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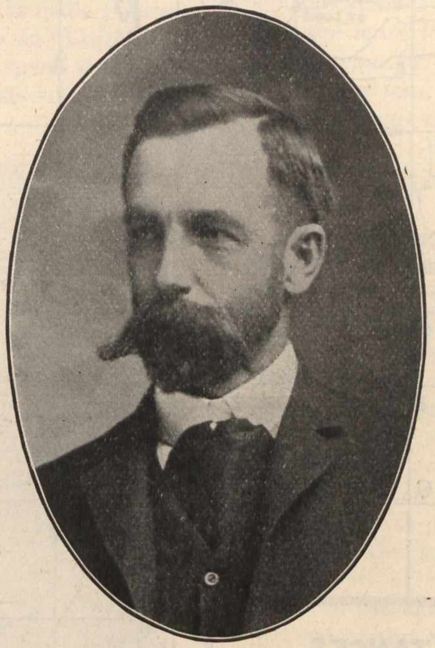
We judge ourselves by what we feel capable of doing; but the world judges us by what we have already done.

Longfellow.



WILLET G. MILLER,
Provincial Geologist of Ontario.

The inter-relation of the Sciences, is a fact which must appeal to every Canadian Engineer who looks northward today. Ontario statesmen, years ago perceived the possibilities of the rich agricultural lands on the 16,000,000 acre clay belt lying south of Hudson Bay; but the chances are, that the Government Railway would not be in existence even now, had it not been for the distinguished geologist whose portrait appears above. His report to the Ontario Government, 1901, on "Lake Temiskaming to the Height of Land," showed authoritatively for the first time, that the forest lands beyond North Bay, were abundantly rich in metallic ores, valuable minerals and precious stones. The first sod of the Temiskaming and Northern Ontario Railway was turned May 10th, 1902. In November, 1903, a construction gang working on this railway, drew the attention of the Bureau of Mines to some minerals with a pink bloom like that seen on purple grapes. Professor Miller, as expert, was deputed to make examination, and straightway pronounced the samples "rich in nickel, silver, cobalt, and arsenic." This was the first scientific discovery of the Cobalt ore deposits of Northern Ontario. It was logically appropriate, therefore, that he to whom the opening up of the North Countree to commerce and civilization was largely due, should be the originator of the name given to the now celebrated city of silver, viz.; "Cobalt:" which he did on June 7th, 1904.* The fine railway and its equipment described in the last and this issue, reflects great honor to the Engineer; but it was the Geologist who made it possible, hence, his place in our portrait gallery of men who have "done things."

Willet G. Miller was born in the County of Norfolk, Ontario, July 19th, 1867.

* See report of the Bureau of Mines, 1905. Part 2, page 10.

He began his education at Port Rowan High School, matriculating 1890, then entered Toronto University, graduating B.A., 1890-93; and received his M.A. degree in 1897. Fellow 1890-93. Examiner in Mineralogy and Geology 1893-95. Assistant in field geology on the Geology Survey of Canada—in the region north of Lake Huron, 1890-93. Professor of Geology in the School of Mining, Queen's University, Kingston, 1893. In charge of field works in geology, Eastern Ontario for the Bureau of Mines, 1897-1901. Appointed by the Ontario Government to the important post of Provincial Geologist in 1902: a position which he still holds with distinction. His post-graduate academic studies were carried on at Chicago and Harvard Universities, U.S.A.; and at Heidelberg, Germany. His special contributions to science, have been on the Archæan and economic geology of Eastern Ontario; in papers on corundum-bearing rocks, iron ores, gold deposits, etc., which have appeared in annual reports to the Ontario Bureau of Mines; articles in the "American Geologist;" and in addresses delivered before the Canadian Mining Institute, etc. His latest literary effort, is the publication of an admirable little work entitled, "Minerals and how they occur:" which will doubtless soon be adopted as the standard text-book on Mineralogy, in the Technical Schools of Canada. Professor Miller at the present time is in camp with his staff at Giroux Lake, Cobalt, making a topographical map of the now famous "Gillies Limit." On July 19th, (his birthday), they "discovered a good, fat, cobalt vein;" and so the daily work of unearthing the treasures of the Cobalt wonderland goes on. That the Provincial Geologist of Ontario may get some of these good things for himself, and live long and prosper, is the hearty wish of "The Canadian Engineer."

THE BRITISH ENGINEER IN MEXICO

THE TEHUANTEPEC RAILWAY.

By The Editor.

[Inasmuch as the Tehuantepec Railway represents one of the finest achievements in the annals of modern railroad engineering, we have deemed it an opportune moment to set before our readers a brief illustrated account of its reconstruction: especially as the work was done by a firm that floats the Union Jack. We are indebted for most of the descriptive data and illustrations, to Mr. James Millar Whitfield, of Toronto—one of the first engineers on the staff of Messrs. S. Pearson & Son, Ltd., who worked on the Tehuantepec Railway: also, to "Engineering News."—EDITOR.

Historical.

There is evidence, that Cortez in 1520, built a military road from the city of Tehuantepec on the Pacific, to the head waters of the Coatzacoalcos on the Atlantic, and that it was used for a hundred years. This route has always been looked upon by far-seeing men of affairs, as an ideal

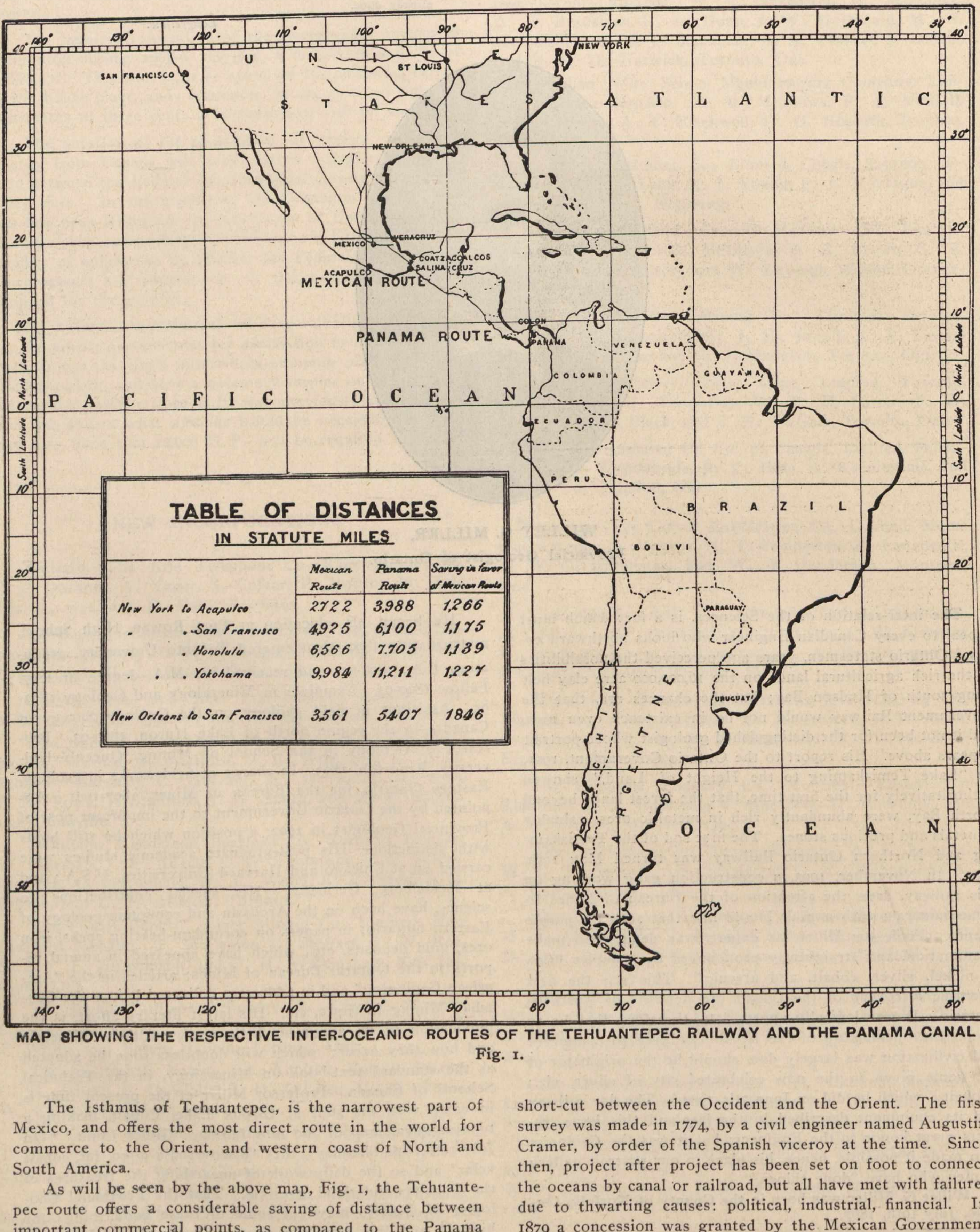


TABLE OF DISTANCES
IN STATUTE MILES

	Mexican Route	Panama Route	Saving in favor of Mexican Route
New York to Acapulco	2722	3,988	1,266
" " San Francisco	4,925	6,100	1,175
" " Honolulu	6,566	7.705	1,139
" " Yokohama	9,984	11,211	1,227
New Orleans to San Francisco	3,561	5407	1846

MAP SHOWING THE RESPECTIVE INTER-OCEANIC ROUTES OF THE TEHUANTEPEC RAILWAY AND THE PANAMA CANAL

Fig. 1.

