the engine in either direction. This invention still further consists in the provision of a steam-turbine wheel with exhausts so constructed that the steam will be readily exhausted after performing its designed work without any tendency to retard the movement of the wheel.

Heating Arrangement for Turbines.—Rudolph Hoffman, Mulhausen, Germany.—849,543.—1907.—The object of the present invention consists in gradually heating the expanding steam in such a way that this steam, although getting gradually cooler with the progressing diminution of pressure, still will keep or remain hot enough that the state of saturation never will be entirely reached nor any water formed in



849,543.

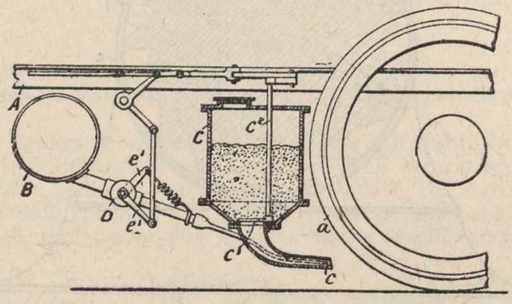
consequence of the expansion of the steam. It comprises an expansion-nozzle a steam-jacket surrounding the nozzle and heat-conducting ribs between the jacket and nozzle arranged to form a continuous steam-passage therethrough, whereby the nozzle and passages supplied with steam therefrom are heated by conduction to heat the working steam.



British Houses of Parliament.

GREAT BRITAIN.

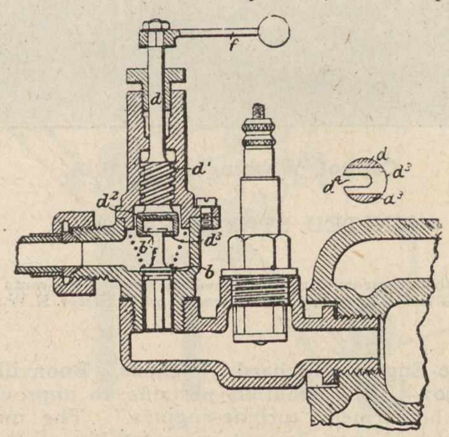
Sanding-Wheels.—**L. De Silva, London, and A. L. Radford, Uxbridge.**—**7,068.**—**1906.**—This invention relates to means for ejecting sand, grit, or other matter on to the wheels of motor or like vehicles. The invention is particularly adapted for use on motor and like road vehicles, the object being to provide means whereby, at the will of the



7,068.

driver, a blast of sand or grit may be directed on to the wheels, thereby enabling them to obtain a grip on the road when the same is in a greasy condition, and also to safeguard against side slip by the adherence of the sand on the wheel. According to this invention, it is proposed to utilize the waste or exhaust gases from the engine for this purpose. A represents the chassis, and B the exhaust-box. C is a sand-box which may be located in front of the driving wheels *a*, and is provided with two chutes *c* for directing the sand to the desired points. The contents of the sand-box are restrained from escaping by means of a slide c^1 in the bottom thereof, said slide being actuated by the driver through the intervention of a rod c^2. D is a valve on the outlet pipe from the exhaust-box B, said valve being adapted normally to permit the gases to escape direct to the atmosphere, but being provided with a by-pass having two branches, which extend towards, and project into, the sand chutes *c* in front of each driving-wheel. The exhaust gases from the engine are normally allowed to pass into and out of the silencer. Means are provided, such as a valve controlled by levers e^1, e^1, whereby, when it is desired to direct the exhaust to the sand-boxes, the outlet through the silencer is partly, or entirely, closed, and the gases, or a portion thereof, forced to escape through the by-pass simultaneously with the withdrawal of the slide c^1 of the sand-box, so that as the sand falls or is drawn out the exhaust gases project it with considerable force on to the wheel. The slide and exhaust-valve may be operated by a common actuating member under the control of the driver.

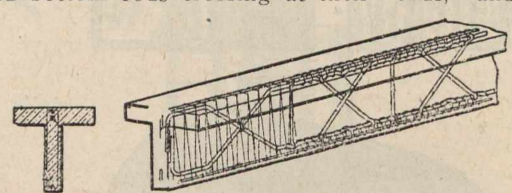
Starting Internal-Combustion Engines.—**The Wolseley Tool and Motor-Car Company, Limited, and A. A. Remington, Birmingham.**—**2,099.**—This invention has for its object to facilitate the starting of multiple-cylinder internal combustion engines; and, broadly described, consists in temporarily utilizing one or more of the motor cylinders as a pump or pumps, driving such pump or pumps by the other motor cylinder or cylinders, to charge, under pressure, combustible mixture, which passes into the cylinder, or each cylinder, which is utilized as a pump, behind the piston thereof during one stroke, into a reservoir on the return stroke, and utilizing combustible mixture thus stored within the reservoir for restarting the engine pistons after the next stop. The reservoir may be charged in this manner up to very nearly the maximum pressure of the working compression in the combustion chambers. Each cylinder is provided with a valve-box between itself and the reservoir, within which is seated a valve *b*. Any one of the cylinders, or any pair thereof. may be utilized as a pump or pumps, to pump combustible mixture into the reservoir, being driven for such purpose by the other cylinders. Each check-valve *b*, when used as a pump-valve, is pressed against its seat simply by a spring, against the force of which it is moved back by the pressure of the mixture caused by the forcing stroke of the pump, and allows mixture to pass into the reservoir, closing again at the end of the forcing stroke and preventing the return of mixture from the reservoir. When the reservoir has become sufficiently charged, the valve is securely fastened down to prevent any risk of firing the contents of the reservoir while the cylinder is working as a motor; and this is conveniently provided for by forming, upon an enlarged portion of the valve-spindle *d*, a quick-threaded screw d^1 which is screwed through a corresponding portion of the valve-box, whereby the spindle may be screwed down upon the end of the valve-stalk *b*, by turning an arm *f*, which is fixed to the spindle, through a moderate angular distance. The spindle *d* is shown to be sufficiently raised to allow the valve to be lifted by mixture which is compressed within the corresponding cylinder. To utilize within a cylinder, the compressed mix-



