PAGES

MISSING

The Canadian Engineer

ESTABLISHED 1893.

WITH WHICH IS INCORPORATED

THE CANADIAN MACHINE SHOP.

VOL. XIII.—No. 4. TORONTO, APRIL, 1906. PRICE 15 CENTS $1.00 PER YEAR.

We judge ourselves by what we feel capable of doing; but the world judges us by what we have already done.

Longfellow.

DR. EUGENE HAANEL,
Dominion Superintendent of Mines.

At noon-day, Monday, March 12th, 1906, we witnessed a remarkable scene at the Canadian Club of Toronto. Two hundred keen business men sat spellbound, listening to a story of scientific achievement and trade possibilities as wonderful as the vision of glory and wealth told by Raleigh and Drake on their first return from the Spanish Main. The orator of the day was a man of striking personality: above medium height, grey hair brushed back, body as erect as a grenadier, face bearing marks of strain, but with an expression like a summer's day; for, with a slight Teutonic accent, he spoke with conscious power, "as one having authority." By way of exordium, the influence of iron and steel in making for progress and civilization was told with masterly skill, followed by a panoramic word-view of the immense magnetic iron ore resources of Canada, hitherto incapable of being smelted in the blast furnace on account of their highly refractory nature. Then was narrated the fact that upon his initiative the Dominion Government sent a Commission across the Atlantic to Sweden and France to investigate the latest processes of electric smelting. Based upon the Commission's report, he (the speaker) submitted a memorandum to the Minister of the Interior (Hon. Frank Oliver), suggesting electric smelting experiments on a comparatively large scale. At this stage, a glance at the faces of the audience as they listened with breathless interest, was a sight never to be forgotten. The silence was profound; for, with the art that conceals art, the speaker led his auditors step by step to Dr. Heroult's electric furnace plant at Sault Ste. Marie, and then, in imagination, throwing open wide the doors, disclosed fifty-five tons of pig iron piled in serried rows, successfully made from titaniferous, nickel-ferro-pyrrhotite and sulphurous, magnetic ores, at an expenditure of electrical energy, electrode and fuel consumption simply startling, and almost ludicrously low in the matter of cost. The orator concluded with these pregnant words:

> The Government has furnished you with facts on which to base a sound judgment as to the feasibility of commercially engaging in the manufacture of pig iron by the electric process; with that its duty to the nation is done, it remains with you business men to apply, perfect and profit.

A scene of enthusiasm followed, for every man present realized what this triumph in metallurgical science meant to his country. The hero of this historic scene was the distinguished man whose portrait appears above, and whom we delight to place in our gallery this month among the men in Canada who have "done things."

Dr. Eugene (Emil Felix Richard) Haanel was born at Breslau, Germany, May 24, 1841. Graduated from Gymnasium, Breslau, 1858. Received A.M., Athens, Ohio, U.S.A., 1872; and Ph.D., Breslau, 1873. Endowed with the gift of teaching, he subsequently occupied the following chairs: Professor of Science, Adrian, 1886; Professor of Natural Science, Albion, 1868-72; Professor of Physics and Mineralogy, and Director of Faraday Hall. This institution, erected by Dr. Haanel, was the first Science Hall in Canada. He was also Dean of the Faculty of Science, Victoria University, Cobourg, Ont. The last period of his academic career was as Professor of Physics, Syracuse University, U.S.A., 1889-1901, where he erected the "Esther Baker Steele Hall of Physics." Then came the call, in 1901, to fill the important position of Superintendent of Mines to the Dominion Government, a service which has just culminated in the signal triumph told above, and which is destined to place Canada in the forefront of nations in the practical application of electro-thermic processes for the smelting of magnetic ores, and developments in iron and steel industry.

Dr. Haanel's place in science for original work will be associated with (1) Hydriodic acid as a blow-pipe reagent; (2) Gypsum tablets in blow-pipe analysis; (3) Hydrobromic acid and tetranchloride of tin in blow-pipe reagents.

In technical literature he will be remembered as the author of "Location and Examination of Magnetic Ore Deposits by Magnetometric Measurements."

He is a member of the following learned societies: Physical Society, Canadian Mining Institute, Canadian Royal Society (charter member), Faraday Society, North of England Institute of Mining and Mechanical Engineers.

Such, briefly told, is the public career of one whom "The Canadian Engineer" is glad to honor. Lord Beaconsfield once said that "there is no gratitude in politics." We trust, however, that the services which Dr. Haanel has rendered to this country at a critical stage in its industrial history will receive the substantial recognition which they justly deserve.

EUROPEAN HYDRO-ELECTRIC DEVELOPMENT

FRENCH PLANTS IN THE VICINITY OF LYONS.

By Charles H. Mitchell, C.E.

Lyons: From the River Rhone.

The city of Lyons with its population of half a million is second in size, but first in industrial importance among the provincial cities of France. This distinction is largely due to its geographic situation, since it is practically in the centre of the country, and is located at the confluence of two navigable rivers, the Rhone and the Soane; hence, secures for it a large provincial trade, and makes it an ideal distributing centre. The surrounding cities and towns contribute their share toward this activity; notably St. Etienne, with its steel works—the largest in France.

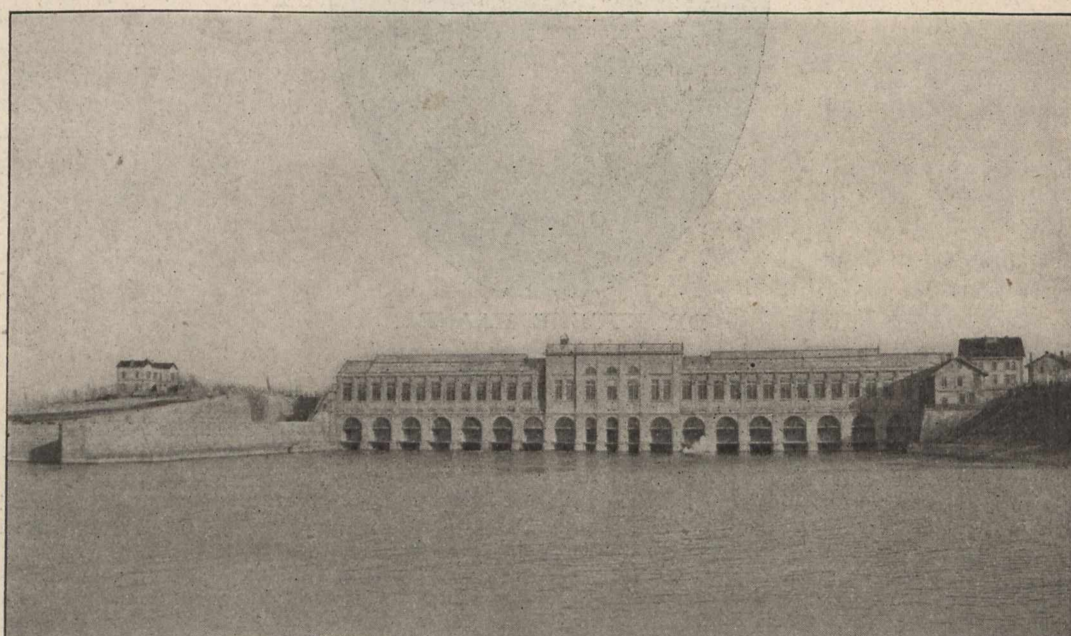
Lyons, as a user of power for manufacturing purposes, offered an attractive field for enterprise. It is not surprising, therefore, that in this city one of the earliest European hydro-electric plants of large dimensions was installed. The diverse character and limited extent of its respective manufactures calls for relatively small quantities of power, requiring a varied distribution and numerous units. The main demands for mixed power come from its silk, fancy goods, leather, wine, brewing and light metal establishments. The total value of manufactures in Lyons amounts to about $100,000,000 annually: mainly silk; of which, over one-half the world's supply is said to pass through the warehouses of Lyons.

The Société des Forces Motrices du Rhone first undertook in 1894 the construction of a hydro-electric plant for the purpose of transmitting power to Lyons, a few miles distant, and thus became one of the pioneer European hydro-electric power producers. The site chosen for development was on the Rhone, a few miles above Lyons, and was such that high tension transmission was unnecessary. The result now is, that as in similar instances in America, a large industrial suburb, Ville-urbanne has sprung up near the generating station, notable for its lack of chimneys and its uniformly neat appearance.

For a distance of about ten miles above the generating station, the Rhone flows through a very irregular bed, consisting of a network of rapids and small swift streams, among gravel islands, in a broad valley, having a total fall of about 35 feet. The main channel is canalized by the Government for shallow draft. The general scheme of the power development comprises a head canal from the Rhone above the rapids to a power house site, thence a tail race canal to an outlet in the Rhone below the rapids, a total distance of about 11 miles, the whole known locally as the "Canal de Jonage." This arrangement affords a working hydraulic head of about 38 feet. The amount of water available is limited by the natural conditions and the requirements of the Government to from 3,000 cubic ft. per second at low water, to 4,800 at high water. The diversion of this water from the river, made necessary the construction of a canal of a minimum depth of 8 feet, with locks for the passage of light draft vessels, so that in case of need the Government could use it in conjunction with the main channel.

The upper portion of the canal follows an old river channel, while the main portion, cut through gravel, is heavy excavation to a wet section of about 200 ft. width. The canal is spanned by nine very substantial bridges. The generating station of itself forms the dam across the canal necessary to secure the head of water and at one end a lock for passing vessels is inserted.

The generating station has frequently been noticed in the technical journals during the past few years, it is not my intention in this article, therefore, to enter into elaborate details, but simply to set forth the engineering features of this notable installation. The building itself is about 475 feet long, and is built largely of concrete, trimmed with stone and tiles. The units are directly connected; of the vertical shaft type, 16 in number; each of about 1,250 net H.P., under normal conditions of the river; there are also 3 exciter units. Water is led to the turbines from separate bays on the upstream side of the station, each having its own screens and sluice gate. The latter is unique, as being in the nature of a cylindrical drum, 10 ft. in diameter, closing the top of a vertical inlet pipe. It is raised and lowered by a chain hoist worked from within the station shown on the right hand side of the interior view of same.



Lyons—Generating Station on the Rhone.

The units are arranged in line at about 27 ft. centres. The right central units, four on each side of the central bay—which contains the exciter units and switchboards—are operated by Jonval turbines made by Escher Wyss & Company, of Zurich, the installation of which was completed about 1897. These are of a special type, having a three stage runner with downward discharge into a draft tube, and water fed to it through three separate and parallel distributors or guides at about 45 degrees; all fitted with cylinder gates. The thrust is provided for by a large disc or piston about 6 ft. diameter, attached to the shaft within, and at the top of the case. The closed chamber on the upper side of the piston is connected to the tail race.

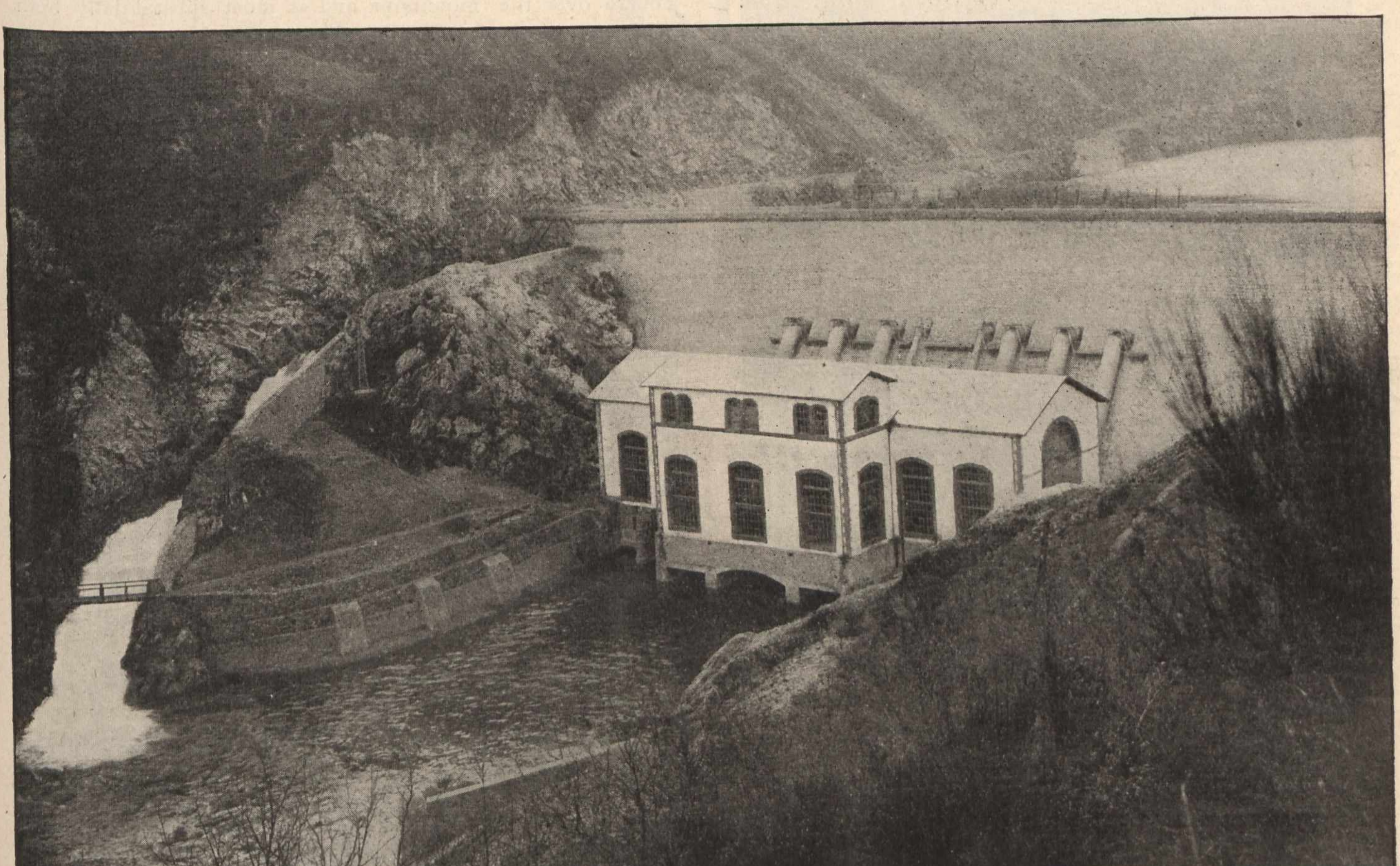
Regulation is secured by a special governor, consisting of a rotating disc and servo-motor actuating valves in conjunction with a high pressure oil pump, by which the gates of the turbine are operated. This turbine gives an efficiency of about 76 per cent. at full load, and the governor is said to regulate within a speed variation of 4 per cent. on a change of half load. The other eight main units, four at each end, were installed in 1902, also by Escher Wyss & Co., and are of the Francis type, having a double runner with central outward discharge, and are said to give an efficiency of about 83 per cent. **It is to be noted that the latter type discharges water in the tail race with less air and commotion than does the Jonval.**

The electrical apparatus is very simple for a station of such magnitude. The generators are wound for three phase, 50 cycles, and 3,500 volts, and revolve at 120 R.P.M. The exciters (3 separate turbine units) provide 170 K. W. each, and revolve at 250 R.P.M. All generators are run in parallel through a simple switchboard directly to the transmission and distribution lines without transformers. The electrical apparatus was built and installed by Brown Boveri & Company, of Baden, Switzerland.

were supplying live steam at about 8 lbs. pressure to the covered forebays at the screens and sluice gates. To a Canadian in Southern France, in the heart of the silk country, this presented an interesting spectacle.

Transmission lines are entirely underground and consist of three wire cables, insulated with paper and armored with hemp lead and steel tape. The cable is laid directly in a trench on a layer of bricks and surrounded with gravel; which, owing to the low potential is found to provide ample insulation. Distribution lines vary in length up to 8 miles from the generating station, there being, of course, variable drops in voltage due to the different lengths, the adjustment of which has received considerable attention.

The power now in use amounts to about 14,000 H.P. at normal conditions. Of this, about 1,500 H.P. is traction load, 3,000 H.P. lighting load and the remainder mixed motor load. The tariff charged may prove interesting at this juncture for comparison with conditions in Ontario in view of the work of the Power Commission. Good quality steam coal at Lyons is about $4.25 per ton. The prices for motor power are as follows:—Up to 100 H.P. at 11½ cents per kilowatt hour; for over 100 H.P. at $34.00 per H.P. per



Clermont-Ferrand, General View.

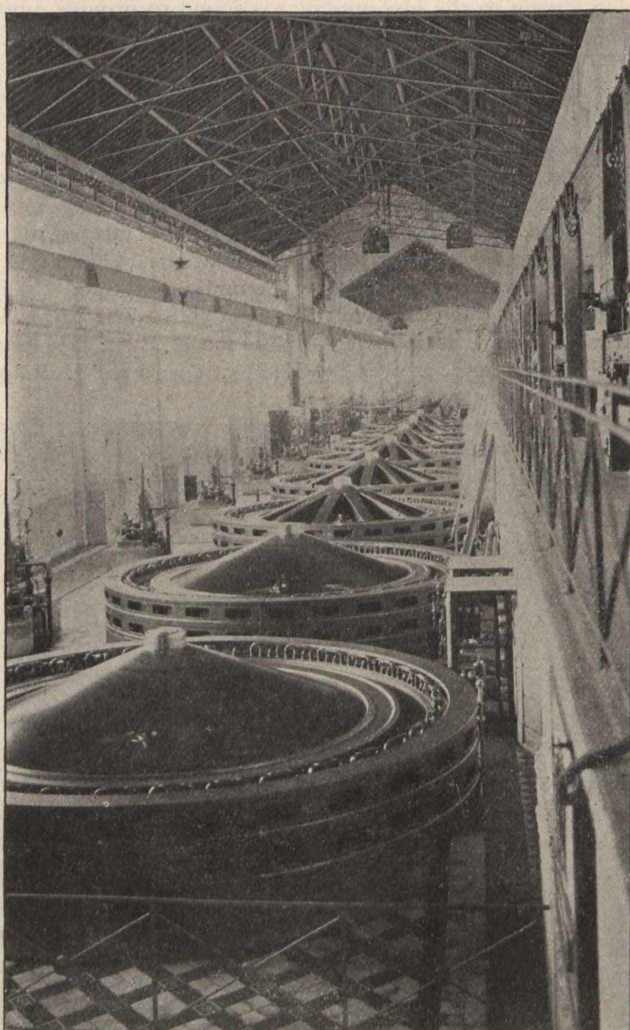
The operation of the station requires comparatively few attendants, being distributed as follows: Eight on turbine deck (one for two units), 4 on alternator deck, 2 at switchboard gallery, and about 8 spare on floor and in workshop. These with a station superintendent and a small technical office staff, constitute the day working force. In the winter an additional crew is required for cold weather troubles. While Lyons is in Southern Europe, freezing weather is frequently experienced. In the winter of 1904-05 the thermometer went at times as low as 5 degrees Fahr. above zero; on which occasions the station experienced trouble from frazil ice. This had been the serious result of occasioning several days' shut down. It is a question whether this ice is formed in the upper river, in the foothills of the Alps, or immediately at the station; the company's engineer inclines to the latter opinion and has tried many artifices to obviate the trouble, but without success. At the time of the writer's visit, January 24th, 1906, the thermometer was down to about 15 degrees Fahr. and in anticipation of trouble, two 25 H.P. steam boilers on scows

year on a 12-hour basis, and $45.00 on a 24-hour basis. There is a sliding discount on the above prices as follows:—On a bill of $20.00 per month, 1 per cent.; on $50.00 per month, 2½ per cent.; on $100 per month, 5 per cent.; on $200 per month, 7½ per cent.; and on $300 per month, 10 per cent. For lighting, which the power company itself operates directly, the charges are as follows:—On meter system 13 cents per kilowatt hour for stoves, hotels, cafes, etc.; 16 cents per kilowatt hour for houses. If on a flat basis the lighting rate is as follows:—For a 16 C.P. lamp, burning 750 hours, per year, $4.20; for 10 C.P., $3.75; for supplementary hours, add 6-10 cent for 16 C.P. and 4-10 cent for 10 C.P. for each hour. In the flat rate the bill is determined by a time meter.

Clermont-Ferrand, From the Sioule.

Clermont-Ferrand, a small city of some 50,000 people, about 80 miles west of Lyons, has as yet but a small demand for lighting, traction and motor current. The hydro-electric plant recently built for its supply is, however, of interest, not only because of some of the constructive engineering features, but because it must come into competition with steam in the heart of a coal producing district.

The generating plant is situated about 20 miles west of the city, in a narrow valley at a high elevation. The available water from the river in continous flow is upwards of



Lyons: Interior of Generating Station on the Rhone.

2,000 cubic ft. per second under normal conditions; but by means of a storage reservoir the natural flow is increased during dry periods. The working head varies between 65 and 78 feet, depending upon the water level in the head (storage) reservoir. The head is secured by a dam in the gorge about 100 feet total height and 370 feet long on the crest, which is curved upstream; the dam is of concrete and contains about 50,000 cubic yards. The water thus impounded forms a reservoir about 5 miles long and about ⅛ mile broad on the surface.

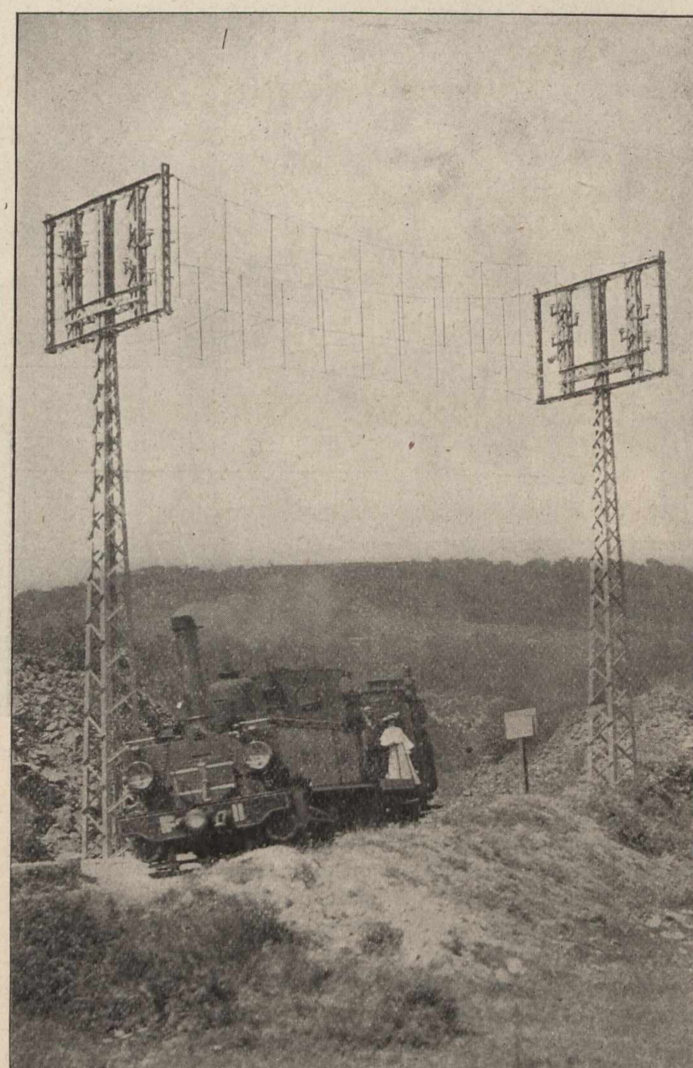
The power station is built as a part of the dam on the lower side, as shown in the sectional sketch, and the penstocks, 5′ 2″ diameter, are carried through the dam proper directly from the reservoir without any intermediate forebay. The spillways for high water, are situated one at each end of the dam, either side of the power station.

The turbines are of horizontal shaft, double, spiral, Francis type, directly connected to the generators, and have two draft tubes. They are rated at 1,200 H.P. under 65 ft. head (considerably too small for the capacity of the generators) and are said to attain an efficiency of 76 per cent. at full and 80 per cent. at three-quarters load. The governors are of the same general type as at Lyons, with about the same refinement. All the hydraulic apparatus was constructed by Escher Wyss & Co.

The generators are three phase of 1,000 kilowatts capacity wound for 1,000 volts, at 50 cycles, and revolve at 333 R.P.M.; they are claimed to have an efficiency of 94 per cent. at full load. They are built and installed by the Societe Anonyme Westinghouse of Havre, who also supplied all other electrical apparatus. The station is designed for six units, but at the present time only three are installed, with two exciters.

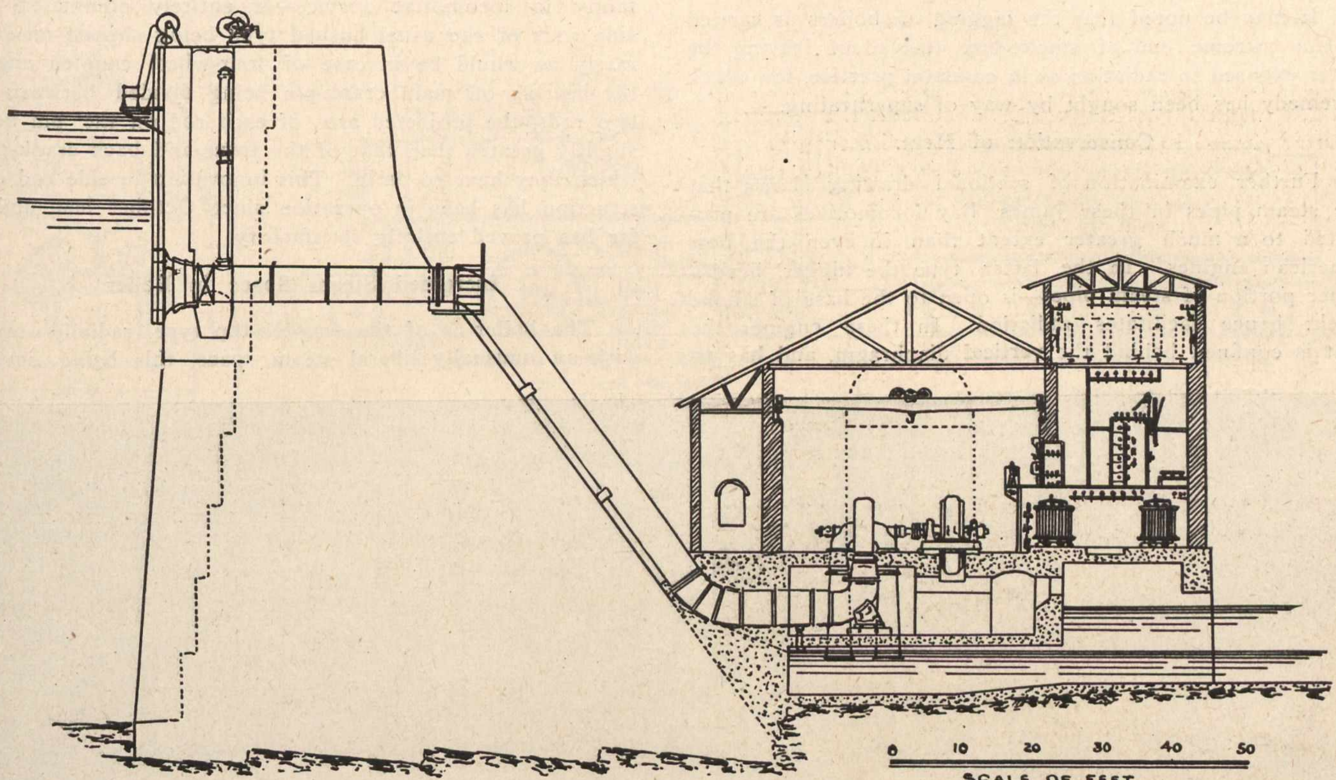
Switchboards are arranged so as to operate the whole station in parallel, or so as to make any combinations of units, and in a general way, are identical with the latest practice of the Westinghouse Company. A feature of station detail, is the admirable isolation of circuits, and of other means of preventing shorts and maintaining continuous operation. The transformers from 1,000 to 2,000 volts are oil cooled 375 kilowatts each, with 97.7 per cent. efficiency at full load.

The transmission line about 20 miles in length, to Clermont-Ferrand, is of special interest, as illustrating some of the latest French practice. The pressure is 20,000 volts and the two circuits now erected with copper wires of 8 min. are each designed to carry 2,500 kilowatts with a loss of about 7 per cent. The line follows a tolerably straight course over the mountains and is most substantially built with structural steel towers about 40 ft. high, set in concrete and normally spaced about 330 ft. apart. The insulators are carried on built steel framework and wires on one circuit are spaced about 34″ apart, the circuits being separated so as to permit repairs on one while current is on the other. The insulators are of a special pattern similar to those used on the Paderno-Milan line, the main line being two-piece, six petticoat. At railroad crossings special wire cradles are erected, as shown in the accompanying view.



Transmission Line: Clermont-Ferrand, Railroad Crossing.

The main sub-station at Clermont-Ferrand, is a very substantial building, thoroughly fireproof, and is arranged with isolated circuits, the barriers being of reinforced con-



Clermont-Ferrand: Dam and Generating Station.

crete. The transformers step down to 3,000 volts for local line distribution.

At the present time the plant is generating about 1,500 kilowatts, of which about half is for lighting, and the remainder for factory motors. First quality steam coal in Clermont-Ferrand costs about $3.40 per ton. On a 12-hour day basis the Bower Company sells, say 100 H.P., at about $33.00 per horse-power per year, and on a 24-hour day basis at about $42.00. The current is sold by meter on a progressive tariff, decreasing inversely as the amount used. Lighting current costs about 15 cents per kw. hour.

TEN-WHEEL FREIGHT LOCOMOTIVE FOR JAMES BAY RAILWAY

Designed by the staff of the Canada Foundry Company, Limited, and built at the Davenport Works, Toronto; some novel features being introduced by the General Superintendent, J. W. Harkom, C.E.

The locomotive illustrated is one of five now in active service on the James Bay Railway, of the Mackenzie & Mann system. These are the forerunners of twenty more for the same interests, to be used in the North-West. The five engines are of the 4-6-0, or ten-wheel class, with 19 in. by 24 in. cylinders, 57 in. driving wheels, and operated at 180 lbs. steam. The weight on the six driving wheels is, say, 111,000 lbs., of which load 35 per cent. is sustained by the driving wheels, 32 per cent. by the leaders, and 33 per cent. on the trailers, an order of weight distribution which gives excellent results. The twenty now in process of construction will carry on the wheels 130,000 lbs. instead of 111,000, or a total, inclusive of truck, of 80 tons each, with an operating steam pressure of 200 lbs. per square inch.

SPECIAL FEATURES.

Spark-arresting Device.

These James Bay locomotives are equipped with a specially designed spark-arresting apparatus, which will be a complete departure from conventional practice, since there will be an utter absence of holes in the diaphragm plates and nettings, through which in the common method of construction the ordinary steam pipes pass, and which, unless exceeding great care and vigilance is maintained, leave openings for sparks to pass out to the atmosphere. The absence of holes in this new apparatus will remove a constant source of danger to the forests of our country.

Economical Adjustment.

An additional advantage of this design is that when once fitted it will be only in case of heavy repairs that these portions of the equipment have to be removed. In the ordinary construction it is nearly half a day's work for two men to take out and replace the internal fittings of the smoke-box; whereas in this new arrangement it will take one man thirty minutes only.

Vertical Diaphragm.

The diaphragm ordinarily runs from tube sheet to top of exhaust pipes forward in the smoke-box, thus throwing the sparks downward and forward before passing upward through the netting to the smoke stack. Now, this diaphragm has to be fitted around the steam pipes in several pieces, whereas in the design adopted in these engines it runs almost **vertically** from top of deflecting plates through smoke-box to top of exhaust pipe, thus missing the steam pipes entirely, and enabling it to be made in one piece, a manifestly superior mode of construction to that in general use.

Soft Exhaust.

In connection with this improved apparatus a high exhaust pipe of unusually large capacity is used, forming a chamber from which the exhaust steam passes into the atmosphere without the loud detonations familiar in ordinary locomotive working, and at the same time removes much of the back pressure on the exhaust from cylinder. In effecting this desirable change the draft on the fire is not unfavorably affected, but, on the contrary, a considerable fuel economy is realized for the obvious reasons evidenced.

Boiler Lagging.

It may be noted that the lagging on boilers is carried to the extreme end of smoke-box instead of leaving the latter exposed to radiation as in common practice, for which a remedy has been sought by way of superheating.

Conservation of Heat.

Further examination of sectional drawing shows that the steam pipes in these James Bay locomotives are protected to a much greater extent than in even the best American engines. In the latter type the nigger head--upper portion of steam pipes—is open to the base of smoke stack; hence facilitates radiation. In these engines the heat is confined behind the vertical diaphragm, and has to pass the deflected plates and through the nettings before leaving the stack.

Cylinder Protection.

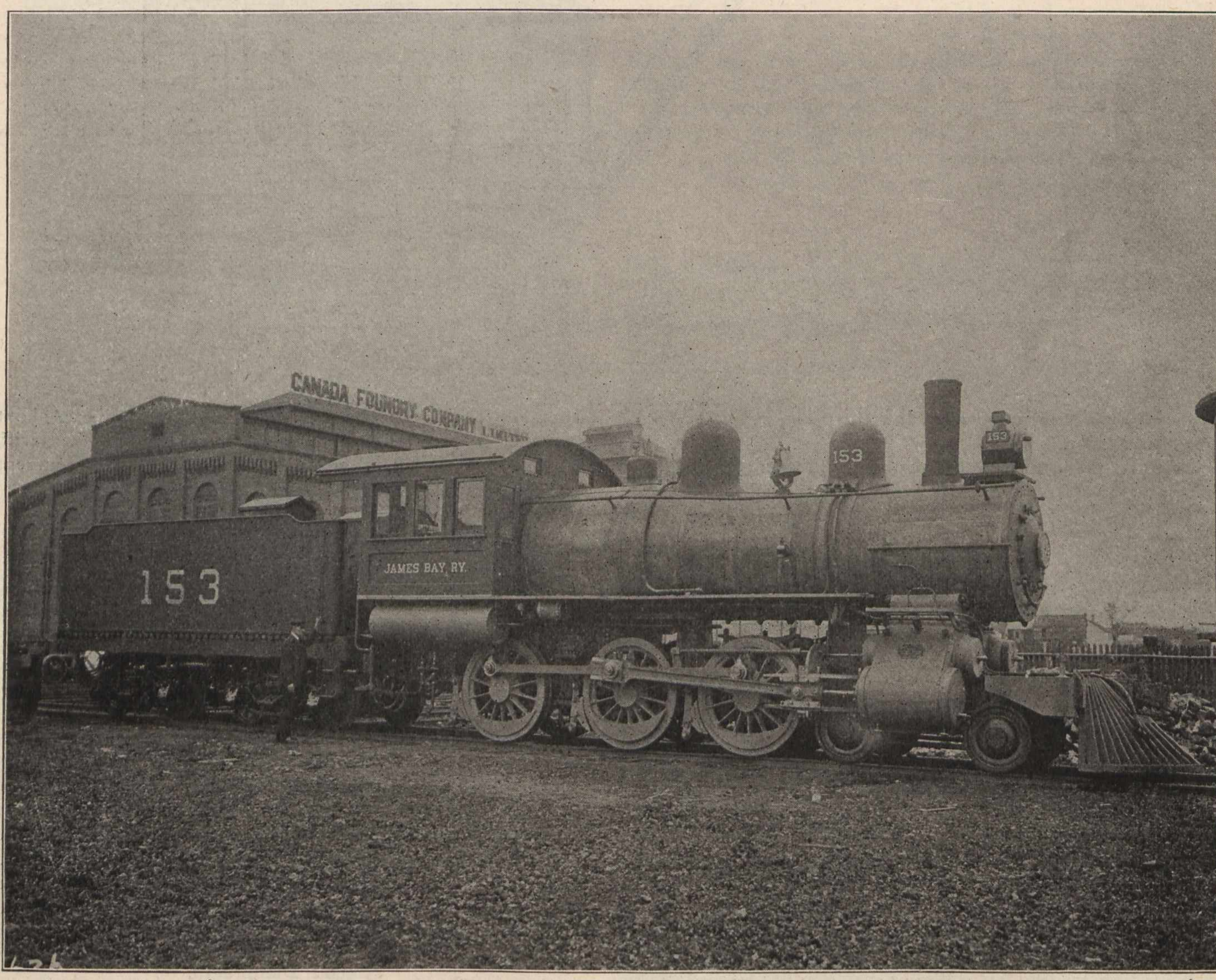
The steam cylinders are provided with valves of piston type having central admission. Having in view the cold environment in northern latitudes, special care has been taken to protect the steam passages, the exhaust only being exposed, and each cylinder is coated with magnesia asbestos lagging 3 inches thick, the result being that, the steam entering the cylinder, assisted by the protection afforded in the smoke-box arrangement as already mentioned, is in a more efficient condition to do its work. Actual experience has demonstrated that it is almost impossible to get water out of the bottom cylinder cocks, or the stack, when working with boiler fed by the strongest alkali waters used in Manitoba. This was proved by careful observations made by some of the staff of the Canadian Northern Railway on the locomotive pictured when making a trip in November last in freight service in South-west Manitoba.