The Isthmus of Tehuantepec, is the narrowest part of Mexico, and offers the most direct route in the world for commerce to the Orient, and western coast of North and South America.

As will be seen by the above map, Fig. 1, the Tehuantepec route offers a considerable saving of distance between important commercial points, as compared to the Panama Canal.

short-cut between the Occident and the Orient. The first survey was made in 1774, by a civil engineer named Augustin Cramer, by order of the Spanish viceroy at the time. Since then, project after project has been set on foot to connect the oceans by canal or railroad, but all have met with failure; due to thwarting causes: political, industrial, financial. In 1879 a concession was granted by the Mexican Government to an American—Edward Learned, of New York City—with a subsidy of $7,500 per kilometer. This grant was revoked in 1882, owing to failure to complete the road in the time specified in the contract; only 35 kilometers being finished. The Government settled with the company, taking over all the property on the Isthmus, and paying $125,000 in Mexican silver dollars, and $1,500 in United States gold. The Republic then placed the making of the railroad in the hands of a Mexican citizen, Don Delfin Sanchez, with a subsidy of $25,000 per kilometer of road built; but the progress made was miserable, so this contract was abrogated also, on April 25th, 1888; the Government paying $562,910 for material furnished and work done; also, $170,225—the equivalent of contractor's profits. The Government—authorized by Congress to build the road,—issued 5 per cent. gold bonds, the total issue being $13,500,000, which were sold to a German syndicate of banks at 70 per cent. of their face value. With the finances all in good shape, a contract was made February 27th, 1892, with Messrs Stanhope, Hampson and Corthell (an American firm of railroad contractors) to spend the $2,000,000 which remained from the issue of bonds—in an attempt

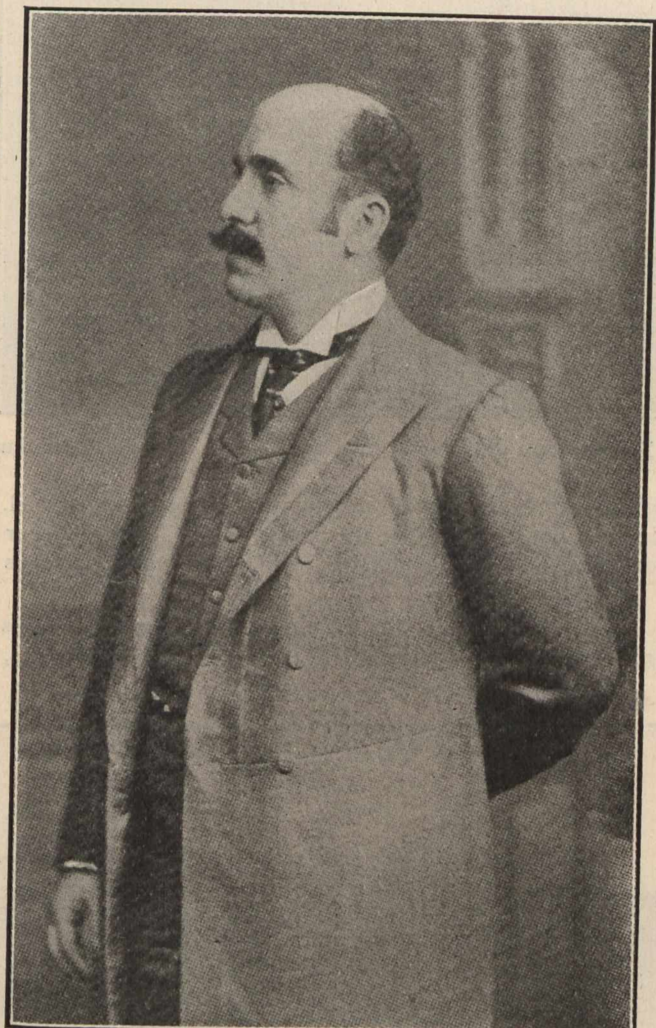


Fig. 2.—Sir Weetman D. Pearson, Bart., President of the Tehuantepec Railway of Mexico.

to unite the rails; for Learned had worked from the Atlantic, while Sanchez had started from the Pacific. By the year 1895 they had succeeded in closing the gap between the "ends of steel," and completed the railway right across the Isthmus, at a cost of $1,111,035.

It was soon found, however, that without terminal harbors of magnitude and proper appliances for handling heavy inter-oceanic traffic, the railroad would be a failure; hence the enterprizing Mexican Government, entered into a 51 years' partnership contract (dating from 1902), with a renowned firm of British contractors, viz., S. Pearson & Son, Limited, of London, for the complete reconstruction of the railway. Commenced in 1898, the work has now been practically completed, and the railroad is in active operation, transporting merchandise and the products of industry generally, across the narrow neck which connects North and South America.

Part Record of the Builders.

Prior to entering upon this great work, Messrs. Pearson, had executed for the Mexican Government a canal system for draining the valley of Mexico, and were at the time constructing a large harbor at Vera Cruz. Their successful building of the celebrated tunnel under the River Thames Blackwall, London, is one of the triumphs in constructive engineering, that men who take a pride in their profession, point out with pleasure to this day. And it is not to be wondered at, that the Pennsylvania Railroad Company—when they decided to connect their system at New York with Long Island City, by means of a series of 19-ft. subaqueous tunnels 3,900 feet long under the East River; probably the most formidable piece of underground engineering ever attempted by man—went out of the United States to England in 1904, and placed the contract in the hands of the engineers who have built the Tehuantepec Railway.

Geography, and Physical Conditions.

The Isthmus of Tehuantepec is situated in the southern part of the Republic of Mexico, in the States of Vera Cruz and Oaxaca. It is some 500 miles north, and 900 miles west of the Isthmus of Panama: geographically between 16° and 18° north latitude, and 94° and 95° longtitude west of Greenwich. The distance across from ocean to ocean as the crow flies, being about 125 miles; whereas the Panama Isthmus is only 45 miles. A noted topographical feature is, the comparatively level character of the land. The rise from the Atlantic or Gulf side is quite gradual, culminating in the Chivela Pass at a height of only 730 feet, from whence the descent to the Pacific is somewhat abrupt. This elevated land is part of the Sierra Madra Mountain range—an extension of the Rocky Mountains of the United States on one side, and of the Andes of South America on the other. This range which forms a rocky backbone to the continent, extending the whole length of the Mexican territory, with an altitude of from 5,000 to 8,000 feet, is here depressed to an altitude of only 924 feet above sea level. This gap of about 50 miles wide, and which marks the topographical boundaries of the Isthmus, is an instance of the manner in which Nature often co-operates with the designs of man.

Climate.

Although the Tehuantepec Isthmus is well within the Tropics, being in about the same parallel of latitude as Southern Arabia, and Southern India, hence might seem to indicate an extremely hot climate, it is in reality nothing near so torrid as we might reasonably expect; probably due to its location in such close proximity to the two oceans; but more especially to the fact that it lies within the gap between them, through which a light ozone breeze is constantly blowing, mitigating the tropic heat, and producing a mild, humid, agreeable climate.

While it is warm in the sun, it is always cool in the shade, the temperature in the three climatic zones, varying from 60° to 100° Fahrenheit. Observant travellers declare, that in this Isthmus as great a change of climate and native products may be obtained in a few hours trip, as would be possible in a journey of a thousand miles in any part of North America. The profile map, Fig. 3, shows that from the Gulf of Mexico to the top of the plateau or watershed where the second zone begins, the distance is not over 90 miles; across the summit of the pass it measures some 10 miles; and it is about 25 miles from the southern edge of the latter zone to the Pacific Ocean: a distance of 125 miles in all. If we were to look down from the wing of a heron in its flight over these three zones, we should see a wonderful difference in the character and color of the vegetation which marks each

Commercial Possibilities.

of the climatic belts. The fertile Gulf watershed with its many streams of pure water glittering in the golden sunlight, as they rush down from the hills into the broad rivers,* which separate the dark green jungles and immense tropical forests of wild rubber, mahogany, cacao, etc.; is in striking contrast to the narrow zone of the high lands, with its spread of short, wiry, yellow bunch grass, and dull, dry pine forests; while in still greater contrast is the third zone, with its brown, barren, rugged, shallow ravines, running down in lines from the top of the Pacific watershed for a short distance, then losing themselves in the broad, sandy desert which stretches away to the shores of the Pacific Ocean.

Such is a panoramic view of the country across which are laid the tracks of the Tehuantepec Railway.