2,099.

ture in the reservoir, for the purpose of starting the engine, the valve *b* of such cylinder is lifted by means of the spindle *d*, for which purpose the head of the spindle is formed with distance-pieces d^2 which pass across the edge of a cap forming the outer end of the valve-stalk b^1, and join into a plate d^3, in which is formed an open-ended slot d^4, into which the valve-stalk b^1 is passed with the cap over the plate d^3, whereby, if the spindle *d* is screwed outwards sufficiently, it draws the valve *b* away from its seat. Sufficient distance is allowed, as shown, between the portion of the head of the spindle *d* from which the distance-pieces d^2 project, and the plate d^3, to provide for the automatic lift of the valve when acting as a pump-valve, the spindle being then in the intermediate position shown. The valve *b* is guided within its box by a fluted portion, which is a sliding fit within a cylindrical portion of the box.

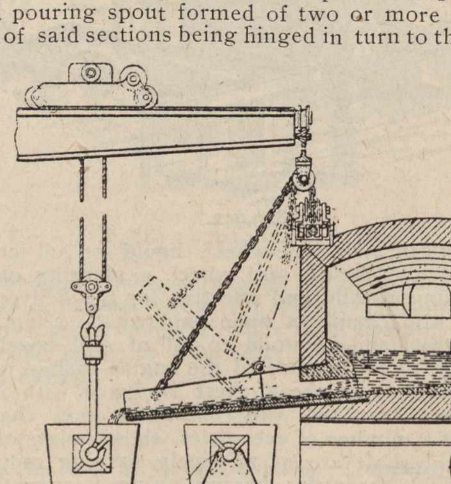
Armoured Concrete Structures.—**Lavanchy.**—**26,364.**—The structure is characterized by a beam of T-shaped section, the metallic armouring of which consists of horizontal top and bottom rods crossing at their ends, and having



26,364.

notches or holes to engage with intermediate rods, the horizontal portions being formed of an iron wire wound as a rectangular spiral.

Drain: Means for Tapping or Discharging Open-hearth and Like Furnaces.—**19,616.**—The improvements consist in a sectional pouring spout formed of two or more sections, one or more of said sections being hinged in turn to the succeeding



19,616.

section, means being provided for swinging said hinged section out of the way of the succeeding section to permit the metal to flow from said succeeding section.

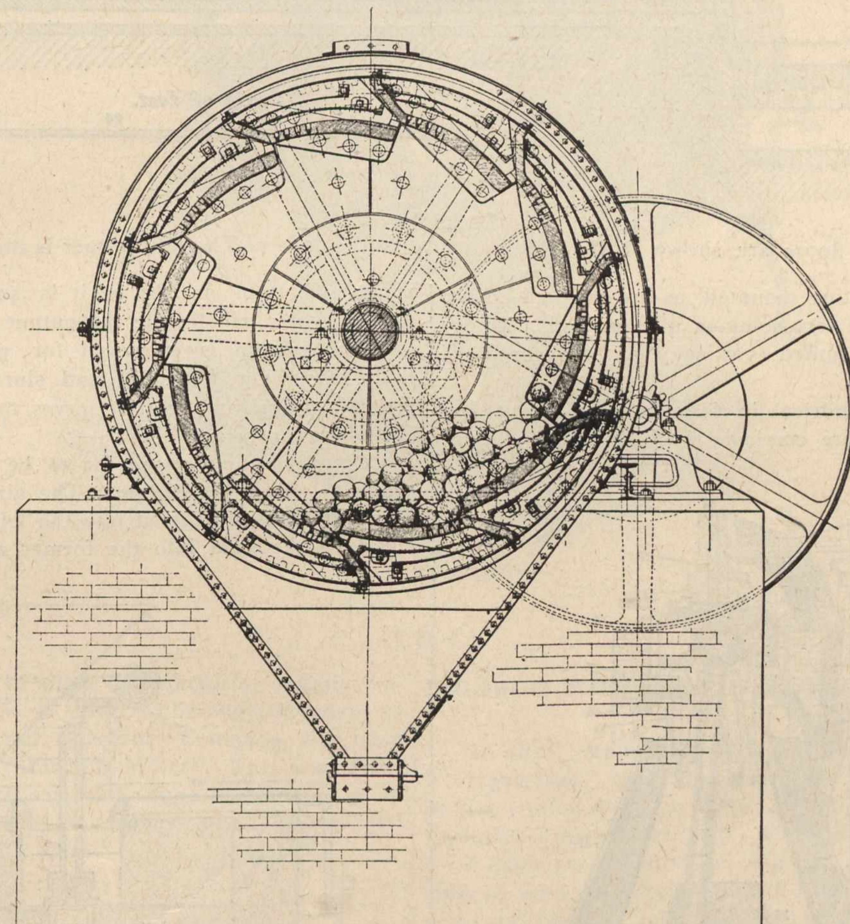
CEMENT-MAKING APPLIANCES.