Knuckle Pin Elimination.

Another radical departure from common practice in locomotive design is in the arrangement of side rods, in which the knuckle pin—a fruitful source of trouble and profanity in locomotive service—is entirely eliminated, the side rods of the usual bushed type being slipped on separately as would be in case of four-wheel coupled engine, the bearing on main crank-pin being divided between the two rods, the projected area of each rod on the pin being slightly greater than that of the front and back crank-pins, which they have to drive. This innovation in side rod construction has been in operation since October last, and so far has proved entirely satisfactory.

Increased Steam Space in Boiler.

The boiler is of the waggon-top type, radially stayed, with an unusually liberal steam space, this being several inches greater from top of crown sheet to saddle sheet than is usual in engines of this class.



Shell Without Longitudinal Seam.

In the engines now under construction the sheet forming the outer boiler shell, including the saddle and sides, is without any longitudinal seam, and consists of a plate 126 in. by 248 in. by 5/8 in. thick, a size which taxes the capacity of the largest rolling mills in the United States.

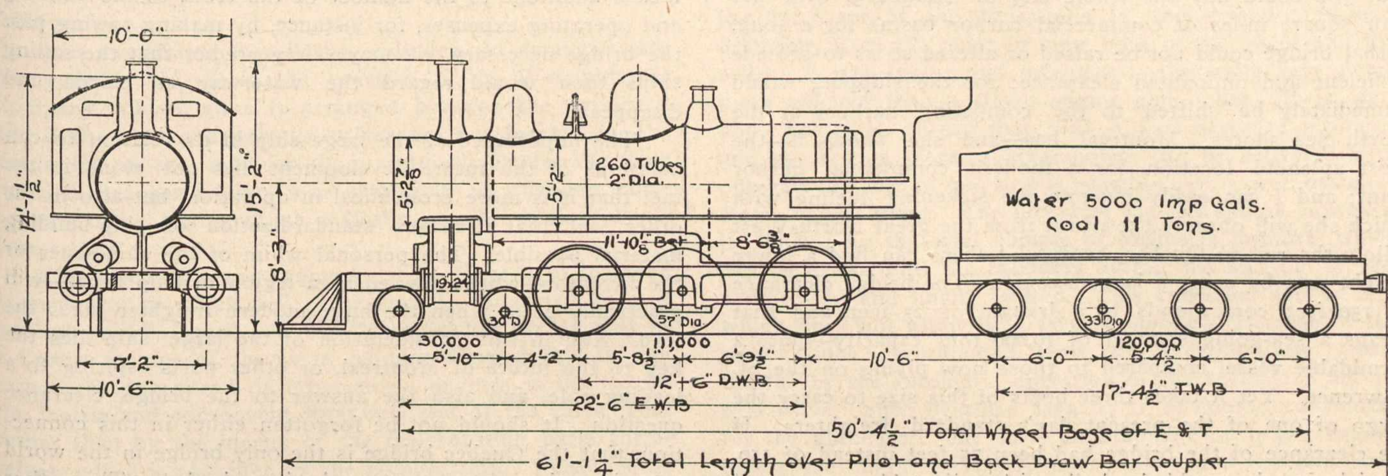
No Bolt Stress in Frames.

The frames are made of cast steel, with a joint of new design, in which the bolts are not subjected to stress or strain while the engine is working.

Tender Tank.

The tenders of the five locomotives as illustrated are of the usual type, with U-shaped front end. In the twenty for North-West service, however, the tender tanks will be of the hopper type, without shelves or flat plates in coal space to hinder or obstruct the easy descent of the fuel to the fireman—a wise and convenient provision.

its contents and effective pull of engine is thrown. This admirable provision is supplemented by some cross bracing of the bolsters and flat plates carrying the air brake



Tender light 48000 Lbs. loaded-120,000 Lbs.
Weight on Drivers Working order——111000 "
" of Engine " " ——141000 "
" " " and Tender——261000 "
Heating Surface Tubes——1618 Sq.Ft.
" " Fire Box——148 "
" " Total——1766 "
Grate Area——30.2 "
Working Pressure——180 Pds.

Diagram of
10 Wheel Freight & Passenger.
Locomotive

Design of Tender.

The general design of tender frame differs materially from general practice, since there are no through bolts, the back and front drawbars being carried by two 18 in. I beams, on which the whole stress of carrying weight of tank and apparatus, which act as diagonal braces. The drawbar at back of tender is applied to the I beams in a similar manner, and is interchangeable with drawbars in cars.

[It must be a satisfaction to our readers to perceive by the specification of new ideas embodied in the design of these Canadian locomotives, that in constructive locomotive engineering, the Dominion is undoubtedly progressive.—Editor.]

CANADA ON THE WORLD'S HIGHWAY

BY ALFRED J. ROEWADE,

Consulting Engineer, Civic Designer, Chicago, Ill., U.S.A.

IV.

THE QUEBEC BRIDGE: A REJOINDER.

The old story over again! Whenever great problems involving provisions for the future require solution, we always find the cautious, conservative mind on the wrong side; because its conservatism leads to scepticism in regard to the future evolution. The greatest, most fatal mistakes are made in this perfectly human and honest way, simply for the lack of imagination, and the Quebec bridge over the St. Lawrence river at Cap Rouge furnishes only a new example of the truth of this old axiom.

Mr. John Kennedy, Montreal's noted harbor engineer, and Mr. Hugh Andrew Allan, of the shipping firm of H. & A. Allan, have both endorsed the bridge plan as satisfactory, and thereby put themselves on record as entertainers of the conservative views in regard to the future of Montreal. This is done in an interview published in the Montreal "Gazette" of March 15th, which later was quoted in the debate on the subject in the House of Commons. Both gentlemen referred to the conditions on the Manchester canal as proofs for the fact that worse obstacles than the Quebec bridge clearance are successfully overcome in other places.

Now, this is certainly a reading backwards of facts. To compare the splendid St. Lawrence river with the narrow, winding, artificial canal, with locks and with crossings existing prior to the canal! In my previous article I simply called attention to the fact that the Quebec bridge, with its insufficient clearance, would reduce Montreal's harbor from the position as a seaport to that of an inland waterway harbor, and thereby check the aspirations of Canada's commercial centre; yet I had no idea of comparing Montreal's maritime location with that of Manchester, for the conditions differ too widely for that. The harbor proper for that part of England where Manchester is located is Liverpool; and the artificial harbor of that industrial centre, with its canal as an accessory, is created in order to save freight on material to, and on industrial products from, Manchester. Enormous exertions were necessary in order to accomplish this, and the best possible had to be made of the natural and artificial obstacles encountered. As special ships had to be provided for the navigation on the canal, this is and must remain strictly local in character, and the real ocean traffic will, as before, use the harbor of Liverpool, there to tranship its cargoes for Manchester into railway cars or lighters.

Montreal is a natural seaport, located at the head of one of the world's mightiest natural waterways, and the regulation work necessary to keep this stream up to level with the demands of navigation is insignificant compared to what has to be done in other places. Montreal's geographical location as a commercial centre resembles more than anything else the location of Hamburg at the head of the (for sea-going vessels) navigable river Elbe. Yet imagine a bridge like the one at Quebec put up at the entrance to this river from the bay. The result would be that you could buy the whole city of Hamburg, with her four square miles of commercial harbor basins for a song, if that bridge could not be raised or altered so as to provide sufficient and undoubted clearance; for the shipping would immediately be shifted to the competing harbors at the North Sea shores. Montreal has—and she knows it—the most splendid location for a modern commercial harbor plant; and I can easily imagine the sickening feeling with which she will observe the wheat from the great North-West follow the rail to Quebec, because it there can find a lower freight rate by using a large steamer. The bridge clearance of 150 feet corresponds to a draught of 25 feet, and that means a sea-going steamer of 10,000 tons capacity—quite a formidable vessel compared to those now plying on the St. Lawrence. Yet it takes three boats of this size to carry the cargo of one of the present day's standard freighters. If the clearance of the bridge had been 75 feet instead of 150, special vessels would be built with adjustable masts and telescope funnels; yet as these features are nuisances in marine architecture, they will not be resorted to except on vessels built for special routes, where such subterfuges are a necessity, and smaller ships would be used, because these always would be on hand. It is easy enough to say that sailing ships can lower their masts, but if this lowering means additions to the number of the crew, to the building and operating expenses, for instance, by making towing past the bridge necessary, we may safely predict that the sailing ships then would regard the waterway as closed and disappear.

The importance of the large ship in its relation to calculations of the future development lies not alone in the fact that it is more economical in operation, but also in the other fact that it makes standardization of ship-building material possible. The personal whim of the shipowner or the inventor—which has led to a legion of ship types—will practically cease when the huge modern freighter takes the lead. And in this consideration of the large ship lies the key to the future of Montreal, or other ports aspiring to a leading role, and also the answer to the bridge clearance question. It should not be forgotten either in this connection, that the Quebec bridge is the only bridge in the world spanning the waterway to a leading harbor. The other bridges mentioned are spanning sections of inner harbors or waterways of less importance to harbor navigation.

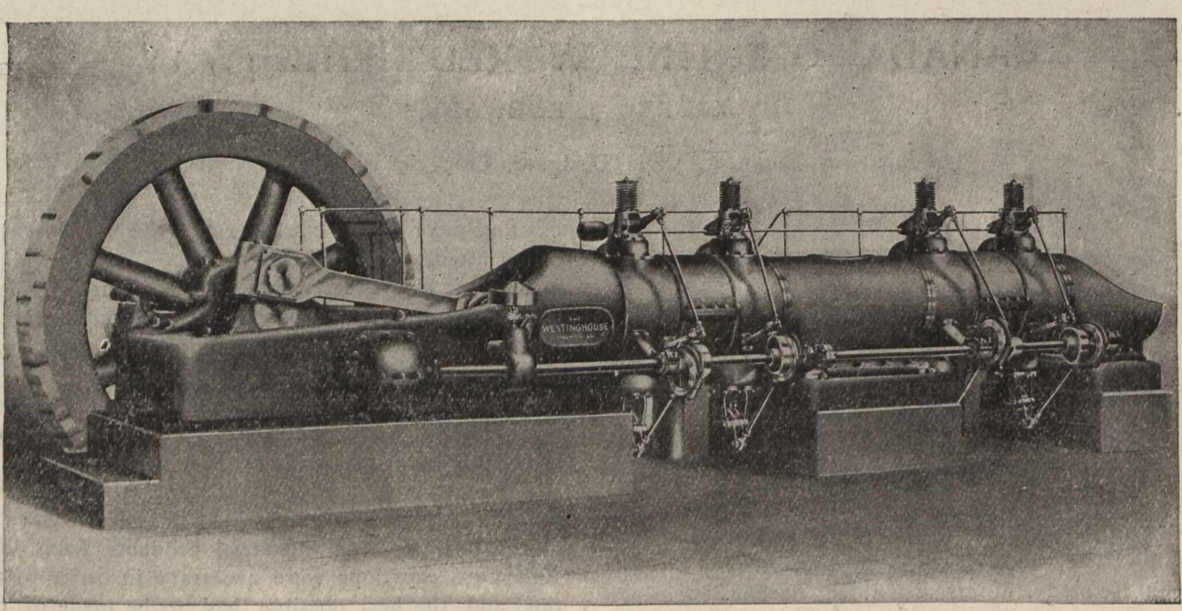
NOTES ON THE DESIGN OF LARGE GAS ENGINES

WITH SPECIAL REFERENCE TO RAILWAY WORK.

By Arthur West.

The following remarks, as the title indicates, are applicable to large size gas engines only. The smaller sizes are unsuited to important electric railway installations on account of first cost, multiplicity of parts and greater expense for attendance, etc. The tendency of the modern plant is constantly in the direction of large size units. This is indicated by the rapid increase in the size of steam turbines installed in modern stations. Similar reasons will, it is believed, cause a demand for large size gas engines for electric railway work in conjunction with producers to operate them.

One of the most important considerations in the design of large gas engines is the arrangement of the cylinders. In a single cylinder single acting four cycle engine an explosion takes place once in every two revolutions. In order, therefore, to get the same rotative effect as with a double acting steam cylinder, it is necessary to work four single acting cylinders on the shaft or two double acting gas cylinders tandem on one crank pin. With this arrangement four explosions are obtained in two revolutions, or an explosion every 180° of crank angle. In case of a misfire or premature ignition due to bad gas, the crank can only move one-half a turn before another explosion takes place. In a single cylinder single acting engine the crank must move two whole turns before the next explosion, while with two single acting cylinders opposed to each other or one double acting cylinder the crank may be required to move one and one-half turns before the next explosion. The relative evil effects of a premature or misfire are, therefore, in the follow ratios:—



Westinghouse Horizontal Double Acting Gas Engine. Heavy Duty Tandem Type.

Two double acting cylinders	1
Two single acting cylinders, opposed type	3
One double acting cylinder	3
One single acting cylinder	4

Gas engines and producers to be commercially successful must be designed to be run with the same class of help as is employed on Corliss engines and boilers. This being the case, misfires and prematures are liable to occur occasionally, and the designer must minimize their possibilities for evil. These considerations, as well as the capacity for caring for heavily swinging railway loads, have caused our adoption of tandem double acting cylinders for railway work.

It is sometimes argued that cylinders so arranged are inaccessible. If, as is the practice of the Westinghouse Company, ample space is arranged between the cylinders, and if the inlet and exhaust valves are not located in the heads, but in the cylinder body entirely above the floor level, such a gas engine is as accessible as a tandem compound Corliss engine or as a Corliss engine driving an air compressor.

The speed of a gas engine must be adapted to the kind of generator to which it is to be directly connected. In a general way, its speed will usually somewhat exceed that of a Corliss engine of the same cylinder dimensions. In my experience, the speed of large steam engines is limited by **the inertia and consequent wear and tear of the valve gear rather than by the inertia of the reciprocating parts themselves,** which is absorbed by the compression. Inasmuch as in a four cycle gas engine the valve gear only moves at half the speed of the engine, somewhat higher speeds are permissible than would be the case with a steam engine having the same dimensions of cylinders.

The speed regulation adopted for large Westinghouse gas engines is specially suitable for generator driving in that no conditions of changeable load or variable friction of valve gear affect the regulator. Our gas engine regulator governs the speed by means of a relay cylinder, and, therefore, produces results similar in type to those obtained with the relay governor used by The Westinghouse Machine Company on steam turbines. The advantage of such a relay governor with the gas engine is that the varying friction of valves with different qualities of gas does not affect the sensitiveness of the governor. Without a relay cylinder the only way in which this result can be accomplished on large gas engines is by some form of a drop cut-off controlling the gas. This is objectionable on a gas engine, as any slight change in the speed of the dash pot very seriously affects the mixture of gas and air, with corresponding bad effect upon the regulation. Such small changes in speed of dash pots are frequent in a Corliss engine, where they cause no bad results. The Westinghouse arrangement employs no releasing gear of any kind, but secures all the advantages of regulation without its use.

The question is frequently asked as to whether large gas engines will drive A. C. generators successfully in electrical synchronism or "parallel." This has been done for several years past in Germany with entire success, and it has also been done in a number of instances very successfully by our company. We have at the present time orders for several such plants on our books, one of which is to drive an electric railway from Warren, Pa., to Jamestown, N. Y., which we expect will be in operation some time during the autumn.

It is sufficient for our purpose to observe here that the cyclic variation, i e., the degree of departure from absolutely uniform rotation, is sufficiently small to conform with the design of generators now built for steam driving.

The European designer of gas engines has allowed himself an amount of complication in valve gear which would not be permissible under American operating conditions. The successful American machine must be as nearly "Fool Proof" as is the large Corliss engine. If it is not, it will fail to be a success from the purchaser's point of view—no matter what thermal efficiency may be claimed by the builders—as a consequence of such complication as the European engineers have been prone to adopt. In the designing of valve gear for large gas engines, wide range of quality of gases must be considered. In this respect the design of the gas engine is very different from that of a steam engine, inasmuch as the steam used has practically constant characteristics, differing only in such minor points as pressure and superheat. With the different kinds of gas to be met with, however, the proportions of air and gas, and sometimes of compression, are radically different, and no gear can hope to be a universal success which does not provide for meeting the widely varying conditions to be encountered in the market.

We are frequently asked, "What is the overload capacity of your gas engine?" A clear understanding on the part of the purchaser of the limitations in this direction is very desirable, from the point of view both of the buyer and the seller. A gas engine and producer is thermally very much more efficient than a steam engine and boiler. It is, perhaps, not amiss to say that, with a well designed producer and gas engine plant, a horse-power can be delivered with one-half the cost of fuel that is possible with a well designed steam engine plant. The power of the gas engine, however, is limited by **the total volume of explosive mixture which can be drawn into the cylinders** during the suction stroke, compressed and finally ignited. This condition sets a limit which does not allow of a large temporary increase of the power, such as obtained with the Westinghouse steam turbine by the automatic operation of the secondary admission valve. Such overload capacity is, of course, convenient for the purchaser, but it is unobtainable on a gas engine, unless the engine is largely under-rated, and the purchaser should consider that this is one of the prices that he pays for the enormously increased output obtained with the gas engine per pound of coal. **The overload capacity is, therefore, simply the amount which the builder rates his machine below its ultimate capacity.** It has been our practice to rate our gas engines in such a way that they would have a safe overload capacity of ten per cent. Our machines are ordinarily good for somewhat more than this, but conservative engineering requires that there be a margin of power in order that overloads may not materially reduce the speed. The above remarks on overload furnish a general guide which may be of service in selecting suitable generator capacity for a gas engine. For ordinary cases the overload capacity of the generator and that of the gas engine should be about equal, although the gas engine will indefinitely carry its overload while the generator will not, in all cases, unless it is bought with that understanding.

The mechanical efficiency of a large gas engine is very much greater with a four cycle than with a two stroke cycle, this being one of the arguments against the two cycle engine. It is no uncommon thing to see two cycle engines which do not realize as brake horse power more than sixty per cent. of the work actually done by the combustion in the cylinders. The efficiency of a four cycle engine varies considerably, but it may be said in a general way that a well designed engine will deliver about eighty-five per cent. of the gas indicated horse-power in the form of brake horse-power. This fifteen per cent. of power lost is not exclusively composed of frictional resistance of journals, cross-head slides, etc., as is the case in a steam engine. The four cycle engine has, of course, to draw in its own mixture of air and gas and compress the same, and its functions, therefore, combine those of a pump, a compressor and a motor. It is the pumping and compressing work which causes the mechanical efficiency of the gas engine to be somewhat lower than that of a steam engine. The actual friction of the working parts need be no greater than with a well constructed Corliss engine, viz., 90-95 per cent. In order to keep down the friction and increase the reliability of the machines, it is the practice of the Westinghouse Company to design large gas engines with provisions for attaching a continuous return oiling system. The large amount of oil put through the journals increases the safety, requires less attendance and keying up, and washes out dust if the engine is required to operate in an atmosphere which is not clean.

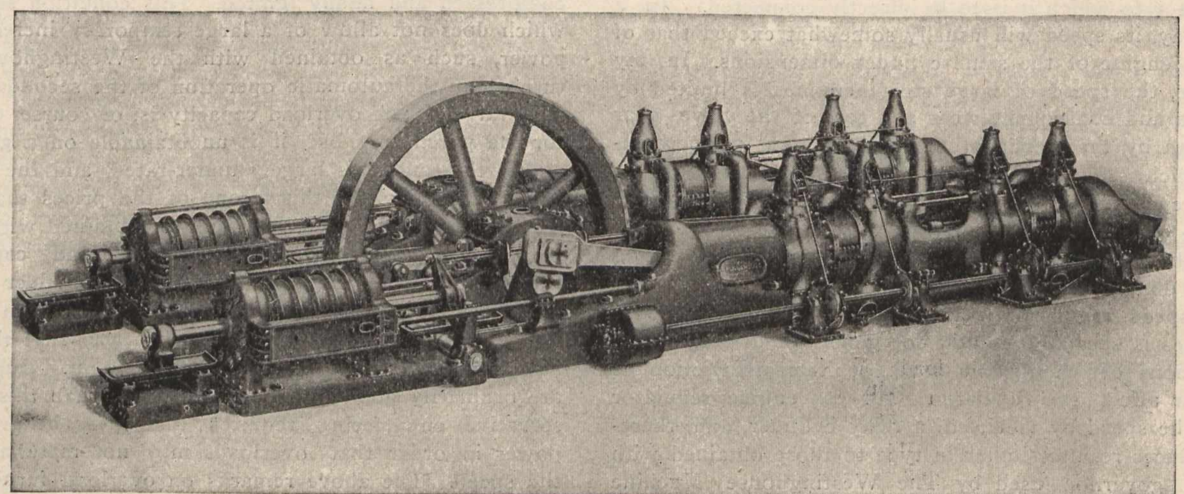
The thermodynamic efficiency of the gas engine varies so much with different kinds of gas that it is hard to say just what the average value would be. It is probably not far from the truth, however, that its thermal efficiency is about twenty-five per cent., though in favorable cases gas engines have obtained efficiencies well over thirty per cent.*

* (Efficiency $= \dfrac{\text{Heat equivalent of work done.}}{\text{Heat input}}$

There is an impression rather prevalent that a gas engine is uncertain and hard to start. A properly designed engine, supplied with fairly decent gas, can be started as easily as a steam engine. Large Westinghouse horizontal gas engines are started by means of compressed air, the only operations required being, (1) open the main gas valve; (2) close the igniter circuit; (3) open one compressed air valve similar in construction to an engine throttle. The compressed air puts the engine in motion, which draws the charge into the cylinders and compresses the same, after which the first explosion takes place. Air is shut off and the engine is in full operation. We find no more difficulty in starting our gas engines than a steam engine of comparative size. I desire to lay stress on this point, as one of the stock arguments against the gas engine is that it is difficult to get into operation.

With certain kinds of gas, inspection of the interior parts of the cylinders is often desirable at regular intervals of, say, a couple of months. This is especially the case with blast furnace gas, and also with producer gas made from certain kinds of fuel. We have taken particular pains to arrange our cylinders so that no parts of the valve gear or valves are below the floor. The inlet valves being located directly on the top of the cylinder, easy access can be had to either end of either cylinder by removing the inlet bonnets. The exhaust valves are also a part of the engine which need occasional attention for regrinding. Especial care has been taken to render these quite easily removable. The cylinders are, therefore, directly accessible from the top through the inlet openings and from the bottom through the exhaust openings. The fact that all the valve parts are entirely above the floor line renders these operations much easier than if a large part of the valve gear extended downward into foundation parts. It is not necessary to remove the cylinder heads, except to examine the piston rings themselves, which is not often required. Inasmuch as clean gas cannot always be secured, the importance of such easy entrance to the gas cylinders cannot be overestimated.

The general type of engine commented on above is shown in the two accompanying photographs. The first shows the type of two engines being built by the Westinghouse Machine Company for the Union Traction Company of Kansas, Independence, Kansas, one being of 500 brake horse-power and one of 1,000 brake horse-power. The second photograph shows one of two twin tandem furnace gas blowing engines now under construction for the Edgar Thomson plant of the Carnegie Steel Company. For electric railway work, no change would be made except to omit the blowing tubes. As electric units these engines would have a capacity of about 3,500 brake horse-power each.



Westinghouse Gas Driven Blowing Engine for Blast Furnace Gas. Heavy Duty Twin Tandem Type.

The large size gas engine has come to fill such an important place in Europe, and has there proven itself to be so reliable and serviceable, that there is no question about its being adopted in this country in the near future, in a form suited to American operating conditions.

It is hoped that these general observations will be found of interest to intending users of gas power in large quantities.

CANADA'S HARDWARE EMPORIUM.

The Aikenhead Hardware Company are now installed in their new premises at 17, 19 and 21 Temperance Street, Toronto. The change of address was celebrated by a banquet held in their new home, the second floor being decorated with bunting and flags, and used as a banquet hall. About eighty sat down to the excellent repast, Mr. T. E. Aikenhead, the president of the company, presiding. After supper the evening was given to reminiscences, speeches, songs and readings, a most enjoyable time being spent.

In 1832 Ridout Bros. & Co. built a store at the northeast corner of King and Yonge streets, a location which was considered altogether out of the way at that time. Ever since, without any interruption, the business started at that time has been carried on and to-day the firm is regarded as one of the most reliable in Canada. All familiar with the fair dealings and integrity that at all times have characterized the conduct of the old firm, will join in wishing them increased success in their new and splendid quarters.

The new premises have a frontage of sixty-four feet, have five stories and a basement, the whole area of which is four and a half times that of the old stand. The retail store in connection with the business, which occupies all the ground floor and part of the first floor will, when completed, not only present the finest appearance, but will be the most spacious and best equipped hardware store in Canada. Moreover, the central location and convenience with which this store can be reached should win for it in the near future the reputation of being Toronto's leading emporium for cutlery, fine machinists' tools, shelf and builders' hardware and contractors' supplies.

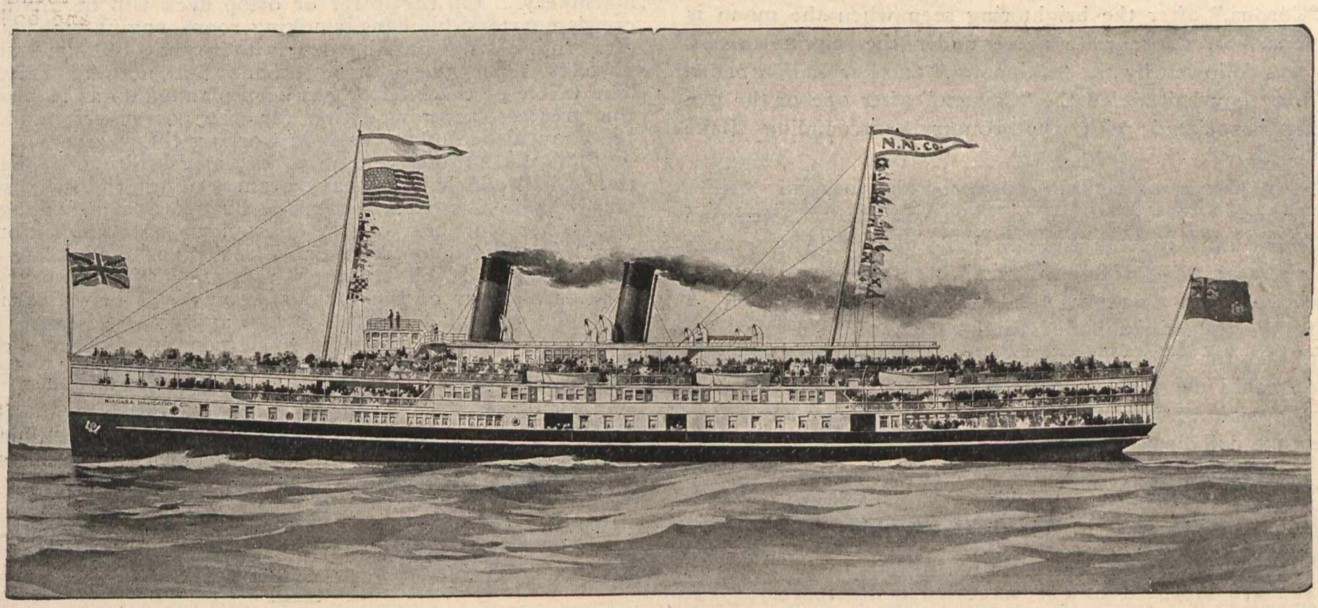
LAUNCH OF THE STEAMER "CAYUGA" ON LAKE ONTARIO

It is nearly one hundred years (1807) since Robert Fulton startled the world by ploughing through the waters of the Hudson at four miles an hour in a boat propelled, not by oars or sails, but by a pair of side paddle wheels, driven by a steam engine, designed and built by James Watt. Since then wonderful progress has been made in the design, equipment and speed of steamers for lakes and rivers. Instead of light draught barges like the "Clermont," 133 feet long, making four miles an hour, we now have magnificent vessels, like the "Cayuga," launched in Toronto Bay last month, 317 feet long, and capable of making 22½ miles an hour.

In spite of a heavy rainstorm, intensified by a terrific gale blowing from the south-east, a large and distinguished company of interested spectators witnessed at mid-day on Saturday, March 3, 1906, the christening and successful launching of what will be when completed the most modern passenger steamer on the lakes.

"I name thee 'Cayuga!'" said Miss Mary Osler, the charming daughter of E. B. Osler, M.P., president of the Niagara Navigation Co., as the latest addition to the fine passenger fleet of that enterprising company glided gracefully into the waters of Lake Ontario.

This is the first vessel launched from the Toronto yard of the Canadian Shipbuilding Company since it was taken over from the Bertram Engine Works Co. last year; and, although the weather was unpropitious, the *eclat* with which everything in connection with the launch ceremony and subsequent festivities went off augurs well for the future of this new corporation, of which much is expected by the country.



The "Cayuga" as she will appear when completed.

Luncheon at the King Edward.

After the visitors had examined the hull of the "Cayuga" as she lay moored in the dock, near the floating shell of the celebrated roller boat, the gentlemen, about 120 in all, adjourned to the King Edward Hotel, where luncheon was served in the elegant banquet hall.

Frederic Nicholls, president of the Canadian Shipbuilding Company, occupied the chair, and those present included E. B. Osler, M.P., president of the Niagara Navigation Co.; Emerson Coatsworth, Mayor of Toronto; A. A. Angstrom, general manager Canadian Shipbuilding Co., and designer of the "Cayuga"; William Mackenzie, president Toronto Street Railway Co.; B. W. Folger, general manager of the Niagara Navigation Co.; H. J. Pierce, president of the International Traction Co., Buffalo; Hon. J. J. Foy, K.C.; Senator J. K. Kerr; F. Barlow Cumberland, vice-president Niagara Navigation Co.; Col. Hughes, M.P,; D. R. Wilkie, president Imperial Bank of Canada; H. Foster Chafee, of the Richelieu and Ontario Navigation Co., Toronto; J. D. McDonald, district passenger agent G.T.R. System, Toronto; C. J. Stalker, auditor Canadian Shipbuilding Co., S. Groves, editor "The Canadian Engineer," etc.

Mr. Frederic Nicholls, after the royal toast had been responded to heartily, said the successful christening and launch was a happy augury for the future; complimented the Niagara Navigation Co. on the enterprise it had shown in deciding to order such a steamer, and to have it designed and built in Toronto. Its other steamers, the "Corona" and "Chippewa," had been placed on the lake in advance of the requirements of then existing traffic, but the foresight of the company had been amply justified; and he predicted that a like result would follow their latest venture, the "Cayuga." After expressing the gratitude of the Canadian Shipbuilding Co. to Mr. Osler and his company for their confidence in entrusting them with the production of the premier ship on Lake Ontario, which meant a great deal to them in the getting of future business, said he was always optimistic with regard to the opportunities of Canada, and in his efforts to make two blades of grass grow where only one grew before, had seen no cause to regret his connection with the upbuilding of its industries. Humorously pointed out that they had got the ships, got the men, and got the money, too; for they had on their books orders for six large steamers, and their shipyards were working to their full capacity; they had the men, for in Mr. Angstrom they had a marine architect and designer in whom they had every confidence, while their reputation for sound and high-class work enabled them to get the money necessary for financing their business safely. They were just at the beginning of a national shipbuilding industry, for when Canada became the granary of the world, freight and transportation facilities would receive a great boom.

Mayor Coatsworth, in proposing the toast of "The Niagara Navigation Co.," said he would be hard to satisfy if he were not gratified on this occasion. He was proud that such a magnificent boat had been built and would be run by Toronto companies, and he viewed with pride the rapid strides being made by these concerns. The "Cayuga" would shorten the trip between Buffalo and Toronto by 1¾ hours. The Niagara Navigation Co., said the Mayor, bring immense numbers of visitors to our city. We need them to fill our stores and keep our merchants busy. Glad to see the workshops full and men all employed.

Mr. E. B. Osler, in replying, said it would be a sad thing if the Niagara Navigation Company were not foremost in enterprise, since its founders, Mr. F. W. Cumberland and Sir Frank Smith, were two of the most enterprising men Canada had even seen. He referred to the inauguration of the shipbuilding industry, and spoke highly of the ability of

Mr. Angstrom. The Niagara Company had always had the good-will of the people, and he thought deserved it. When any concern went ahead of the times the general tendency was to pitch into it, but so far the company had escaped unreasonable criticism. It had been a moderately successful concern, content to go on paying steady, reasonable dividends, not like the banks. (Hear, hear, and laughter.) He thanked the railways of the United States for most loyal support, and said it was largely due to the encouragement received from them that the boat had been built.

Mr. D. R. Wilkie proposed the continued prosperity of the Canadian Shipbuilding Co. and its officers. He thought Toronto might become one of the greatest shipbuilding ports of the world. Canada was not now building a navy, but in a few years could no longer shirk the duty she owed, and then would have an opportunity of sharing in the defence of the Empire.

Mr. A. A. Angstrom, the manager of the company and architect of the boats, modestly disclaimed any credit for his work, saying he was only the representative of an organization, and alone could do nothing.

In proposing the toast to Miss Mary Osler, who named the new steamer, B. W. Cumberland referred to the appropriateness of the names of the company's steamers. The first was the "Chicora,"—the pretty flower—named from the Indian territory of and around Florida, followed by the "Cibola." This steamer was burned, and was replaced by the "Corona," after the bright ring seen when the moon is in eclipse—an appropriate name under the circumstances. This was followed by the "Chippewa," another Indian name, and now they had added the "Cayuga," after one of the five nations associated with the country surrounding Lake Ontario.

H. J. Pierce, of Buffalo, answered the toast of "Allies and Friends." He spoke of his own company constructing an electric railway from Niagara Falls to Buffalo over their own right of way, which would shorten the time between those two points by half an hour.