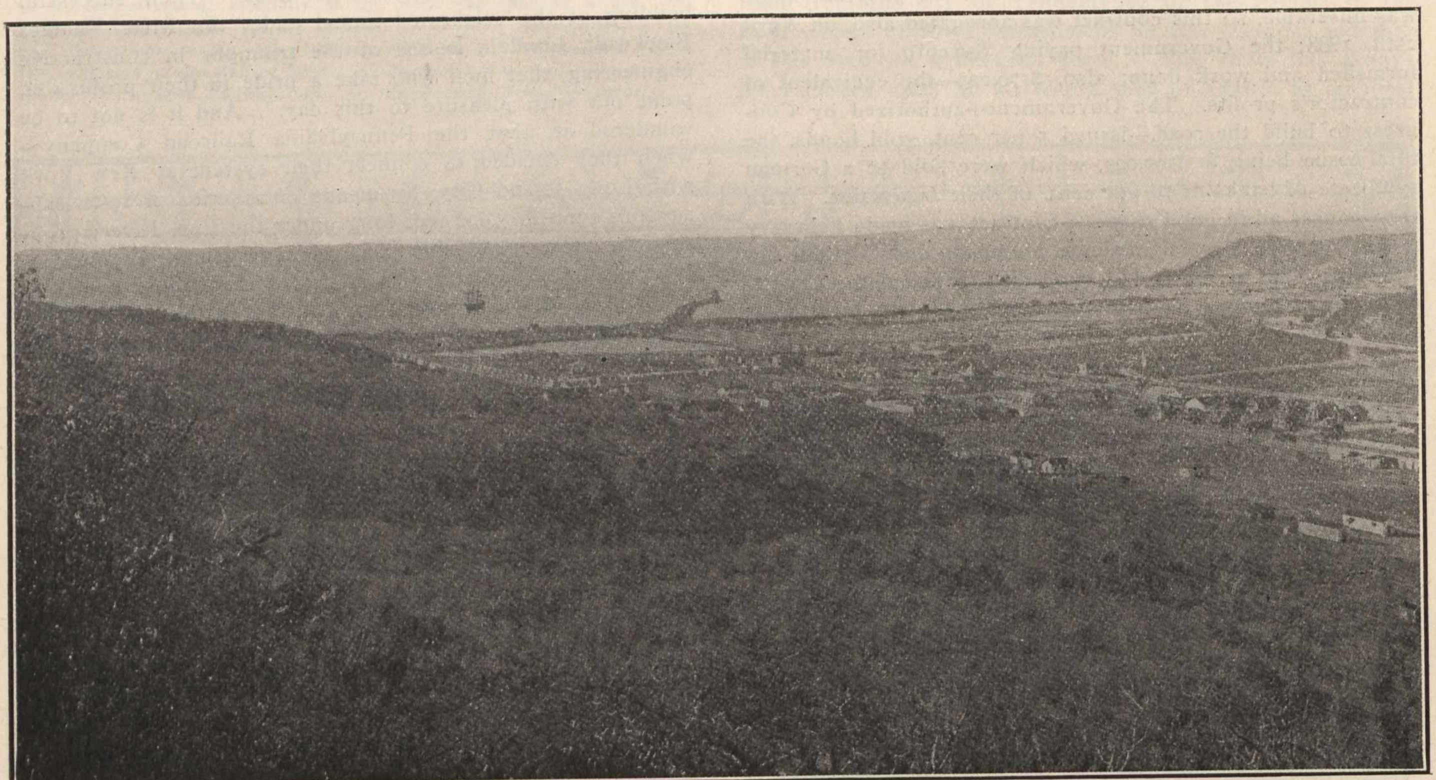


Fig. 3.—General View of the Harbor of Salina Cruz, Showing the two Breakwaters Advancing into the Ocean. Pacific Terminus.

Construction and Equipment.

The reconstruction of the railway—which is 189 miles long, and of United States standard gauge, viz., 4 feet, 8½ inches—began in 1898. The light pioneer road, had undulating grades, numerous sharp curves, narrow cuttings, unsubstantial embankments, and flimsy wooden tressels and bridges. The treacherous condition of the old road may be gathered from Mr. Whitfield's narration of personal experiences. He says:—"To show the condition of the road at that time (1899), the writer took one of the big engines, (Baldwin Mogul freight locomotive), out on a trial trip—the first over the road—and we ran off the track 26 times in 40 miles!" . . . "The locomotives were fired with wood, and sometimes on a heavy grade, and owing to green fuel, we would get stalled. One Christmas Day, I lost my dinner (roast beef and plum pudding!) owing to being stalled thus in the Chivela Canyon."

The first work of Sir Weetman D. Pearson and his engineering force, consisted in tearing up by the roots, the old shifty track, and ballasting 66% of the roadbed with 12 to 15 inches of crushed stone, and the remainder with gravel. Then replacing the rotten, unseasoned sleepers with ties made of American pine, California redwood, or hardwood from the Tehuantepec forests, having Servis steel tie plates and securing thereon, 80 lb. steel rails in place of the old 56 pounders. The ties were laid 13 or 14 to a rail length of 30 feet. The new grades are limited to 1.6% (compensated for curvature) and the curves to 8%, or a minimum radius of 492 feet. The only tunnel on the line is 300 feet long.

Fig. 4.—The Breakwater at Salina Cruz.

* The Coatzacoalcos river for 20 miles up from its mouth is a magnificent waterway, varying from 1 1-2 to 3-4 of a mile in width, and from 20 to 60 feet deep.

Originally there were 838 wooden tressels and bridges along the route; these have been reduced to 257, all being constructed of iron or steel; the longest 200 feet, the shortest 50 feet. This wholesale elimination was achieved by filling in tressels, and replacing the smaller span bridges with culverts in solid banks. The bridges were designed for consolidation (2—8—0) engines, with 44,000 lbs. per driving axle, and train loads of 4,000 lbs per foot of track.

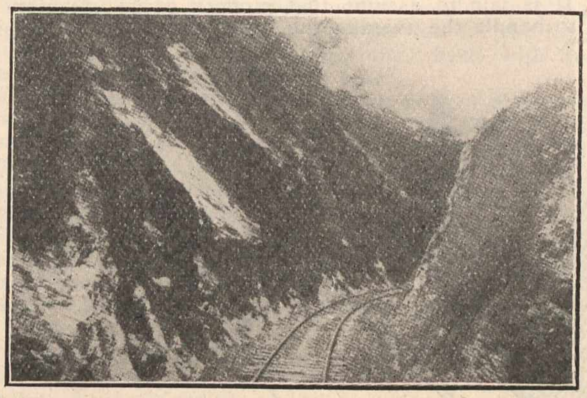


Fig. 5.—Example of Rock Cutting.

According to Mr. Whitfield, there were in 1899, 16 engines mostly of Belgian make, with two heavy Baldwin Mogul freight locomotives. The heaviest engines (2—8—0) are of 67 ton consolidation; ten wheel type (4—6—0) are also in use. Some of the engines were designed for oil fuel, and others are being fitted to use this fuel. Oil from Beaumont, Texas, is used, being brought by tank steamers to Coatzacoalcos, where there is a storage tank of 1,500,000 gallons' capacity. It is distributed to 6,500 gallon tanks located at various stages along the railway. Since oil has been discovered on the Isthmus, it is expected shortly to furnish from the local wells, all the oil needed for engine fuel. Many of the box freight cars are provided with roof openings 10 x 8½ feet, covered by steel sliding doors for facilitating the direct haulage of freight by the dock cranes. The rolling stock equipment comprises a special weed-killing car, from which is sprayed by steam a hot chemical solution, over the rank vegetation which grows almost in a night on the tracks in the humid tropical section of the Gulf watershed. The main workshops were at first located at Coatzacoalcos, but have been removed to Ruicon Antonio, at the height of land, where a model town for the employees has been laid out. The average weight of freight trains is 560 tons, and the trip across the Isthmus is made in 13 hours by freight, and 9 hours by passenger trains. There are 30

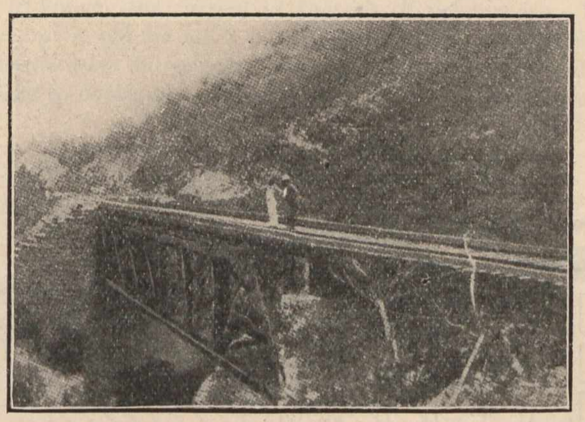


Fig. 6.—Typical Steel Bridge.

passing sidings, 2,000 to 3,000 feet long, with a maximum distance of seven miles between sidings. The present traffic is 75,000 tons per month.

Harbors and Terminals.

At Coatzacoalcos, the Atlantic terminus, there was at first an old-fashioned wharf, two or three hundred yards up the river, with a shallow sand-bar at the mouth, over which it was impossible for large steamers to ride in during the "northers," i.e., "a very rough sea with a gale of wind blowing from the north;" a phenomenon of frequent occurrence. But as the wide river is 50 feet deep, and hence provides an admirable inland harbor, it was only necessary to increase the depth of water at the bar from 12 to 30 feet, to admit the largest vessels afloat at all tides. This will be accomplished in a few months by dredging, aided by the converging jetties or training walls 4,265 feet long, built of loose quarry rock. The old wooden wharf has been replaced by a series of structural steel wharves, having a total frontage of 3,640 x 85 feet wide, supported on 6" solid steel piles, and decked with timber. The wharf tracks are to have six 5 to 10 ton electric cranes; six 10 to 20 ton steam cranes; six sets of conveyors and electric capstans for handling cars; which, together with the lighting of the adjoining town, are operated from a central power station. Behind the wharves and steel sheds is the railway terminal yard, embracing 13 miles of tracks. Gravity is utilized on these tracks—a system which though claimed as American, is said to have originated in Great Britain.