Particulars of Some of the Machinery Which is Helping the Industry to Grow.

Concrete machinery makes an interesting study. Labor-saving devices are as necessary in the cement and concrete industry as in any other commercial enterprise. The following article gives details of many of the appliances used in the manufacture of cement. We are indebted to the Ontario Minister of Mines for permission to reproduce these particulars from his report.

Washmills are usually built with concrete sides and bottom, and are circular, hexagonal or octagonal in form. The diameter is from eighteen to twenty feet, and the depth is about eight feet. There is an upright centre shaft having horizontal arms or spokes, which carry "drags," usually three in number. Washmills are employed for the preliminary mixing.

Of intermittent kilns, there are two types, the "bottle" kiln and the Batchelor. The former, as the name would indicate, is in vertical section, shaped somewhat like a bottle. The outer structure is built of brick or stone, and the lining, on account of the excessive heat to which it is exposed, is of fine clay. The fire is started on the grating below, and when well under way alternate layers of coke and dried slurry are laid in. When the burning is completed, and the clinker allowed to cool, it is "drawn." The processes of loading, firing and sorting the clinker all require considerable skill, and of a kind, too, wholly born of experience.



Gates Ball Mill.

Ball mills are employed to do the coarser grinding of the clinker only. This is a cross section showing shields and screens.

No attempt to utilize the waste heat from the firing chamber is made in the bottle kiln. This is done in the Batchelor kiln. If we conceive a long, covered archway, with a cement floor, annexed to the bottle kiln in such a way that the escaping gases are obliged to pass through it on their way to the stack, we have the principal of the Batchelor kiln. The slurry is pumped over this floor to a depth of a few inches, and while one charge is being clinkered in the furnace of the kiln a second is being dried on the archway floor. The Batchelor kilns are usually constructed in batteries of six, having a single stack to which all flues lead.

The Dietsch kiln is one of the continuous types. The "forewarmer" is really the lower part of the stack, there being here a shelf or ledge which prevents the mass of slurry bricks above from falling down. The coal is charged into the furnace from the floor beneath that from which the dried slurry is charged. The "drawing" is done from below, every four or six hours, and to replace the material thus drawn a fresh supply is dragged by hand from the ledge above referred to. The kiln is provided with suitable "ports" or "eyes" for firing and loosening the bricks when "hung up."

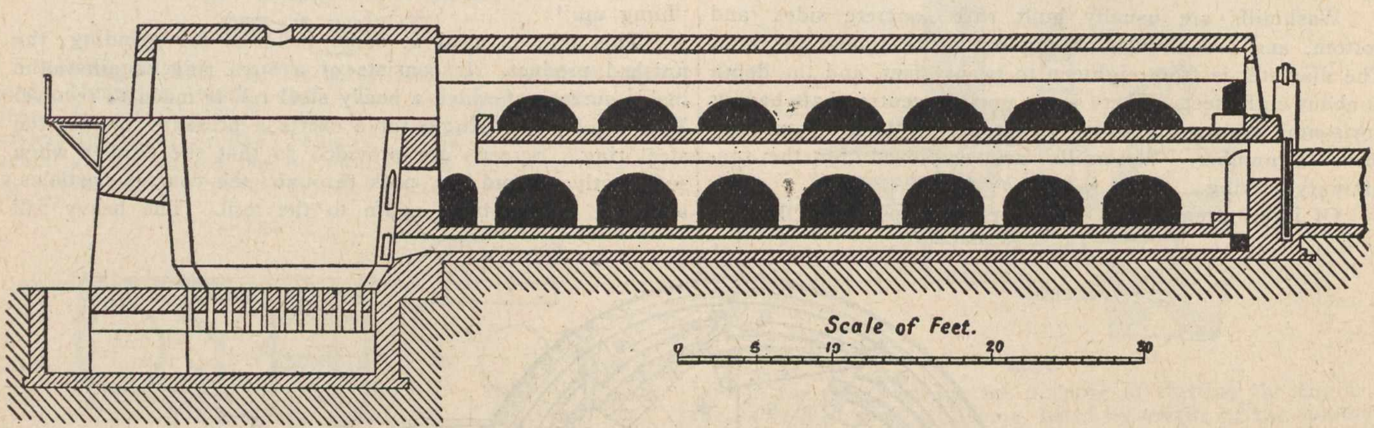
This mill is used at some factories for grinding the finished product. It consists of a steel ring, against the inside surface of which a heavy steel roll is made to revolve. This roll by centrifugal force exerts a pressure against the steel ring. Screens are provided so that the clinker when sufficiently ground can pass through, the coarser particles, however, falling back again to the mill. The heavy roll above referred to is attached to an upright pendulum-like shaft.

The general scheme in the Alborg kiln is similar to that of the Dietsch kiln. There is, however, no ledge in the Alborg kiln. The narrowest portion of the kiln, or "throat," occurs where the coal is charged into the kiln. Above this, the slurry bricks part with their moisture, and below it the firing takes place. Below the firing zone the cooling occurs. No attempt is made to utilize the waste heat.

The rotary kiln is simply a huge revolving cylinder of boiler steel, set slightly on an incline. The lower end is closed by a "hood" mounted on wheels, so that it can be rolled back at pleasure. Through this hood passes the pipe which admits the fuel, usually ground coal. The fluid slurry is pumped in at the upper end. Rotary kilns have a capacity of about one hundred barrels per day, depending on the kind of slurry and the length of the kiln.