B. W. Folger responded to the toast of "The Management." As for the new boat, he said he did not see how any person could not love a boat. It was because of this love that the craft was generally called she. We love any enterprise that will float. The shipbuilding company a year ago was practically without an order. Now it had six orders to fill, and both yards were working full capacity. A unique feature about the "Cayuga" is that everything for her is to be made in Toronto.

We are indebted to our esteemed contemporary, "The Marine Review," for the following lucid description of the "Cayuga":

The "Cayuga" is a departure in many respects from the other steamers of the Niagara Navigation Company, the most important being that she will be propelled by twin screws instead of paddle wheels. The general outlines of the other steamers are followed as far as possible; and the internal arrangements are planned on the most modern lines to afford the greatest accommodation and conveniences for the passengers. Her dimensions are: Length, 317 ft. 6 in. over all; beam of hull, 36 ft. 6 in.; over guards, 51 ft. 8 in.; depth, 15 ft. moulded; draught, 10 ft. The hull is of steel and is divided into eight water-tight compartments by seven bulkheads; thus rendering her practically unsinkable. She will be driven by twin screws, power being supplied by two sets of engines, of the vertical inverted, direct-acting, quadruple expansion type, balanced on the Yarrow, Schlick & Tweedy system, having cylinders, 17½ in., 25 in., 36 in. and 52 in. diameter by 30-in. stroke. Steam will be supplied by seven Scotch marine boilers 11 ft. diameter by 12 ft. fitted with two corrugated furnaces. The Howden heated draft will be used. The engines are designed to develop 4,300 H. P., which is about 30 per cent. in excess of the Richelieu & Ontario Navigation Co.'s steamer "Montreal," at present the largest and most powerful passenger steamer navigating Canadian waters, and is exceeded by very few vessels on the United States side of the Great Lakes.

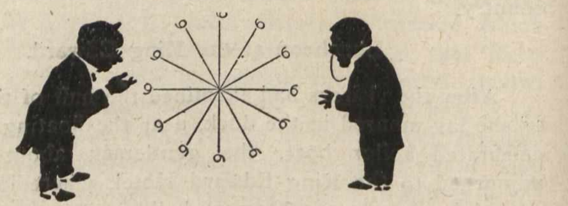
The vessel is planned on the lines of the day service observation type of steamers, having four principal desks, namely: main deck, promenade deck, upper promenade deck, and lower or orlop deck below the main deck. There will be three gangways on each side, the forward ones for passengers and express, the middle ones for passengers' baggage and the aft one for passengers only. This latter will lead directly into the entrance hall on the main deck, where will be found the purser's office, a parcel checking room and other offices with which passengers have to come in contact. Here also will be the ladies' retiring room, which will be specially fitted for the comfort and convenience of ladies, and will include a number of new features. There will be a staircase 7 ft. wide to connect the entrance hall with the promenade deck above. The dining room will be on the main deck, and will be fitted with large observation windows on each side, so that an uninterrupted view may be had. It will have a seating capacity of 150. The main deck will be of steel covered with wood, and interlocked rubber tiling will be used as a flooring in several parts of the vessel devoted to passenger accommodation. On the promenade deck the principal feature will be the general saloon, which will extend the full width of the steamer. It will be a particularly handsome apartment, and the sides, instead of being straight, will consist of a series of bow windows, so that views may be had ahead and astern as well as straight out. At each bay seats will be provided so that small parties may keep together. Two of the bays will be finished as private parlors, which will be available for letting to parties who desire to be alone. The upper promenade deck, which will be reached by a stairway from the general saloon, as well as by stairways from outside on the promenade deck, will extend over the whole vessel, instead of ending just forward of the wheelhouse as in most vessels of this type. The rail will be inside the lifeboats, and the entire width of the deck will be available for passengers. The captain's quarters, the wheelhouse, and the pilot's room will be on this deck. A light shade deck amidships will give shelter over this deck. The space over the engine room, instead of being closed in with steel plates, will be surrounded with a framework in which plate glass sides will be fixed so as to enable passengers to have a view of the machinery. On the lower or orlop deck will be found the crew's quarters, kitchens, smoking room, engine and boilers, etc. In working out the details there may be some slight changes from these arrangements but nothing material. The whole of the interior has been planned so as to provide the greatest accommodation for the passengers, and for the convenience of the crew in working the steamer.

The decorations will be particularly striking. The entrance hall will have a heavy beam ceiling; the main stairway will be in cathedral oak; the dining room in mahogany, and other portions of the passenger accommodation in weathered and quartered oak. The designs show some very fine effects and will present a rich and artistic appearance. The furnishings of the various rooms will be in harmony with the general decorative design and color scheme.

The steamer is expected to be completed for the opening of the current year's traffic, and it is hoped to have her running on June 15, when a full service of six trips a day will be given. The steamers to be put on the run will be the "Cayuga," "Chippawa" and "Corona." The "Chicora" will probably be used as a spare steamer, or put on some other route.

PERPETUAL MOTION AT LAST.

I submit herewith a drawing of a model of a perpetual motion machine. I know how other inventors who have worked along this line have been made fun of, and the fear of ridicule has for many years kept me from making my invention public. In fact, I invented it while still a small boy, and I think a single glance at the drawing will show how simple both the machine and its inventor are.



The machine consists of a number of radial arms, to the end of which is attached a weight, the whole revolving on an axis. The machine revolves from right to left. As it turns, the weights attached to the ends of the arms gradually change from 6 to 9 pounds each, the transformation being reversed as the weights begin to rise. This may seem complicated—even absurd—to some; but every great invention has been laughed to scorn by the ignorant and fatuous populace. Besides, a single glance at my drawing will show that in spite of what physicists may say, the weights on my machine do act in just that way.

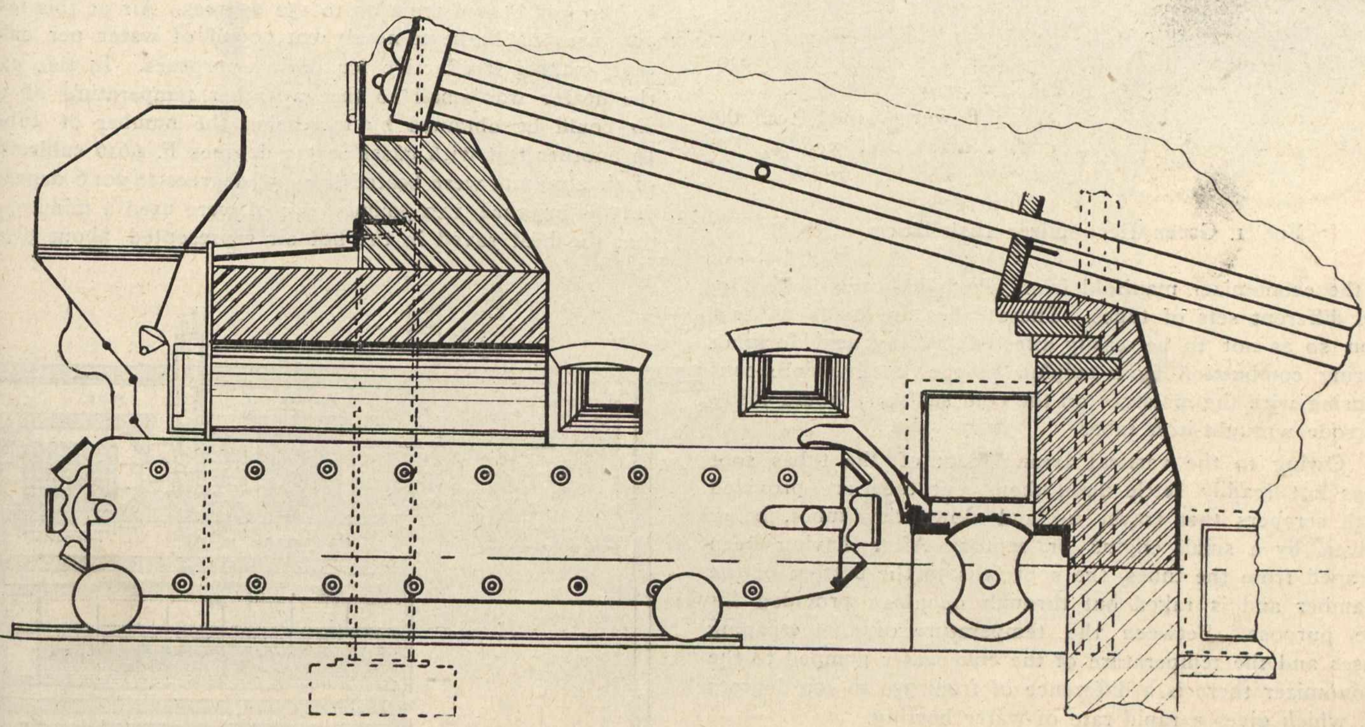
I am not looking for any financial reward. I shall be satisfied if no one throws a brick.—I. N. Ventor in the "Technical World."

COMPLETE COMBUSTION IN BOILER FURNACES

The theory of the complete combustion of fuel has been so thoroughly expounded by capable engineers and chemists, and the means of effecting this are so simple, that it is difficult to understand why modern power stations are still in trouble concerning it; and are continually in the law courts for causing a smoke nuisance. The greatest offenders have undoubtedly been boilers of the water-tube type: although if the conditions necessary for complete combustion are carefully considered when designing the furnace, there need be little doubt about attaining satisfactory results from water-tube boilers, even with low-grade bituminous coal. Furnace designers, although fully alive to these necessary conditions, appear to have had difficulty in applying them, hence, the offensive clouds of smoke which are continually descending from boiler chimneys upon our cities and townships. It has often been a surprise to trained engineers that the famous firm of Babcock and Wilcox, Limited, have not hitherto applied an effective smoke prevention appliance to their well-known water-tube boilers. It is, however, the unexpected that is always happening. This month, through the courtesy of the above mentioned company, we have pleasure in setting before our readers a new arrangement of furnace and stoker recently introduced in connection with their boilers, which it is claimed **"is absolutely smokeless, even when running 50 per cent. overload."***

It consists essentially of a refractory arch or lining, which is fitted in front of the boiler, and covers more than half the grate area, the whole grate being brought further forward than in the old design. The result of this arrangement is, that the volatile constituents of the fuel, such as hydrocarbons, which formerly ascended directly to the water tubes, and were there split up by the comparatively cold surfaces into fine particles of solid carbon and soot, or passed along to the chimney as CO, an unburnt gas; are now—immediately they leave the green fuel—brought in contact with the incandescent arch, and, due to high temperature zone through which they have to pass, readily absorb additional oxygen, and burn to CO_2, thus completing the combustion of the hydrocarbons; getting the full heat energy out of the fuel; increasing the volume of steam generated, and effectively preventing the emissions of smoke.

This form of furnace can be hand-fired, though it is obvious that the results will not be as satisfactory as when working with a chain grate coking type of stoker; for the volatile gases given off intermittently and in large volume are not so easily dealt with as they are by means of the latter device; since the gases are given off more continuously and in smaller volume. It has been urged as an objection against chain-grate stokers that they allow an excess of air to pass through the fire; the over-fire, high temperature zone, however, provided by the new "Babcock" furnace, effectively takes care of the unconsumed oxygen; for it is claimed that analysis of the flue gases from several batteries of boilers equipped with the new refractory arch furnace shows an average of 12 per cent. CO_2, with an entire absence of CO., which is indicative of complete combustion.



Refractory Arch for Smoke Prevention.
(Babcock & Wilcox, Limited.)

One of the chief advantages of this stoker is, that it can be withdrawn from the boiler at any time for examination or repairs, without disturbing the brickwork or setting. The tracks are provided for it to run on as shown in the sketch.

This type of furnace can be fitted to any type of water-tube boiler, and would, no doubt, be efficacious in considerably abating the smoke nuisance.

*[While we consider this apparatus a distinct advance in modern boiler furnace construction, we hesitate to assent to the claim that it is "absolutely smokeless." When using anthracite it may be; but in the order of things, the terms "absolute" and "perfect" can not be predicated of the results attained by any open grate furnace. At the same time, for all *practical* purposes the combustion in this furnace may be *complete*.—Editor.]

POWER COSTS.

Before the Canadian Society of Civil Engineers, W. H. Laurie recently gave the relative costs per brake horse-power per year developed by means of gasoline, steam and gas engines as follows: Gasoline engines, 78.00; gas engine with illuminating gas, 46.80; steam engine, 37.44; semi-water gas from anthracite, 7.80; semi-water gas from gas coke, 5.74; water and producer gas from bituminous coal, 5.00. These costs were based on the assumption of 312 days of ten hours; one-eighth gallon of gasoline at twenty cents for a brake horse-power; 15 cubic feet illuminating gas at $4 per ton; one pound of $5 a ton anthracite coal for semi-water gas; .92 pounds gas coke at $4 a ton for semi-water gas; and .8 pound bituminous coal at $4 per ton for producer gas.

GREEN'S AIR HEATER AND ECONOMIZER.

Fig. 1 shows the usual manner of installing the economizer manufactured by the Green Fuel Economizer Co., Matteawan, N.Y. Cold water comes from the pump direct

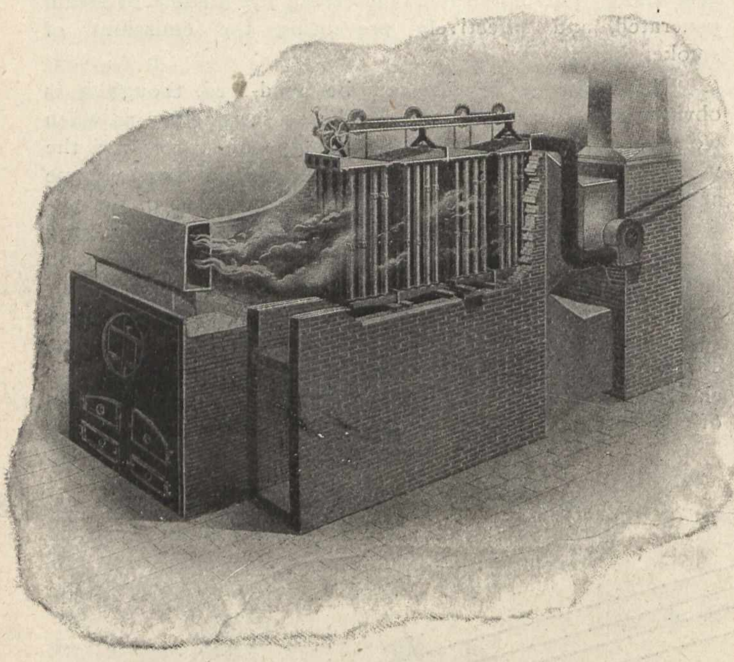


Fig. 1. Green Economizer Installation.

to the economizer manifold from which it is distributed to the different sets of tubes. These tubes are made of cast iron so as not to be easily affected by any acid forming during combustion from sulphur in the coal, which, condensing with the moisture on the cold surfaces, would easily corrode wrought-iron tubes.

Owing to the vertical arrangement of the tubes soot does not readily settle upon them, but they are provided with scrapers that travel up and down the tubes, being driven by a small engine or motor. After having been scraped from the tubes, the soot falls to the bottom of the chamber and is raked out through openings provided for the purpose. Between the temperature of the escaping gases and the temperature of the cold water pumped to the economizer there is a difference of from 350 to 400 degrees F., which gives a rapid rate of water heating.

In the process of manufacture the tubes are cast vertically in dry sand moulds, and are then turned off at the ends and pressed into the heads by means of powerful hydraulic pressure. No packings or other similar devices are employed to secure tightness, and the vertical manner of installing the economizers makes it possible for them to expand freely without injurious strains.

In Fig. 2 is shown a tube air heater unit in which, as in all of these heaters, the tubes are 9 feet long between headers with an internal diameter of 3⅞ inches, and hydraulically pressed into the top and bottom boxes. To secure uniform velocity and distribution of the air passing over from one series of tubes to the next, the boxes of the headers are made sloping. The air is kept moving at good speed, which, together with the system of frequent redistribution through the tubes, prevents the possibility of short circuiting or eddying, giving a high efficiency of heating surface. As shown in Fig. 2, each unit of tubes is separate so that any number of units may be set up to fill the capacity requirements of any given plant. Also, if it is desirable to prolong the time that the air is in the heater, any number of rows may be connected up in series.

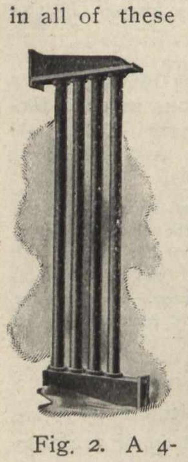


Fig. 2. A 4-tube Air Heater Unit.

In entering the heater the cold air enters where the flue gases leave to pass to the chimney, while the heated air is taken out at the end nearest the boiler, where the flue gases are the hottest. In this manner a uniform difference of temperature is maintained between the flue gases outside the tubes and the air inside the tubes, by means of which rapid transfer of heat is obtained.

These heaters and economizers are used in steam laundries, testing mills and hospitals. Where hot air is required for drying, it is usual to install an economizer and an air heater in series as shown in Fig. 3. In this installation a number of dampers and passages are provided so that it is possible to operate the economizer and heater together, to operate them separately, or to allow the gases to pass direct to the chimney. By this method either or both of the devices can be cleaned or repaired while the boiler plant is in operation. In an installation of this kind, where hot air is used for drying, the heat saved from the escaping gases takes the place of the steam that would otherwise be used in steam heating coils, thus effecting a double saving.

In a test of a combined economizer and heater plant where the gases entered the economizer at 460 and the heater at 301 degrees F. the water in the economizer was heated from 112 degrees to 248 degrees and the air in the air heater was heated from 70 to 152 degrees. Air at this temperature would take up nearly 0.01 pound of water per cubic foot, making it effective for drying purposes. In this case the heater was small so that a higher temperature of the air could be obtained by increasing the number of tubes. In another test with gases at 512 degrees F. 4,616 cubic feet of air a minute were heated from 54 degrees to 201.6 degrees. In this instance, 12.2 pounds of coal were used a minute, so that the heat saved in the hot air represented about 9 per

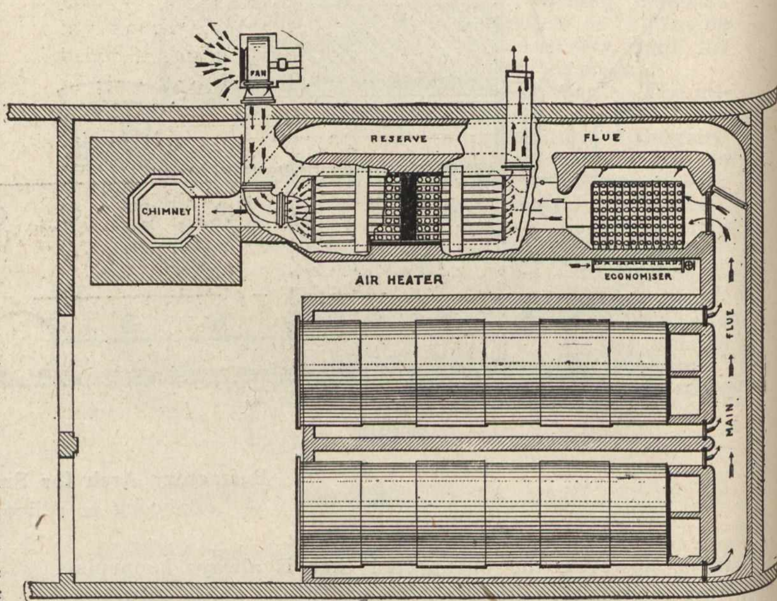


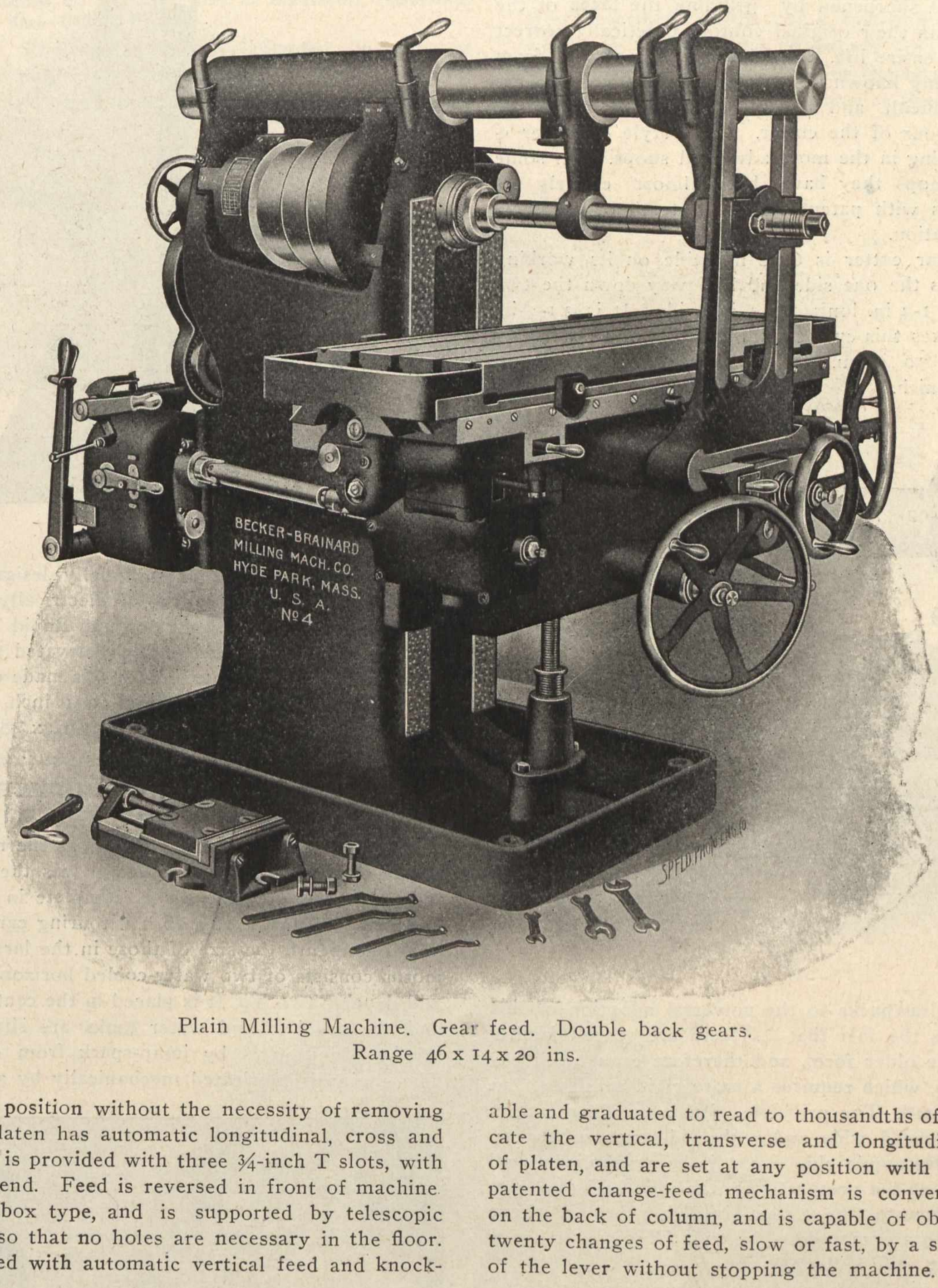
Fig. 3. Combined Installation of Heater and Economizer.

cent. of the total heating value of the coal, or, with the average boiler efficiency, about 14 per cent. of the heat recovered in the boilers. This would mean a saving of about one ton of coal a week. In a third plant a saving of 14 per cent. of the fuel was obtained, so that the saving will average about one-seventh of the total coal bill.

A PLAIN MILLING MACHINE.

Gear Feed.

This machine embodies a number of new and important improvements which will be appreciated. Attention is called to the positive gear-feed drive and change-feed mechanism, by which twenty changes of feed can be made without stopping the machine; the new clutch mechanism in connection with the hand wheels; also the box type of knee and telescopic elevating screw. The spindle has a No. 12 B.& S. taper hole in front end, is made from hammered crucible steel, has a ¾-inch hole through its entire length, and runs in self-centreing bronze boxes arranged to compensate for wear. It has a slot across end to engage clutch on arbor, is threaded to take a chuck, and a threaded collar covers the screw when not in use. It is connected with the change-feed mechanism by three spur gears, making a positive-driven feed. The spindle is double back-geared, and gears are protected with guards. The arm is made of steel, is designed for horizontal adjustment, and has an arbor support which may be removed, so that any of the attachments can be placed in position without the necessity of removing the arm. The platen has automatic longitudinal, cross and vertical feeds. It is provided with three ¾-inch T slots, with oil pans at each end. Feed is reversed in front of machine The knee is of box type, and is supported by telescopic elevating screw, so that no holes are necessary in the floor. It is also provided with automatic vertical feed and knock-off. Hand wheels for operating the feeds are provided with clutch arrangement enclosed in hub. When the table has been set to required position, the clutch may be instantly disengaged by pressing in the knob on the front of the hand wheels, thereby preventing any accidental change from their fixed position, and also preventing them from revolving when the automatic feeds are thrown in. Dials are adjustable and graduated to read to thousandths of an inch, to indicate the vertical, transverse and longitudinal movements of platen, and are set at any position with set screw. The patented change-feed mechanism is conveniently arranged on the back of column, and is capable of obtaining instantly twenty changes of feed, slow or fast, by a simple movement of the lever without stopping the machine.

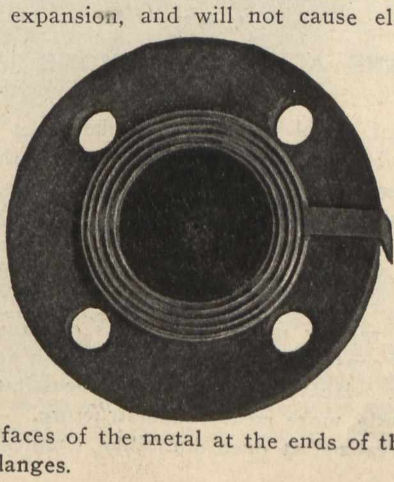


Plain Milling Machine. Gear feed. Double back gears.
Range 46 x 14 x 20 ins.

A NEW GASKET.

Gaskets for joining pipe for carrying steam, air or water, under pressure, have always been a source of trouble and inconvenience in all classes of manufacture, and to all plant operations.

An interesting gasket has recently been brought out by The Smooth-On Manufacturing Company, Jersey City, N. J., which consists of a thin, corrugated iron gasket, which is treated with a coating of metallic iron cement on each side, and then clamped in the joint. The spring of the corrugated metal tends to keep it in constant contact with the surfaces, and together with the metal cement, makes a tight and permanent joint, which is air, water, or gas tight, can be easily and quickly taken apart and then replaced. The joint is very thin. It will not leak when hot or cold, due to unequal expansion, and will not cause electrolysis nor



corrode the faces of the metal at the ends of the pipe or between the flanges.

MACHINE SHOP NOTES FROM THE STATES.

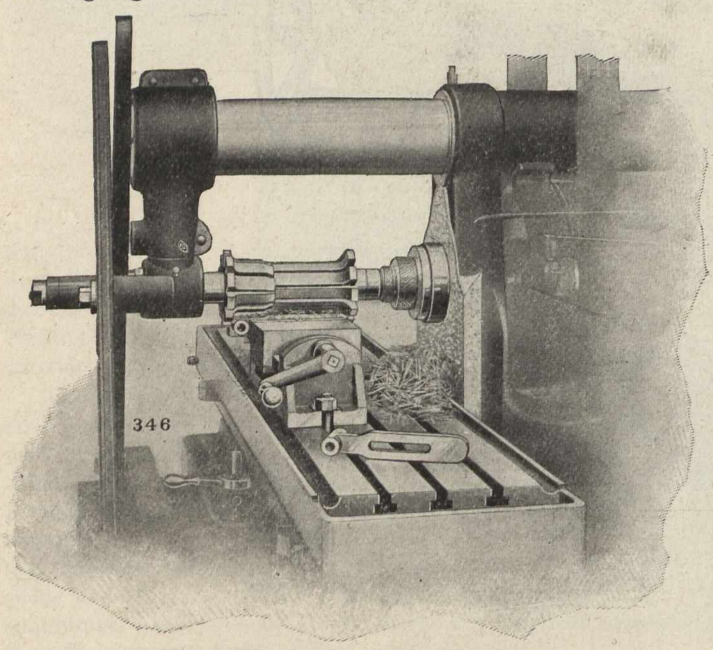
By Charles S. Gingrich, M.E.

XXIV.

The illustration herewith is a good example of present day practice in forming irregular pieces on a miller.

The cutter is of the formed or patent relieved style. Such cutters are sharpened by grinding the faces of the teeth, and maintain their original contour practically correct throughout their entire life. They differ in this respect from the form commonly known as "gun-shop" cutters, a process which is very difficult and almost certain to change the form of the contour of the cutter. This style of cutter is rapidly disappearing in the more advanced shops. In some American gun shops they have been almost entirely replaced by cutters with patent relieved teeth of the style shown in illustration.

This particular cutter is 6 1-2 in. wide on its working face. It finishes the one side and half way down the two ends of pieces 6 1-2 in. long, 1 1-4 in. wide. It is 3 1-4 in. diameter, and takes this cut at a table travel of 1 1-2 in. per minute, running 50 r.p.m., and feeding .030 in. per turn, leaving a good finish.

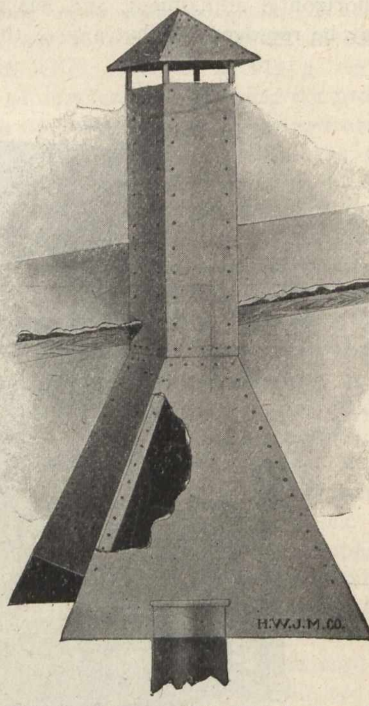


One of the drawbacks to the universal adoption of this style of cutter is the fact that its teeth are spaced farther apart than on the older form, and therefore each tooth has more work to do, which requires a more rigid machine than those formerly used. The principle of using milling cutters with the teeth spaced wide and with wide spaces between them so as to give ample chip room, is being applied to all styles of cutters at the present time, the idea being to give each tooth a chance to take a good-sized chip and then have plenty of room to accommodate the chip. This means heavy cutting, requiring stiff millers.

The designs of these machines have been rapidly changing to meet the new conditions of modern cutters and the new high speed steels. The job shown in the illustration was done on a No. 3 Plain Cincinnati Miller.

FIRE AND ACID-PROOF SMOKE JACKS.

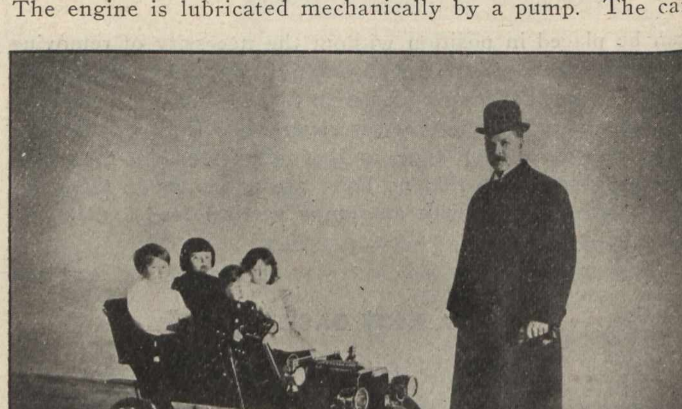
The use of metal and wood smoke jacks has always been more or less unsatisfactory; so much is this the case, that many users, especially the various railways, have turned to asbestos as the only solution of the problem. The "Transite" asbestos smoke jack, as manufactured by the H. W. Johns-Manville Co., New York, N.Y., meets all requirements in a most satisfactory manner. Metal jacks deteriorate very rapidly under the effects of gaseous vapors, whilst a wood construction is not desirable on account of its inflammability. Heavy cast iron jacks necessitate a heavier, and consequently more costly superstructure. In the jack illustrated is realized at once durability, coupled with lightness of construction. "Transite" will last as long as the building itself, is fire, gas and weather proof, and is unaffected by expansion or contraction. It is only one-fifth the weight of cast-iron and can be worked and handled in the same manner as wood. The material from which these



jacks are manufactured was originally designed for fireproofing flooring, and insulation of electrically propelled cars, being first used by the Interborough Rapid Transit Company of New York City, both in their elevated and subway cars The lumber, as the name indicates, is made of asbestos, varying in thickness from 1-8 inch to 1 inch, and is made in standard sheets 40 in. x 40 in, or 42 in. x 48 in.

A BABY AUTOMOBILE.

One of the greatest attractions at the recent automobile shows in New York and Chicago was the baby motor car illustrated below. The car is complete in every detail, being an exact model of a 16 h.p. touring car, the parts being only one-eighth the size of those in the larger machine. The motor consists of two water-cooled horizontal cylinders, and will develop two h.p. It is placed in the centre of the chassis, and the gasoline and water tanks are situated under the hood. Ignition is by jump-spark from electric batteries. The engine is lubricated mechanically by a pump. The car



has two speeds forward, and one reverse, power being transmitted to the rear axle by a Cardan-shaft. The tonneau is detachable, has two side-doors, and accommodates four passengers as shown in the picture. All levers and pedals necessary for a perfect control are provided, also two brakes and five lamps. As will be noted, a baby-chauffeur has been trained to run the automobile, which is the smallest working model ever produced, weighing only 243 pounds.

STURTEVANT HIGH PRESSURE BLOWER

[A number of technical journals, both in Canada, U.S.A., and Europe, have published elaborate descriptions of the Sturtevant Company's new pressure blower, but, inasmuch as "The Canadian Engineer" goes into the hands of every engineer of distinction and manufacturer of importance in the Dominion, the men who design and buy; hence are more than mere passive readers of current technical literature, we have deemed it an opportune moment to set forth the special features of this blower, which embodies the latest resources of constructive engineering in this particular line.—Editor.]

The B. F. Sturtevant Company—founded in Boston 1857—were the pioneers on this continent in the designing and manufacture of fans and pressure blowers for foundries and smelting works. And the high class work and thoroughness which has characterized their manufactures in this and other lines, along the years, has brought its reward, in the necessity for the laying down and erection of the fine new plant at Hyde Park, Mass., shown to advantage in Figs. 7 and 8.

In a recent issue (February, 1906) we described and illustrated their high-speed automatic, vertical steam engine, for the driving of direct-connected generators, pressure blowers, etc. Through their courtesy we are now enabled to set forth the special features and advantages of the Sturtevant, high-pressure blower; which can be either direct connected to the steam engine, or geared to motor as shown in Fig. 5.

This high-pressure blower is made in two types: In the horizontal, the two shafts lie in a horizontal plane, while in the vertical, one shaft is above the other. The blower hereafter described, consists of a cast-iron shell or housing in which are two rotating members or "rotors." One of these, the impeller, revolves in the larger portion of the casing which in the vertical type is the lower. It does the real work of compression. The other rotor, known as the idler, does no work; it successively provides spaces or chambers of proper shape at the desired points in the revolution, so that the impeller blades may return to the suction side of the blower without allowing escape of compressed air.