At Salina Cruz, the Pacific terminus, the works are more extensive, and include an outer harbor formed by two huge, curved breakwaters, reaching out 3,280 feet and 1,900 feet long respectively, into 60 feet of water, and embracing an area of about 20 acres, with an inner tidal basin nearly three-quarters of a mile in length, which has been dredged out to a depth of 33 feet at low water on the site of the old town.

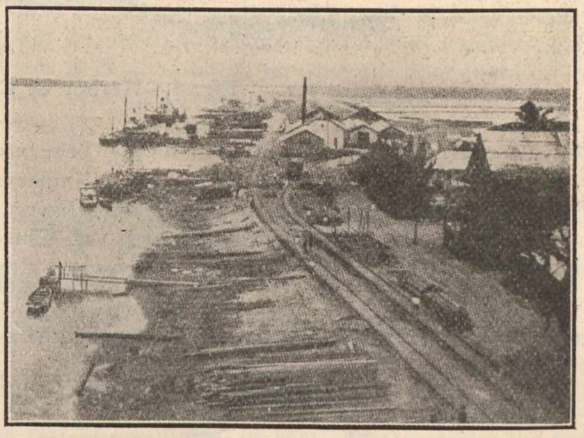


Fig. 7.—Coatzacoalcos Harbor: Atlantic Terminus.

The capacity of this basin can be more than doubled when increase of traffic demands. The wharf system and general traffic equipment is similar to that at the Gulf terminus, to which has been added a commodious graving or dry dock, 600 feet long, 100 feet wide, and 31 feet deep, and is thus capable of accommodating the largest vessels. At the wharves, berths for two 12,000-ton steamers are to be ready this month.

As the original village was on the site of the inner basin, a new town has had to be built on higher ground, near the harbor, as shown on Fig. 3. It is laid out in open squares, and supplied with modern systems of drainage, water supply, and electric lighting.

Minor steamship lines are already using the two ports; and it is calculated that by September, 1906, the harbor works at each end will be practically completed, and the whole transit system of the Tehuantepec Railway ready for transcontinental traffic; enabling the largest ocean-going vessels to discharge or load the heaviest freight alongside the commodious wharves, in all sorts of weather.

The commercial advantages of the Tehuantepec route as compared with that of Panama, were admirably set forth in an official report to the United States Government in 1870, by Admiral Shufeldt. He says:—

The fact that Tehuantepec is nearer to the "Axial" line of commerce of the world—Hong-Kong, Yokohama, San Francisco, New York, Liverpool—gives this route great advantages over Panama. An inspection of a globe will show that the shortest ocean route from Panama to the East—Hong-Kong, Yokohama—must pass along our coast to at least off San Francisco. In fact, the shortest line, the great circle, drawn between Panama and Yokohama, passes through the Gulf of Mexico at Corpus Christi, more than one hundred miles east of San Francisco, and through the Aleutian Islands. We may assume that the average saving in distance by the Tehuantepec route over Panama to all points on our Atlantic coast, and to Europe is about twelve hundred and fifty miles. The ordinary freight steamer makes about ten miles an hour, or say two hundred and fifty miles a day. Assuming the time of crossing the two isthmuses to be the same, it will take a steamer about one day to pass through the Panama Canal, and the freight about two days to pass over Tehuantepec from ship to ship, leaving still four days to the average of Tehuantepec.

This railroad constructed in a most substantial manner, and provided with the very best facilities, equipment, etc., in order to handle a large amount of traffic at the minimum cost per ton. Modern machinery and methods will enable this railroad to conduct a profitable business at a rate of not to exceed $2 a ton from ship hold to ship hold, and with the best modern loading and unloading facilities, proper wharves, warehouses and harbor terminals, the time from ship to ship should not exceed an average of two days.

It is fair to assume that modern cargo steamers are able to handle the average run of ocean freights with profit

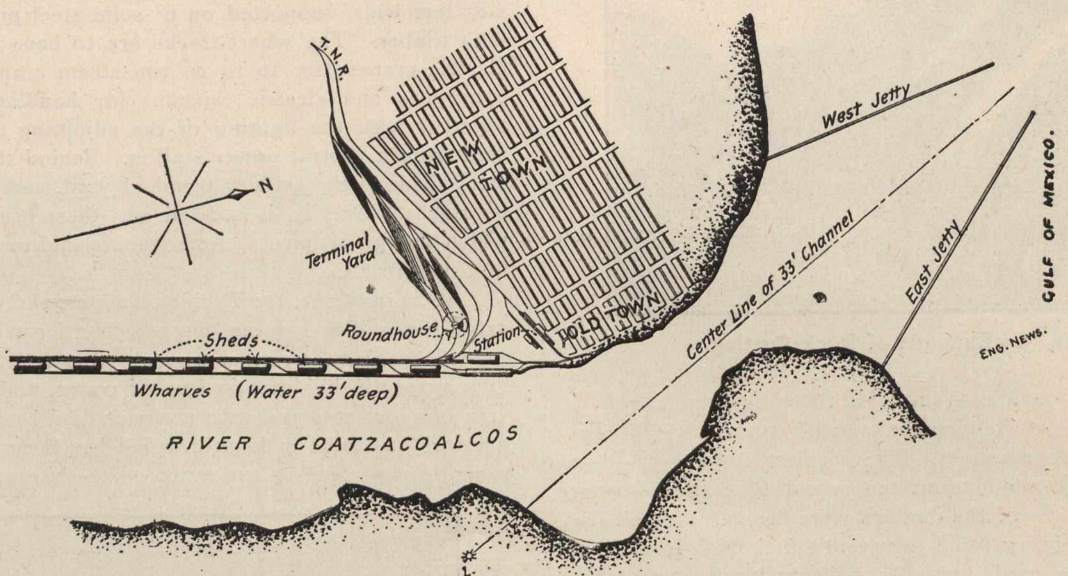


Fig. 8.—Harbor at Coatzacoalcos: Atlantic Terminus.

But a more recent verdict in favor of the Tehuantepec route, is that of Mr. J. F. Wallace, (late Chief Engineer to the Panama Canal Commission), in an address delivered before the Illinois Manufacturers' Association at Chicago, March 2nd, 1906. He said:—

While the construction of the Panama Canal will confer great benefits on the commerce of the world, the com-

on a basis of one-tenth of a cent per ton per mile, or, in round figures, $1 per 1,000 miles. The advantages of the Tehuantepec route over the existing route to the far East by way of the Suez Canal are as follows:—

From New York to Australia, say the port of Sydney, the saving of distance by way of the Tehuantepec Railroad would be 5,700 miles, and any railroad rate across the Isthmus of Tehuantepec, less than $5.70 per ton, should take this business from the Suez route. In addition it would

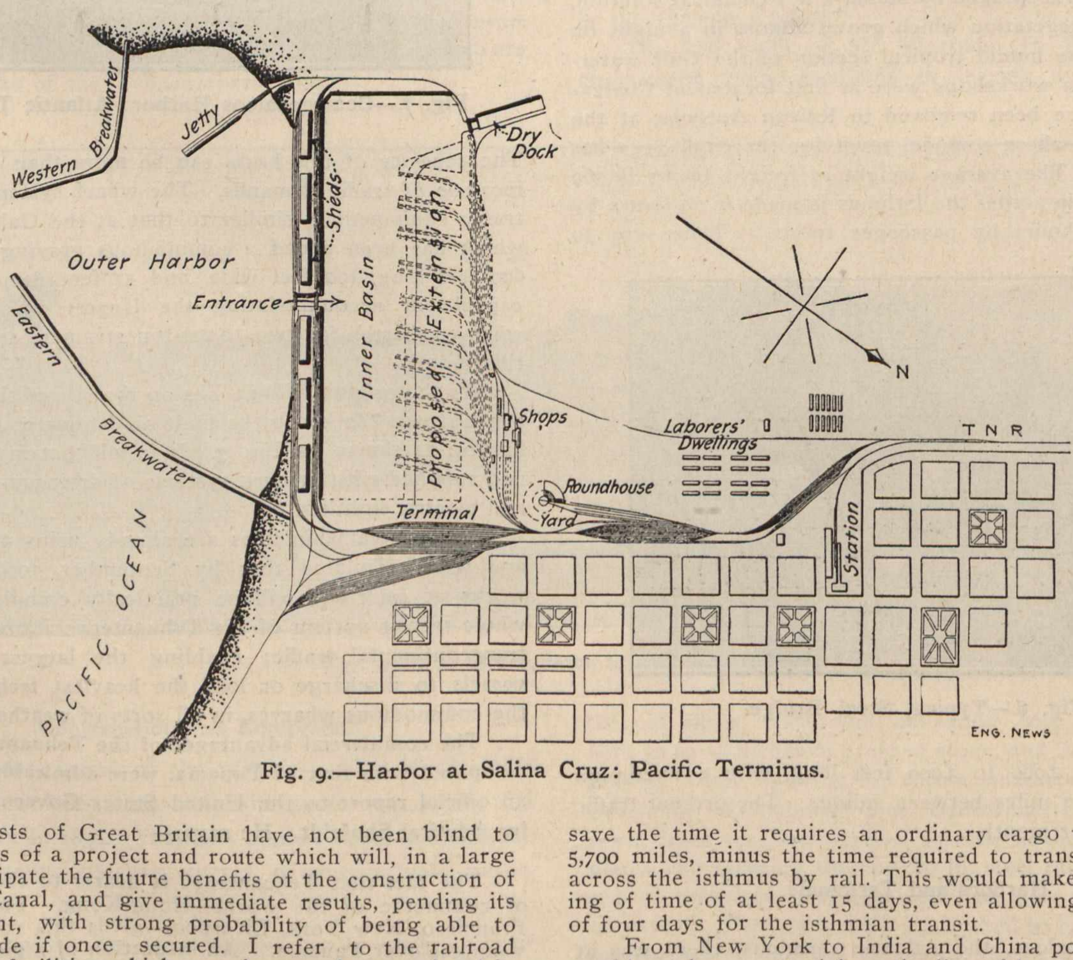


Fig. 9.—Harbor at Salina Cruz: Pacific Terminus.