Ball mills are employed to do the coarser grinding of the clinker only. They are in the form of short cylinders, revolving on their axes, and containing a number of large steel balls. The circumference of the mill is provided with overlapping "wearing plates" and two sizes of screens. The material as it is reduced to sufficient fineness passes through holes in the plates and through the meshes in the sieves, all particles not sufficiently reduced to pass the finer of the sieves being returned to the mill in the process of revolving. The finer particles pass to a hopper below. The clinker is fed in through one of the trunnions of the mill.

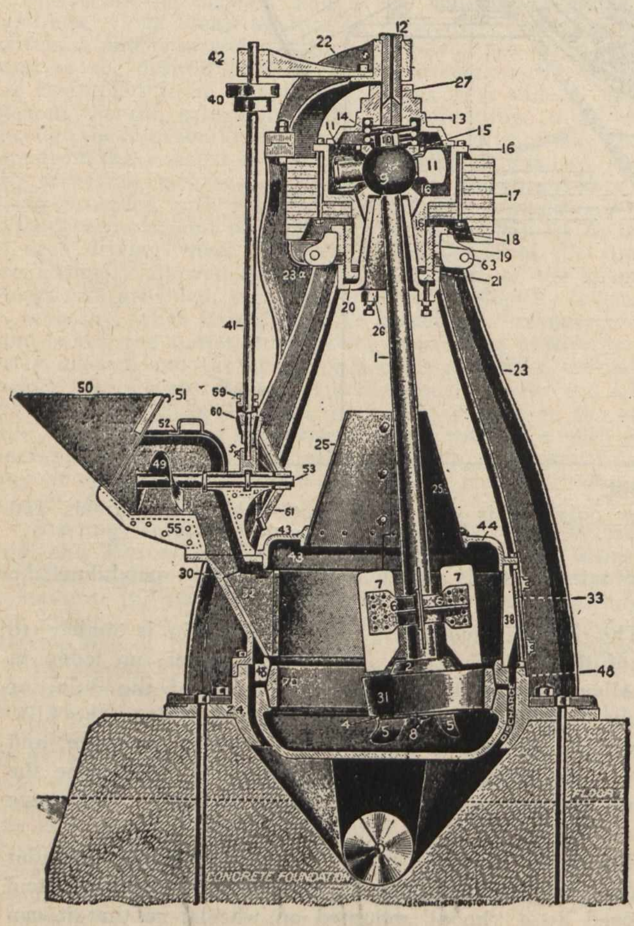
These mills are used both for wet and dry grinding. They consist of two built-up stones. The parts are of



Batchelor Kiln.
The two slurry drying floors are shown in the right, one along the other. The kiln proper is the chamber on the right.

natural emery rock, and are mounted, as are the well-known buhr stones, at one time very common in flour mills. Emery grinding stones are mounted vertically as well as horizontally.

Tube mills are cylindrical in form, usually about five by twenty feet. They are employed in both raw and final



Griffin Mill.
This mill is used in some factories for grinding the finished product.

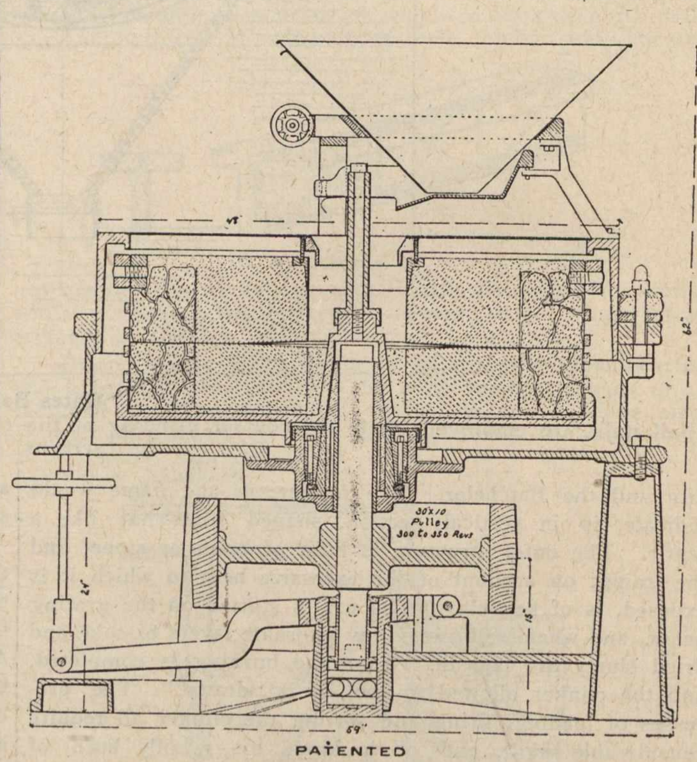
grinding. A tube mills must, of course, be lined with some resisting material, usually silex stone, since it is partially filled with flint pebbles, which accomplish the grinding of the clinker or slurry, as the case may be. As in the ball mills, the feed is through one of the trunnions of the mill.

The Gates rock and ore breaker is of the gyratory type, and is capable of crushing from 75 to 125 tons per hour, depending on the size of the machine employed. The size to which the rock can be reduced can be controlled at will within certain limits. The axis of the mill is vertical.

The Mosser cooler consists of a circular tank, eight feet in diameter and thirty-two feet high, fitted with internal blast pipes and cones. The hot clinker is elevated outside and dumped in at the top. The tank is supposed to be kept practically full of clinker, which is withdrawn from the bottom as fast as it is supplied at the top. A Mosser cooler will handle the output of four rotary kilns.