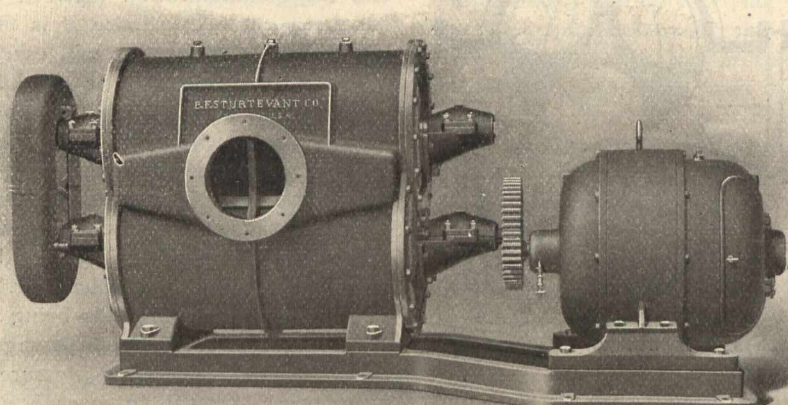


Fig. 5.—Blower Geared to Electric Motor.

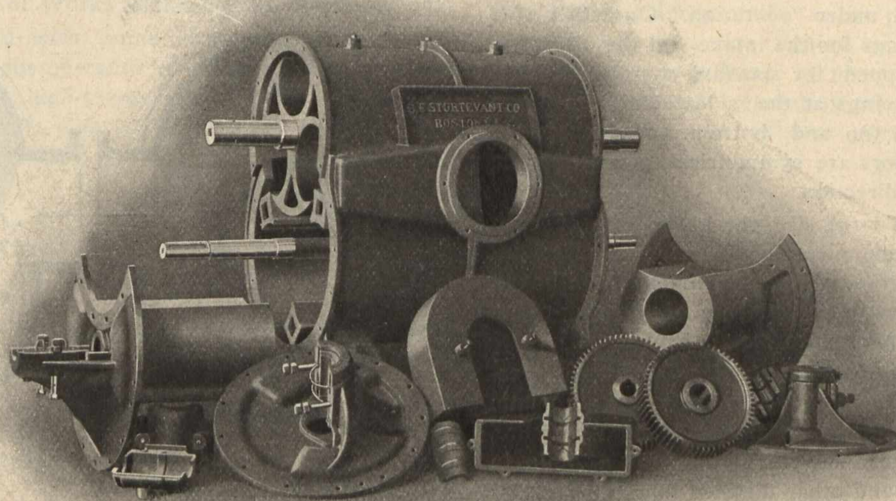
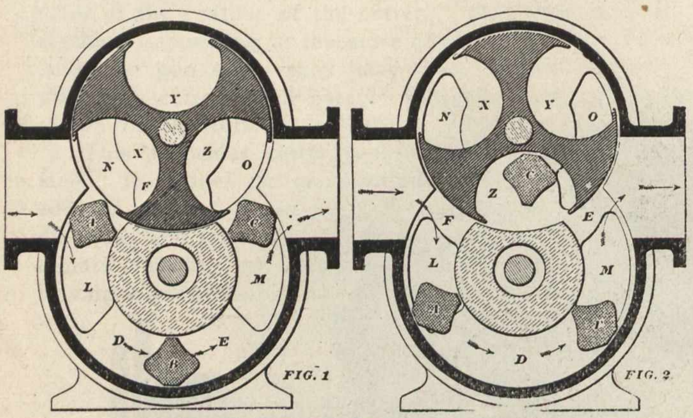


Fig. 6.—Parts of High Pressure Blower.

Ample clearance between the rotating members and the casing insures high mechanical efficiency by absolutely perventing internal friction due to contact of metal surfaces. Between the idler and the impeller the space is so great that only excessive variation in the accurate running of the gears will allow the two rotors to come in contact. This clearance is at least one-eight inch in small blowers and in large sizes, one-half to three-quarter inches.

The idler, or drum, revolving in the smaller part of the casing, which in the vertical type is above the impeller, is symmetrical, and has a periphery nearly a complete circle. It consists of three hollow vanes or blades cast in one piece with the shaft, which is of cast iron, very rigid, and of ample strength to transmit the little power necessary for rotation. The idler, revolving with large clearance, is turned at the same speed as the impeller by means of two spur gears running in oil and incased for protection against dirt and accident.



Action of Rotors: Stages 1 and 2.

The impeller, mounted on the driving shaft, is made up of three diamond shaped bars or blades and a central web which is keyed to the steel shaft. Being symmetrical it is perfectly balanced at all speeds. As it revolves, three separate pockets are formed in the annular space between the shell and a core extended lengthwise of the lower part of the casing. In reality the core is in two parts, each cast in one piece with the end plates, the space between them allowing the web to revolve.

The cast-iron shell or casing consisting of two hollow cylinders partially intersecting, is accurately bored and amply strong and rigid to withstand the strains due to handling, setting on foundation and operating at high pressures. The ends of the casing are finished to receive the four cover plates in which are cast chambers or passages for lessening the noise and increasing the efficiency of the machine, as is explained under "operation." On either side of the housing are openings for the intake and the discharge of the air, flanged and tapped for standard gas-pipe fittings; the small sizes have openings at the sides, and the large blowers openings at the top and bottom. In every respect the casing and rotors are symmetrical, permitting the blower to run in either direction.

Except in blowers of large size, the lower half of each journal box is cast in one piece with the cover plate, insuring rigidity, simplicity and correct alignment. The boxes, except those for very small blowers, are of the ring-oiling type, lined with Sturtevant white metal, hammered in.

When it is desired to maintain absolutely constant pressure, the blower is provided with a relief valve, or automatic governor. For transferring gases and air at high pressure, stuffingboxes are provided for the shafts, and a drain in the bottom removes tar and other distilled liquids.

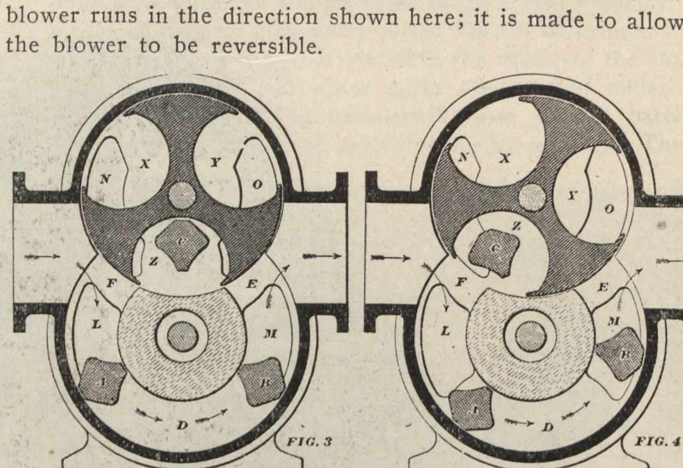
Operation.

Air at atmospheric pressure entering the blower at the intake is successively imprisoned in the three pockets formed by the three blades of the revolving impeller, and discharged at any desired pressure up to 10 pounds per square inch. The volume of free air delivered varies directly with the number of revolutions; the pressure varies with the resistance met in the delivery pipe. The principle upon which the blower operates is clearly shown by the accompanying diagram which is a sectional view of the rotors and casing. In the explanation it is assumed that the blower is running at a speed to produce average pressure, and that this pressure exists in the discharge outlet.

While the rotating members were in the positions shown in Fig. 1, air entered freely and completely filled the chambers *X* and *D*, while pockets *E* and *Z* were discharging air to the delivery pipe. From the previous movement of the rotors, the pressure in *Y*, filled with air carried over by the revolving idler, had been increased slightly by air flowing through the leakage passage *N* as will be explained later. The space between blades *A* and *C*, just above the concave portion of the core, was practically filled by the wing of the idler, and consequently while in this position it took no part in the action.

While revolving from the position in Fig. 1 to that shown in Fig. 2, air in pocket *D* has been carried along, and the communication between chamber *D* and the inlet has been cut off. Space *Z* is filled with compressed air, which further movement will carry toward the suction end where it will flow back to the inlet and in escaping cause noise. But this noise and loss is prevented by the leakage chamber *O* which allows the pressure to be transmitted to the air in space *Y* thereby increasing its density just before it is discharged. Continuing, the rotors reach a position, Fig. 3, so that the air is now entering the pocket *F*, the air in *D* is being carried around between the blades *A* and *B* in the annular space, and *E* is discharging. Above the impeller the remaining pressure in *Z* is being transmitted to the air in *X* by means of the leakage passage *N* provided for the purpose, thereby making its pressure a little greater than atmospheric. The air in space *Y* under slight pressure from previous leakage is imprisoned, and being carried around by the idler.

When the last position completing the cycle is reached, pocket *F* will be filling, the pressure in chamber *Z* will have been reduced to atmospheric by leakage, space *Y* will discharge and a little compressed air from the delivery pipe will flow back through leakage passage *M* and increase the pressure in D which will result in a quieter discharge when further movement brings *B* into the discharge passage. The purpose and advantage of the leakage chambers is now apparent; they make it possible to recover the pressure tending to escape from the impeller pockets and by making the increase in pressure gradual cause the blower to run with less noise. Leakage passage *L* has little effect when the blower runs in the direction shown here; it is made to allow the blower to be reversible.



Action of Rotors: Stages 3 and 4.

The three blades of the impeller, set at equal distances around the periphery, cause three admissions of air at each revolution. Upon leaving the last position, Fig. 4, the rotors quickly reach a position in which the conditions are exactly the same as those shown in Fig. 1, the operation continuing as explained.

In selecting a blower for the foundry, it is customary to rate the volume of air according to the maximum amount of iron which the cupola can melt. The capacity of the cupola being known, the size of the blower may be found from the fourth column of the accompanying table. If the maximum output is not known the diameter of the cupola becomes the basis for computation, the first column of the table giving the usual capacities for the diameters given in the second column. The values of the third column are based on 30,000 cubic feet of air per ton of iron; our tests show this to be a fair average, although 23,000 to 40,000 cubic feet may be required, depending upon the local conditions and method of operation. In case a given cupola requires less than 30,000 cubic feet per ton, the blower will melt a larger amount of iron than that given in the table.

Foundry Statement for Sturtevant High Pressure Blowers.

Tons iron per hour	Usual inside diam. cup. for work inches.	Cubic feet of air per min.	No. of blower.	R. P. M.
1	23	300	4	450
2	27	1,000	5	430
3	30	1,500	6	360
4	32	2,000	7	350
5	36	2,500	6	290
6	39	3,000	8	330
7	42	3,500	9	260
8	45	4,000	9	290
9	42	4,500	9	330
10	54	5,000	10	270
11	54	5,500	10	300
12	60	6,000	10	325
13	60	6,500	11	230
14	60	7,000	11	250
15	66	7,500	11	270
16	66	8,000	11	290
17	66	8,500	11	305
18	72	9,000	12	200
19	72	9,500	12	215
20	72	10,000	12	225
21	78	10,500	12	235
22	78	11,000	12	245
23	78	11,500	1[illegible]	22[illegible]
24	84	12,000	1[illegible]	20[illegible]
25	84	12,500	1[illegible]	21[illegible]
26	84	13,000	13	215
27	90	13,500	13	225
28	90	14,000	13	235
29	90	14,500	13	240
30	90	15,000	13	250

Description of Works at Hyde Park, Mass.

Having described with some degree of minutiæ, the construction and modus operandi of what may be described as the most modern high-pressure blower on the market, let us now glance at the plant where they are made.

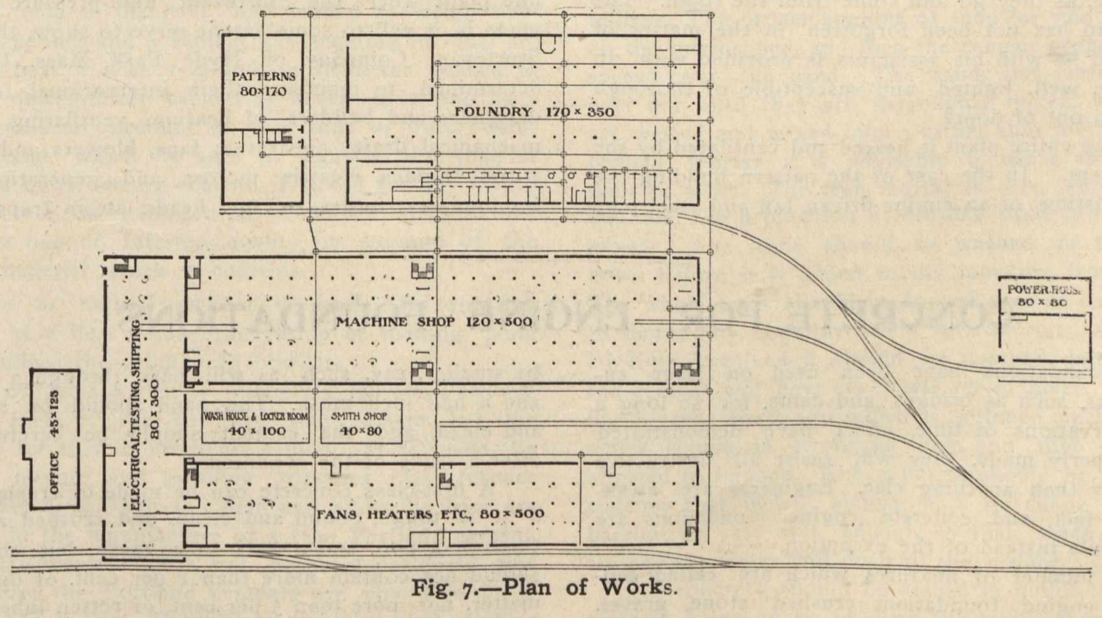


Fig. 7.—Plan of Works.

Owing to excessive pressure of increased business, and the necessity for much more extended facilities for manufacturing than was available at the old plant, Jamaica Plain, Mass., the fine, commodious, and modernly equipped new works, at Hyde Park, Mass., were commenced in 1901, and are now in full swing.

The works are located about nine miles from Boston, and the situation is admirable; for the tract of land on which the plant stands, containing over 15 acres, with a frontage of 1,300 feet, is alongside the freight yard tracks of the New York, New Haven and Hartford Railway: near its station at Readville, the distributing point for all freight passing over either the Midland or Providence divisions. The water supply is ample, and the environing space for dumping waste material is sufficient for years to come. The arrangement of the buildings is the result of wide experience, and careful study of the best conditions for turning out expeditiously that special line of manufactures the problem of simplifying inter-transportation receiving particular attention; a glance at the general plan will show how advantageously this has been carried out. Numerous spur tracks permit of ready handling of in-coming and out-going freight, while a complete system of industrial railways connect all departments. The track system is laid with 12 pound T rails, 24-in. gauge centres.

The plant comprises a commodious four-story office building, measuring 45 ft. by 125 ft.; a three-story building 80 ft. by 500 ft. devoted to the manufacture of blowers, heaters and galvanized iron work; a building 80 ft. by 250 ft. of the same height, on the first floor of which all engines will be tested, stored and shipped, while the other floors will be utilized by the electrical department; a general machine shop measuring 120 ft. by 500 ft., with 40 ft. side galleries devoted principally to the building of engines; a forge shop 40 ft. by 100 ft.; a two-story building of the same floor area devoted exclusively to lockers, washing and sanitary facilities for the employees; a pattern and storage building 80 ft. by 150 ft. in ground plan; a foundry measuring 170 ft. by 350 ft.; a power house 80 ft. square with detached fire and service pump house. All told, the aggregate floor area of the buildings exceeds nine acres. Brick has been used for all walls; steel columns and girders form part of the construction of such buildings as are equipped with travelling cranes; all upper floors are of plank with top course of maple, laid on heavy wooden beams and designed in the case of the principal buildings for carrying safe loads of 200 to 250 pounds per square foot. The roofs are of heavy plank covered with tar and gravel.

The machinery of the entire plant is electrically driven and the buildings are lighted at 220 volts from a central power-house containing at present one 100-k.w. and one 250-k.w. Sturtevant generating set. The power plant engines run condensing the exhaust steam derived from engines under test upon the plate in the testing building is utilized for heating; supplementary live steam being admitted at reduced pressure as may be required. Waste exhaust is discharged through a Sturtevant exhaust head. The boilers are equipped with Sturtevant fuel economizer for heating the feed water. The power-house is placed sufficiently far from the ends of the buildings to permit of ample extension of each, and near enough to the water supply to reduce to a minimum the expense of conveying condensing and other water. Steam, electricity and compressed air are transmitted to the individual buildings through a concrete tunnel and a supplementary system of covered trenches.

One of the noticeable features in the equipment of this plant is to be found in the sanitary arrangements. Most generous provision has been made in the case of the foundry, which has a large locker and wash room. Expanded metal lockers to the number of 225 are already in position. Enamelled iron sinks, six in number, are served with tempered water and are generously patronized by the employees.

heater, is placed close to the division wall, delivers the heated air into a vertical flue and thence to the various rooms. The air for this apparatus is taken directly from out of doors. As a result, there is a peculiar freedom from dust in the pattern storage rooms, which could not be avoided were any of the air drawn back from the pattern shop. The foundry apparatus is located overhead in the end of one of the craneways and arranged to take fresh air from out of doors or return the air from the building and reheat it. This apparatus consists of a ¾ housed steel-plate fan discharging in two directions into galvanized iron pipes. The fan is driven by a direct-connected horizontal engine. The heating apparatus for each building is designed to operate with exhaust steam. The entire heating system in each building is under thermostatic control, by which means an even temperature is maintained throughout all the rooms.

Distribution of air is made through a system of over-

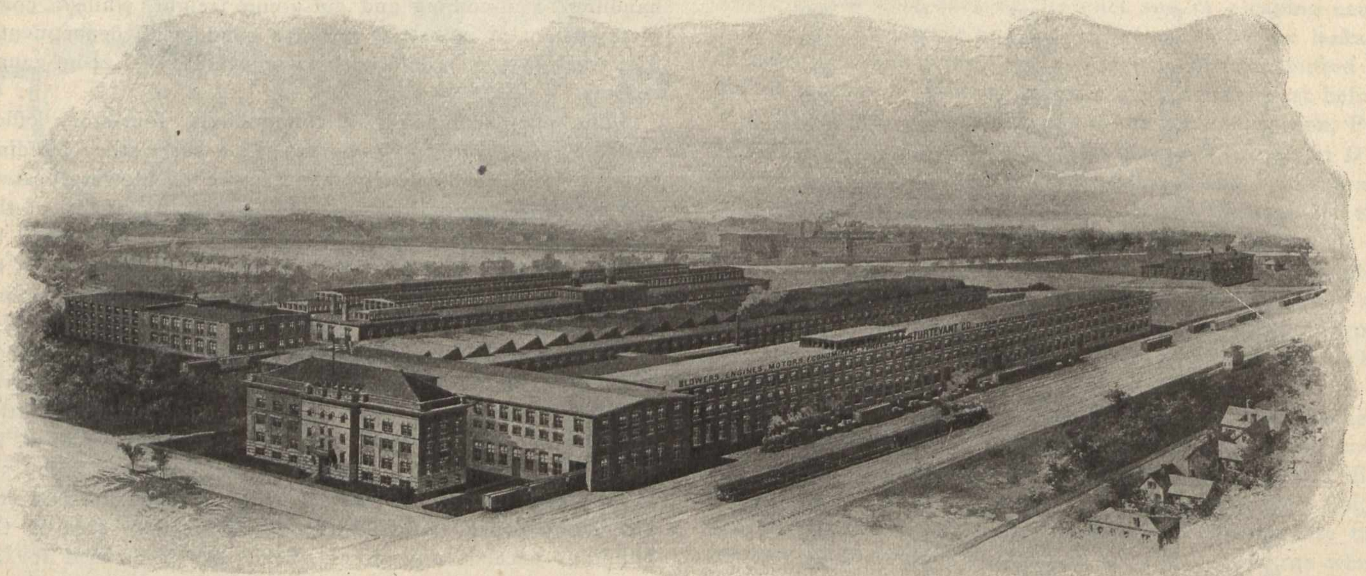


Fig. 8: Birds-eye View of B. F. Sturtevant Company's Works, Hyde Park, Mass., U.S.A. Machine Shop is the Central Building with Saw-tooth Roof.

A series of slate partitioned shower baths has proved to be very acceptable during the past summer. The floor of this room is of tar concrete; the upper walls and ceilings which are white and fresh are in pleasing contrast to the steel work and base of the walls which are finished in dark green. Within the same room is installed the time recording system so placed that a double line of men pass the board, one upon either side, as they go and come from the room. The foundry foreman has not been forgotten in the matter of convenience and he with his assistants is provided with an attractive office, well lighted and susceptible of thorough ventilation from out of doors.

Naturally the entire plant is heated and ventilated by the Sturtevant System. In the case of the pattern building the apparatus, consisting of an engine-driven fan and steel pipe head galvanized iron piping, discharging downward to the floor, thereby distributing the air in even volume and economizing in the amount of heat required. The foundry apparatus is of material service upon summer days particularly during the "heat," when it is employed to force cool air into the building.

Incomplete and inadequate though the description of the fine plant where the Sturtevant high-pressure blowers are made is, it will to some extent serve to show, that the B. F. Sturtevant Company, of Hyde Park, Mass., U. S. A., are determined to maintain their international reputation as designers and builders of heating, ventilating, drying and mechanical draft apparatus; fans, blowers and exhausters; steam engines, electric motors and generating sets; fuel economizers; forges, exhaust heads, steam traps, etc.

CONCRETE FOR ENGINE FOUNDATIONS

Concrete foundations have been used on large engineering works, such as bridges and dams, for so long a time that observations of time effect have demonstrated that, when properly made, they will resist all destructive influences better than anything else. Engineers are awakening to this fact, and concrete engine foundations are becoming the rule instead of the exception.

There is a number of mixtures which are called concretes, but for engine foundations crushed stone, gravel, sand and cement are the only components which should be used. The stone should be clean, hard and durable, and in size should not be larger than will pass through a three-inch ring, and for very particular work the stone should be smaller, say, such as will pass through a two or two and a half inch mesh. The sand should be sharp, coarse and clean, and the cement should be carefully selected after a study of the conditions.

A first-class concrete can be made of crushed limestone if it is tough, sound and clean, and crushed and screened through a two and a half inch mesh, but the limestone should not contain more than 1 per cent. of dirt or clayey matter, nor more than 5 per cent. of rotten limestone, which you can crush between your fingers. Crushed limestone for concrete should not contain more than 20 per cent. of fine stone, which will pass through a one and a half inch mesh. Clean gravel makes a good substitute for crushed stone when used in the proportions of one part gravel and one part crushed stone. Very good concretes have been made by using sand and gravel just as it comes from the pit, that is, by using it from thirty-mesh sand up to two and a half inch gravel, but the using of such mixtures is not advisable, unless the engineer has made some study of the filling of voids. If the sand and gravel is mostly small there will be an excess of small stuff for filing the vacant spaces between the larger pieces, while to properly cover all the surfaces of the fine sand with cement will require more cement than is necessary with a proper mixture of sizes. If the large sized pieces are in the majority, the concrete may be full of holes.

The study of voids in concrete materials is simple and interesting. Take any water-tight measure that is convenient and fill it even with crushed stone or other material. To conform to actual conditions the stone should be wet before it is put into the measure. When the measure is full of stone, pour in as much water as the measure will hold without overflowing. Then on measuring the water, you will have the amount of sand and cement required to fill the voids in stone of the size just measured.

Crushed granite makes the best concrete, other things being equal. It can be used in different sizes the same as sand and gravel; that is, the fine-crushed stone is used in place of sand, and a study of the voids in the size stone at hand and a proper mixture will save greatly in cement. Crushed granite, in fact all concrete material, should be so free from dirt that the handling of it will not soil the hands. Where the stone and sand picks up most of the dirt is during the time in which it is stored and handled on the job. It is nothing unusual to see piles of sand and crushed stone lying on top of the clay that has been dug out to get the foundation on a solid bed. That is not right. The stone and sand should be placed on clean floors or beds where there is no possibility of dirt falling or being thrown into it.

There are several cements used in making concrete. Genuine Portland cement is made by heating lime and clayey matter until they melt and run together, and the product is then ground into fine powder with which we are all familiar. A good Portland cement is so fine that over 9 per cent. of it will pass through a mesh of 10,000 openings per square inch. For ordinary work a Portland cement should be used that will have its initial set in three-quarters of an hour and its final set in ten hours, but if a quick-setting cement is desired it can be compounded so that it will have its initial set in twenty minutes and its final set in an hour.

A cement is considered as having its initial set when it will bear, without being appreciably indented, a wire 1-12 of an inch in diameter and loaded to weigh one-quarter of a pound, and a cement has acquired its final set when it will bear a wire 1-24-inch in diameter loaded to a pound. A quick-setting cement is never as strong as a slow-setting one on account of the soda or other adulterating material which is used to regulate the time of setting, and a quick-setting cement, if stored for any length of time, will lose its quick-setting properties and become a slow-setting one of inferior quality on account of the adulterating material which it contains.

Rosendale or natural cement is made by roasting natural rock at a heat below the fusion or melting point and then grinding the product to powder.

A grade of cement that is frequently labeled Portland, and sold as such, is the so-called slag cement, but the proper name for this is Puzzolan cement. It is made by mechanically mixing and grinding together blast furnace slag and slaken lime. But the lime and hydraulic base are not fused as in the manufacture of a true Portland cement. The name slag cement does not properly designate this cement, because the Portland cements are now also made from blast furnace slag. Puzzolan cement is much lighter than Portland, its specific gravity being from 2.6 to 2.8, while Portland cement has a specific gravity of from 3 to 3.5. Unless it is treated with soda the Puzzolan sets much slower than Portland cement does.

A concrete made from Puzzolan cement is very nearly as strong as if Portland was used, and for some locations it is better than Portland, because it never sets real hard, and is, therefore, tougher and not as brittle. It is well fitted for foundations which will always be damp or for any underground work, but it is unfit for use where it will be subject to mechanical wear or where it will be exposed to the air, because its sulphides will oxidize, and the surface will shrink, crack and turn white. On account of its toughness it is advisable to use Puzzolan cement for the interior of engine foundations, and to keep the air from it a 1½-inch casing of Portland cement mortar should be built around the concrete centre.

Silica cement is merely a Portland cement mixed with sand and then reground. To be exact it should be called a mortar. On account of the very thorough mixture of the sand and cement during the regrinding, a silica cement is excellent for grouting purposes, such as the bed plates and outboard bearings, or where a foundation is being made out of all sizes of stone instead of solid brick work.

Concrete, using Rosendale cement as a binder, for ordinary use is made by measure as follows: One part of cement, two parts sand, and five parts crushed stone. If a stronger concrete is desired the proportions can be one part cement, two parts sand and four parts crushed stone.

Portland or Puzzolan cement concrete for ordinary use is proportioned, one part of cement, two and one-quarter sand, and six crushed stone. Whenever a stronger concrete is desired the sand and stone proportions may be reduced to one of cement, two of sand and five of crushed stone. A very strong concrete can be made of one part of Portland coment, two parts of fine granite screenings and three parts of coarser granite screenings. The larger screenings all to pass through a three-quarter inch mesh.

All concrete should be mixed on substantial platforms, and if they are made of wood care should be taken to see that they are perfectly water tight, because the best and finest of the cement will run out with the water. The platforms or beds should be placed in a position where foreign matter will not get into the concrete during the handling or mixing of the materials, and concrete should not be mixed in batches larger than a cubic yard. A simple way of measuring the proper proportions of concrete materials is to use headless and bottomless barrels, or three different sized box frames, one for sand, one for stone and one for cement. The boxes or barrels can be put on the platform and filled with material and levelled off, the frames or barrels can then be lifted out of the way. The measuring of concrete materials in the ordinary round-bottomed wheelbarrow does not give proper proportions.

The order of mixing concrete should be about as follows: The proper amount of sand for one batch is spread on the mixing bed, and then the cement proportion is evenly spread over the sand. The sand and cement are turned over dry until they are thoroughly mixed, and then they are wetted and mixed into a rather thin mortar. In wetting cement mortar it is advisable to use a spray instead of pails or a jet. The thin mortar is then spread out on the bed, and the proportion of crushed stone is spread over the mortar. The stone should be washed or thoroughly wet down before it is added to the moisture from the mortar. The whole mass should be turned over at least twice so as to thoroughly coat the stone with mortar. As soon as the concrete is mixed it should be dumped into the mold so the cement will have its initial set in place. Cement which has become hard, and which is softened up by mixing with water, is not as strong as lime, and this should not be allowed to happen. The concrete should be of such a consistency that it will almost hold its shape in the wheelbarrow, or just wet enough so that when it is properly tamped the water will flush to the surface.

All concrete should be placed in molds, and if the concrete is going to be in view the mold should be built of planks that are planed on one side and both edges. The planks, when finished, should not be less than 1¾ inches in thickness, and should be tied together and stiffened so that the concrete will not yield during filling and ramming

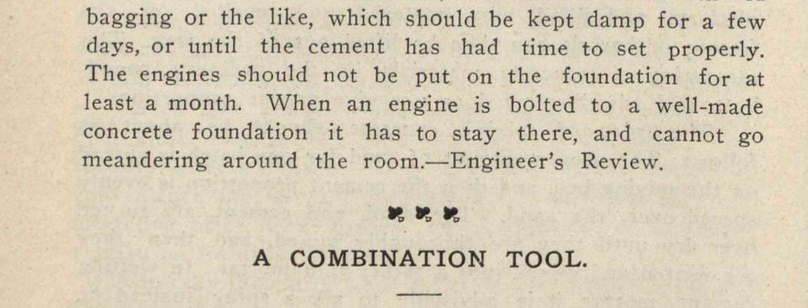
Four feet is about the limit for distance between studs or tie braces. Concrete should not be made with sharp corners, and fillets should be placed in the molds at all sharp angles. No corners should be sharper than two inches, and, if stone larger than two inches is used, the corner should be as wide as the largest stone. Molds should not be removed for at least two days after the last concrete is put in. Before the concrete is put in the molds should be wet down on the inside. This will prevent the wood of the mold from absorbing water from the concrete next the planks. The chemical action between the cement and water can then take place. The absorption or evaporation of the water before chemical action takes place accounts for the crumbling of the outside of mortar which is strong in the interior of wall. When the concrete is being dumped in molds, men should be put to ramming the concrete in the mold so that the mortar will fill all voids between the stone. Nine inches is about as thick as it is possible to ram properly, and if there is not enough concrete mixed to fill out a layer in the mold a plank should be put across the mold and the layer tamped up square instead of sloping down. If the concrete is allowed to slope, the slope will not ram properly, and when the next layer of concrete is put in it does not join chemically with the under layer, and there will be a tendency for the upper concrete to slip on the slope.

Concrete which is exposed to air and weather should have a Portland cement mortar finish on the outside. This finish can be put on when the mold is removed, but a better way is to put on the facing as the concrete is built up in the mold. If a concrete foundation is faced off in this way, it is then possible to use Puzzolan cement for mixing the concrete.

The manner in which a mortar facing may be put on when filling the mold is as follows: Take a piece of sheet iron, say six feet long and ten inches wide, bend up one and a half inches of the ends at right angles and set the plate in the concrete with the bent-up ends touching, the proportion of one of cement to two of sand, and tamp the mortar in with a trowel or shovel. Then fill in the concrete. When the concrete is as high as the mortar the sheet iron can be removed and the concrete tamped. The mortar should be stiff so that the stones will not penetrate to the mold when being tamped. The mortar facing and the concrete centre being carried up together make a monolith of the whole. When the concrete is completed the top should be faced the same as the sides, and then covered with old bagging or the like, which should be kept damp for a few days, or until the cement has had time to set properly. The engines should not be put on the foundation for at least a month. When an engine is bolted to a well-made concrete foundation it has to stay there, and cannot go meandering around the room.—Engineer's Review.

A COMBINATION TOOL.

A more useful tool than the one illustrated has seldom, if ever, been placed on the market. It combines a drill, an ordinary vise, a pipe vise, an emery wheel, an anvil, a forge, and a blower for the forge. The Detroit Tool Company,



Detroit, Mich., are to be congratulated on their new product. The device consists of a steel-faced bed, or base; at one end is a stationary head stock, at the other a moveable tail stock and an overhung forge pan. The head stock contains the mechanism of the rotary blower, drill-grinder, and the stationary part of the vise and pipe vise jaw. The tail stock serves as an anvil, support for work being drilled, and the moveable member of the vises. This part slides on the bed between two adjustable guides, and is moved by a screw operated by a hand-wheel at the outer end of head stock. The air from the blower is conveyed through a channel in the base to the forge at the opposite end. The fan shaft of the blower projects through the air intake at the front side of the gear case, and is fitted to receive an emery wheel, the intake being located as to form a current of air, drawing the emery dust into the forge away from the operator. The blower and emery wheel are operated by a crank wheel located on the rear side of the gear case, which wheel is fitted with a pulley for the application of power when so desired. The fan and emery wheel are geared 12 to 1, and may easily be run by hand 2,000 revolutions per minute. The drill is operated by the same driving wheel, being fitted with a clutch arrangement so that it may be thrown in and out of gear at the will of the operator, so that either the drill or the blower may be operated independently of each other. The emery wheel is of special construction, having an open centre, with the spokes beveled propeller fan fashion to throw the air into the blower intake. With this unique appliance are furnished: (1) Drills, (2) blacksmith's hardy and tongs, (3) crucible holder for holding a crucible or metal ladle, or for holding a soldering iron over the forge fire.

INTERNATIONAL WATERWAYS COMMISSION.

The International Waterways Commission held a short session in Toronto recently, the discussion resulting in anything but a roseate proposition for the people of Ontario. From what can be learned there is a disposition on the part of the American Commissioners to "grab everything."

The American Commissioners want to preserve the scenic beauty of the Falls, and are agreeable that no more power concessions shall be granted, placing the Province of Ontario in the position of having to cancel some four or five charters that have been made for the manufacture of power at Niagara. This would throw the control of the electrical power situation over to the American capitalists, who have the right to generate 200,000 horse-power on the American side, while contracts have been made for the sale to the United States of half the power generated by companies on the Canadian side.

Politics In It.

The American Commissioners state that from 27 to 33 per cent. of the water of Niagara is now used, and that any further use of it will impair the beauty of the place.

The master hand of the American politician is seen in the whole transaction, and the charge is made by Canadians who are familiar with the situation that one of the power companies has the New York Legislature at Albany by the throat, and is able to get about what it wants. This means is being taken, it is said, to force out competition and give all the benefits to the present companies, while two-thirds of their product will go over into the United States.