mercial interests of Great Britain have not been blind to the possibilities of a project and route which will, in a large measure, anticipate the future benefits of the construction of the Panama Canal, and give immediate results, pending its accomplishment, with strong probability of being able to retain the trade if once secured. I refer to the railroad transportation facilities which are about to be completed in the interests of British capitalists, across the Isthmus of Tehuantepec, a distance of about 176 miles.

save the time it requires an ordinary cargo vessel to steam 5,700 miles, minus the time required to transfer the freight across the isthmus by rail. This would make an actual saving of time of at least 15 days, even allowing the maximum of four days for the isthmian transit.

From New York to India and China points, this route would not be so material, as the line of least resistance from a traffic standpoint would be over the transcontinental lines through San Francisco, Seattle and other Pacific ports.

From Liverpool to points in the Far East where the distance is the same, the Tehuantepec Railroad would charge the Suez tolls, which are approximately $2 per ton, and compete for the business with a fair profit.

Turning to the ports, however, in the United States, the advantages given by this route are also remarkable. From New Orleans to Hong Kong the saving would yield the Tehuantepec Railroad $4.80 a ton on the basis of equivalent charges by the Suez route, in addition to saving from twelve to fourteen days in time.

From New Orleans to Yokohama the saving over the Suez route would be 8,400 miles, which would enable the Tehuantepec Railroad to charge $8.40 per ton for the transit of freight on its railway on an equivalent basis with Suez, and save approximately 24 days in time.

From New Orleans to Australia, the port of Sydney, the figures would be practically the same. As there is little question of the ability of this railroad to handle freight from ship to ship for $2 a ton or less, its ability to build up an enormous business to the Far East in competition with the Suez route is plainly manifest.

Let us now compare the Tehuantepec route with that of the Panama Canal, on the same assumption that $1 per ton will carry ocean freights 1,000 miles, and that $1 per ton will be the minimum rate charged for transit through the canal.

From Liverpool to Hong Kong, the saving in distance via Tehuantepec will be 1,200 miles, and allowing two days for the transit of the freight across the Isthmus of Tehuantepec, the saving of time will be approximately two days. The saving in distance will be equivalent to $1.20, which, added to the minimum charge of $1 through the Panama Canal, would give $2.20 as a maximum charge to the Tehuantepec Railroad.

From Liverpool to Yokohama the saving, as against the Panama route, will be 1,100 miles. From New York to Australia, port of Sydney, the saving will be 761 miles, which, on the same basis as just stated, would yield the Tehuantepec Railroad a maximum charge of $1.76 a ton, or approximately 1 cent per ton per mile some 40 per cent. higher than the average rate on the trunk lines in the United States.

From New York to San Francisco the saving will be approximately 1,200 miles, which would yield $2.20 as a maximum rate to the Tehuantepec Railroad.

From New Orleans to Hong Kong, a common point for northern China, the saving of the Tehuantepec line over Panama is approximately 2,000 miles, which would permit the Tehuantepec Railroad to charge a maximum of $3 per ton on an equivalent basis, and save in time approximately five days.

From New Orleans to Australia, port of Sydney, the saving would be approximately 1,400 miles, allowing the Tehuantepec Railroad a maximum charge of $2.40.

From New Orleans to Honolulu the saving would approximately be 2,000 miles, permitting the Tehuantepec Railroad to charge a maximum rate of $3 per ton.

From New Orleans to San Francisco the saving in distance via the Tehuantepec route would be 1,800 miles, permitting the Tehuantepec Railroad to charge a maximum of $2.80 a ton, with corresponding saving of several days in time. The advantages of Tehuantepec over the Suez and Panama routes in the saving of money and time make it self-evident that in the years that will elapse before the completion of the Panama Canal our British cousins will undoubtedly build up a large and profitable business which it will be difficult thereafter to divert back to the Panama route.

Such, briefly told, is an account of the building of one of the most remarkable railroad enterprises in the world. That the work was done by British Engineers, is a matter in which every citizen of the Empire can take pride. And not only is the achievement worthy of attention from an engineering standpoint; but its commercial possibilities in the interests of all parts of the British Empire, are manifest; for it should not be forgotten, that this railway until 1953 (47 years) will be under the control of British capitalists, viz., S. Pearson, & Son, Limited, who are the administrators and managers of the "National Railroad Company of Tehuantepec."

THE ELECTRIC FURNACE: ITS EVOLUTION, THEORY AND PRACTICE

By Alfred Stansfield, D. Sc., A.R.S.M., Professor of Metallurgy in McGill University, Montreal.

Article IV.

Electric Furnace Design, Construction and Operation.

An electric furnace consists essentially of some substance R, (Fig 21), through which an electric current flows, and of an envelope C, which retains the heat and the contents of the furnace. Carbon electrodes, A and B, are usually needed to convey the current in and out of the furnace. If the envelope could be made perfectly heat tight, and if no fresh charge were introduced during the operation, it would be possible to obtain any temperature in R up to the volatiliz-

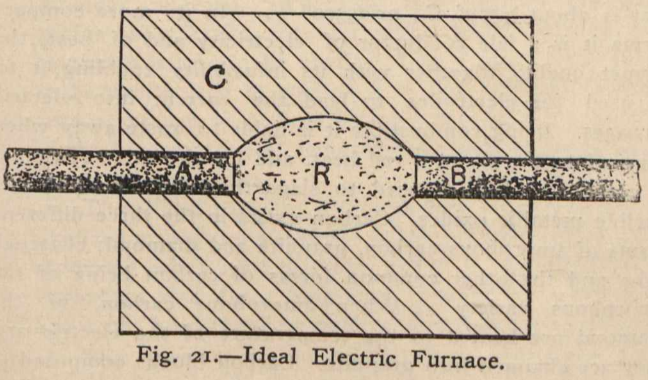


Fig. 21.—Ideal Electric Furnace.

ing point of the contents of the furnace, with the smallest electric current, provided it were allowed to pass for a sufficient length of time. With the materials actually available for furnace construction this is not possible. For a definite size and construction of furnace, a definite rate of heat production will be needed in order to attain any particular temperature.

The rate of production of heat is measured by the number of Watts supplied to the furnace, and may conveniently be stated in Watts per cubic inch, or Kilowatts per cubic foot of the interior volume of the furnace. The rate of heat production which is necessary to enable a certain temperature to be attained, may be calculated from a consideration of the area, thickness and conductivity for heat of the walls of the furnace; but it is more easily obtained by reference to furnaces of similar construction which have attained definite temperatures with definite consumption of electric power.

The above considerations apply more particularly to an intermittent furnace such as the Moissan, or Stassano furnaces, in which a charge of ore or metal is submitted to the heat of the electric current until it has all been reduced or melted, and the whole of the furnace and its contents has been heated to a uniform high temperature. In the case of a continuous furnace, such as the Héroult furnace recently employed to smelt iron ores at Sault Ste. Marie, a constant stream of cold material enters the furnace, and after reduction and fusion, is tapped out as molten pig and slag, only a portion of the contents of the furnace being heated at any one time to the smelting temperature. In such a furnace the temperature attainable is limited by the melting temperature of the charge; any increase in the rate of heat supply will serve mainly to increase the rate of smelting, without materially increasing the temperature of the furnace. It is like melting ice in a pail, the ice melts faster on a hot day than on a cool one, but the water surrounding the ice will not become warm as long as there is any ice left to melt. Even in such a furnace the charge must ultimately be heated to the smelting temperature, and a definite rate of heat supply is needed if the furnace is to smelt at all.

Materials of Furnace Construction.

The materials for constructing the interior of electric and other furnaces, should be infusible at the temperature of the furnace; should resist the action of the metallic slags or other contents of the furnace; should retain the heat of the furnace as far as possible, and should be capable of being formed into bricks, or coherent linings which will resist the mechanical action of the charge in the furnace. The following are a number of the more important materials which can be employed.