This system is employed for pumping all kinds of fluids, including wet marl and slurry. The accompaying figure is diagrammatic, but serves to illustrate the method. The operation is as follows:—

"Suppose the compressor to be in operation and the switch set as in the figure. The air will be drawn out of the right tank and forced into the left one, and in so doing will draw the fluid into the former and force it out of the



Emery Mill.
This mill is used both for wet and dry grinding. The above is a cross section.

latter. The charge of air in the system is so adjusted that when one tank is emptied the other is filled, and at that moment the switch will be automatically thrown, reversing the pipe connections, and thereby reversing the action in the tanks."

MACHINE SHOP NOTES FROM THE STATES.

By Charles S. Gingrich, M.E.

XXXIV.

In the manufacture of small duplicate parts such as are used in the manufacture of fire arms, sewing machines, typewriters, and similar small and accurate mechanisms, it has been the practice to use Lincoln pattern millers. This is the old original form of small manufacturing milling machine invented by Francis A. Pratt while superintendent of the Lincoln Foundry and Machine Company, and from which it took its name, "Lincoln Miller." This was away back in 1854. Strange to say, this type of machine as in use to-day, has very few improvements over the original one.

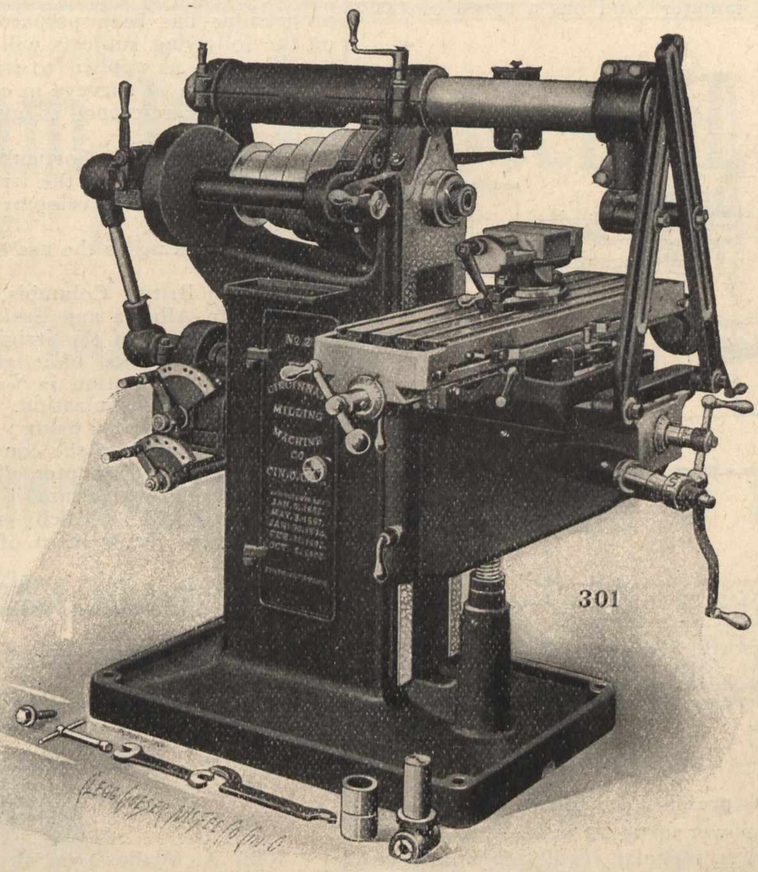


Fig. 1.

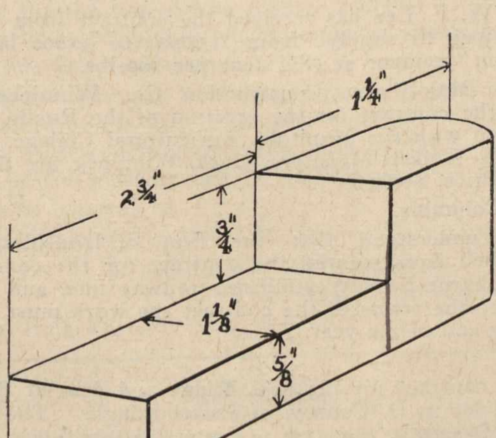


Fig. 2.

There is a strong tendency, however, to get away from these old-fashioned machines and methods. The column and knee type miller, shown in Fig. 1, has been proven very much more productive and a more economical machine to install in every way. One of these machines now at work in the shop of the Cincinnati Milling Company, turns our 24 pieces of small iron castings of the dimensions shown in Fig. 2. The cutters are high-speed steel, 4½ and 3½-inch diameter, with nicked teeth. The total width of the cut is 4¾ inches—removes about ⅛-inch of metal—at a table travel of nearly 2 inches per minute. The finished pieces are accurate within .001 inches, ready for assembling without any additional handwork. This machine is turning out these pieces at a rate of one jig full, or 24 pieces, in 15 minutes. This includes chucking and handling.

In addition to repetition work, this type of machine is adapted for doing a greater variety of milling work than any other type.

PIG-IRON PRODUCTION FROM NORWEGIAN ORE.

In the "Meddelelser fra Norges Oplysningskontor for Noringsveiene" (a government institution), there appears in the edition for March 16 an article which will interest Canadian mine owners, etc. The following is a translation:

"Attempts to produce pig-iron from Norwegian ore reduced with Norwegian carbon have for the first time met with success, the carbon being in the shape of graphite, which is found in great abundance in different parts of the country, mostly in the north, where deposits to the extent of 10-20 metres and more are found close to the sea.