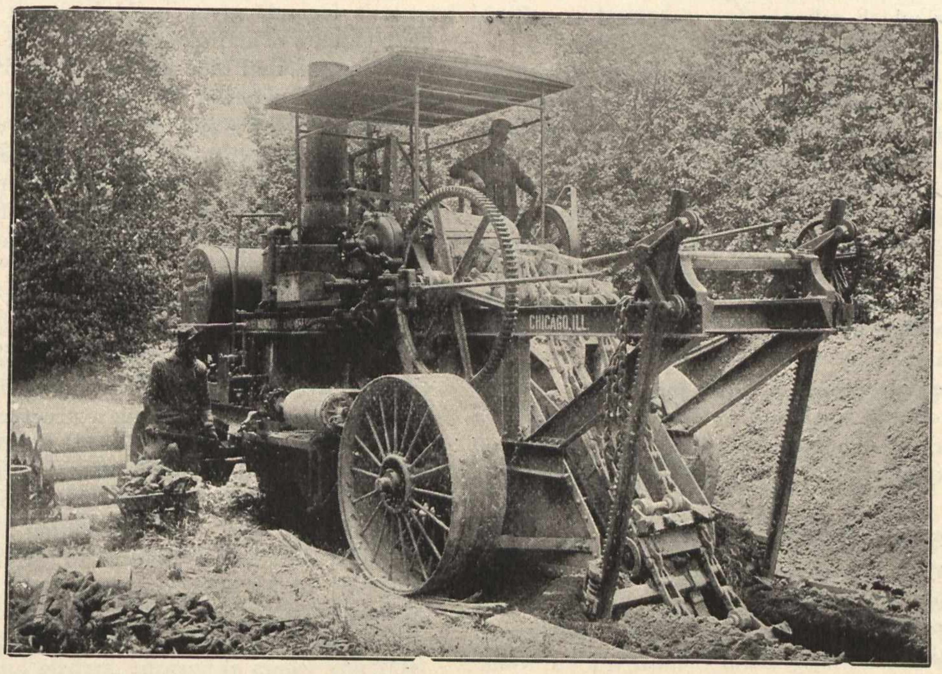
Want a Treaty.

The American Commissioners desired to secure a report of the commission which might form the basis for a treaty between Great Britain and the United States regarding the waters of the Falls and the Niagara, as the greater volume is on the Canadian side. This the Canadian Commissioners declined to do unless specially instructed by the Canadian Government. Another meeting will be held at Washington, D.C., on April 24th next.

A resolution of condolence was passed by the commission and ordered to be forwarded to the family of the late Hon. Raymond Prefontaine, Minister of Marine.

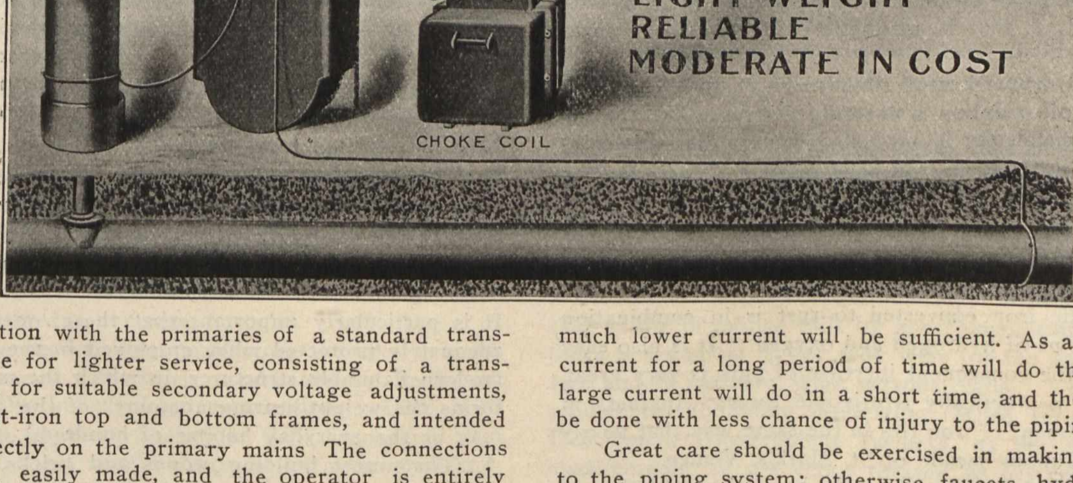
PORTABLE TRENCH EXCAVATOR.

Through the courtesy of the Municipal and Contracting Company, Railway Exchange, Chicago, U. S. A., we are enabled to introduce to our readers a modern trench machine of the wheel type, which is undoubtedly one of the most economical digging appliances ever invented. They are made in five sizes, excavating trenches any depth to twenty feet at one cut, with widths varying from 14 in. to 60 in., and vertical sides. They are also made for cutting ditches with sloping sides. Records show that with these machines 600 cubic yards can be excavated in 10 hours. A large number of these machines were in service last season, and the improvements made since lead the makers to claim that the 1906 machine is as perfect as experience and expert knowledge can devise, and that it will be a money-maker for contractors and municipalities.



THAWING BY ELECTRICITY.

Practical demonstration has proved that thawing frozen water pipes by electricity is a reliable and economical method. A demand has consequently been created for a light-weight equipment which is moderate in cost. The Westinghouse company has designed two outfits, one for heavy service, comprising a specially designed choke coil used in connection with the primaries of a standard transformer and one for lighter service, consisting of a transformer adapted for suitable secondary voltage adjustments, mounted in cast-iron top and bottom frames, and intended to be used directly on the primary mains The connections are simple and easily made, and the operator is entirely protected from injury.



Owing to the many different conditions met with in service it is impossible to prescribe the exact voltage or current necessary to do any particular thawing, as these quantities will vary with the size, length and location of pipe, as well as with the atmospheric temperature. In general, the voltage necessary to force the same amount of current over pipes of the same diameter will vary with the length of the pipe. Large pipes require less voltage to force the same current through a given length, but require more current to thaw. For pipes up to five inches in diameter approximately 500 amperes is usually sufficient, while 12-inch mains may require a thousand amperes. For small pipes a much lower current will be sufficient. As a rule, a small current for a long period of time will do the work that a large current will do in a short time, and the thawing will be done with less chance of injury to the piping system.

Great care should be exercised in making connections to the piping system; otherwise faucets, hydrants or pipes may be burned and disfigured, owing to the heat developed by the heavy current passing through poor connections. Two substantial clamps for this purpose are provided with the apparatus.

THE PRESERVATION OF IRON AND STEEL

By B. H. Thwaite, C. E.

More than a quarter of a century ago the writer stated the opinion "that one of the most dangerous forms of construction was that in which reliance for structural strength depended upon unprotected metals."

In consequence of the partial collapse of the Charing Cross Station roof, considerable attention has been directed towards the condition of similar structures, and doubts are openly expressed as to the advisability of employing iron and steel so freely in the future as these metals have been employed in the past. It is always wise to draw general conclusions from an isolated experience, and such a course is particularly to be depreciated in the case of the Charing Cross disaster, although this concurrence will doubtless furnish useful lessons when all attendant circumstances are fully known and analyzed.

The object of the present article is to consider the effects of corrosion upon iron and steel, and to discuss methods by which the permanence of structures in which these materials are used may be extended by the application of preservative methods.

The Chemical Aspect of Corrosion.

When iron or steel is exposed to the influence of air containing water vapor and acids, the process of decay, generally described as oxidation or rusting, is commenced.

For the production of rust three substances are necessary: oxygen, aqueous vapor and an acid—and the intensity of the action depends upon the proportions of aqueous and acid vapors contained in the air. The rusting of iron takes place in two stages and as carbon dioxide is the acid most generally present, the nature of the reactions may be thus expressed:

(1) $Fe + H_2O + CO_2 = FeCO_3 + H_2$.
(2) $2FeCO_3 + 3H_2O + O = Fe_2H_6O_6 + 2CO_2$

In the first stage, water and carbon dioxide produce carbonate of iron concurrently with the liberation of hydrogen, and in the second stage the carbonate of iron combines with water and oxygen to form ferric hydrate, or rust, the carbon dioxide being set free.

The above equations do not precisely express the chemical changes taking place, because iron rust is not pure ferric hydrate, and its composition is further complicated by the occurrence of mineral acids, such as the oxides of sulphur in the atmosphere. But the explanation is sufficient to give a general idea of the process.

Thermal effect may displace that of an acid—for instance, when iron or steel is exposed to heated air, oxidation proceeds in two stages, which may be expressed as follows:

(1) $2Fe + O_3$ of air $= 2FeO + O$.
(2) $2FeO + O = Fe_2O_3$.

When superheated steam is present, a third form of oxidation is produced, that is, magnetic oxide, or forge scale Fe_3O_4, thus:

$3Fe + 4H_2O$ (super-heated steam) $= Fe_3O_4 + 8H$.

The effect of oxidation is not only destructive to the integrity of the metal, but it may also have a disruptive influence. For instance, an iron band or tie-rod encircling or penetrating masonry may disrupt or fracture such masonry by increase in the mass of the tie-rod or band as the result of the oxidation of the metal.

Examination of the expression FeH_6O_6 shows that each atom of metallic iron converted to rust is in combination with twelve atoms of hydrogen and oxygen. It is also easy to realize that the consequent increase of bulk is very great, and represents a practically irresistible force. In fact, it was the enlargement of iron ties in the same way that nearly destroyed the famous facade of St. Mark's, Venice.

To illustrate the destructive effects of the oxidation of metals, let us take the case of an unprotected wrought-iron lattice bar, 4 in. by 1 in., exposed to the air of a city, in which the aqueous proportion of the atmosphere is high, as are most of the towns in which moisture is added by the burning of hydro-carbonaceous coals. Calculating by the writer's formula given in Molesworth it will be found that the complete oxidation of the whole of the metal will require 110 years, so that in a period of fifty-five years only one-half the original material will remain. In situations where the metal is exposed to specially destructive gases, the process of decay may be still more rapid. For example, it is said that some parts of the ironwork at Charing Cross Station have already been reduced to less than one-half the original thickness, after less than forty-five years' service, and in spite of paint.

Such a statement permits one to realize the extent of the undermining influence of rusting action during a period of years in sapping the strength of metal, upon which many valuable lives may depend. If metal be subject pari passu to vibration, its entire molecular structure may be rearranged, culminating in the disappearance of the fibrous character, and in its place the establishment of the crystalline structure characteristic of cast-iron, and the corresponding reduction of tensile strength. In calculating the effect of time and work in a metallic bar exposed to the effects producing vibration, both of the influences described should always be taken into account.

Special Causes for Corrosion.

Other causes, besides the chemical action of oxygen, water and acids, may result in the corrosion of metals. For example, if iron and steel of different densities are brought into contact with each other, the less dense of the two is more liable to rust than the other.

Metals of electrical polarity opposite to those of iron and steel, either reduce or accelerate the process of rusting or oxidation. For instance, metals that are electrically positive in relation to iron and steel, preserve the latter more or less, and at their own expense. Zinc being positive in relation to iron and steel, the latter metals gain by contact with zinc, which suffers in like proportion. On the other hand, lead is negative in polarity relationship to iron and steel, and the oxidation of the latter is accelerated by contact. The same effect also applies to copper, brass, and more especially to gun-metal, which should never be brought into contact with iron or steel when exposed to an oxidizing environment, except under strict and sustained supervision.

If any one requires ocular proof of the effect of negative polarity, let him examine some old iron railings embedded in lead, and he will find striking evidence of its existence in the attenuated character of the iron near the point of contact with the lead.

The Importance of Preservatives.

It is now some fifty years since the completion of many of the metallic structures associated with the building of our railroads and although, fortunately, the margin of safety adopted by the old school of engineers was high, it behoves the supervisors of our oldest railway structures to keep a vigilant watch over the metallic structures under their care, and which were built in the early days of the Railway Era.

The importance of preserving iron and steel from the strenuous efforts of oxygen and other agents, to restore them to their native condition of iron oxide or carbonate in which they are found, has been recognized by engineers and chemists ever since the beginning of the iron and steel age. It is particularly important that these metals should be adequately protected when employed in the construction of modern habitable structures, in which the metal framework forms the weight-bearing anatomy of the structure which may be the everyday habitat of hundreds of human beings.

That most building stones and bricks, as also terracotta, are not impervious to the flow of air and the penetration of moisture is well known, thanks to the classic researches of Pettenkofer and others. Therefore, it is only to be expected that unprotected steel columns, or beams embedded in brickwork, masonry, or terra-cotta, will suffer from the action of rust, more particularly when located in the basement and foundations of a building; hence the necessity for really efficient protective material becomes perfectly clear.

Cement and Cement Concrete as Efficient Preservation.

During the writer's examination of the steel-frame system of building construction in the United States, he enquired into the methods in use for preserving from oxidation the iron and steel employed in buildings. He learned that a covering of high-class Portland cement had proved an excellent preservative for iron and steel employed in the most trying situations. It had been found that the expansion and contraction of the metal, owing to temperature variations, had synchronized with the expansion and contraction of the Portland cement, and that the removal of steel columns and beams after some years of service had shown that the coating of Portland cement had effectively preserved the metal from any appreciable oxidation or rusting effects.

Further demonstration of the preservative qualities of Portland cement is furnished by instances cited by various speakers, in a discussion on the preservation of materials, at a meeting of the American Society of Civil Engineers. The following facts are abstracted from the record of the discussion:

Mr. Rudolph P. Miller stated that, on the demolition of a modern steel skeleton building four years old, in New York City, the floor beams and girders, encased in cinder concrete, were found to be remarkably free from rust. Where there was any, it was in very small patches, more generally on the rivet heads, and it was probably there before the floor arches were placed.

Mr. George Hill, while admitting his interest in a paint business, expressed his conviction that steel which had been properly embedded in concrete remained absolutely unimpaired and perfect in its condition. He mentioned a series of experiments made by him for the representatives of the Melan system of reinforced concrete, in which steel bars were embedded into stone concrete. After exposure to the weather for from sixty to ninety days, wherever the concrete had been in contact with the steel, no rust showed at all. The steel was not painted, and showed bright; but wherever there were voids in the concrete, due to the use of rather dry cement with a stone aggregate, rust had set in.

In the same volume of the proceedings it is recorded that Mr. George W. Dickie, of the Union Iron Works, San Francisco, had used Portland cement for many years, with very satisfactory results, for the protection of iron and steel from corrosion. As an example it was stated, that while recently repairing the iron hull of a ship, Mr Dickie had occasion to remove a portion of the cement floor which had been laid some forty years before, and the iron beneath the cement lining was then found to be absolutely free from rust. The fact that the cement was exposed to the most active kind of corrosion—that caused by sea water—makes this experience a very strong argument in favor of Portland cement as a preservative of steel.

Turning now to experimental testimony, we may refer to the conclusions drawn by Professor Norton from his extensive series of investigations extending from 1901 to 1904. These researches demonstrate conclusively that neat Portland cement, even in thin layers, is an effective preventive of rust, and that cement concrete is equally effective if without voids of cracks and imperfect contact with the metal, but that it is of the utmost importance that the metal should be perfectly clean when bedded in concrete.

The absolute necessity for preventing the presence of voids near the metal was clearly established by Professor Norton, and is also indicated by the experience of Mr. Hill, stated before the American Society of Civil Engineers.

This is a point that should always be borne in mind, and another is that the cement used must be of really good quality. If these precautions are neglected there will certainly be risk of corrosion. On the other hand, if Portland cement grout or concrete of approved quality be properly applied there is not the slightest reason for fearing the corrosion of the iron or steel embedded in or covered by the material.

It is very important that the absolute safeguard offered by Portland cement should be universally recognized, especially in view of the recent injudicious repetition of rumors to the contrary.

The chemical reactions underlying the setting of Portland cement may to some extent explain its preservative influence. Any ordinary moisture present on the metal owing to the application of the cement will be absorbed in the setting process, so that one active element of oxidation will be removed. As the alkaline character of the cement serves to neutralize any acid, another destructive agency is counteracted. Further, as Portland cement is practically impervious to the penetration of air, oxygen cannot gain access to the metal to establish and maintain the process of corrosion.—From "Concrete and Constructional Engineering," London.

THE ART OF HANDLING MEN.

We learn from the "World's Work" that it is the experience of those who have made it a careful study that it is not a wise policy for the executive head of a business to do much, if any, detail work. He may think—and it may be so—that no one else can do the work as well as he, but he should be able to judge whether his subordinates are doing the right kind of work, and their reports to him should show to his trained mind whether the work has been properly performed.

He should see that they give details in their reports so concisely and correctly that they can easily be digested when they reach him.

The executive head should have the salesmen, the bookkeepers, the shipping clerks, and all of the working force, report to the heads of their several departments, and the executive head should require such heads to in turn condense the reports into intelligible statements for him.

The executive head, by being systematic, will soon have a most satisfactory system at work, the success of which will mean his own success.

If the executive of an institution recognizes and encourages the heads of the various departments, they will in turn encourage those under them, and all the machinery of the institution will run smoothly. Encouragement should be given all along the line, and all suggestions, no matter by whom made, should be listened to, for very often good suggestions are made by even the most lowly employees.

Above all other things, however, the chief executive should bring into regular conference heads of departments, officers and factory committees and secure their ideas.

Regular conferences with the various salesmen should also be part of the system.

By so doing the chief executive will have the benefit of the points of view of the men intimately in touch with the work that he is superintending. Even their enquiries and objections may be of value.

Another point in the management of subordinate heads of departments, is to provide everyone with an understudy.

FRIVOLOUS USE OF THE TELEPHONE IN WASHINGTON, D.C.

A quiet investigation has been under way in Washington, D.C., for about two months, from which, according to a newspaper despatch from that city, it has been learned that of the telephone calls by government employees during office hours about 23 per cent. were for the government service and 77 per cent. were personal calls. The newspapers publish the following interesting record for the Treasury Department: Government business, 23 per cent.; dinner engagements, 12 per cent.; theater, 28 per cent.; poker engagements, seven per cent.; bucket-shops, eight per cent.; loan companies, four per cent.; social, twelve per cent.; miscellaneous, six per cent. Fifty-three per cent. of the calls were made by male employees and 47 per cent. by females.

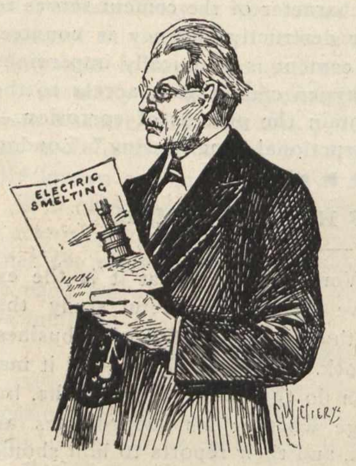
ELECTRIC SMELTING OF MAGNETITE ORES:

SUCCESSFUL EXPERIMENTS AT SAULT STE. MARIE.

An address delivered by Dr. Eugene Haanel, Dominion Superintendent of Mines, before the Canadian Club, Toronto, March 12, 1906.

Incentive to Commerce.

"The iron and steel industries," said Dr. Haanel, "are the foundation of our modern civilization. To realize our dependence upon them, try to imagine what the state of affairs would be if our iron and steel industries were swept away. Transportation by railway and by boat as we have it to-day would cease, the machinery in our factories would be banished, and the comforts and luxuries of our life destroyed. We might better do without gold or silver than this much cheaper metal."



The commercial status of a nation, he continued, depended largely upon the development of the iron and steel industries. Not speaking of England, which was the pioneer in this work, Germany and the United States to a great extent owed their prestige to the development of their iron and steel industries.

The country which required to import its iron ore was handicapped in the race for commercial supremacy. In the fiscal year of 1903 and 1904 Canada had imported pig iron to the value of $43,000,000. Thus was Canada dependent on other nations for a material necessary in every industry.

In Canada, which was the Eldorado attracting a teeming population, the need for iron was increasing to provide tools and agricultural implements for the new settlers, structural material for railways, boats and bridges, and material for the modification of established and the inauguration of industries. To stimulate and encourage production of iron and steel from abundant raw material the Government had given generous bounties and imposed import duties.

The distribution of the raw material in Canada was peculiar, while the necessary coking coals for blast furnaces were found at the extreme east and west. In Ontario, Quebec, Saskatchewan and Alberta, were large ore deposits, but not coal deposits capable of furnishing coke for metallurgical purposes. If these deposits were to be used by processes of production at present in use, coke would have to be brought to blast furnaces erected in the vicinity of the mine, or the ore transported to blast furnaces near the base of the coke supply. The heavy transportation costs made the process uneconomical.

Deeply impressed with the desirability under which the country rested in regard to the upbuilding of a steel industry, on entering his present position, Dr. Haanel set himself to finding some other method or some other source of energy than the combustion of carbon in blast furnaces. Unless a new method could be proven to be practicable, immense ore deposits must remain undeveloped and regions remain waste which might otherwise teem with a vast industrial population.

The Electric Process.

The electric process had been profitably employed in different parts of Europe, especially France. "In the solution of the problem of applying electric energy to the extraction of metals from their ores, Captain Stassano in Italy and Heroult and Keller in France had rendered conspicuous service. It was seen that if by the electric process pig iron could be economically produced, such countries as Brazil, Chili, Sweden, Norway, Finland, and Canada, all rich in iron ore deposits, and possessing extensive water powers, but lacking coal, would be able to render themselves independent of outside sources by employing the electro-thermic process of manufactures of their iron and steel.

"It was with a view of ascertaining the practicability of introducing electric smelting into Canada that the Honorable Clifford Sifton, then Minister of the Interior, appointed a Commmission to investigate this subject, results of which have been laid down in a special report.

"The only experiments which the Commission was able to witness in the electric smelting of iron ores were those made by Dr. Heroult at La Praz, France, and Mr. Keller, of Keller, Leleux and Company, at Livet. The first was a mere trial, the latter more extensive experiments continued for a number of days, but were made in furnaces not designed for the production of pig-iron, but in furnaces which had been constructed for the production of ferro-silicon. The ore used in the Livet experiments had been imported for that purpose from Spain, and was an excellent hæmatite, very porous, free from sulphur, and containing a considerable percentage of manganese, consequently an ore easily treated in regard to sulphur, and also easily reduced.

"The output of pig-iron per 1,000 electric horse-power days was for one set of experiments equal to 5.76 tons, for second set of experiments it was equal to 12.12 tons, but the iron made in this last experiment was mainly white iron. Mr. Harbord, the metallurgist of the Commission, adopted as the probable output 1,000 electric horse-power days the mean of the two experiments, namely; 7.82 tons.

"Not alone was this discrepancy between the two experiments very satisfactory regarding the absorption of electric energy required per ton of pig produced, but a number of points requiring determination for our Canadian ores, such as the successful smelting of magnetite, the utilization of iron ore of high sulphur content, and the substitution of charcoal for coke required to be demonstrated.

"As a matter of fact, an experiment was made at Livet with the substitution of charcoal for coke, which proved an absolute failure, and it was assumed by Mr. Harbord and Mr. Keller that charcoal could be used only if it was first briquetted with the ore, and the briquette broken up the size of one inch cubes.

"Regarding the electric smelting or iron ores of high sulphur content, Mr. Harbord states that the experiments cannot be said to have demonstrated that low sulphur pig-iron can be obtained without manganese in the ore mixture, and before this can be considered experimentally proved, it will be necessary to have a series of experiments made with non-manganiferous ores.

"For the successful introduction of electric smelting of Canadian ores the following points which could not be settled by the European experiments require demonstration:

Could magnetite, which is our chief ore, and which to some extent is a conductor of electricity, be successfully smelted?

Could iron ores with considerable sulphur contents be made into pig iron of marketable composition?

Could charcoal, which can be made from mill refuse, and other available sources of wood useless for other purposes, be substituted for coke, which must be imported?

And, lastly, what was the exact amount of electric energy required per ton of pig iron produced?

"With a view of ascertaining these important facts experimentally, I prepared a memorandum to the Honorable Mr. Oliver, Minister of the Interior, recommending an appropriation for the investigation of the whole subject.

"It was fortunate that Dr. Heroult, of La Praz, who had been the first to experiment on the subject of electric smelting of iron ores, happened at that time to be on a visit in Ottawa. He signified his consent, if the appropriation were made, to undertake the designing of a furnace of about 250 horse-power capacity, and the investigation of the factors entering into the economic production of pig-iron from Canadian iron ores by the electro-thermic process.

"The Lake Superior Power Company, of Sault Ste. Marie offered a building in which to erect the plant, and the use of one of their alternators of 300 electric horse-power capacity, free of expense for four months. It was decided to accept this offer, and the plant was ordered to be erected in the building provided for this purpose.

"The necessary transformer to transform the current down from 2,200 volts, to about 400, such as was required for our experiments, and the necessary measuring instruments to determine the power consumed were ordered from the Westinghouse Company, and electrodes six feet long and sixteen inches square section were ordered from Sweden. The construction of bins, overhead work of the furnace, construction and erection of furnace and experimentation to adjust the capacity of the crucible of the furnace to the power available consumed the greater part of the fall and winter.

Tried at the Soo.

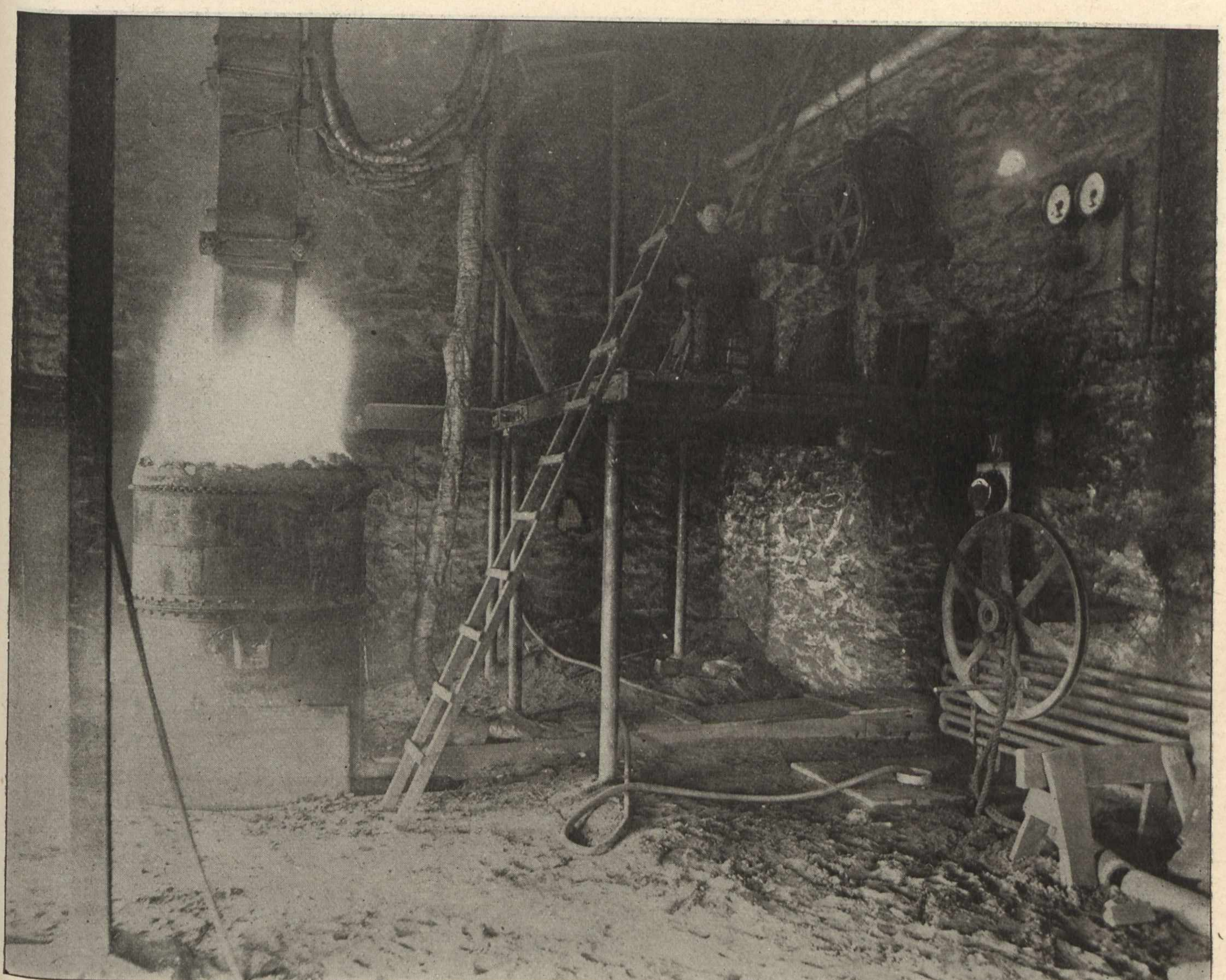
The experimentation on Canadian ores began in earnest the middle of February, the furnace being in operation night and day, with some intermissions, until March 5th. During that time about 150 casts were made, yielding about 55 tons of pig iron. For the first experiments the ores employed were hæmatite, such as used by the Algoma Steel Company in their blast furnaces; for the remainder of the experiments different classes of Canadian magnetite from the different sources of supply, all of high sulphur content, with the exception of the Wilbur magnetite, which was low in sulphur, were employed.

"From theoretical grounds, much difficulty was expected to be encountered in the smelting of magnetite. This can be best understood by describing to you the construction of the furnace which, you will perceive, is exceedingly simple."

The Furnace Described.

Dr. Haanel used a glass to describe the furnace, explaining that the walls are lined with fire brick; the bottom with carbon; and that just above this carbon lining is the tapping hole, whilst higher up is another hole for floating off the slag. In this crucible the ore is placed, and a suspended carbon electrode 6 ft. long x 16 in. square, (imported from Sweden), is inserted therein. An electric current is passed through the electrode into the ore. Now, whenever the electric current meets with resistance, it is changed into heat. In this case the electric current sent through the electrode is stopped by the ore in the crucible, and the heat generated from this resistance reduces the ore from a mineral condition into a metallic state. Charcoal is the reducing material, and the iron is melted to the bottom of the crucible, when it is tapped out and run into pig-iron moulds, as in blast furnace practice.

"The regulation temperature is maintained by a man who looks after the instrument and moves the electrode, but this is only in the experimental stage. When it is put to commercial utility this regulation will be automatic."



Electric Furnace, showing Method of Regulating Electrode and Measuring Instruments in Place.

Charcoal Displaces Coke.

Even the first experiments with magnetite showed that our fears had been groundless and that magnetite could be smelted with as much facility as hæmatite, and with an output equal to that of the best experiment made with hæmatite.

"Moreover, since it was important to substitute, if possible, charcoal, which can be cheaply produced in Canada, for coke—which is costly and must be imported—the charges were made with charcoal. No difficulty was experienced, the furnace working quietly and regularly, requiring little attention or regulation of the electrodes.

"Analysis of the iron produced, soon proved that although the slag was not particularly basic, the sulphur could be caused to pass into the slag, resulting in a pig iron containing a few thousandths of one per cent. of sulphur.

"In every instance the output was far greater, in several instances one-third greater, than the figures adopted by Mr. Harbord, in the report of the Commission on Electric Smelting."

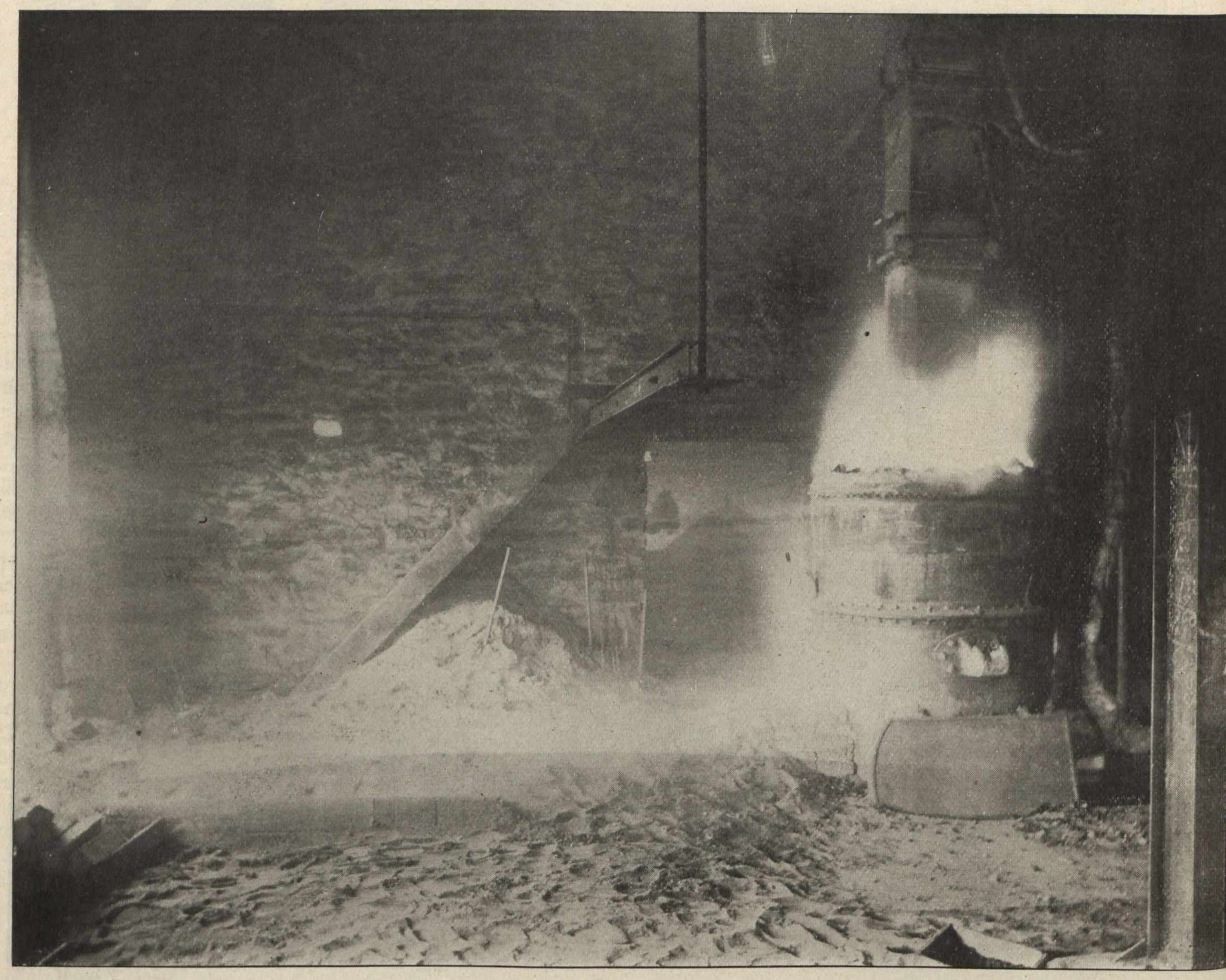
Experiments with roasted and briquetted nickeliferous pyrrhotite, containing 1.6 per cent. of sulphur, were equally successful, furnishing a ferro-nickel iron pig, containing 4½ per cent. of nickel, and about 0.006 sulphur. The estimated value of this product was $40 to $44 a ton. So successful have these experiments proven that the Lake Superior Power Corporation have decided to acquire the Government plant for the purpose of converting their stock of briquetted ore into marketable ferro-nickel pig.

Electrode Waste Insignificant.

"One of the most important points in the investigation which could not be successfully settled by the experiments at Livet was the consumption of the electrodes, and it was found that the consumption was beyond expectation low, and that an electrode which had been in use for three weeks, and during that time had been exposed to free air in an incandescent state for many hours, and had been used for melting down charges, which is always attended by waste of electrode without corresponding output in metal, that even with this severe test, the consumption per ton of pig iron produced was only 15 to 20 pounds." According to Dr. Heroult's estimates, this means an electrode outlay of 30 cents per ton of pig iron, instead of 77 cents as heretofore. One pound costs 1½ cents.

Poor Ores Made Valuable.