Fireclay Bricks. The clay from which these are made consists of pure clay, or kaolin, Al_2O_3, $2SiO_2$, $2H_2O$, with a variable proportion of silica in addition to the amount present in the kaolin, and as little as possible of fluxing materials such as iron oxide, lime, magnesia, potash or soda. Even silica lowers the melting point, and should be present only in moderate amount. These bricks are largely used for lining ordinary metallurgical furnaces, but are not usually sufficiently refractory for electric furnaces; they can, however, be used as a backing for more refractory material. Being siliceous in composition, they are easily fluxed by slags containing metallic oxides. When not exposed to such slags they will stand temperatures up to about 1,400° C.—1,800° C., 2,500° F.—3,300° F. They should be laid in fireclay mud, instead of lime mortar, which would crumble away at a red heat.

Silica Bricks. These should contain about 95% to 97% of silica, SiO_2. The melting temperature of silica is a little above that of platinum, being about 1,830° C., or 3,330° F., and the silica brick should stand up to about 1,750° C., or 3,180° F. They are useful for the roof and other parts of open-hearth steel furnaces, that are exposed to a very high temperature, but not subjected to the action of metallic slags, which would soon flux them away. They have the property of expanding with the heat, instead of contracting like fire-clay bricks. Silica bricks should be laid in a siliceous mud for mortar, and in general, all refractory bricks should be laid in a mortar of the same composition as the brick, to avoid fluxing; thus it would not do to lay basic brick in siliceous mortar, as the mortar would combine with and flux part of the brick.

Lime, CaO. This is an extremely refractory material, and is useful for lining small electric furnaces. Its melting temperature is not exactly known, but may be about 2,040° C., or 3,700° F. Lime is obtained by burning limestone, (CaO, CO_2), thus driving off the carbon dioxide which it contains. Burnt lime absorbs moisture from the air and slakes, forming the hydroxide CaO, H_2O. Lime mortar contains slaked lime, and when it is heated in a furnace, the water that is combined with the lime is driven off, and the mortar crumbles away. Lime cannot be made into fire bricks by mixing it with water, as the bricks would crumble in the furnace, and it is difficult to render lime coherent by the use of any other material. This difficulty of binding and liability to slake has prevented the general use of lime for furnace linings. Small electric and oxy-hydrogen furnaces may be constructed of blocks of quick-lime or of the natural limestone which becomes converted internally into lime during the operation of the furnace. Being basic or non-siliceous in character, lime will resist the action of metallic slags, and it would form a valuable material for lining electric and other furnaces if it were not for the objections already mentioned. The use of lime in the electric furnace is also limited by its property of forming a fusible carbide when heated with carbon.

Magnesia. (Burnt Magnesite, Magnesite Bricks) MgO. Magnesia is even more refractory than lime, melting at perhaps 2,200° C., or 4,000° F. It is produced by burning magnesite (MgO, CO_2), thus driving off the carbon dioxide, in the same way that lime is produced from limestone. Although it resembles lime chemically, magnesia does not slake very easily, and when strongly burned it shrinks considerably, forming a heavy material very different from the light, chemically prepared magnesia which is used as a medicine. This shrunk magnesia can be cemented together to form a moderately strong fire-brick, which is extremely valuable for lining basic open-hearth furnaces and electric furnaces. It is not easily fluxed by metallic slags, since it is basic in composition. On account of their great compactness (a brick weighs about 8½ lbs.), they are very good conductors of heat, being about twice as good as fire-clay bricks, and in constructing electric furnaces of magnesite bricks an outer coating of some other material should be used to diminish the loss of heat, except when this cooling is desired to prevent the fluxing of the walls. Magnesite bricks are liable to crack under the influence of heat unless it is gradually applied. Their property of contracting when heated renders them unsuitable for building the arched roofs of furnaces, and silica bricks would be used for this purpose except in furnaces where the roof was exposed to a temperature at which they would melt. Furnace linings may also be constructed of burnt magnesite in the form of a powder; it is mixed with tar or pitch to make it bind, and rammed into place around a core by means of a hot iron rod. Magnesia does not combine with carbon to form a carbide, and on this account its use in the electric furnace is preferable to that of lime. Electrically fused magnesia has recently been obtained, and forms a very compact and refractory material for lining electric furnaces, or it may be applied as a paste mixed with silicate of soda to render ordinary fire-clay bricks more refractory.

Dolomite. This is a limestone containing a considerable proportion of magnesite, and when burnt it forms a valuable refractory material, which, like burnt magnesite, may be employed as a powder, or in the form of bricks. It resembles magnesite, but is not quite so good.

In furnaces constructed partly of silica bricks, and partly of dolomite, or magnesite bricks, it would be expected that they would flux one another at the line of contact. On this account, a course of chromite brick is sometimes introduced as a parting layer between the two, as this brick, itself very refractory, does not easily flux with either acid (siliceous) or basic materials. When magnesite bricks are used, however, it is found that this precaution is unnecessary.

Alumina, Al_2O_3. This is prepared from the mineral bauxite (Al_2O_3 $2H_2O$), which is also the source of the metal aluminium. Bauxite has long been used as a lining for furnaces, and recent attempts at purification with a view to improving it for use as a refractory material, have been successful; and the purified, calcined bauxite, bonded with a little fire-clay, sodium silicate, or lime, makes an excellent brick; which appears to be as good as magnesite brick for use in the basic open-hearth furnace. It is also said to be a good lining for rotary Portland cement kilns, and for lining lead refining furnaces, where they are exposed to the fluxing action of corrosive lead slags. Alumina is classed as a basic material, like magnesia or dolomite, and its melting temperature is stated to be about 2,200° C.

Carbon. (Coke, charcoal, Graphite). Carbon is the most refractory substance known; it has never been melted, but softens and volatilizes at the temperature of the electric arc, that is about 3,500° C., or 6,300° F. In its more compact forms it is a fair conductor of electricity and of heat, the former quality together with its infusibility enabling it to be used for electrodes to lead the current into electric furnaces. Being combustible it is liable to waste away when exposed to the air at a red heat, and for the same reason it is corroded when exposed to slags that contain easily reducible metallic oxides. Carbon exists in the three different forms of amorphous carbon, graphite and diamond; charcoal, coke and the other common forms of carbon being of the amorphous variety. When amorphous carbon, or the diamond are heated to the temperature of the electric arc, they are changed into graphite. Carbon blocks composed of coke or graphite can be used for lining furnaces, provided they are not exposed to air or to oxidising slags, but carbon has not been much used for metallurgical furnace linings. In the electric furnace it is often employed, forming a lining which also serves as an electrode, as in the Héroult iron smelting furnace, the aluminum furnace, (Fig. 5, p. 172), and the Wilson carbide furnace (Fig. 7, p. 172); but it cannot usually be employed for the entire lining, because it is so good a conductor of electricity that the current would tend to be short-circuited by the lining instead of passing through the charge or resistor in the furnace. Coke powder can be used for lining parts of furnaces, using pitch or tar as a binder, and such linings will conduct the electric current and may be used as electrodes. In experimental work a lining of charcoal powder cemented with molasses and water may sometimes be used, and has the advantage that it retains the heat of the furnace very well, and being a poor electrical conductor, it can be used for the entire lining without fear of short-circuiting the current. If exposed to the air, however, it will burn up completely if it once reaches a red heat. Graphite is a better conductor of electricity and of heat than amorphous carbon, and is less easily oxidised by air or metallic slags; hence, electrodes are often composed of it. Graphite is often used in the construction of crucibles, the graphite being mixed with its own weight of fire-clay. The graphite renders the fire-clay refractory, and the fire-clay protects the graphite from oxidation. These crucibles are not so refractory as the graphite alone would be, and for electric furnace experiments, crucibles may be cut out of a block of graphite or retort carbon.

For lining electric furnaces, when carbon is undesirable, some products of the electric furnace itself are very suitable. They are not so refractory as carbon, but are more refractory than the other furnace materials such as magnesia, silica, lime or alumina.

Carborundum. This is produced by heating silica and carbon to a very high temperature in the electric furnace. It has the formula SiC, is crystalized, and besides being valuable as an abrasive, it forms a very refractory furnace lining. The carborundum powder can be made to cohere by the use of fire-clay (6 parts of the powder to 1 of fire-clay), or, by a solution of silicate of soda, or water glass, which should be very dilute if the highest temperatures are to be reached, as the silicate of soda makes the carborundum less refractory. Tar or glue can also be used as binding materials, and a very strong brick can be obtained by using glue as a temporary cement and exposing the moulded article to an oxidizing atmosphere at a high temperature for some hours, when the partial oxidation of the carborundum furnishes silica which acts as a permanent bond.

Carborundum Fire-Sand. This is a name applied to the uncrystalized variety of carborundum, which is found in the cooler parts of the carborundum furnace. It only differs from carborundum in not being crystalized, and can be used in the same manner as a refractory material.

Siloxicon. This is made in the same manner as carborundum, but less carbon is used in the charge, with the result that the silica is not completely reduced, and the resulting substance retains some oxygen. The composition is not constant, as a series of compounds are formed, but a typical formula is Si_2C_2O. This forms a refractory material for lining furnaces, and may be made to cohere by grinding to powder, moistening with water, and strongly firing the moulded material. Probably this oxidizes the siloxicon grains superficially, forming silica which acts as a bond. Siloxicon is said to be unaffected by acid or basic slags, and to be undissolved by molten iron, but although this may be true at moderate furnace temperatures it can scarcely hold at the higher range of temperatures such as are produced in the electric furnace.