"This mineral has hitherto remained practically unnoticed, it being sufficiently pure for crucibles, pencils, etc., whereas it cannot be used as fuel. Now, however, Mr. Albert Hiorth, C.E., has succeeded in producing good iron from poor ore, unsaleable for the use in blast furnaces. During experiments, which took place at the new electro-chemical establishment of the Technical School of Christiania, iron sand containing 13 per cent. titanic acid was smelted together with graphite as a medium of reduction, and lime as slaggy material. With these materials, which are rather impure (the graphite thus contains about 20 per cent. silicia), the iron produced, when analyzed, showed only a trace of titan and 0.01 per cent. silicia. The experiment has thus proved that graphite can be used for the reduction of ordinary iron ore to good pig-iron, even of highly titaneferous ores, in which Norway is so rich, and which are now without value.

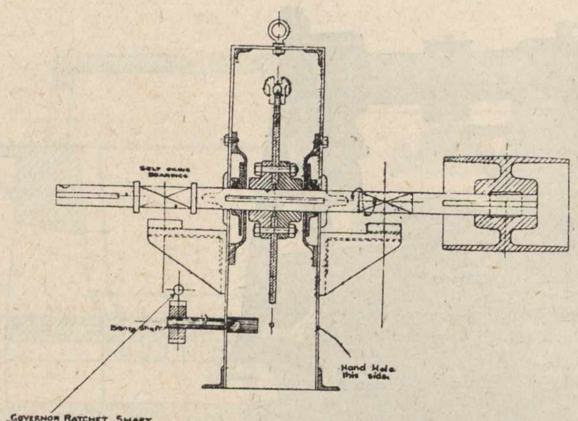
Work on the Brandon gas plant has been started, and, it is understood that the work will be completed as soon as possible.

TANGENTIAL WATER WHEELS.

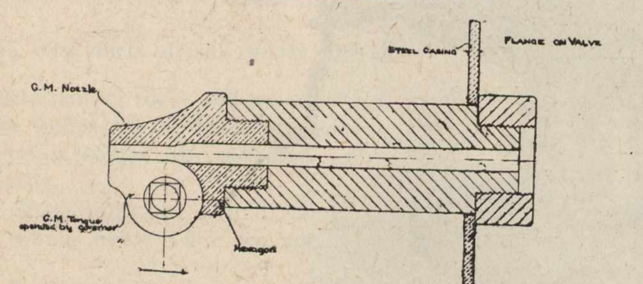
Tangential water wheels may be used wherever power is required, and in any place where water under high pressure can be secured. The drawings reproduced to illustrate this article, show one of the latest high pressure water wheels manufactured by Mr. Percy Pitman, of Cropthorne, Pershore, England.

This wheel is operating on one of the high pressure water mains of a water supply company.

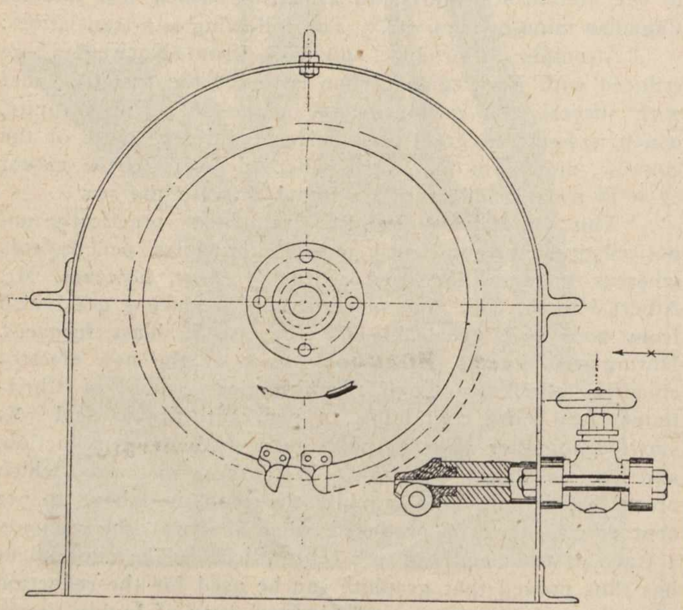
It is 30 inches in diameter and has a speed of 1,000



Viewed in Direction of Arrow



R. P. M. under 700 pounds pressure per square inch (1,614 ft. head), and develops any power up to 25 B. H. .P. as desired. It is fitted with improved rectangular regulating nozzle with operating tongue, which is connected to the governor mechanism, and gives very close speed regulation for driving electric lighting plants, etc. Speed regulation to within 2 to 3 per cent. under changes of load has been obtained under ordinary working conditions. The buckets and nozzles are of phosphor bronze, accurately machined to a fit. The nozzle gives a solid and transparent jet of water, at all stages of opening, and is entirely free from spray.



It is fitted with high speed governor, as shown; also a ¾-inch diameter high pressure stop valve, and hand regulating mechanism. This governor can be cut out instantly if it is desired to regulate by hand.

These machines are made for pressures from 700 to 1,050 pounds per square inch, and in sizes from ⅛ to 50 horsepower. They may be used for driving lathes, dynamos, ventilating fans, coffee mills and roasters, cream separators, potato peelers, churns, sausage machines, bottle washers, hair-dressers' brushes, sewing machines, paint mills, shop window attractions, hay choppers, and cartridge machinery.

IRRIGATION IN THE WEST.

The first irrigation convention ever held in the West will be opened in Calgary on July 17th. A most interesting programme has been prepared, and resolutions and papers on the following subjects will be submitted:

Forestry as applied to irrigation.

Extension of surveys in connection with irrigation, having particular reference to guaging of streams and location of reservoir sites.