"Many of our magnetites are too high in sulphur to be handled by the blast furnaces, and consequently have so far been of no commercial value. But the very best of pig iron, as has been proven, can be made from ores which contain as high as one per cent. of sulphur. A blast furnace will not usually handle an ore which contains one-tenth of one per cent. of sulphur and requires therefore an ore which can be got at a low sulphur figure. The Algoma Steel Works pay, I understand, $4.50 for the hæmatite ore which they use in their blast furnaces. A pig iron equal in value, and lower in sulphur contents, can be made by the electric process from sulphur ores, which can be bought for $1.25.



Showing Electric Furnace just after Metal has been Tapped.

Ore Lands and Water Power Contiguous.

"Regarding water power required for the application of this process, it may be stated that many water powers exist in Ontario surrounded by iron ore fields in localities ill-adapted for the application of electric energy for any other purpose, and could be developed to furnish an electric horse power a year from $4.50 to $6.

"With such a price for the energy required, the small consumption of electrode, the cheapness of ore employed, and the peculiar excellence of the pig iron produced, electric smelting of iron ores in Canada, using charcoal or peat coke, made from our peat bogs of enormous extent, may be pronounced a commercial success. Under the prevailing conditions in Canada it now only remains for the engineer to design a plant on a commercial scale, say of 100 to 150 tons daily output, with all the necessary labor-saving appliances. Just as in the case of the blast furnaces, so likewise with the electric furnace, experience gained will result in further economy, and the day may not be far distant when the carbon monoxide, which is of high calorific value, and which at present, as a product of the reaction taking place in the electric furnace, is allowed to escape without utilization, will be employed for increasing the output by at least a third or half. If that should take place the blast furnace could not compete with the electric furnace even under the conditions where coke might be cheaper than at present quoted in Ontario and Quebec.

Electric Furnace Inexpensive.

"A further advantage of the electric process is that the units employed are comparatively small and cheap of construction. A unit of 1,500 h.p. is perhaps the largest that under present circumstances should be constructed. Such a unit would have an output of 18 tons per day and corresponds in size to about the larger Swedish charcoal blast furnace. With the present advance, which has been made in the transference of electric energy, batteries of electric furnaces could be set up at various iron ore deposits which could be fed with electric energy from some centrally located water power, thus affecting a saving of the transportation costs of the ore from the mine to the furnace.

"When a deposit is worked out the furnaces may be moved to the next deposit, simply lengthening the wires which carry the high tension current to the transformer or the plant."

This method is especially applicable in the case of the many pocketty deposits of magnetite which occur in the Ottawa Valley.

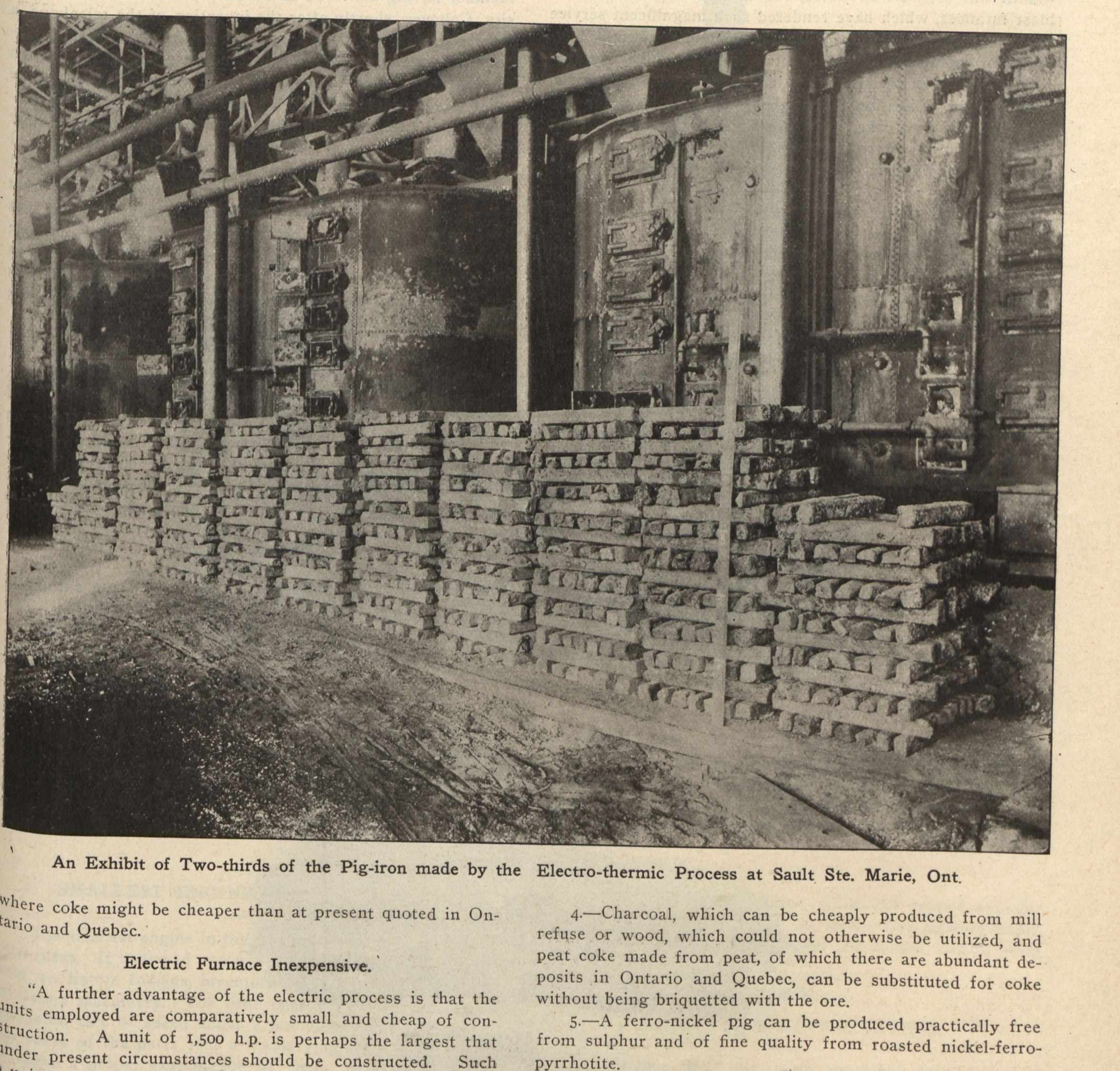
Successful Results of Experiments.

"The following is a summary of the results of the experiments which have been completed under Government auspices at Sault Ste. Marie:

1.—Canadian ores chiefly magnetite can be economically smelted by the electro-thermic process.

2.—Ores of high sulphur content can be made into pig iron containing only a few thousandths of sulphur.

3.—The silicon content can be varied as required for the class of pig to be produced.



An Exhibit of Two-thirds of the Pig-iron made by the Electro-thermic Process at Sault Ste. Marie, Ont.

4.—Charcoal, which can be cheaply produced from mill refuse or wood, which could not otherwise be utilized, and peat coke made from peat, of which there are abundant deposits in Ontario and Quebec, can be substituted for coke without being briquetted with the ore.

5.—A ferro-nickel pig can be produced practically free from sulphur and of fine quality from roasted nickel-ferro-pyrrhotite.

6.—Pyrite cinders, resulting from the roasting of pyrite in the manufacture of sulphuric acid, and which at present constitute a waste product, can be smelted into pig iron by the electric process.

7.—Titaniferous iron ores containing up to 5 per cent. can be successfully treated by the electro-thermic process.

"The last conclusion is based upon an experiment made with an ore containing 35 per cent. of titanic acid, yielding a pig-iron of passable quality, judging from its fracture.

What It Means to Canada.

"The result of the introduction of electric smelting into Canada may be summarized as follows:

(1) The utilization of our extensive water powers, which cannot at present be profitably employed for any other purpose.

(2) The utilization of the large number of iron ore deposits which, on account of their high sulphur content, cannot be treated by a blast furnace, and have so far been valueless. A consideration of extreme importance, for already the question has arisen, how long the present supply of blast furnace iron ore is likely to last, and ores are now accepted by furnace men with a metallic content such as would not have been looked at a few years ago, and when these ores are exhausted and none but sulphurous ores or titaniferous ores are available, the stacks of the numerous blast furances, which have rendered such magnificent service to our present civilization, will be silent and smokeless, having been supplanted by the electric furnace which can successfully treat an ore which the blast furnace cannot handle.

(3) The utilization of our extensive peat bogs for the production of peat coke, to be used as reducing material for the operation of electric furnaces, and the utilization of mill refuse and sawdust, for which there has been so far no practical use.

(4) Rendering it unnecessary for Canada to import fuel for metallurgical processes.

(5) Enabling Canada to produce her own pig-iron from her abundant resources for home consumption, and consequently retaining in her own country the money which otherwise would have to be sent abroad to purchase pig iron in the crude and manufactured state.

(6) The development of steel plants and rolling mills using only electric energy.

The Best Crucible Steel.

"It is only a year since the Report of the Commission appointed to investigate the different electrothermic processes for the smelting of iron ores and the making of steel, in operation in Europe, was sent out to the public, but already a steel plant adopting Heroult's system has been erected in Syracuse, N.Y., and will be in operation in about two weeks; another using the Kjellin system has been erected in Sheffield, England, and I have been notified that two of the Kjellin system, and one Heroult have been erected in Germany. These furnaces are designed to make the best crucible steel, and their introduction means the abandonment of the old crucible process. I see no difficulty in the way of constructing electric furnaces of a capacity equal to that of our open hearth furnaces, and the production of structural steel by the electric process is likely to become an accomplished fact in the near future.

Realization Beyond Expectation.

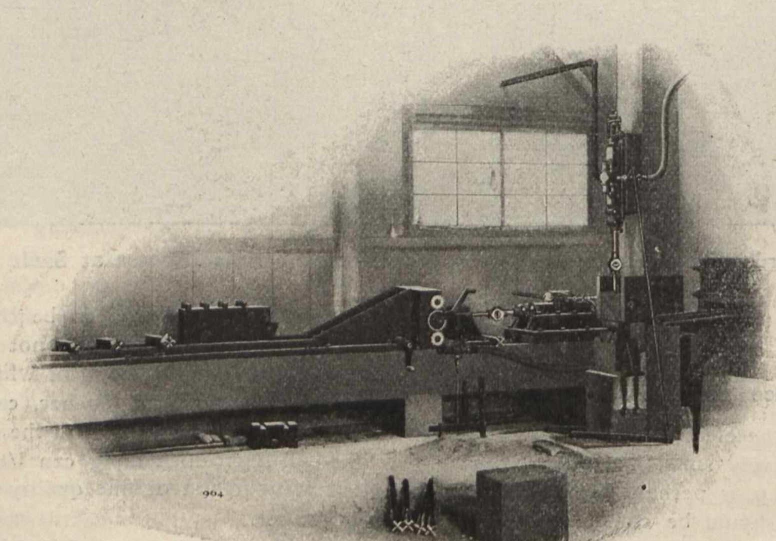
"I need not picture to you the future which opens a vista of commercial success for Canada by the inauguration of the new metallurgy of iron and steel, on account of the magnificent asset of her abundant supply of water-power. I remember having delivered in Faraday Hall, Victoria University, Cobourg, shortly after the invention of the telephone, a lecture in which I tried to picture the results of the discoveries which had been made in the practical application of that wonderful agency we term electricity, and while what I said, seemed greatly to interest the audience, the outcome of the lecture was the pronouncement that certainly the lecturer possessed a brilliant imagination. But when I look back at what I said, how feebly and inadequately did I describe what might take place, and the twenty years that have elapsed, have shown a progress such as I could not have imagined, so much greater has been the final outcome than the feeble prophecy ventured by me to the audience on the occasion named. But in the matter of electric smelting we do not draw upon the imagination, but present to you hard facts and well established figures.

Appeal to Capital.

"To reap the benefits of the experiments made at Sault Ste. Marie means intelligent enterprise in the expenditure of capital. The Government has furnished you with facts on which to base a sound judgment as to the feasibility of commercially engaging in the manufacture of pig-iron by the electric process; with that its duty to the nation is done, it remains with you business men to apply, perfect and profit."

AJAX DRILL SHARPENER.

In contract work, mining and quarrying, where rock drills are employed, means for sharpening steel bits that have become dulled must be introduced. In cases where but few drills are required the usual forge, blacksmith and helper, supplied with dollies and swadges, are about the only equipment necessary. In larger undertakings, however, where a number of rock drills are used, the automatic Ajax drill steel sharpener will be found invaluable. The Ajax is an apparatus for forging drill steel bits by power instead of by hand. Its operation is such that the bits are formed in the same manner as when hand forged, but the cost of the work is considerably reduced, and the output of the blacksmith shop materially increased. The capacity of the Ajax is about 1,200 drills in twenty-four hours, and



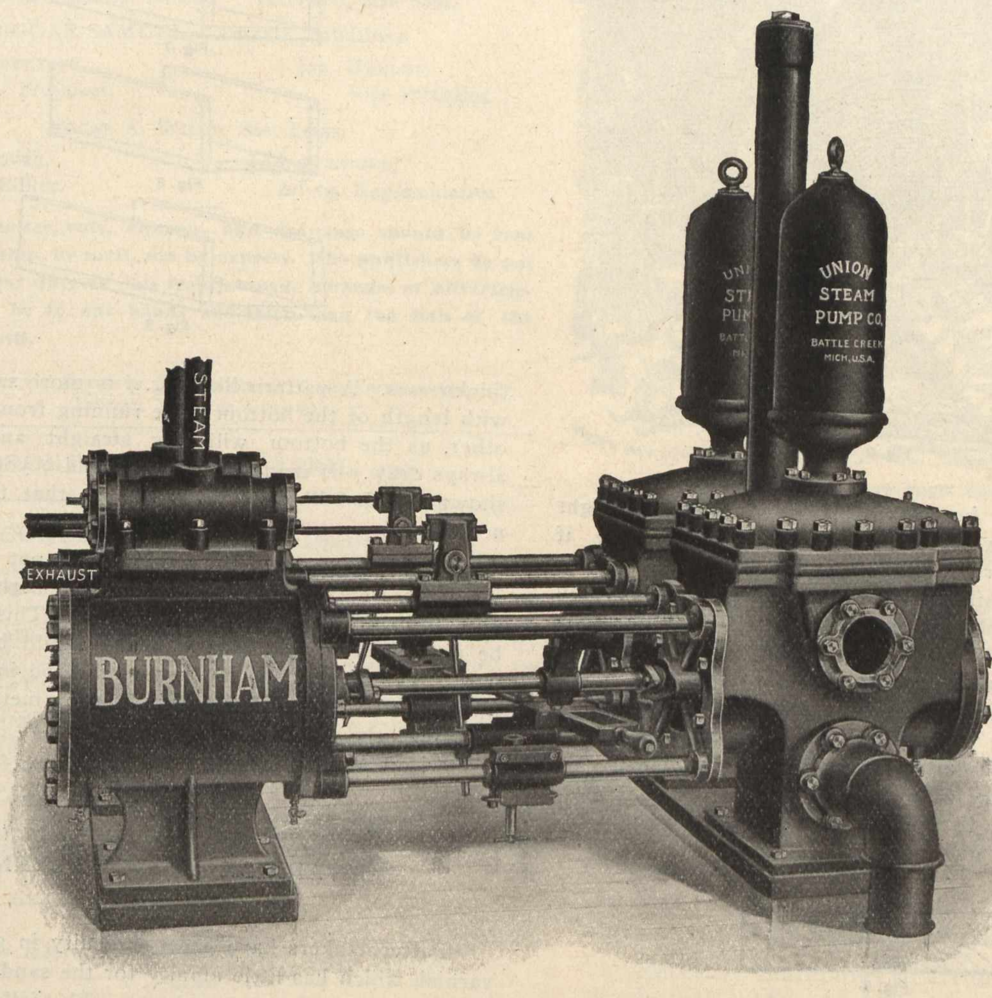
Ajax Drill Sharpener.

the time required for shaping each bit ranges from thirty seconds to one minute. A special die is provided for each size to be forged. Bits sharpened in this way are more regular and better than when hand-forged.

At the United Verde and Homestake Mines one Ajax outfit now does in each case the work formerly requiring twelve men, and the air necessary to sharpen 500 drills in ten hours is about one-fifth as much as that needed to run one three-inch drill. The Ajax sharpener includes a vertical hammer, consisting of a modified air-drill, with anvil, dies and suitable support and guides, which side-set and forge the wings, and a similar hammer set horizontally and provided with a second set of anvil and dies and a clamp, which does the dolly work and forges up the face of the bit. The general arrangement of the apparatus is shown by the accompanying illustration.

THE BURNHAM STEAM PUMP.

Through the courtesy of Messrs. Darling Brothers, Montreal, we are enabled to place before our readers something entirely new in the pump line. A brief description will give some idea of their advantages. The pumps are single cylinder, double acting, and are so arranged that they will operate together, or independently. The valve motions on both pumps are connected by a centering bar, and so arranged that when one pump is at the end of the stroke, the other one is only at the centre. The link motion used in connecting the valve motion is very simple in construction, and no difficulty is encountered in cutting out either pump, when in operation. Two Burnham pumps connected in this way have all the advantages of a duplex steam pump, and the fact that they can be run as independent pumps is a feature that will be appreciated by engineers. In a test made with two of these pumps connected as shown, and fitted with 5-inch discharge pipe, reduced so as to carry five pounds pressure, the pulsations were hardly perceptible.



SMALLEST ENGINE IN THE WORLD.

The smallest engine in the world rests entirely on a five-cent piece. It is owned and was made by John H. Cunningham, an Eaton, Indiana, inventor, who has a fad for making miniature machinery. The little engine operates at a remarkable rate of speed under a pound of steam. So small are some of the parts that a magnifying-glass is necessary to make a proper examination of them. The screws that hold the parts together are made from needles, the threads being so fine as to defy the naked eye. The screws are a fraction of a milliometer in diameter. The fly-wheel measures three-eighths of an inch in diameter. It was turned from steel by Cunningham, who says it is the largest wheel that the engine will turn. The engine has one-sixteenth of an inch stroke; the cylinder head measures one-eighth of an inch in diameter, while the capped cylinder head measures one-quarter of an inch. The striking boxes are packed with lint scraped from silk thread, cotton being too coarse for the purpose.

HAND V. MACHINE RIVETING.

In riveting with pneumatic hammers, two men and one heater average 500 rivets in 10 hours, whereas by hand 250 rivets is a good day's work for three men and one heater. The cost per rivet, according to the "Engineering and Mining Journal," was 1.62 cents by pneumatic hammer and 3.68 cents by hand. On 93,480 rivets in a shipyard in Chicago the machine cost was 1 cent to 2.5 cents; the hand cost 2.5 cents to 4.5 cents.

THE GRAIN OF LUMBER IN PATTERNS

BY J. L. GARD.

One thing that few pattern-makers seem to understand about lumber, and one of much importance, is how the grain of the wood can be placed to make the patterns most serviceable. When quarter-sawed lumber is spoken of, it is generally supposed to apply to oak, or other hard woods, and is understood as meaning a method only of showing the markings on the face of the board.

But there are quarter-sawed boards in pine more than any other kind of lumber. A quarter-sawed board is one that is cut from the log radially, as in Fig. 1. To cut all boards quarter-sawed would waste too much of the log, which is the reason that only a few boards from each log are sawed radially.

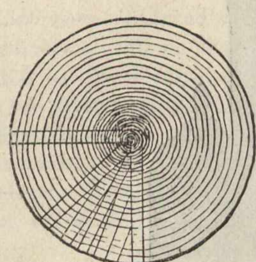


Fig. 1

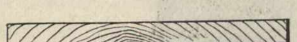


Fig. 2

A quarter-sawed board will stay practically straight during many changes of temperature or humidity. So if you have a thin pattern to make that has no ribs to hold it straight, select, if possible, a quarter-sawed piece, which can be easily done by looking at the grain on the end. You may waste a little stock to get such a piece, but just consider the convenience of having the pattern stay the way it was made. I remember an instance of making new patterns to replace some that were badly warped. Cleats were ordered put on the new patterns to be afterwards stopped off. I sent the patterns to the foundry without cleats, with word that when they became crooked to send them back and I would put the cleats on. But I never saw them again.

Fig. 3

Fig. 4

Fig. 5

Fig. 6

A board like Fig. 2 will not stay straight long. This reminds me of the boy who tried to plane such a piece straight; the more he planed the worse it got, until it began to look as if there would be no board left. The boss told him he didn't plane fast enough to keep ahead of the warping.

When gluing two thicknesses together, it is better to place them so that the grain will lie as in Fig. 3, because the warp of one piece will counteract that of the other, and the joint will not open as readily on the edges as if placed like Fig. 4 or 5.

If you glue one piece across another you will get the effect of Fig. 6, unless the glue lets go or one piece splits in shrinking. The pull on board A in shrinking is often powerful enough to bend board B in its length. Cross grain is only effective with absolutely dry material of four or more

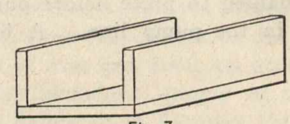


Fig. 7

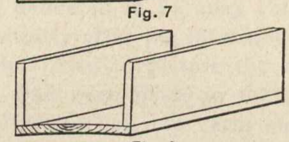


Fig. 8

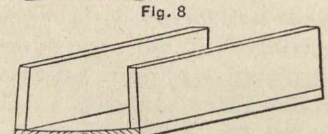


Fig. 9

thicknesses. A pattern like Fig. 7 is more serviceable made with length of the bottom piece running from one rib to the other, as the bottom will stay straight and the side will always draw. If made like Figs. 8 and 9 you get the effect shown which will distort the ribs so that the pattern will not draw.

When the grain of the wood can be put in to run in the same direction as the line of draft, a slight warping will not affect the drawing of the pattern. This cannot always be done, because patterns so made would be weak in vital parts. Distribution of the grain of wood in patterns is as much a study as the distribution of metal, both equally affecting the utility of their respective constructions.—"American Machinist."

VARNISH FOR PATTERNS.

Patternmakers have great difficulty in getting a pattern varnish which has little affinity for the sand, can be smoothed finely, and will resist moisture. The following is a recipe used in the pattern shops of several of the largest engineering works in Europe and America:—

Vermillion. (Fifteen cents per pound.)
Best orange shellac.
Pure alcohol.

Mix the varnish and vermillion together to the consistency of paint, thin down with alcohol to work free; when perfectly dry rub down with very thin sand-paper before sending to foundry.

PATTERNMAKERS' GLUE.

1 pound glue,
1 pint to 1 quart water, as glue requires,
¼ pint wood alcohol,
¼ pound dry white lead, well pulverized,
½ ounce precipitated chalk.

Preparation of above:—Place glue in water until same is dissolved, add alcohol, heat 2 or 3 minutes, then add chalk + lead (mixed together), stir well, and use hot.

The Canadian Engineer.

ESTABLISHED 1893.

With which is Incorporated

THE CANADIAN MACHINE SHOP

ISSUED MONTHLY IN THE INTERESTS OF THE

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.

SUBSCRIPTION—Canada, Great Britain and the United States, $1.00 per year foreign, 7s., paid in advance. Advertising rates on application.

OFFICES—62 Church St., Toronto. TELEPHONE, Main 1392.

BIGGAR-SAMUEL, LIMITED Publishers.

THOS. ROBERTSON, President. JAS. HEDLEY, Vice-President.

EDGAR A. WILLS, Sec.-Treas.

SAMUEL GROVES, Editor. J. J. SALMOND, Advtg. Representative

Editorial matter, cuts, electros, and drawings should be sent whenever possible, by mail, not by express. The publishers do not undertake to pay duty on cuts from abroad. Changes of advertisements should be in our hands not later than the 10th of the preceding month.

PRINTED AT THE OFFICE OF THE MONETARY TIMES PRINTING CO., LIMITED, TORONTO, CANADA.

TORONTO, CANADA, APRIL, 1906.

CONTENTS OF THIS ISSUE.

Aikenhead Hardware Company....... 124
Automobile, A Baby..................... 130
Announcements.......................... 147
Book Reviews 149
Canada on the World's Highway.... 121
Cayuga, Launch of..................... 125
Combustion in Boiler Furnaces....... 127
Concrete for Engine Foundations.... 134
Combination Tool....................... 136
Canadian Mining Institute.............. 150
Catalogues............................... 149
Drill Sharpener, Ajax 144
European Hydro Electric Development.......................... 116
Electric Smelting of Magnetite Ores 140
Editorial Notes.......................... 148
Electrical Prediction Reviewed........ 147
Gas Engines, Notes on the design of Large.............................. 122
Green's Air Heater and Economizer. 128
Gasket, A New.......................... 129
Grain of Lumber in Patterns, The.. 146
Haanel, Dr. Eugene.................... 115
Locomotive for James Bay Railway. 119
Milling Machine, A Plain 128
Machine Shop Notes from the States................................. 130
Notes..................................... 156
Patent Record............................ 154
Perpetual Motion 126
Preservation of Iron and Steel, The 138
Smoke Jacks 130
Sturtevant High Pressure Blower... 131
Steam Pump, The Burnham........... 145
Trench Excavator, Portable........... 137
Thawing by Electricity................. 137

ANNOUNCEMENTS, ETC.

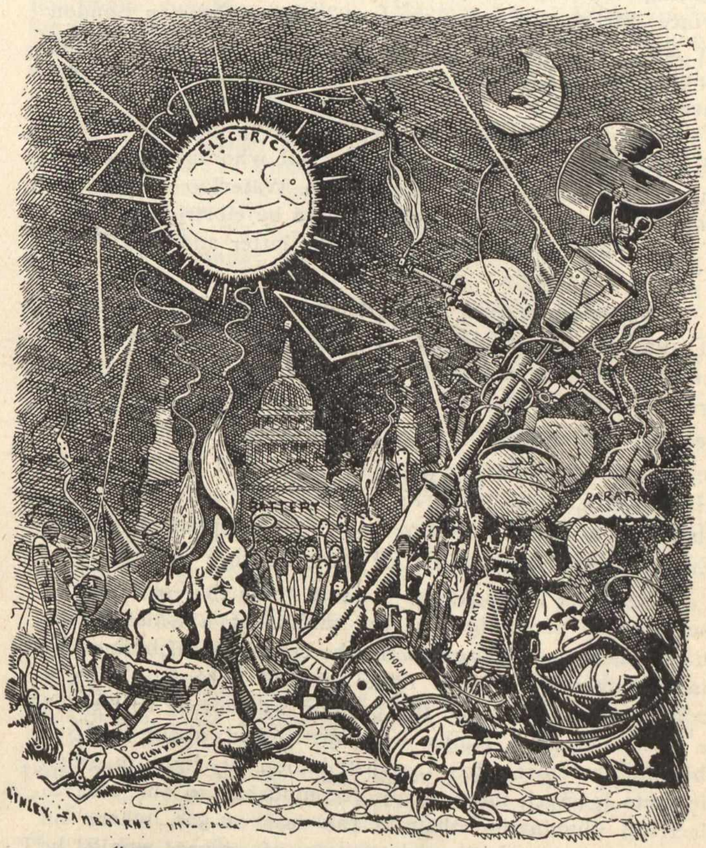
In our last issue we omitted to state that the fine picture of the Clydesdale was used by courtesy of our esteemed contemporary, "The Canadian Thresherman," of Winnipeg.

Although this issue contains eight extra pages, we have been constrained to omit the popular serial articles on "Descriptive Metallurgy of Iron and Steel" and "System in Industrial Establishments." These will, however, appear in our May number, together with a finely illustrated description of the Montreal Pipe Foundry at Three Rivers, Que.

In view of the new era in metallurgy inaugurated by the recent triumph in electric smelting at Sault Ste. Marie, and the necessity of every young engineer in this country being equipped to "fill the bill," when new electro-thermic plants spring up near our waterfalls everywhere, we have arranged with Dr. Alfred Stansfield, Professor of Metallurgy at McGill University, to write a series of copyright articles on **"The Electric Furnace: Its Principles and Practice."**

The second article on "European Hydro-Electric Development," from the pen of Charles H. Mitchell, C. E., and entitled "French Plants in the Vicinity of Grenoble," will appear in May. No Canadian civil or electrical engineer can afford to miss this series.

ELECTRICAL PREDICTION REVIVED.



"COMING EVENTS CAST THEIR SHADOWS BEFORE."

Nearly twenty-eight years have passed since Mr. Linley Sanbourne in "Punch," expressed in pen and ink his famous prediction of the coming triumph of electricity as the future illuminant of our streets and homes. The electric globe like a full orbed sun is shown dominating a ludicrous scene. Striding along on lightning feet, he prostrates, by his electric flashes, gas posts, lamps, and candles, even outshines the moon. The bull's-eye lantern of the burglar is shown on its knees pleading to be spared; while even the glow-worm (which gives what Thurston says will be the light of the future: illumination without heat), is represented as badly discomfited.

Recently champions of artificial gas, like the "Gas World," have been jubilant over the interesting fact that London has removed the electric arc lamps from certain of her leading thoroughfares, such as Queen Victoria Street; Fleet Street, etc., and substituted gas lamps in place thereof. The impression conveyed around the world to the uninitiated is, that electricity has been weighed in the balance and found wanting; hence the return to gas. Here is what Mr. Alpheus C. Morton, Chairman of the Street Committee of the City of London Court of Common Council has to say about it. In a recent interview he said:—

> You must not think that I have any hostility to electricity—far from it. Our only object has been to get the streets well lighted at the lowest cost, irrespective of whether electricity or gas was the illuminating agent.
>
> Instead of our being biased in favor of gas, as some people suggest, quite the contrary is the case. We have had our difficulties with the gas company, and if other things had been equal you may be sure we should not have gone in for gas. The electrical interest is not without its friends on the council, who may be trusted to see that the electric light is treated on its merits.
>
> And the merits of the gas have been found to be greater? *

That is at present very emphatically our opinion. For one thing, the price we have been paying for arc lamps is very high. In Edinburgh, where some of us inspected the lighting the other day, they had got better lighting in Princes Street at £9 10s. per lamp than we have in London for £26. I think the Edinburgh people will probably be sending up to London one of these days to see what we have done here.

Three or four years ago we lighted up our city bridges with gas under pressure; and let any one who has any doubts on the subject compare them with Waterloo and Westminster bridges, which are still lighted by electricity. There is simply no comparison between the latter and Blackfriars bridge, for example.

. Our readers will thus perceive, that in the matter of quality and efficiency, the return to gas lamps on London streets is simply turning back the clock, as a protest against the avarice and money-grabbing propensity of monopolist industrial corporations. With regard to the relative merits of gas and electricity as illuminants, some remarks made recently by Mr. S. M. Hills, in a lecture before the Northampton Institute Engineering Society, are of considerable interest.

The ideal illumination, he said, was that obtained by the diffusion of sunlight at the surface of a white cloud, and the nearest approach to this he considers is obtained by distributing a number of lights around a room. Thus, a room illuminated by one 16-c.p. lamp will not be so well lit as if sixteen 1-c.p. lamps were distributed about it. It is obvious, therefore, that the distribution of light in small elements is much more easily accomplished in the case of electrical illumination than in the case of gas, where an expensive and complicated system of pipes would be requisite. In drawing comparisons between the spectra of the sun, gas, and electric light, Mr. Hills was able to show that the latter possessed greater penetrative power, and was more like that of sunlight than was gas. Hence, in the state of the atmosphere when it is overcharged with water vapor, electricity, especially that supplied to flame arcs, far surpasses any arrangement of gas burners, or even an immense gas torch.

In considering the broad question of illumination, *intensity* is not of such vital importance as *quality*. As "The Times" points out, "human vision has been developed under sunlight, to which incandescent gas bears very faint resemblance." No wonder the optics of our race have suffered under the regime of artificial gas, and that spectacles have become an almost universal necessity—even for the young. The electric light, such as the Nernst lamp, is a near approximation to sunlight—the correlate of the human eye; hence its use will be more in accord with the laws of nature. If, therefore, electricity can be so cheapened as to lead to its general introduction for lighting purposes, the material comfort and physical development of the human race will manifestly be augmented.

*[Reliable data has just come to our desk indicating that in recent tests of the new incandescent gas lamps in Fleet Street, these were found to average 135 c. p. instead of 200 c. p. claimed; and in the similar case of Kingsway, the gas lamps nominally estimated at 1,000 c. p. averaged only 515 c. p.]

Editorial Notes

Phosphorus Still Unmastered.

Hitherto, the bane of the steel-maker has been *phosphorus;* while the blast furnaceman's devil has been *sulphur.* The iron ores of Canada are largely magnetic; and the oxides in these ores are invariably associated with sulphur. Hence, the importance to this country of the "Soo" experiments; which have proved that sulphur can be perfectly eliminated by the electric furnace smelting process. If, however, our iron ores were mostly phosphoric, we should still be in a bad way; for even the electric furnace—with its 1,000° higher temperature than the blast-furnace—can not *chemically* eliminate the phosphorus. But like the poor, the "Basic Process," we always have with us; by means of dolomite lining and lime additions we can *mechanically*, take out practically all the phosphorus, so that anxiety there need not be about our limited resources of phosphoric ores. Besides, phosphorus is a preventive of oxidation; and since cast-iron impervious to rust is an ideal metal for water pipes; and immense quantities of these will be required for supplying *aqua pura* to Canada's rising towns and cities—in "the good time coming," there will be no difficulty in utilizing even the ores in which the phosphoric contents are high.

Logic From the Laboratory.

At the Quebec meeting of the Canadian Mining Institute, a paper entitled, "Some laboratory experiments in making steel directly from iron ores with the Electric Furnace," was read by J. W. Evans, in which the facts were both curious and interesting; but the deductions made from the thimblefuls of iron produced, would have enabled John Stuart Mill to add another pertinent example to the chapter in his "Logic," on "Fallacies of Generalization." With one eye fixed admiringly on the buttons of metal made in his miniature furnace, the essayist read this:—

In the writers opinion it is doubtful if pig-iron can be made in Canada by the electric furnace cheaply enough to compete with the blast furnace at the present time, but the finer grades of steel undoubtedly can be made profitably when smelted directly from the ores.

In the paper itself, there is not the slightest scientific evidence to warrant either of these gratuitous conclusions.

In very marked contract to the above *ex-cathedra* deliverance, is the following passage, taken from Dr. Alfred Stansfield's paper, read at the same meeting:—

Working on a small scale, it is usually impossible in furnace work to imitate both the arrangements and the results of large scale operations. One may build and operate a model furnace, but it will not usually give normal results. To obtain good conditions, it is usually necessary to depart widely from the adopted type of furnace—such changes being due mainly to the very much greater loss of heat that occurs on the small scale.

Again we are constrained to quote the wise aphorism of J. E. Stead,—himself one of the greatest metallurgists living,—"The result of careful experiment is the voice of Nature speaking truth, the interpretation of it is the work of fallible humanity."

Quebec Bridge Controversy.

The trenchant critique of the Quebec Bridge, in our March number, from the pen of Mr. Alfred J. Roewade, has evidently stirred Montreal to its foundations, and even evoked a discussion in the Dominion Parliament. In another column appears Mr. Roewade's rejoinder to his critics, and on the face of it, he does not appear to have the worst of the argument. His opponent's suggestion about mechanical devices for lowering masts and smoke stacks, is not particularly convincing. We conceived it a public duty, to allow Mr. Roewade's article to appear in our columns, and so far, can see no cause to regret our action.

Book Reviews

Machinery and Tools, 1906.—By Brown & Sharpe Mfg. Co., Providence, Rhode Island, U.S.A. Size, 6 x 4, pp. 514. (Free to buyers everywhere.)