The silicon carbides, although very refractory, are slowly oxidized at high temperatures in the presence of air, siloxicon oxidizing when heated above 2,674° F., or 1,470° C. Carborundum was, for a long time thought to be unoxidizable, but it has been found to oxidize slowly at high temperatures.

The temperature to which these substances may be heated is not exactly known, but they are less refractory than carbon, being dissociated into graphite and silicon vapour at the highest electric furnace temperatures. They can be used in some forms of electric furnace as a layer protecting some less refractory material such as fire-clay or magnesite bricks, and applied as a paint mixed with silicate of soda they improve very materially the lasting qualities of fire-clay bricks in ordinary metallurgical furnaces. Further information with regard to these products of the electric furnace can be found in the "Electrochemical and Metallurgical Industry," and other journals.

Table III.

Refractory Materials.

Material.		Melting Temperature.	
Fire-clay brick. Kaolin with additional silica		1,400° C. to 1,800° C.	2,550° F. to 3,270° F.
Silica brick. Silica with binding material		1,700° C. to 1,800° C.	3,100° F. to 3,270° F.
Silica (pure)		1,830° C.	3,330° F.
Lime (pure)	about	2,040° C.	3,700° F.
Magnesia brick	"	2,100° C.	3,800° F.
Bauxite brick	"	2,100° C.	3,800° F.
Magnesia (pure)	"	2,200° C.	4,000° F.
Alumina (pure)	"	2,200° C.	4,000° F.
		Decomposes.	
Siloxicon, Si_2C_2O. **Carborundum fire-sand**, SiC (amorphous) **Carborundum**, SiC (crystallized)		2,200° C. to 2,900° C.	4,000° F. to 5,200° F.
Carbon	boils	3,700° C.	6,700° F.

Note. Very little reliable information with regard to the melting temperatures of refractory materials is available and the above table must be regarded as an attempt to combine what little there is, in the hope that experimenters may be induced to supply the missing information. With regard to silica, the writer, a number of years ago, found the chemically pure material to be a little more refractory than platinum, say 1,800° C., while Boudouard has recently stated it to be 1,830° C. The data for alumina, lime and magnesia are very confusing; Moissan states that alumina is more fusible than lime, and magnesia less fusible than lime, but other figures given for their melting points give magnesia as 1,920° C., and alumina as about 2,200° C., thus completely reversing the order. The figures stated in the table are based upon the conflicting information available. It should be remembered, however, that the melting points of some of these refractory materials, and still more the dissociating points of the silicon carbides may not be sharply defined like the melting points of pure metals, but have, in the former case, a range of increasing softness before true melting occurs, and that this melting temperature is largely affected by the oxidizing or reducing atmosphere in the furnace. Siloxicon is said to turn into carborundum at 5,000° F., or 2,760° C., carborundum fire-sand to crystallize into carborundum at 7,000° F., or 3,870° C., and carborundum to be infusible at the same temperature, while it is admitted that these substances are less refractory than carbon, whose boiling point is taken to be 3,700° C., or 6,700° F. Recent experiments place the formation temperature of carbide of silicon at 1,600° C., its crystalization at 1,950° C., and its decomposition into graphite and silicon vapour at 2,220°, but it seems probable that these figures are somewhat low.

In addition to its ability to resist high temperatures and corrosive slags, the power of a furnace lining to retain the heat which is produced in the furnace must be considered. It is rare that good refractory and heat retaining qualities are combined in the same material, and to get the best effect it is usually necessary to adopt a stratified construction, placing refractory materials on the inside, and heat retaining materials outside. Generally speaking light porous substances are good retainers of heat, while heavy compact bodies are poor heat insulators. Comparatively little information is available with regard to the conductivity of furnace materials for heat, particularly at high temperatures. The following figures are taken from Prof. Richards "Metallurgical Calculations," to which the reader is referred for further information:—

Table IV.

HEAT CONDUCTIVITIES OF FURNACE MATERIALS.

In Centimeter, Gram, Second, Calorie Units.

Fire-clay bricks	(0° C.— 500° C.)	0.00140
Fire-clay bricks	(0° C.—1,300° C.)	0.00310
Alumina bricks	(0° C.— 700° C.)	0.00204
Magnesia bricks	(0° C.—1,300° C.)	0.00620
Lime	(20° C.— 98° C.)	0.00029
Quartz sand	(18° C.— 98° C.)	0.00060
Carborundum sand	(18° C.— 98° C.)	0.00050
Fire brick dust	(20° C.— 98° C.)	0.00028
Infusorial earth	(17° C.— 98° C.)	0.00013
Infusorial earth	(0° C.— 650° C.)	0.00038

The figures indicate the number of gram calories of heat that would pass in one second through a centimeter cube of the material, if the hot and cold sides of the cube differed in temperature by 1° C. It will be understood that a material having a high conductivity for heat, as shown in the table, would, if used in the construction of a furnace wall, allow a considerable amount of heat to escape and be wasted. Light powders like infusorial earth are good for retaining the heat in a furnace, but these do not retain their heat insulating qualities at high temperatures and should only be used as an outer jacket to the furnace. Undoubtedly much could be gained in ordinary furnaces by a more careful attention to the heat conducting qualities of the materials of which the walls are composed, and in electric furnaces, where the cost of the heat is usually considerably greater, it is even more important to guard as far as possible against loss. On the other hand cases are common in large fuel-fired furnaces, and occur even in electric heating, where the importance of preserving some portion of the furnace that is exposed to corrosive slags or very high temperatures is greater than the need to save the heat, and in such cases, air cooling, and even water-cooling of the furnace walls may be adopted. It should be remembered that the rate of loss of heat from a furnace will be proportional to the area of its walls, that is, to the square of the linear dimensions. The ratio of heat loss per unite volume will, therefore, be inversely proportional to the dimensions of the furnace, or a furnace that is twice as large as another (in linear dimensions) will only have half as large a heat loss, for a given volume of the interior of the furnace. This supposes the furnace walls to be of equal thickness in the two furnaces, but in small experimental furnaces the walls are usually thinner than they are in full-sized furnaces, and under these conditions the small furnace fares even worse in proportion; and in the extreme case of a small furnace constructed as an exact model on a scale of one inch to the foot of a large furnace, so that the walls would be thinner in the same proportion, the heat loss for each cubic inch of the model would be 144 times as great as from the large furnace, provided, of course, that both attained the same temperature. In other words if the furnaces were merely being kept hot, no work being done in them, the small furnace would need 144 times as much heat per cubic inch as the large furnace in order to keep it heated to the same temperature.

In Table IV. the figures in brackets show the temperatures between which the experimental determinations were made, thus in the first line of the table one side of a fire brick may have been kept at 500° C., and the other side at 0° C., while the rate at which heat passed through it was determined. The conductivity in the last column is consequently a mean value for the given temperature range, and the actual conductivity of fire-bricks at high temperatures will be even higher than the figure given on the second line. In applying these figures to calculate the losses of heat through furnace walls, it should be remembered that the heat transmitted is proportional to the cross section, that is, the area of the piece of wall considered, inversely proportional to its thickness, and proportional to the difference of temperature between the two sides of the wall. The conditions are in fact just the same as in the flow of electricity in a conductor. By way of comparison with the figures in the table, it may be mentioned that the conductivity for heat of silver is 1.1, of copper 0.9, and of iron 0.2 when cold.

Furnace walls without refractory materials. The properties of a number of refractory materials have been considered, but it not infrequently happens, in electric furnace construction that the heat can be developed in the midst of a large mass of the material to be heated, and although a very high temperature may be reached internally, the exterior never becomes strongly heated, and mere retaining walls, which need not be extremely refractory can be used. The best known example of this is the Acheson furnace for the production of carborundum (Fig. 8, p. 173). The Wilson carbide furnace, (Fig. 7, p. 172), also depends for its preservation upon the unacted on, and relatively cool portions of the charge, as the walls of the crucible are only made of iron. The same principle can be applied in the case of continuous electric smelting furnaces by constructing the furnace in such a way that the heat is developed within the mass of ore descending in the shaft of the furnace, and by regulating the current so that a portion of the ore will remain unfused around the sides of the furnace. When this can be done no trouble will be experienced in maintaining the walls for an indefinite period, even when corrosive slags are produced, but this method does not lend itself readily to processes in which the charge must be heated considerably above its melting point, as being liquid the hot central portion will mix with the cooler parts round the sides, and will eventually fuse the whole of the protecting layer of ore. This process of restricting the zone of highest temperature to the middle of a furnace depends upon a constant abstraction of heat around the sides. This is usually the result of the air cooling of the outer walls, it is even more ideal if it can be caused by a continual supply of fresh ore, so that the heat is not really wasted, but is used in heating the fresh ore, but in some cases it is even necessary to resort to water cooling of parts of furnaces in order to preserve the walls. As an example of this may be mentioned the De Laval smelting furnace, (Fig. 18, p. 216), which has a dividing partition between the two troughs, B and C, which contain molten metal and serve as electrodes. The partition being entirely within the furnace, will experience very little air cooling, and the arrangement of the electrodes tends to make the current flow most strongly against the partition in passing through the slag, E; which will become very hot at this point, and would certainly dissolve the partition away if it were not for the cooling effect of the water-jacket J placed within it. As further examples of water cooling, may be mentioned the water-cooled electrodes in Héroult's electric steel furnace, the electrode being cooled in this manner at the point where it passes through the furnace roof, and the part exposed to to the air is consequently below a red heat, and does not oxidize as it would otherwise: also a closer joint can be maintained around the electrode, the roof is protected from cutting by the flame issuing from the furnace, and less loss of heat occurs. Another use of water-cooling is in electrolytic furnaces where the molten electrolyte is contained in an iron vessel, which is required to be gas-tight. Since both the electrodes pass through the walls of the vessel, or the vessel itself may be one electrode, it is necessary to introduce an insulating joint at some point, and this joint must be unaffected by heat by the electrolyte, or by the gases given off in the operation. A satisfactory method of effecting this, is to make the vessel in two parts, one of which may be the lid; and to maintain, by water-cooling, a layer of solidified electrolyte between the two parts, which are slightly separated, as in Borcher's appliances for the electrolysis of fused zinc chloride, and for the electrolysis of fused salts of lead—(see Borcher's "Electric Smelting and Refining"). Electrode holders are sometimes water-cooled, to prevent them becoming unduly heated, and occasionally even the electrodes themselves are water-cooled, as the metal tube electrode in Siemens' arc furnace, (Fig. 3, p. 171), or the water-cooled iron electrode in Borcher's aluminium furnace, or in Gin's steel furnace.