Agricultural and horticultural experiments and the use and duty of water on the irrigated farms.

The industrial development following the wake of irrigation.

Laws relating to the use of water and the administration thereof.

(a) In British Columbia.
(b) In Alberta and Saskatchewan.

Social phase of the irrigation movement.

The co-operation of irrigation and drainage.

Status of irrigation in Canada.

Permanent organization.

An effort is also being made to induce the following gentlemen to address the convention:

Prof. L. G. Carpenter, director and professor of irrigation, Colorado Agricultural College, Fort Collins, Colorado.

Prof. F. W. Newell, director reclamation branch, United States Department of the Interior, Washington, D.C.

Hon. George Day, Blakley, Cassia County, Idaho.

Mr. John Widstoe, Superintendent State Agricultural College, Logan, Utah.

Prof. B. C. Buffum, director Experimental Station, Larimee, Wyoming.

Full information may be obtained from Mr. C. W. Peterson, Chairman of Committee on Arrangements, Calgary, Alta.

OBITUARY.

John A. Walker, vice-president and treasurer of the Joseph Dixon Crucible Company, died at his home, Jersey City, N. J., on May 23rd.

Charles C. Malloch, C.E., of Ottawa, was drowned at Mills Isles Rapids, June 1st, while with the Georgian Bay Canal staff taking hydraulic measurements at the pitch of the rapids.

CONTRACTS AWARDED.

Manitoba.

Mr. W. F. Lee has received the contract from the City of Winnipeg to supply from 15,000 to 30,000 barrels of "Sampson" cement at 78¼ cent per 100 lbs.

The May-Sharpe Construction Co., Winnipeg, have secured the contract for the erection of the Roblin Hall, in connection with the Manitoba Agricultural College. Messrs Hooper & Walker, McIntyre Block, Winnipeg, are the architects. Price, $106,000.

British Columbia.

It is understood that the firm of Ironsides, Rannie & Campbell have secured the contract for the construction of the Eburne-New Westminster railway line, and that according to the terms of the contract the work must be completed by end of the year.

Ontario.

The contract for the new bridge and dam at Buckhorn has been let to D. Conroy, of Peterborough. The contract price is $56,000.

EDUCATIONAL.

A circular that those who anticipate taking a course in railway theory and practice has been received from McGill University, Montreal. It is a prospectus of the McGill Railroading Course for 1907-08. This is a subject that is made a specialty of in the Montreal Institution of learning. Detailed information may be had from Mr. J. A. Nicholson, M.A., Registrar, or Professor Clarence Morgan, McGill College, Montreal, Que.

The City of Woodstock has applied to the Ontario Railway and Municipal Board, asking it to approve a by-law providing for the issue for debentures to the extent of $7,045, for the extension of the electric lighting system.

City Engineer Rust, of Toronto, says that it will cost $5,000 to prepare a report on the cost of a power and distribution plant in the city, as it would entail a great deal of work and the services of an engineer to assist in preparing the report. He asks that Mr. C. B. Smith be retained in connection therewith.

The Ontario Box Factory is erecting new premises on Sherbourne Street, Toronto, and the Otto Higel Company, makers of piano parts, are adding a new building to their works.

John D. Atcheson, architect, has prepared plans for an addition to the John W. Peck & Co., wholesale warehouse, Princess Street, Winnipeg. The contract has been let to Carter, Hall & Co. Price, $35,000.

The Canadian Pacific Railway has decided to erect a machine shop at Brandon, at a cost of $15,000.

STEEL RAILWAY BRIDGES AND HAND-RAILING FOR SUBWAY.

Tenders will be received by registered post only, addressed to the Chairman of the Board of Control, City Hall, Toronto, up to noon on Tuesday, July 16th, 1907, for the supply and erection of steel railway bridges and hand-railing required for the Lansdowne Avenue Subway.

Envelopes containing tenders must be plainly marked on the outside as to contents.

Specifications may be seen and forms of tender obtained at the office of the City Engineer, Toronto.

The usual conditions relating to tendering as prescribed by city by-law must be strictly complied with or the tenders will not be entertained.

The lowest or any tender not necessarily accepted.

E. COATSWORTH (Mayor),
Chairman, Board of Control.

City Hall, Toronto, May 18th, 1907.

DEPARTMENT OF RAILWAYS AND CANALS

RIDEAU CANAL.

NOTICE TO DEALERS IN CEMENT.

SEALED TENDERS addressed to A. T. Phillips, Superintending Engineer, Rideau Canal, Ottawa, and endorsed "Tender for Cement," will be received until 16 o'clock on Friday, the 21st of June, 1907, for the supply of 1,600 barrels of Portland Cement, to be delivered in bags into the Ottawa Forwarding Company's Sheds, in the Canal Basin, in the City of Ottawa, by the 31st July, 1907

Specifications can be procured at the office of the Superintending Engineer of the Rideau Canal, Canadian Building, Ottawa, on and after this date.

The Department does not bind itself to accept the lowest or any tender.

By order,
L. K JONES,
Secretary.

Department of Railways and Canals.
Ottawa, 25th May, 1907.

Newspapers inserting this advertisement without authority from the department will not be paid for it.

British Columbia.

The G.T.P. has begun construction of its branch line from Kitamaat to Kitsalas canyon. The charter of the company calls for the expenditure of $100,000 before the end of August. This line will develop the timber and mineral resources of that section of the district. Telqua and Bulkley valleys will be tapped all the year round.

Ontario.