Every machinist, worthy of the name, in the world knows that "Brown & Sharpe" is synonymous with the finest bench and measuring tools in the trade. Established in 1833 on a small scale, their works now cover 14½ acres. At the St. Louis World's Fair, 1904, they were awarded the Grand Prize for exhibit of machinists' tools and measuring tools. Among our readers are many intelligent mechanics, and the number is daily increasing. To such we would say, send for this new edition of the B. & S. Co.'s well-known handbook straightway. It contains many tables useful in shop practice and illustrated descriptions of their latest tools and machinery.

The Arithmetic of Electrical Measurements. By W. R. P. Hobbs, R.N., Head Master of Naval Torpedo School, Portsmouth. 12th edition. London: Thomas Murby & Co., 6, Bouverie Street, E. C. Size 7¼ x 4¾, 126 pp. (Price one shilling.)

The fact that this text-book has reached its 12th edition is proof that it has filled a large gap in the literature of electrical engineering. It originated in this way. The author read the following statement in Professor Fleming Jenkin's preface to his work on "Electricity and Magnetism:" "The difference between the electricity of the schools and the testing office has been mainly brought about by the absolute necessity in practice for definite measurement." The lecturer is content to say, under such and such circumstances a current flows or a resistance is increased. **The practical electrician must know how much current and how much resistance, or he knows nothing.** It was with a view, therefore, of guiding the student of electrical science to the best methods of translating theory into practice; especially in the way of making accurate arithmetical calculations that this excellent book was written. The chapter showing the applications of Ohm's law—the foundation of all electrical measurements—is simple in statement, logical in arrangement, and practical almost to a fault, in the number of problems solved, and examples for working given. While section X. on the "Best Arrangement of Cells" is exceedingly useful In fact, as an elementary treatise on electrical engineering calculations, the work before us is in a class by itself; and we are not surprised to find that it is used universally in the British Government Dockyard Schools, and has been adopted by the leading technical institutions of Great Britain.

The World-Wide Atlas of Modern Geography: Political and Physical.—By J. Scott Keltie, LL.D, etc., Secretary Royal Geographical Society. Seventh edition. 1906. Edinburgh and London: W. & A. K. Johnston, Limited. Size, 12½ x 10. 128 colored plates and complete index. (Price 7s. 6d.)

This atlas is without a doubt the best and cheapest popular map book in the English language. The authoritative introduction by Dr. J. Scott Keltie contains a concise historical account of geographical discoveries and territorial changes up to the French Antarctic expedition under Dr. Jean Charcot in 1905. We had occasion to look up a location in the recently explored Chibogamoo region of northern Quebec, and amazed we were to find what we wanted. The 128 maps are admirably tinted in artistically contrasted colors; the line engraving excellent in definition, while the text and number printing is a printer's pride. A better atlas for popular use in Canada, where new regions and far northern lands are in these progressive days being constantly brought under public notice, we can hardly conceive.

Machine-Shop Arithmetic.—By Fred H. Colvin and Walter Lee Cheney. Fourth edition. 1905. New York: The Derry-Collard Company. Size, 6x4. pp. 144. (Price 50 cents.)

Here is a book which every machine-shop superintendent ought to place in the hands of his apprentices. In the nineties, when teaching the largest Science Classes in the United States in Machine Drawing and Construction, we would have rejoiced at having a book like the one before us to place in the hands of the fine, young mechanics under our instruction. It is astonishing how utterly impracticable are the methods of teaching even the rudiments of arithmetic in our public schools. We are afraid that if 90 per cent. of the young fellows in our modern workshops, (who have been lagging behind because of their inability to attack and properly solve machine-shop problems as they arise in practice), could be induced to earnestly master the contents of this little volume of 144 pages, that they would almost curse the teachers who kept them fooling over interminable fractions and assinine weight and proportion examples about sugar, treacle, tea and the like, instead of simple examples in elementary applied mechanics, etc., which would not only have trained the memory, imagination, and inventive faculties at an age when the mind is plastic and impressionable, but would have laid the sure foundation of success in early manhood. These thoughts pressed themselves irresistibly upon us as we carefully read this admirable little text-book, suitably entitled, "Machine-Shop Arithmetic"; for the examples given are all adapted to machine-shop practice. It shows how technical problems are attacked and worked out, and lays down philosophically, the principles underlying the various arithmetical rules; in fact, gives in clear language the reason "why" for everything. Beginning with decimals, passes on to mensuration, then to cube and square root, rule of three, etc. Since we read Butter's "Tangible Arithmetic," we have seen nothing to equal the lucid, perspicuous exposition of the principle underlying square root extraction. The practical examples of applied arithmetic include change gears, screw cutting, speed of drills, countershaft and pulley calculations, tap-drill figuring, shrink and force fits, etc., ending in a lucid exposition of the metric system of measurements and valuable tables.

That this book has already reached a fourth edition surprises us not. It ought to be in the hands of every public school principal, and used as a text-book in every technical high school in Canada.

BOOKS RECEIVED.

Eminent Engineers.—Brief biographies of thirty-two of the inventors and engineers who did most to further mechanical progress. By Dwight Goddard. New York: The Derry-Collard Company. Size, 8 x 5¾, pp. 280, 32 illustrations. (Price $1.50.)

Tables for Blacksmiths and Forgers.—Giving the allowances for the drawing down and staving of round, square and flat sections of all sizes. By John Watson. London, E.C.: Longmans, Green & Co., 39 Paternoster Row. Size, 6¼ x 4¾, pp. 88. (Price 2s. 6d. nett.)

Link Motions, Valves and Valve-setting.—By Fred H. Colvin. New York: The Derry-Collard Company. Size, 6 x 4, pp. 82, 43 illustrations. (Price 50 cents.)

The Wiring Handbook, with Complete Labor-saving Tables and Digest of Underwriter's Rules.—By Cecil P. Poole. New York: McGraw Publishing Company, 114 Liberty Street. Size, 8 x 4½, pp. 85, 32 pocket tables. (Price $1 nett.)

Standard Telephone Wiring.—For common battery and magneto systems. By James F. Fairman. New York: McGraw Publishing Company. Size, 7 x 4½, pp. 91, 74 illustrations. (Price $1 nett.)

The Chemistry of Materials of Engineering.—By A. H. Sexton, F.C.S., F.I.C. Manchester: The Technical Publishing Co., Limited, 287 Deansgate. Size, 7⅜ x 5¼, 35 illustrations. (Price 5s. nett.)

The Seven Follies of Science.—A popular account of the most famous scientific impossibilities and the attempts made to solve them. By John Phin. New York: D. Van Nostrand Company, 23 Murray and 27 Warren Streets. 1906. Size, 7½ x 5¼, pp. 178, 35 illustrations. (Price $1.25 nett.)
To be reviewed in our May number.

Electric Power Transmission.—A practical treatise for practical men. By Louis Bell, Ph.D. New York: The McGraw Publishing Company. Size, 6 x 9¼, pp. 703, 341 illustrations. (Price $4 nett.)

A Treatise on Producer-Gas and Gas-Producers.—By Samuel S. Wyer, M.E. New York: The Engineering and Mining Journal, 505 Pearl Street. pp. 296, 113 illustrations. Size, 9¼ x 6½. (Price $4 retail.)

CATALOGUES AND CIRCULARS.

Telephones.—The R. E. T. Pringle Co., Limited, 172 Dalhousie Street, Montreal, are the Canadian agents for the Deveau Private Line and Intercommunicating Telephones. They are described in two neat pamphlets which Messrs. Pringle have sent to us. 3¼ x 6, pp. 8.

Tools and Machinery.—F. H. Hopkins & Co., Montreal. This booklet contains a classified list of tools and machinery for all forms of construction work, railroad, mill, and contractors' supplies, as handled by the above company. 8 x 3½, pp. 20.

Department of Railways and Canals.—The annual report of the Department of Railways and Canals for 1905 has just come to hand, accompanied by 10 maps showing the various railway and canal routes of the Dominion. The report of the Deputy Minister of Railways and Canals, statement of the accountant of the Department, report of the chief engineer, and other miscellaneous statements are contained in this volume.

Hoisting Engines and Pile Hammers.—Georgian Bay Engineering Works, Midland, Ont. "Midland" hoisting engines, with, or without boilers, and "Midland" automatic pile hammers, are recommended to those who wish a "machine of quality," at a price consistent with good workmanship and material. The 16-page catalogue just issued is worthy the attention of anyone interested. 9¼ x 6, pp. 15.

Gasoline Fire Pots and Torches.—R. E. T. Pringle, Limited, 172 Dalhousie Street, Montreal, Que. A booklet illustrating and describing gasoline appliances of all kinds for plumbers and electricians, prices being included. 6 x 3, pp. 46.

Gas Generating Plants.—Loomis-Pettibone Gas Generating Plants are attractively described by means of diagrams and colored plates in a new pamphlet that is being issued by the Power and Mining Machinery Company, Milwaukee, Wisconsin. This system gasifies bituminous coal, wood, charcoal, lignite, etc., and produces a gas that is particularly adapted to the operation of gas engines. The water gas made by this system can be used separately in various feeding work, such as forging, welding, tempering, etc. This pamphlet can be had upon application to the company.

Roller Bearings.—Hyatt Roller Bearing Co., Harrison, N.J., U. S. A. A brief mechanical statement of facts, explaining the commercial advantages of the Hyatt Roller Bearing, as well as a short treatment on its principal applications; also a list of prominent users, is set forth in the very complete catalogue which they have just issued. 6¾ x 8½, pp. 45.

Pipe and Steamfitters' Tools.—The Canadian Fairbanks Co., Montreal. Catalogue "B" is a complete illustrated list of tools, etc., which the Fairbanks Company are prepared to supply to steamfitters, plumbers, etc. 6¼ x 9½, pp. 37.

Edison Primary Batteries.—These batteries are used in connection with slot machines, gas engines, small fans, railway signals, phonographs, and for many other purposes. Complete descriptions and price lists are given in an artistic booklet which the Canadian sales agents, the Canadian General Electric Company, are sending out. 3½ x 6, pp. 16.

Marine Gasoline Motors.—Hamilton Motor Works, Hamilton, Ont. A lucid description of the two and four cycle marine gasoline engines, as built by this company, is given in a neatly arranged catalogue of 16 pages. 6 x 4½.

Motors and Generators.—In bulletin No. 367, February 1906, the National Electric Company, of Milwaukee, Wis., U. S. A., type "NL" direct current motors and generators, are fully described. 7 x 10, pp. 8.

Circular No. 1117, August 1905, published by the Westinghouse Electric and Manufacturing Co., Pittsburgh, Pa., describes and illustrates type "SA" motors, direct current, variable speed. 7 x 10, pp. 10.

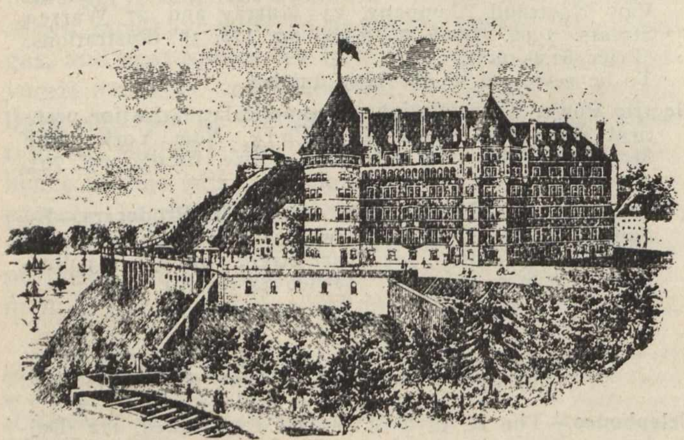
Turbines and Centrifugal Pump.—J. P. Morris Company, Philadelphia, Pa., U.S.A. Bulletin No. 2 is of a technical character, and deals with the effect on the efficiency and power of a water-wheel designed for one specific head when operated under varying heads. 8½ x 10¾, pp. 11.

Shipyard Electrical Equipment.—Allis-Chalmers Co., Cincinnati, Ohio, U.S.A. "The Electrical Equipment of a Modern shipyard" is the title of Bulletin 1039, which gives a description of electrical power distribution as applied in the shipbuilding plant of the Fore River Ship and Engine Company at Quincy, Mass. 17 illustrations. 8 x 10½, pp. 16.

CANADIAN MINING INSTITUTE

ANNUAL MEETING AT QUEBEC.

The eighth annual meeting of the Canadian Mining Institute was held in the picturesque city of Quebec, March 7th, 8th and 9th, 1906. The headquarters were at the Chateau Frontenac, an ideal place for a convention of men whose lives are largely spent in superintending operations in narrow tunnels deep down in the earth; for, situated as this world renowned hostel is, on the commanding heights overlooking the broad waters of the St. Lawrence, and with points of scenic beauty and deep historic interest on every



Chateau Frontenac, Quebec.
Headquarters of the Convention.

side, the mind is instinctively drawn out from morbid introspection, into wider and nobler views of life and action. If the Cassandra-like forebodings of "The Mining Record," had been realized, faction fights and an open split ought to have characterized the meetings of this important body. Whether the city charm dispelled "petty jealousies," or the genial influence of President Smith smoothed out the rough places, or the wise counsel of Dr. James Douglas made the "malcontents" and "dissentients" forget their troubles and grievances we know not; suffice it to say, that during the three days' session much valuable information affecting the important art of mining was mutually imparted, wise resolutions on national policy were adopted, and the Convention ended in peace, harmony and good-will.

The following is a partial list of members and others in attendance:—

Toronto: Eugene Coste, E. T. Cirkell, Dr. T. L. Walker, Prof. G. R. Mickle, Dr. W. G. Miller, S. Groves (Editor "The Canadian Engineer").

Montreal: Dr. J. B. Porter, Dr. A. Stansfield, Dr. Frank D. Adams, John E. Hardman, J. A. Bancroft, Geo. Le Couteur, A. W. G. Wilson, J. S. Brown, Geo. C. Tunstall, R. T. Hopper, A. McMeekin, E. E. Winter, L. H. Cole.

Ottawa: Elfric D. Ingalls, A. P. Low, Dr. A. E. Barlow, A. M. Campbell, D. B. Dowling, Owen O'Sullivan, James White.

Quebec: Abbë J. A. K. Laflamme, Joseph Obalski, W. J. V. Atkinson, Jules Cote, Geo. R. Smith, J. J. Penhale, Sherbrooke.

Kingston, Ont.: Dr. C. W. Dickson, Prof. R. W. Brock.

Major R. G. Leckie, Sudbury, Ont.; Hiram W. Hixon, Victoria Mines, Ont.; J. W. Evans, Cobalt, Ont.; D. Gillies, Carlton Place; A. B. Wilmot, Sault Ste. Marie, Ont.; Dr. Douglass, New York; Frederick Hobart ("Engineering and Mining Journal," New York); J. B. Tyrell, Yukon; W. H. Edwards, Black Lake.

A striking figure at the Convention was Narabhai D. Daru, of Surat, India, Barrister-at-law, and Associate of Royal School of Mines, London, who has been in Canada some time, having been sent here by the Government of India on mining and geographical matters.

Alfred Collyer, R. A. Stinson, and John S. MacLean, representing Allis-Chalmers-Bullock, Limited, Montreal, were also in attendance.

Owing to the absence of Secretary H. Mortimer-Lamb through illness, the onerous duties of this office were taken care of by Dr. J. B. Porter, of McGill University, to whom the success of the Convention was largely due.

The valedictory address of President George R. Smith, M.P., was of a popular character, consisting of a highly interesting historic sketch of mining enterprise in Eastern Canada.

"We meet to-day," said Mr. Smith, "on historic ground. This very spot, the site of this magnificent hotel, was for many generations the seat of Government of New France, and here was founded her colonial Empire. Immediately below the far-famed Terrace surrounding us on every side we can look down upon the narrow strip of land hemmed in between the river and the rock, and here it was that Champlain's builders erected the first European edifice in New France. The first Canadian sappers and miners a few years later began their work upon almost the identical spot whereon the miners of to-day are assembled to discuss the progress and the prospects of Canada's mineral development.

"Here was laid the foundation of that French sovereignty which, from the old Chateau St. Louis, was exercised over the enormous territory extending from the mouth of the Mississippi River to the Great Canadian Lakes, and thence along their shores and those of the St. Lawrence River and Gulf to where the waves of the Atlantic lap the eastern shore of the western world.

"Assembled, as we are, under the very shadow of the splendid monument erected to the memory of the first Canadian Governor and founder of Quebec, within the walls of a modern chateau, where we can still hear the ghostly echoes of that bold defiance that the haughty old Count Frontenac hurled at his country's foes, it would be strange, indeed, if our thoughts did not run back at times to the very beginning of things in the history of this rapidly developing Canada of ours. We are even tempted by the well-known peculiarities of stratification in the rocks of the famous "Quebec Group" to seek to penetrate the veil which separates the earliest chroniclers of the country from prehistoric times and to hark back to the glacial period of our planet's existence. Even when the fiat went forth which first shed created light upon a world of chaos, the Laurentian hills, those rocks upon which Quebec is built, lifted aloft their hoary heads, white with the snow of a thousand years.

"Not many generations passed away after Champlain's founding of Quebec before successful efforts were made by the pioneers of New France to wrest from the vitals of the earth the hidden wealth underlying, so contemptuously referred to at a later date by some of the attaches of the French court.

"The distinguished French statesman, Colbert, who, like his royal master, Louis XV., was deeply interested in the progress and prosperity of New France, recognized not only the vast importance of retaining the fur trade of America in the hands of the French, but realized still more the desirability of the proper cultivation of the soil and the operation of mines. Less than threescore years after the founding of Quebec M. de la Tessiere, a French engineer, who had been instructed by Colbert to explore the north bank of the lower St. Lawrence, discovered in 1666 the iron deposits of Baie St. Paul. The Intendant Talon was instructed by the Minister to carry on similar explorations in other parts of the country. It was under his auspices that the mineral wealth of the St. Maurice country, in the district where the Radnors forges were subsequently erected, was first brought to light.

"The French engineer, M. de la Potardiere, who was sent to Canada to inspect and report on these mines, failed to justly estimate the value and importance of the deposits in question, and of which we find early mention in the diary of the Ursulines of Three Rivers, and so their development was for some time delayed. Frontenac, however, in 1672, refers to them as of considerable importance. In this view he was corroborated by DeDenonville in 1681.

"The first company to develop these mines was formed in 1733, though it was not until some time later that they were placed in really successful operation.

"The St. Maurice forges were, nevertheless, the first of their kind in America, and in 1739 they were described as an honor to Canada. The famous Swedish naturalist, Paul Kalm, who visited this country in 1749, spoke of them as quite as well equipped as those of his own country, and they found plenty of employment in smelting the ore and casting the product into stoves to heat the dwellings of the early Canadian settlers."

Mr. Smith went on to speak of the mighty strides made in mining development up to the present era, and said there was no doubt that the Dominion had entered upon a period of remarkable discoveries as well as of wonderful mining development. The Cobalt deposits and those of the Lake Chibogamoo District are among the latest to claim public attention. It was hardly necessary to speak of the present and continuing development of asbestos and chrome iron industries, as these would be described in detail in papers which will be read before the convention. The enormous development in transportation facilities in districts up to now inaccessible which will result from the construction of the Grand Trunk Pacific and other contemplated roads must necessarily lead to further commercially valuable discoveries. There is also a constant and increasing demand for mining locations, and he thought he was well within the mark in saying that the revenue of the Mining Department of the Province of Quebec would show for the current year an increase over that of last year of more than 500 per cent. The energetic efforts of the present Minister of Mines for this Province, the Hon. John Prevost, to assist as much as possible in the development of the Province are well known.

Mr. Smith expressed regret at the absence through illness of the Secretary of the Institute and spoke in appreciation of the manner in which Dr. Porter had come to its assistance by taking up the arduous duties. He thanked the members of the Institute for their continued kindness to himself in again electing him by acclamation, and trusted nothing would occur to make them feel that their confidence had been misplaced. Mr. Smith received quite an ovation upon the conclusion of his remarks.

The council then remained in business until one o'clock.

Afternoon Session.

At the afternoon session of the Institute a number of papers were read and discussed. Before proceeding with the reading of papers, however, Mr. E. D. Ingall, Ottawa, was called upon for a review of the mineral situation in the Dominion since the last meeting, which that gentleman gave in an interesting manner. The grand total of mineral production during the past year amounted to over $68,500,000, showing an increase of over $8,500,000 for last year. There had been increases in every department, except in gold in the Yukon, which had decreased by about $2,000,000. The Yukon was in a state of transition. Surface mining had almost been worked out, and a change in conditions would be necessary. The iron ore industry was in a promising state. The Cobalt silver production was also referred to. The coal fields of Canada also showed steady investigation, and this is one of the important and constantly growing industries of the country.

Prof. W. G. Miller, speaking for Ontario, said the output of that Province during the past year had been the largest ever reported, amounting in refined state to $23,000,000.

Mr. J. B. Tyrell said that little could be added in regard to the Yukon as a gold mining camp. It had its extreme boom days. The gravel of that country was extremely rich, he having heard of as much as $625 being panned out from one shovel. While much of the surface gravel has been worked out, there is still much gold in the country. Conditions will have to change. The transportation problem was serious. The supply of water was also a problem. While the output fell off it was in part due to the scarcity of water almost as much as to working out of the surface mining. Systematic development has not yet been undertaken. That country will yet produce a vast amount of gold, but most of it may have to lie fallow for some years until conditions change and cost of living and transportation become cheaper.

Mr. E. Coste, Toronto, spoke of needed ameliorations in the iron ore industry. There were enormous iron ore ranges in Canada, and a united effort should be made in the development of our own industry. The Institute might consider the question of bounties on Canadian ores.

Mr. J. Obalski reported for Quebec. There had been a great increase in mineral production in this Province last year. Asbestos had been the main increase, amounting to about $2,000,000. Mica production amounted to $1,000,000, the total being $4,000,000. The cement industry was also being developed satisfactorily.

The chairman, in commenting on the reports made, said he thought that the Dominion should be congratulated on the very encouraging condition of affairs.

Papers were then read by Mr. Hiram M. Hixon on "The ore deposits and geology of the Sudbury district." A deliverance of a highly polemical character, in which the theory of the igneous magmatic origin of the Sudbury ores championed by the Canadian Geological Survey was unsparingly denounced, as being worthy to rank with the witch-hazel and the divining rod. His own view was, that the ores were of volcanic origin. This interesting diversion—which was treated by the trained geologists mostly with a smile—was followed by Dr. C. W. Dickson, of Kingston, on "Genetic Relations of Nickel Copper Ores." The view set forth in this exceedingly technical paper was precisely that of the magmatic segregation theory, criticized so severely in the previous thesis. The discusssion which followed was very unsatisfactory, and although in Dr. Dickson's paper, the technical data from the laboratory standpoint, indicated sound academic training, extempore logical statement and socratic debating power is not a strong point with him. This matter will doubtless be heard of again.

A paper by Mr. Joseph Obalski on "Rare Earths in the Pegamatite Veins of our Laurentian Range," followed by discussion terminated the afternoon session.

Evening Session.

Exploration, survey and mining in the Chibogamoo region of Northern Quebec occupied a portion of the evening session, consisting of the following papers:—**"Notes sur un Depot de Pyrrhotite Nickelifere sur une pointe appellee, "Malachite Point,"** by Mr. A. Muscovici; **"The Chibogamoo Mining Region,"** by Mr. John E. Hardman, of Montreal, was illustrated by a series of intensely interesting, photographic slides, showing the wonders of flood, forests, mineral lands and mountains in the recently explored regions south of James' Bay, and west of Mistassimi Lake. Space alone forbids us telling the story of adventurous pioneering done by Mr. Peter McKenzie, the discover of valuable ores in these far northern lands. The pleasure of the impressions made was largely due to Mr. Hardman's clear annunciation and admirable powers of description; by far the best at the meetings. Then followed Mr. A. P. Low's expert account of the geology of **"The Chibogamoo Region."** Another paper of interest to the French members, was Mr. J. Obalski's, **"Probabilité de trouver des Mines au Nord de la Province de Quebec.**

Appeal to the Government.

The remainder of the evening was devoted to the discussion of the necessity for the establishment of a Bureau of Mines by the Federal Government: the matter being brought before the meeting by the reading of two papers upon the subject, one **"On the Advisability of the Establishment of a Federal Department of Mines,"** by the absent Secretary, Mr. H. Mortimer-Lamb (read by Dr. Porter), and the other by Mr. J. B. Tyrell. The discussion (in which the Editor of **"The Canadian Engineer"** took part: showing the need of popularizing the Blue Books in accord with the recent plea of Earl Grey, and declaring that an official appeal by the Institute to the Government would be rendering a service to the country) resulted in the unanimous adoption of a motion by Major R. G. Leckie, seconded by Mr. J. B. Tyrell, to the effect **that the President and a delegation of the Institute proceed to Ottawa to interview the Government on the subject of meeting the needs of the mining men in this respect.**

Second Day: Morning Session.

At eleven o'clock the second day's proceedings commenced with presentation of officers reports. The tone of the discussion which the annual reports of Council and Secretary, and financial statement of Treasurer evoked, may be gleaned from a remark made by that veteran mining engineer, Major Leckie, who declared warmly that he was present at the first meeting of The Canadian Mining Institute, but "never had he known friction like that which now exists." Fierce though the controversy was—sometimes volcanic—it evidently acted as a safety-valve. In all charity, therefore, we draw a veil over the scene, expressing only our admiration of the high moral tone which characterized the part Dr. Porter took in the debate, and to note the firm, yet genial manner in which President Smith steered over stormy waters into the harbor of peace and goodwill.

Subsequent to the business proceedings came a paper by Mr. D. B. Dowling, of the Geological Survey, entitled **"Notes on the Utilization of Poorer Grades of Coal Slack."** This was the most practical paper read at the Convention. Data of inestimable value on the use of Western lignites and low grade coals was given. Careful experiments had demonstrated that under like conditions 3.58 pounds of coal develops 1 horse-power in steam engine, whereas 1.53 pounds = 1 horse-power in the gas engine, or a difference in favor of gas engine of 2.24 to 1. It takes 6 pounds of common lignite, containing 30 per cent. of moisture to develop 1 horse-power for steam, but only 3.8 pounds for gas, or 2.27 to 1 in favor of gas. Poorest coal in gas engine equal to best coal in steam engine. It was shown that lignite used alone, gave trouble with tar, but when mixed with anthracite the tar was burnt up and no trouble experienced. The economic use of peat as fuel in gas producer installations was dwelt upon, and a bright future for the peat and lignite industries predicted for the West.

Dr. Porter in eulogising the paper, said it was one of the most important read before the Institute; no one had dwelt so elaborately upon the mechanical mixture of high-grade coal and lignites. [See article on "Suction Gas Producers" in **"The Canadian Engineer,"** October 1905.] Other papers were: **"Recent Developments at Cobalt,"** by Mr. W. G. Miller, and **"The Windy Arm Mining District"** (Yukon), by R. G. McConnell.

Afternoon Excursion on the St. Lawrence.

At 2.30, sleighs with jingling bells and filled with gay parties dashed merrily down from the Chateau Frontenac through the deep snows to the river-side, where the members of Canada's Mining Institute, their ladies and a number of invited guests, embarked on the celebrated Icebreaker, S. S. "Moncalm," and at 14 miles an hour cut through the ice—6 to 10 inches thick—for six miles up the St. Lawrence, past Wolfe's Cove and beyond the new Quebec Bridge. Intensely cold and biting was the breeze, and doubtless helped to cool down the high cerebral heats which had been generated by the keen polemics of the morning. Exhilarating and bracing was the trip on the boat which keeps the St. Lawrence open for navigation during the icy days of winter. Hearty cheers for the owners and captain evinced the gratitude of all for their pleasurable outing.

Annual Dinner: 8 P.M.

The annual dinner held in the Empire Room of the Hotel Frontenac was a brilliant function. The Romanesque decorations of walls and ceiling, brilliant lights of many colors, music, flowers, tables loaded with good cheer, champagne flowing like water, outbursts of jovality and expressions of good comradeship, all made for a renewal of that *esprit de corps*, needed in a brotherhood, which has on its shoulders very largely, the mapping out and development of the great mineral resources of the Dominion.

Mr. George R. Smith, M.P.P., President of the Institute was toastmaster, and filled the post of honor with distinction and tact. On his right at the table d'honneur, were Sir Louis Jette, C.M.G., Lieutenant-Governor of the Province of Quebec; Dr. F. D. Adams, McGill University; Dr. James Douglass, past-President American Mining Institute (a native of Quebec); and on his left, Hon. Jean Provost, Minister of Lands, Mines and Colonization; J. G. Garneau, Mayor of Quebec; and others.

Here followeth a typical French-Canadian report of toasts and speeches, from the columns of our esteemed exchange the "Quebec Chronicle":—

The first toast, "The King," was duly honored by the singing of the National Anthem, the sixty guests standing and giving three cheers and a tiger in honor of Edward the Great and the Good.

The next toast, "The President of the United States," proposed by President George R. Smith, M.P.P., in a speech brimful of delicacy and fine sentiments, was also enthusiastically honored. In the course of his remarks Mr. Smith, who showed himself a past master in the art of toast-making, stated that Quebecers have a soft spot in their hearts for their American brothers. Nothing pleased them more than to have Americans coming on pleasure trips and sight-seeing. But Canada offered more than climate and scenery to her visitors. Canada was a mine for the investor. Good investments are within reach all over Canada; and good money can be made. In alluding to President Roosevelt he termed him a man among kings and a king among men, one who whether cowboy, soldier, diplomat or statesman, was a perfect man and an ideal ruler, admired and praised by the whole world. On the conclusion of his remarks the distinguished assemblage sang "The Star Spangled Banner." After this toast had been honored, President Smith called on Mr. Rodden, an eminent mining engineer and miner, for a mining camp song. He did full justice to a rollicking mining lyric, "Drill, Ye Terriers, Drill." This melody was realistically accompanied by miniature dynamite explosions.

"The Lieutenant-Governor of the Province of Quebec," to follow faithfully the list, was the sixth toast, and drew forth the greatest applause.

In proposing this toast the chairman proclaimed his pride in Quebec, her institutions and her laws. Her pioneers had civilized, colonized and Christianized the whole of this Province and a large part of Canada and the United States; and never did we have at the head of the affairs of this Province a more eminent man than Lieutenant-Governor Jette, who had lent lustre and dignity to every position he had filled, whether as lawyer, judge, statesman, High Commissioner or Lieutenant-Governor.

Sir Louis Jette, C.M.G., Lieutenant-Governor, who, on rising to reply, was cheered to the echo, delivered what is considered by competent judges to have been as humorous, witty, spirited and eloquent a piece of after-dinner oratory as has been heard in Quebec for a long time. His postprandial style certainly compares favorably with that of Justin McCarthy and Chauncey Depew. His surprisingly delightful eloquence was punctuated with applause.

After Lieutenant-Governor Jette's speech Mr. Rodden sang, "Off to Philadelphia in the Morning."

"The Dominion Parliament" followed, Elfric D. Ingall, of the Dominion Geological Survey, responding.

The next toast, "The Legislature of the Province of Quebec," brought Hon. Jean Prevost. He made a very lengthy, able, eloquent and patriotic address, which was heartily applauded. At its conclusion the members of the Mining Institute congratulated the hon. member on his very liberal and broad-minded sentiments.

The "City of Quebec" was then proposed. His Worship the Mayor (J. G. Garneau, Esq.), in his reply, taking occasion to speak of the great pleasure it gave him to see so many eminent gentlemen in our midst, and extending a very hearty welcome for their next visit to the old Rock City.

"The Mineral Industries," proposed by Dr. Francis D. Adams, was ably responded to by Major Robert G. Leckie and Hiram M. Hixon.

The last toast on the list, "Our Guests," followed, Dr. J. B. Porter proposing it in honor of Dr. James Douglas, of New York, our eminent and world-renowned former fellow-citizen, scientist and degree-holder of many universities whose heart beats as warmly for his native city as ever.

Dr. Douglas, in reply, gave a most interesting review of Quebec, from his boyhood days to the present time. Lieutenant-Governor Jette, as well as the rest of the audience, were attentive listeners to every word that fell from Dr. Douglas' lips, and, although it was the last on the list, it was the pièce de resistance. Dr. Douglas was warmly applauded, and congratulated on his great effort.

This brought the pleasant gathering to an end.

Third Day: Morning.

The following papers were read at the Friday morning session:—

"On the need of a topographical survey of the Dominion of Canada, particularly with reference to the Development of the Economic Resources of the Dominion," by Dr. F. D. Adams.

Messrs. James White (Dominion Topographer), Dr. A. E. Barlow, and Mr. E. D. Ingall discussed this paper, and the general opinion was that 50 per cent. of the time of the Geological Survey was actually wasted in the necessity for making maps to illustrate their legitimate work. It was agreed that this matter should be emphasized by the President's deputation before the Government.

"Some Laboratory Experiments in the Electric Smelting of the Titaniferous Iron Ores of Hastings County," by J. W. Evans.

"The Teaching of Metallurgy in College Laboratories," by Dr. Alfred Stansfield, Professor of Metallurgy, McGill University.

"The Education of Mining and Metallurgical Engineers, with Special Reference to Teaching and Practical Work," by Dr. J. B. Porter, Professor of Mining, McGill University.

The main points in this paper were: (1) Teach principles, not processes; (2) teach the men to think, not to copy—to attack the proposition; (3) that business methods should form an important part of modern engineering education; and the necessity of a knowledge of **estimating** was emphasized. Dr. James Douglas took part in the discussion, and his remarks were "pure gold."* Mr. Nanabhai D. Daru, of India, also took part in the conversation.

At this stage the following resolutions were unanimously adopted:—

I.

That in the opinion of this Institute bituminous coal should be admitted into central Canada free of duty, when used exclusively for the manufacture of coke for use in blast furnaces producing pig-iron: and that a copy of this resolution be forwarded to the Premier, Sir Wilfrid Laurier, and the Hon. W. S. Fielding, Minister of Finance.

II.

That in the opinion of this Institute the Dominion Government should enact legislation providing for the payment of a bounty of $3.00 per ton on pig-iron, the product of ores raised or mined in Canada or Newfoundland. . The Act to remain in force for five years from date of passage: and that a copy of this resolution be forwarded to the Premier, Sir Wilfrid Laurier, and the Hon. W. S. Fielding, Minister of Finance.

An admirable paper by Dr. A. E. Barlow on **"The Nickel Deposits Near Webster, Western North Carolina,"** illustrated by views and mineralogical specimens, terminated the morning session.

Afternoon, 2.45: Final Meeting.

The first order of business at the final session was the report by the scrutineers of the result of the ballots cast for the election of officers. The result showed that the popular President, Mr. Geo. R. Smith, M.P.P., had been unanimously re-elected for another term. The full results were as follows:—

President—Mr. Geo. R. Smith, Thetford Mines, Que.

Vice-President—For one year—Dr. F. D. Adams, Montreal; Major R. G. Leckie, Temagami P.O., Ont. For two years, Frederick Keefer, Greenwood, B.C.; G. Herrick Duggan, Sydney, C.B.

Treasurer—J. Stevenson Brown, Montreal.

Secretary—H. Mortimer-Lamb, Montreal.

Councillors—For one year—Mr. John Blue, Mr. C. J. Coll, Mr. Thos. Cantley, Mr. Frank B. Smith, Mr. J. C. Gwillim, Mr. Jas. McEvoy, Mr. W. G. Miller, Mr. Harry Williams. For two years—Mr. W. H. Aldridge, Mr. B. A. C. Craig, Mr. A. M. Hay, Mr. R. T. Hopper, Mr. Thomas Kiddie, Dr. A E. Barlow, Dr. J. Bonsall Porter, Mr. W. D. Robb.