A number of the employees of the Intercolonial Railway are to receive increases in their pay. The Department of Railways has $50,000 which will be distributed this way.

Manitoba.

The largest consignment of railway construction equipment ever sent to Western Canada is now on the way for the use of the Grand Trunk Pacific Railway. It includes 25 locomotives, 500 ballast cars, 1,000 flat cars, and ten steam shovels.

Alberta.

Messrs. Dukelow & Son, of Prince Albert, have commenced grading on the Grand Trunk Pacific, just east of Edmonton. About 50 teams are at work.

The building of the Edmonton Electric Railway has been commenced by the Bithulithic & Contracting Co., who have the contract for the paving.

MUNICIPAL.

Ontario.

City Engineer Kerr, of Ottawa, says that the water supply of the city is inadequate. At present 14,000,000 gallons of water is consumed per day, while the safe working capacity of all the pumps is only 20,000,000 gallons. Mr. Kerr says the capacity should be at least 28,000,000 gallons, and in order to secure this recommends the installation of a duplicate set of pumps.

Manitoba.

The Town Council of Wetaskiwin have decided to install a gas producer and engine in their power house. The contract for the engine and electrical apparatus has been placed with the Canadian Westinghouse Co., which company will supply the producer plant manufactured by the R. D. Wood Co., of Philadelphia.

British Columbia.

Extensions are to be made to the Vancouver Water Works. A new main is to be laid across Coal Harbor, and 12-inch mains are to be laid on Smyth and Beatty Streets. The new work will cost about $10,000. Mr. Madison is superintendent of Water Works.

Saskatchewan.

A bridge is to be built at Moose Jaw this summer that will cost about $25,000

The town of Yorkton has under consideration the installation of a water works system. Mayor W. D. Dunlop has been inspecting a number of water works plants in the United States, with this object in view.

Manitoba.

The ratepayers of Morden voted in favour of installing a municipal electric lighting system. Address S. Scott, Morden.

A report has beeen circulated that a deal is pending between the Bell Telephone Company and the local Government, whereby the latter will acquire the company's systems in Winnipeg and in larger towns, and will have a working agreement affecting long-distance lines.

MINING.

Ontario.

The reports of the recent experiments made at Sault Ste. Marie in the smelting of Canadian iron ores by the electro-thermic proceess were issued recently by the mines branch of the Department of the Interior. The report is a most complete one, and contains a detailed statement of the work done and results obtained, of all measurements made, of the pig and slags produced and the iron ores employed

British Columbia.

It is reported that coal has been discovered near Wellington. There is said to be a 7 feet seam, 3 feet of top coal, and 4 feet of good hard coal.

After many years of inactivity the iron mines on the west coast of Texada Island are to be opened up on a large scale, and within a short time steady shipment of the ores to the Irondale smelter will be started. Mr. James A. Moore, of Seattle, is behind the project.

Work on the Giant and Californian Mining Companies properties is to be resumed. These plants have been closed down for several years, but Mr. W. Y. Williams, who has been appointed superintendent will have everything overhauled, and running again shortly.

Ontario.

A company has been formed to erect a big copper concentrator at the Soo. The company has a capital of $2,000,000, and will be known as the Superior Copper Co. A railway will be built from the Algoma Central to the Superior Mine, a distance of five miles. Contracts for the work will be let about the middle of this month. The plant will have a capacity of 400 tons per day. Messrs. George Kemp and F. C. Smith, of Sault Ste. Marie, are interested.

LIGHT, HEAT, AND POWER.

Ontario.

Port Arthur has not yet decided whether it will develop Silver Falls at a cost of about $1,000,000, or allow a company to do so and purchase the power, the minimum rate quoted being $15.

Work on the surveying of the routes for the power lines in connection with the Hydro-Electric Power Commission has commenced. Parties of surveyors will start at Niagara and work to Hamilton, while other parties will commence work on the net-work of surveys which it will be necessary to make through Western Ontario.

Quebec.

The Montreal, Light, Heat, and Power Co., has offered to sell its plant to the city for $25,000,000.

Alberta.

The Alberta Portland Cement Company will generate 5,000 horse-power at Rednor, and as it will only require 2,000 horse-power for its own use, has applied for permission to supply power to Calgary, which is likely to be granted.

British Columbia.

A large power-house, to cost $40,000, will be built in connection with the new C.P.R. "Empress" hotel at Victoria. An additional emergency boiler will be added to the heating plant. Skene and Gribble are the contractors.

John Galt, C.E., Toronto, has reported on the proposed development of the Shuswap Falls for the Vernon City Council. He finds the development of the electrical power, together with the building of the necessary transmission line will cost $179,000.

The Stave Lake Power Company, which is now engaged in establishing a 15,000 horse-power hydro-electric plant at Stave Falls, will call for bids soon for supplying the generating plant and turbines. Three 5,000-K.W. generators will be installed in the power-house.

Ontario.

Bids will be received by the Board of Control, Toronto, until July 16th, for the supply and erection of steel railway bridges and handrailing required for the Lansdowne Avenue subway. E. Coatsworth, mayor.—(Advertised Canadian Engineer).

Quebec.

Tenders will be received by the Department of Marine and Fisheries until June 10th, for the furnishing of steel plates and shapes for a hull being built at Sorel. F. Gourdeau is Deputy Minister of Marine and Fisheries.

Bids will be received until the 10th of June by the Department of Marine and Fisheries for the charter of a suitable steam vessel to deliver supplies to the lighthouses above Montreal on the 24th of this month. F. Gourdeau is Deputy Minister of Marine and Fisheries.