A vote of thanks to Dr. Porter—acting Secretary **without remuneration**—was carried with acclamation; the President expressing the hope that the Institute would remember what he (Dr. Porter) had done. Then followed a most interesting paper by Prof. R. W. Brock, of Kingston, on **"The History of the Rossland District,"** which was illustrated by a number of lantern slides, portraying scenes in that famous mining centre. A series of very fine views in connection with the asbestos industry at Thetford Mines (controlled by President G. R. Smith) were also shown, as were a series of views taken by Dr. J. Bonsall Porter during a recent trip to South Africa.

An invitation from Mr. Arthur St. Jacques, Gentleman Usher of the Black Rod, on behalf of Hon. Mr. Archambault to attend the ceremony in connection with the prorogation of Parliament that evening, was read by the President and accepted by the members.

Votes of thanks to the Hon. W. Brodeur, for the pleasant "Moncalm" trip; to Gen. Manager Evans of the Q. R. L. & P. Co. for the special car excursion to St. Anne de Beaupre and Montmorency Falls; and to the Mayor for the hospitalities of the fair city of Quebec, brought to a close the eighth annual meeting of The Canadian Mining Institute.

---

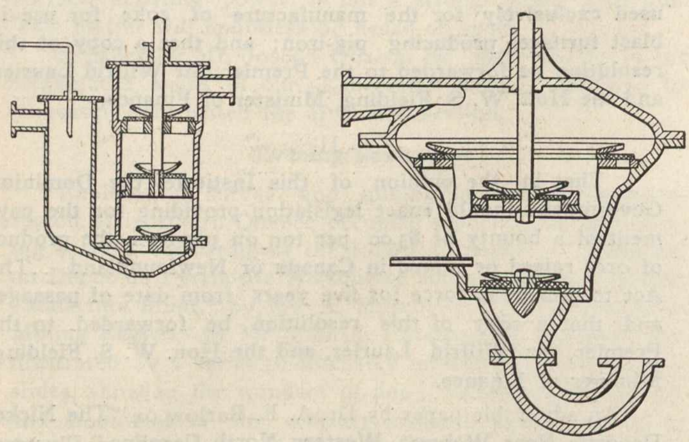
*We purpose some day giving a **verbatim** report of this speech.

INTERNATIONAL PATENT RECORD

CANADA.

Specially compiled by **Messrs. Fetherstonhaugh and Dennison,** Patent Attorneys, Toronto, Montreal and Ottawa.

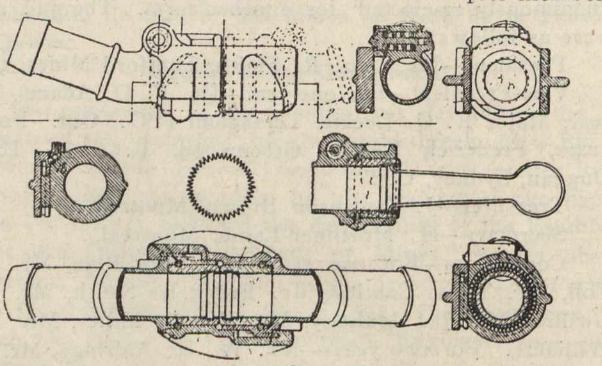
Vacuum Dust-extracting Apparatus.—Frederick William Schiodt, Copenhagen, Denmark.—96,440.—The apparatus consists of the interposition in the course of the suction conduit leading to the pump from the mouthpiece at which the dust enters the apparatus of a chamber and means for supplying liquid thereto so that the dust entering said



96,440.

chamber along with the current of air whereby it is carried will be absorbed or precipitated by the liquid, and the liquid thus charged with dust will be caused to pass along with the air through the pump.

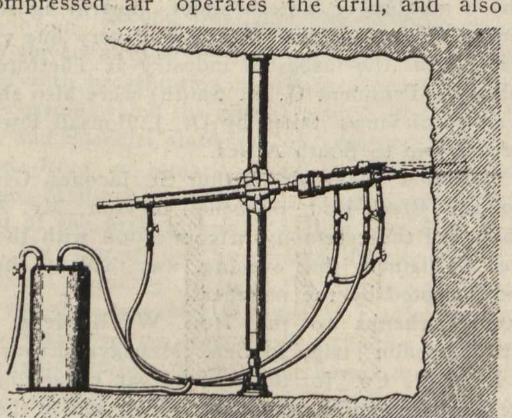
Hose Coupler.—C. W. Martin.—95,085.—The invention consists of a straight-way hose coupler, which is easily and quickly coupled or uncoupled, and forms, when coupled, a perfectly tight joint, and it consists of two coupler members,



95,085.

each having projecting lugs and wings on their sides, which are interlocked by partial rotation upon a horizontal transverse axis, suitable spring-actuated locking and releasing devices being arranged in conjunction with the interlocked portions.

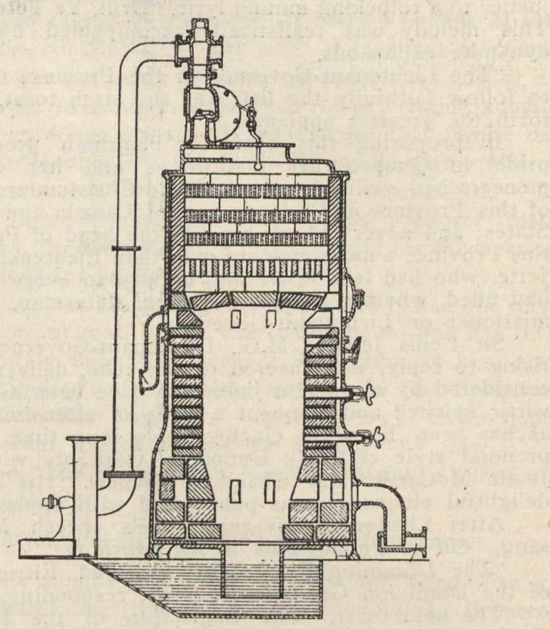
Water-feed, Dust-laying, Rock-drilling Engine.—95,005.—The apparatus shown is that of a rock-drill working in a gallery and connected to a tank and compressed air feed. The compressed air operates the drill, and also is con-



95,005.

nected to an atomizer attached to the drill cylinder, from which atomized jets of water are discharged around the edge of the hole being drilled, thus laying all dust arising therefrom.

Gas Producer Generator.—H. G. Hills.—95,225.—The invention consists of a gas producer arranged to have an upward draught-blowing period, alternating with the downward passage of steam during the gas-making period and



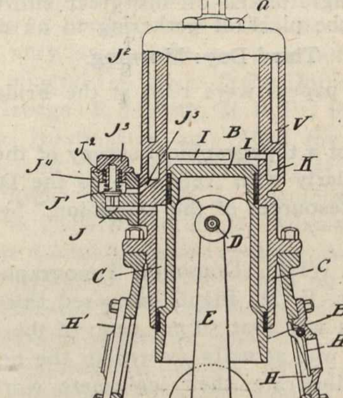
95,225.

non-return valves on the air inlets; also having an improved steam-raising and heat-storing device consisting of metal and brick checker work placed upon the incandescent zone at the top of the gas producer, and combined with a suitable water supply.

UNITED STATES PATENTS.

Specially selected and abridged by **Messrs. Siggers and Siggers,** Patent Attorneys, 918 F. Street, N. W., Washington, D. C., U. S. A.

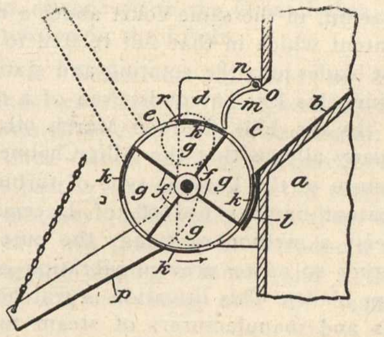
Explosive Gas Engine.—Edward G. Short, of Carthage, N. Y.—812,304.—This invention relates to new and useful improvements in gas engines, and especially to a forced-feed engine in which the supplies of air and fuel are kept separate and normally under pressure until they are fed into the combustion-chamber, at which time the pressure is variable, being greater upon the fuel than upon the air-supply. It consists of a cylinder with a combustion-chamber, and a piston working therein, an exhaust chamber, a fuel-



812,304.

duct, an air and fuel combining chamber, having free and unobstructed communication with said combustion-chamber, an air-compression compartment, and a vacuum-space intermediate the combustion-chamber and the compression-compartment, a valved passage-way leading from the vacuum-space to said exhaust-chamber, valve mechanism for allowing air under pressure from said compression-compartment together with fuel, to simultaneously enter the combining-chamber, and means for actuating said mechanism exposed on one side to the atmosphere and on the other side to the vacuum-space, as set forth.

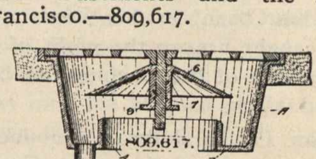
Coal Chute.—Charles Wallace Hunt.—803,288.—This invention relates to chutes for coaling locomotives and other like purposes in which the delivery of coal shall be controllable, and may also be measured. In the figure the chute is represented in sectional elevation as applied to a bin *a* of ordinary construction, having a delivery floor *b*, inclined toward the mouth or opening *c*. Adjacent to the mouth or opening *c*, and on opposite sides thereof may be secured side plates *d* of suitable dimensions, between which is mounted a revolving bucket *e*, which may be divided by partitions *f* into any desired number of compartments *g*. Each compartment is preferably closed in part by flange *k* to form a bucket for better retention of coal, to better cut off the flow of coal through the opening *c*, and to prevent the escape of coal from the compartment while it is being filled. It does



803,288.

not interfere with the free delivery of the coal from the compartment when the drum is rotated. A guard plate *l*, curved to conform to the curvature of the drum, is secured to the bin or side plates *d* below the opening *c* to co-operate with the flanges *k*, and to prevent the escape of coal between the wall of the bin and the drum during the movement of the drum, and before each compartment thereof reaches the proper position to receive its charge of coal. One or more strikers *m* are mounted above the drum, being preferably hinged or pivoted, as at *n*, upon a rod *o*, which extends across the opening *c* near the top thereof. Obviously, a single plate *m* might be made to extend from side plate to side plate; but preferably such plate is divided into several sections. Should a lump of coal be firmly embedded in the bucket and yet project beyond the circumference of the drum, the movable guards or strikers will yield enough to permit the passage of such projecting lump. The spout *p* is hung upon the shaft so that the clearance between the spout and the drum will always be the same in any position of the spout, and counterbalance weights *r* may be connected to the side arms of the spout beyond the axis of the drum to provide for the easy handling of the spout and its maintenance in an elevated position when not in use, as indicated by dotted lines.

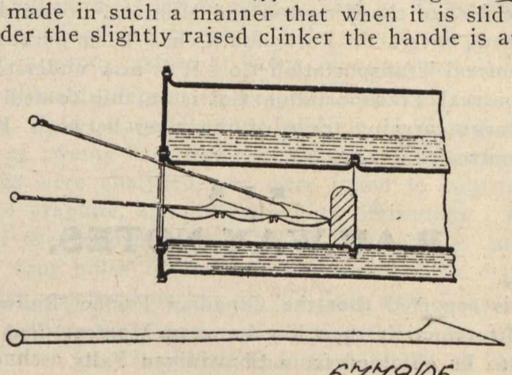
Ventilator for Basements and the Like.—Peter H. Jackson, San Francisco.—809,617.



809,617.

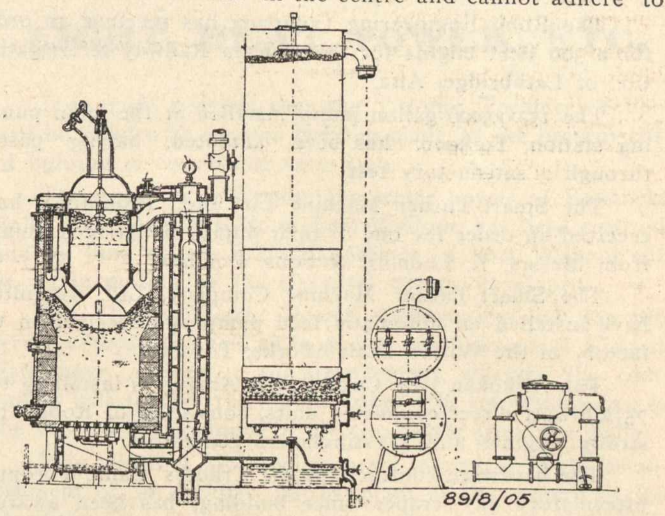
GREAT BRITAIN.

Clinker Slices.—Gabb.—6,778.—The wedge end of the slice is made in such a manner that when it is slid on one face under the slightly raised clinker the handle is at a considerable angle to permit depression and levering to a considerable extent about the rear edge of the wedge face as a fulcrum.



6,778.

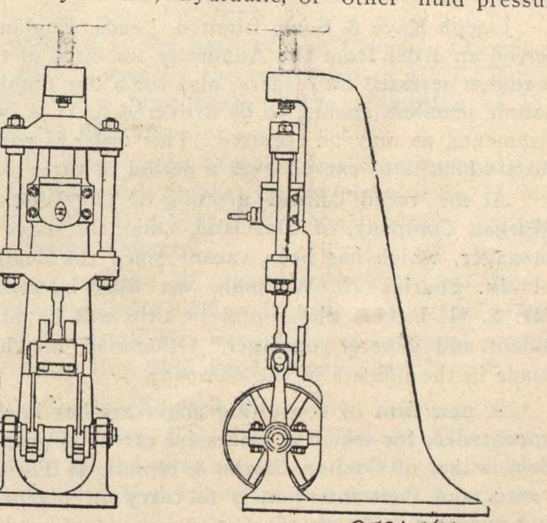
Gas Producers.—Genty and Soc. Nouvelle des Etablissements de l'Horme et de la Buire.—8,918.—(Date applied for under International Convention, May 9th, 1904.).—The feeding of the fresh fuel is at the periphery of the shaft, while the combustion takes place only at the centre of the shaft, and the clinker collects in the centre and cannot adhere to



8,918.

the refractory walls. This result is secured by the arrangement between the retort and the shaft of a central cone together with an inverted conic frustrum, the central cone being provided with suction passages which abut on the refractory material of the shaft, whereby the suction of the gas is caused to take place inside the central cone only.

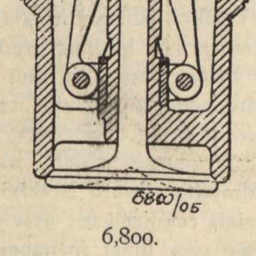
Testing Machines.—Speirs & Petch.—21,041.—The machine is provided with a mechanically-operated head, and a ram operated by steam, hydraulic, or other fluid pressure



21,041.

which serves to determine the strain or stress imparted to the object to be tested.

Self-acting Induction Valves for Internal-Combustion Engines and Generally for Use With Elastic Fluids.—Wolseley Tool and Motor Car Co., Ltd., and Remington.—6,800.—The valve is kept against its seat by means of a spring which acts through the medium of toggle joint appliance which, as the tension of the spring increases, owing to the opening of the valve, reduces the leverage through which the force of the spring is transmitted to the valve.



6,800.

INDUSTRIAL NOTES.

The United States Steel Corporation has nearly 175,000 employees, one-fifth of whom are stockholders.

The Robb Engineering Company has received an order for a 300 H.P. engine for the Alberta Railway & Irrigation Co., of Lethbridge, Alta.

The 15,000,000 gallon pump installed at the main pumping station, Toronto, has been accepted, having passed through a satisfactory test.

The Smart-Turner Machine Co., Ltd., Hamilton, have received an order for one of their duplex boiler feed pumps, from Messrs. E. Leonard & Sons, London.

The Smart-Turner Machine Company, Ltd., Hamilton, have installed an automatic feed pump and receiver in the factory of the Wilson Scale Works, Toronto.

The Atikokan Iron Co., of Port Arthur, is installing two 75 kilowatt direct connected units, consisting of Robb-Armstrong engines and Westinghouse generators.

The hardware contract for the Traders' Bank, Toronto's fifteen-story sky-scraper office building, has been awarded to the Aikenhead Hardware Co., Limited, Toronto.

The Hamilton Cataract Power, Light & Traction Co. recently ordered a direct connected centrifugal pump and motor from the Smart-Turner Machine Co., Ltd., Hamilton, Ont.

The new factory that the Eagle Knitting Company will build in Hamilton will be the only one of its kind in this country. The buildings will be of cement trimmed with brick, and will be entirely fireproof.

Joseph Kaye & Sons, Limited, Leeds, England, have received an order from the Admiralty for 8,100 of their patent seamless serrated oil feeders; also for a like number of their patent seamless spouts, to be delivered to H.M. naval establishments, as may be required. This order is part of a contract which is to extend over a period of three years.

At the recent annual meeting of The Wellman-Seaver-Morgan Company, of Cleveland, Ohio, the office of general manager, which has been vacant since the death last June of Mr. Charles H. Wellman, was filled by the election of Mr. S. H. Pitkin, whose present title will be first vice-president and general manager. Otherwise no changes were made in the officers of the company.

A new firm of consulting engineers has lately made its appearance, for which a successful career is prophesied. The firm is that of Connor, Clarke & Monds, 36 Toronto St., Toronto, and their intention is to carry on a general consulting business. As the firm is composed of members whose experience has been along different branches of engineering, the field is comparatively well covered, and it is therefore probable that they will actively participate in those enterprises requiring the services of engineers.

H. W. Petrie, who has been established in the machinery business in Toronto for over thirty-five years, has opened a branch in Montreal, at the corner of St. James and Little St. Antoine Streets. Mr. Petrie has already established quite a large connection in the province of Quebec, and the opening of a branch in Montreal will no doubt prove an advantage to a large number of his customers. The firm carries a complete stock of saw-mill, wood-working machinery, contractors' machinery, hoisting engines, boilers and steam appliances.

The Harbison-Walker Refractories Company, of Pittsburgh, Pa., manufacturers of highest grade fire clays, silica, chrome, magnesite brick, importers and shippers of grain magnesite, magnesite cement, chrome, ore, etc., report that during the past two months they were in receipt of many orders and contracts, among which were the following: Bethlehem Steel Company, South Bethlehem, Pa., orders for all refractory materials required for new open hearth furnace construction and two new blast furnaces, eight new stoves, connections, etc. Milliken Bros., Mariner's Harbor, Staten Island, N.Y., entire requirements of refractory material for five new basic open hearth furnaces, soaking pits, heating furnaces, gas producers, etc. Central Iron & Steel Company, Harrisburg, Pa., complete lining for blast furnace. H. C. Frick Coke Co., all brick required for 264 bee hive ovens. Republic Iron & Steel Company, all brick required for 100 bee hive ovens.

The Westinghouse Machine Company, of Pittsburgh, Pa., on March 9th, filed a second bill of complaint against the Allis-Chalmers Company, of Milwaukee, Wis., in the United States circuit court for the district of New Jersey, in which the latter concern is charged with the infringement of a certain patent relating to the manufacture of the Parsons steam turbine. It will be remembered that the Westinghouse Co. filed a similar bill in the same court about a month ago; but while the patent which in that suit related to the method of fastening the blades into the rotating and stationary elements of the turbine, this last patent is even of a more important character. In the bill filed on March 9th, the Westinghouse Company alleges that the Allis-Chalmers Company in the manufacture of the Parsons type of turbine is infringing upon the patent number 639,608, of December 19th, 1899, which protects a method of tying the outer ends of the blades together so as to prevent vibration or the breaking of the longer blades. This litigation is watched with interest by all users and manufacturers of steam turbines, particularly on account of the fact that the use of these engines is increasing to enormous proportions. The Westinghouse people claim to be the largest manufacturers of this style of steam engines in the country, having been the pioneers in that field. They have over 500 in operation throughout the country, aggregating a capacity of about 1,000,000 h.p., while at the present time there are under construction in their shops at East Pittsburgh 100 units of these turbines approximating a total of one quarter million horse-power.

(Continued on Ad. Page 58.)

MARINE NEWS.

The Richelieu and Ontario Navigation Company will build three new passenger steamers at a cost of about a million dollars.

The Hamilton Steamboat Co.'s steamer, "Macassa," was the first to cross Lake Ontario this season, making the trip from Hamilton to Toronto on March 10th.

The Ottawa Navigation Company's steamer, "Sovereign," which has been in her winter quarters in the Lachine Basin, caught fire on the night of March 17th, and in spite of the efforts of the Lachine fire brigade was completely destroyed.

The Canadian Pacific Railway announces that on May 25th and at intervals thereafter the Canadian Australian line new twin screw steamer, "Maheno," of 5,282 tons will sail from Vancouver to Sydney, calling at Honolulu, Fiji and Brisbane. This will be the first turbine steamer on the Pacific.

The fleet of the Kingston and Montreal Forwarding Co., with headquarters at Portsmouth, has been purchased by the Montreal Transportation Co. It is now understood that the Montreal Transportation Co. is in full control of the grain barge carrying trade of the river between Kingston and Montreal.

RAILWAY NOTES.

It is reported that the Canadian Pacific Railway have decided to electrify their line between Montreal and Quebec, power to be obtained from Shawinigan Falls.

The first railway in Canada to be operated by motors, run by gasoline generating steam, with a speed of thirty miles, will be the Port Credit, Brampton and Guelph road.

The Canadian Northern are preparing to commence work in earnest in the spring on their long-talked-of line to Hudson Bay. A party of surveyors have been working all fall and winter on the proposed line.

The East Toronto and Danforth Electric Railway is applying for a charter.

A scheme is on foot in Hamilton to build a union depot at the corner of King and Catharine Streets for the use of all electric railways. The expenditure is estimated at $250,000. The promoters are the Hamilton Terminal Company.

It is announced that a powerful syndicate has been floated to undertake the construction of the Canada Central Railroad, formerly known as the Ottawa Valley road. The line will be electrically operated, and will run from Montreal to Ottawa, thence on to the Great Lakes, with the idea of further extension in the future.

Hon. H. R. Emmerson, Minister of Railways and Canals, has under consideration the question of using motor cars on the branch lines of the Intercolonial; also on the rural service lines. Motor cars have proved very successful for some time past in Europe, and at the present time practical experiments have been made with them in the United States. The cars will probably be introduced on the Intercolonial during the coming summer, and it is hoped they will accomplish a great saving over the steam locomotive service.

The Niagara, St. Catharines and Toronto Railway Company have placed an order for 5,000 tons of 80-pound steel rails for extensions and improvements. The first work to be taken up will be relaying the entire main line of the Niagara, St. Catharines and Toronto Railway between St. Catharines and Niagara Falls, while the extension of the line to Fonthill and Welland is to be pushed as rapidly as possible. An order has been placed, we understand, with the Canadian Shipbuilding Company for a new steamer for the Port Dalhousie-Toronto route. Arrangements are being made with the International Railway Company for an improved service between Bridge Street, Niagara Falls, N.Y., and Buffalo.

MINING MATTERS.

Ore valued at $1,448,521 was shipped from Cobalt in 1905.

At the coming session of the Ontario Legislature the Minister of Mines will introduce legislation with a view to having all the nickel ore mined in Ontario converted into marketable nickel before leaving Canada. Canada supplies 60 per cent. of the nickel of the world, but at present the ore is converted into the finished product in the States and sold as American nickel.

From a statement issued by the Bureau of Mines the output of the seventeen shipping mines in Cobalt during 1905 was 2,144 tons. The returns in value do not make a fair showing, as during part of the year nothing was received for cobalt, nickel or arsenic. The chief items were: Silver, 2,441,421 ounces, valued at $1,355,306; cobalt, 118 tons, valued at $100,000; nickel, 75 tons, valued at $10,525; arsenic, 549 tons, valued at $2,693, an aggregate of $1,438,524.

A valuable deposit of graphite has been discovered at French Vale, Cape Breton, by Neil D. Campbell. At a depth of twenty-five feet he found a thirteen-foot seam. Samples were analyzed, and were found to contain 70 per cent. of graphite, an unusually high percentage. The location of the deposit is ideal. The Intercolonial line passes within four miles of the property, while at a distance of six miles a natural harbor on the Bras d'Or Lakes is found.

A million dollar deal took place in Cobalt recently, when Mr. Hunter, of Cincinnati, and Captain W. A. Marsh, of Toronto, secured a tract of land in the Abitibi district, near the south-eastern watershed, and within five miles of the T. and N.O. Railway. The land is leased, and the title perfect. On the tract is a mineral vein ninety-five feet wide containing gold, silver and copper. The new owners will put in a diamond drill at once and proceed to take out ore for shipment. Experts pronounce the property one of the most valuable in Northern Ontario.

The Canadian Mining Institute have decided to send a delegation to Ottawa to ask the Federal Government to establish a bureau of mines.

LIGHT, HEAT, POWER, ETC.

It is quite possible that the Toronto Technical School will be fitted with its own lighting plant, as the present cost of lighting is considered very high.

The work of developing the water power of Kakabeka Falls, sixteen miles west of Fort William, has been realized, and by June 1st the industrial wheels of Fort William will be set in motion by the electrical energy developed.

The Hydro-Electric Power Commission and the different companies engaged in power development of Niagara Falls have arrived at an arrangement whereby the companies will furnish the Commission with information as to the cost of development of electric power from the Falls.

It is said that Montreal men are interested in the establishment of an electric power plant at the mouth of the Maritime Coal Company's mines at Cumberland, N.S. This company, of which Senator William Mitchell, of Montreal, is the head, will be the first to take up Edison's idea of generating electric power right at the mines, and transmitting it by wire, instead of hauling coal long distances for that purpose.

PERSONAL

The vacancy at the head of the Canadian Pacific engineering staff, caused by the retirement of W. F. Tye, engineer-in-chief, has been filled by the promotion of F. P. Gutelius to the position.

Major G. Washington Stephens has been appointed president of the Canadian Rubber Co., in place of Sir H. Montagu Allan. Mr. D. Lorne McGibbon becomes vice-president and general manager.

We regret to have to announce the death of Alphonse Robert, of Ottawa, who died on January 30th. Just prior to the time of his death Mr. Robert was a sectional engineer on the Georgian Bay Ship canal survey.

Captain Charles Edward Perry, civil engineer, son of the late Lt.-Col. Perry, C.E., died at Ottawa on March 15th. With his death passed away one of the best known and most widely experienced civil engineers in Canada.

Mr. E. R. Clarke, hydraulic engineer, Canada Foundry Co., Ltd., has severed his connection with that company, and has allied himself with the firm of Connor, Clarke & Monds, consulting engineers, 36 Toronto St., Toronto.

Wm. Gormally, superintendent of the Union Station, died at his home in Toronto on March 13th. Mr. Gormally's railroad career extended over a period of forty-five years. He was ten years station superintendent, ten years station master, and the other twenty-five years served as a conductor and trainman on the G.T.R.

In connection with the description of the Ontario Power Company's plant, which appeared in our last issue, we omitted to state that Wm. Kennedy, Jr., of Montreal, hydraulic and mechanical engineer, visited Europe four times in connection with the purchase and inspection of large turbines for water powers in Canada; three of these visits were made for the Hamilton Cataract Power Company, and the fourth for the Ontario Power Company. He visited Switzerland, Italy, Germany, and Buda-Pesth, Hungary; and got designs and prices from the principal turbine builders in all these countries before coming to a decision as to what would best meet the requirements of the different companies he represented. Altogether Mr. Kennedy arranged in Europe for turbines of about 70 000 horse-power capacity, all of which have been installed; and 12,000 horse power additional for the Kaministiqua Power Company, to be installed at Kakabeka Falls on their arrival within the next few months.

Mr. W. F. Tye, chief engineer of the Canadian Pacific Railway, has resigned his position. It is understood that he is to go into constructional work. Mr. Tye has been chief engineer of the company since May, 1904. Before that time he was assistant chief engineer, and has also served with the Canadian Pacific Railway in the capacity of chief engineer of construction. He first joined the Canadian Pacific in 1882, but later left that company, only to return to them in 1897. He is widely known throughout American railway circles.

MUNICIPAL WORKS, ETC.

Peterboro', Ont., is looking into the question of developing electric power under municipal control.

The corporation of Kenora, Ont., will develop 5,000 to 7,000 h.p. on the Winnipeg River at a cost of $150,000. T. Pringle & Sons, Montreal, consulting engineers.

Dunnville has carried the by-law to raise $20,000 to establish a municipal gas plant by a large majority. The franchise of the Pittsbugh company will expire in August next, and, if satisfactory arrangements can be made, the town will take over the present plant.

The city of St. John, N.B., will ask the Legislature for power to take a lien for taxes on the property of deceased persons and bankrupt estates. They will also seek power to buy or expropriate the gas plant operated by the Street Railway Company, and to operate street railways in Cardston, a section of the city where there are no lines.

At one of the recent sittings of the Private Bills Committee in the Quebec Legislature a new industrial scheme was knocked on the head by the defeat of the bill introduced by the Southern Electric Company. This company proposed to acquire its power from the Shawinigan, and asked the right to operate on the south shore of the St. Lawrence, whence it intended to reach Thetford Mines and other important centres.

TELEGRAPH & TELEPHONE

It is announced that an engineer named Kimura has invented a successful wireless telephone.

In Haldimand township a company has been organized, to be known as the Rural Telephone Company. Arrangements have been made for connection with the Bell Telephone Company. It is expected that the line will be in operation in the early spring. It will connect a wide tract of rural territory with the county town.

Sixty thousand dollars will be expended between now and the 1st of June by the Central New York Telephone and Telegraph Company in extending the scope and increasing the efficiency of its service in the Thousand Island territory and between St. Lawrence River points in general. One of the new cables will connect Cape Vincent with Kingston, via Wolfe Island, and the other will extend from Massena Point to Cornwall on the Canadian shore. The short cable service between Thousand Island Park, Frontenac, and the adjacent shore points of Clayton and Alexandria Bay will be made more efficient.

NEW INCORPORATIONS.

Manitoba.—Western Canada Coal Mining Co., Winnipeg, $50,000; J. W. Cockburn, J. A. Christie, W. A. Black, Jas. G. Dagg, Winnipeg; F. H. Dagg, Holland.

Ontario.—Canadian Multi-phone Co., Hamilton; $200,000; E. R. Marshall, J. Thomson, A. J. J. Fraser, F. J. Stewart, J. Mack, Hamilton.

The Silver Star Mining Co., New Liskeard, $40,000; W. H. Rice, H. S. Hennessy, Haileybury; W. J. Evans, F. W. Ferguson, W. V. Cragg, New Liskeard.

Hamilton Light and Equipment Co., Hamilton; $40,000; E. Wilson, Hamilton; W. B. Bentley, G. A. Turner, J. M. Neil, E. A. Hay, Toronto.

Canadian Ramapo Iron Works, Niagara Falls, $300,000; A. B. Mackay, J. W. Nesbitt, J. G. Gauld, J. Dickson, Hamilton.

Ben Allen Portland Cement Co., Owen Sound, $500,000; C. Payton, Owen Sound; J. McMillan, Keppel; J. E. Day, J. M. Ferguson, E. V. O'Sullivan, Toronto.

Foster Cobalt Mining Co., Toronto, $1,000,000; C. W. Kerr, C. S. MacInnes, C. C. Robinson, J. H. Spencer, W. E. Watson, Toronto.

The Cobalt Silver and Copper Mining Co., Sault Ste. Marie, $500,000; F. E. Ketchum, G. P. McCallum, C. W. Baldwin, C. J. Brook, C. H. McBean, Sault Ste. Marie, Mich.

The Queen City Mining and Development Co., Toronto, $150,000; J. B. LeRoy, J. R. Humphreys, T. Mitchell, H. M. East, H. R. Frost, Toronto.

The Savage Mine of Cobalt, Toronto, $500,000; G. Taylor, L. M. Heal, G. W. Spence, S. Whittaker, E. M. Duncan, Toronto.

Cobalt-North Ontario Mining Co., Haileybury, $40,000; J. E. Meyers, W. H. Altman, F. B. Thirkfield, E. Ament, Chicago, Ill.; G. A. Mason, Highland Park, Ill.

The Williamson-Marks Mines, Limited, Toronto, $300,000; H. W. Williamson, I. Marks, F. A. Fleming, C. C. Keele, J. H. Hunter, Toronto; Jas. Playfair, Midland.

The Red Rock Silver Mining Co., Haileybury, $1,000,000; D. A. Dunlop, M. G. Hunt, N. A. Timmins, Haileybury; R. McBride, H. McBride, Sudbury.

Tarentorus Mining Co., Sault Ste. Marie, $7,000,000; A. Edwards, R. H. McAllister, J. C. Curtain, A. Vallier, Sault Ste. Marie; S. G. McAllister, Fort William.

Dominion.—Ideal Concrete, Ltd., Montreal; $50,000; L. N. Benjamin, G. Bowin, P. A. Bowin, L. A. Mongmais, L. A. Tye, Montreal.

The Maritime Light and Power Co., St. John, N.B., $100,000; J. R. L. Starr, J. H. Spence, L. Heal, A. Rogers, S. Whittaker, Toronto.

The General Development Corporation of Canada, Montreal, $1,000,000; H. E. Clothworthy, E. B. Robinson, H. A. T. Robinson, Lord Rosmead, W. G. P. Morden, London, Eng.; P. W. Moore, Drogheda, Ireland.

Dominion Stove and Heater Works, Montreal, $500,000; L. E. Kimpton, H. L. Mitchell, R. T. Heneker, W. C. Strachan, W. G. Mitchell, Montreal.

Sheldons Limited, Galt, $200,000; W. D. Sheldon, S. R. Sheldon, J. M. Sheldon, W. H. Sheldon, J. R. Blake, Galt, Ont.

Dynamic Machine Works, Montreal, $15,000; S. Humphreys, G. Humphreys, E. J. Fetherstonhaugh, L. Blackmore, W. G. Throsby, Montreal.

Telegraphone System of Canada, Montreal, $50,000; F. C. Hirsch, T. Hanley, R. Bartholomew, Montreal; E. Adler, Lachine; G. P. Mathewman, Ottawa.

The Interprovincial and James' Bay Mining Co., North Temiscamingue, Que., $20,000; A. Burwash, D. Lunam, P. Gibbons, R. S. Smith, North Temiscamingue; N. McCuaig, Bryson; M. J. Malone, North Temiscamingue.

The Dominion Foundry Supply Co., Montreal, $50,000; D. S. Donald, J. F. Gaffney, G. H. Weaver, E. W. Gilman, Montreal; E. H. Bennett, Bayonne, N. J., U. S. A.

Canada Smelting and Refining Co., Montreal, $15,000; G. P. McClure, M. J. O'Brien, T. J. Gates, W. Chagnon, F. H. Wilkinson, Montreal.

The R. P. Inglis Co., Montreal, $250,000; R. P. Inglis, G. Boulter, W. H. C. Mussen, F. H. Markey, R. C. Grant, Montreal.

The Moffat Fuel Saver, Ottawa, $100,000; N. J. Ker, J. G. Turiff, E. Seybold, A. Fleck, R. C. Tate, W. H. Ostrom, A. W. Fraser, D. MacMahon, J. Moffat, Ottawa.

Hydrogenic Fuel Company of Canada, Montreal, $100,000; J. C. Simpson, P. M. Robertson, S. A. McMurtry, F. H. Shaw, F. G. Bush, Montreal.