Production of Heat in Electric Furnaces.

As already mentioned, the rate at which heat is produced in an electric furnace may be measured by the Watts supplied to the furnace, allowance being made when necessary for any electrolysis that takes place. A certain rate of heating is necessary for the attainment of a definite temperature, this rate depending on the thickness and heat retaining qualities of the furnace walls, upon the size of the furnace, and upon any cooling influence, such as the introduction of fresh ore to the furnace. A few examples will now be given of the rate of heat production in typical electric furnaces, the rate being given in watts per cubic inch, or in kilowatts per cubic foot: rates expressed in the latter unit being 1.728 times as large as in the former unit.

Moissan's Arc Furnace. (See Fig. 6, p. 172). His small furnace, composed of blocks of quick-lime, employed 35 to 40 amperes at 55 volts, direct current; or 1,925 to 2,200 watts. The interior cavity of the furnace was about 1.75 inches in diameter, and about 1.7 inches in height, corresponding to a volume of 4.1 cubic inches. The watts per cubic inch will, therefore, be 470 to 587, or say 500 as a round figure, as some allowance should have been made for the heat produced in the electrodes themselves. This figure, as will be seen directly, is about one hundred times as great as the usual rate of heating in a fair-sized electric furnace, as used for steel making, for instance.

Moissan's electric tube furnace, containing a carbon tube in which the material to be heated was placed, and the furnace itself being composed of limestone and lined with alternate layers of carbon and magnesia, employed 300 amperes at 70 volts (=21,000 watts), or 1,000 amperes at 60 volts, (=60,000 watts). The dimensions of the interior of the furnace, assuming that his perspective drawings are to scale, would be 4.4 inches long, 3.2 inches wide, and 4 inches high, corresponding to a volume of 56 cubic inches. The watts per cubic inch would then be 380 to 1,100. Making a deduction for the heat produced in the electrodes themselves would reduce these figures by 10% or 20%.

An even more intense rate of heating is mentioned, in which he employs 1,200 to 2,000 amperes at 100 volts in an unlined limestone furnace. The internal diameter is stated to be 4 inches, and assuming the height to be the same, the volume of the cavity would be 50 cubic inches. The watts supplied would be 120,000 to 200,000, or 2,400 to 4,000 watts per cubic inch.

The operation of this furnace is only of short duration, the lime, produced by heating the interior of the limestone blocks, soon melting, and running like water, while vaporized lime roars out around the electrodes, and the furnace is soon destroyed. The temperature produced was limited by the rapid melting and vaporizing of the lime, but by supplying the heat at such an enormous rate, the greater part of the cavity might well be considerably hotter than the boiling temperature of melted lime.

The small furnace, first mentioned, could be used for longer periods, as the rate of heat production being so much less, the furnace is less rapidly destroyed, while the tube furnace, lined with carbon and magnesia, could be run continuously.

Stassano Steel Furnace. This furnace resembles the Moissan furnace, as the ore to be smelted is heated by radiation from an arc. The furnace described in volume 1 of the "Electrochemical Industry," and which is somewhat larger than the one figured in Dr. Haanel's Report,* took an alternating current of 2,000 amperes at 170 volts, and used about 450 horse-power. The horse-power corresponds to 336 kilowatts, but part of this would be wasted outside the furnace. The volt-amperes are 340,000, and assuming a power-factor of 0.75 this would give 255 kilowatts consumed in the furnace. The interior of the furnace was about 40 inches cube, or 64,000 cubic inches, giving 4 watts per cubic inch, or 6.9 kilowatts per cubic foot. The difference between this figure and those employed by Moissan, depends in part upon the lower temperature required, in part upon the great loss of heat in the Moissan furnace produced by the vaporizing of the materials of the furnace, and in part upon the larger size and better heat retaining construction of the Stassano furnace.

Héroult Steel Furnace. The furnace at La Praz, figured by Dr. Haanel, is about 7 feet long, 4 feet wide, and 2 feet high inside, giving a volume of 56 cubic feet. The power employed was 353 kilowatts, or 6.3 kilowatts per cubic foot, which agrees well with the Stassano furnace.

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* Report of Dominion C mmission on European Electro-Thermic processes, p. 14, b.

(To be Continued.)

ENGINE STOP AND SPEED LIMIT SYSTEM

The desirability of stopping an engine from a distance in order to prevent accidents to life or property has been recognized from the earliest days of steam engineering. In some cases provision for this purpose was made through the use of an alarm bell placed in the engine room, to be operated from one or more distant stations. A rather crude system has also occasionally been employed, whereby a heavy weight controlling the throttle could be released from one or two stations by mechanical means. Some years ago this subject was taken up by the Consolidated Engine Stop Company, which company devised a very complete system in which the electric current figures as the operating agent. This system has been added to from time to time, until at present it includes mechanisms adapted to all the various types of steam engines; also to electric generators, motors, and steam turbines.

As applied to an ordinary steam engine or turbine, the stop mechanism acts on the throttle valve. A cable attached to a weight passes around a drum, and when a magnet forming part of the apparatus is energized, a pawl is tripped, which allows the weight to descend. On the drum shaft is a sprocket wheel the chain of which is connected to the throttle mechanism, hence, as the weight descends, the throttle by this means is closed. This type of Monarch engine stop is shown in Fig. 1. Another type is made for application to engines having a Corliss valve gear.

Another part of the system consists of a Speed Limit Device, Fig. 2, by means of which, when the speed of an engine or other source of motive power exceeds a predetermined limit, an electrical contact is made which operates an engine stop like the one above described.

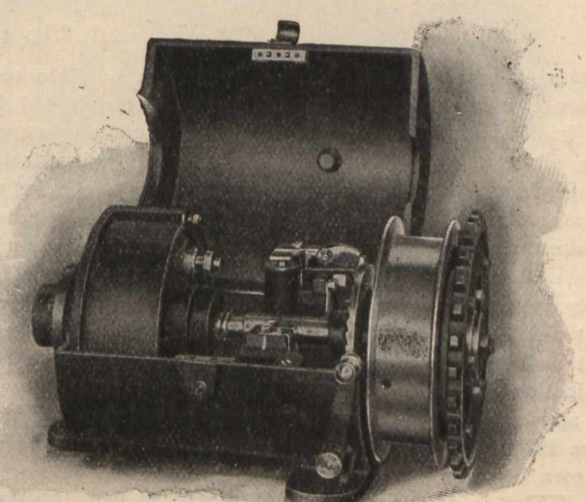


Fig. 1.—Stop Mechanism for Ordinary Steam; Reciprocating or Turbine Engine.

To provide for the case of electric light and power plants or where generators are operated in multiple and driven by separate engines, and where it is desirable to open the generator circuit simultaneously with the shutting down of any particular engine, a Circuit Breaker Trip has been devised, Fig. 3. This consists of a weight which is attached to the circuit-breaker. When the circuit is closed to shut down the engine, the magnet on the trip at the same time draws down an armature releasing the weight, thereby

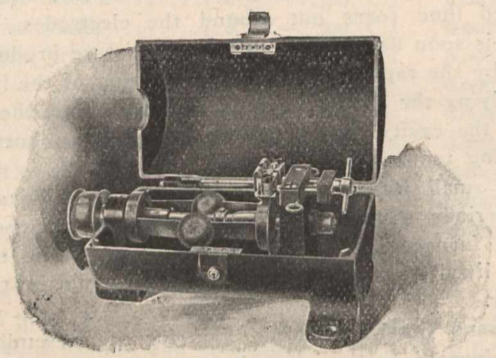


Fig. 2.—Speed Limit Device.

tripping the circuit-breaker. This apparatus is also applied to stop electric motors in factory or other service.

The details of the electrical circuits have been worked out in a very complete manner. A small slate or marble test board is used having upon it a switch for tripping the stop, a buzzer or a lamp, and two small key switches, which are used for testing the circuits. The buzzer is of high resistance, consequently if the batteries become weak, an intermittent response of the buzzer will indicate this; and yet current for at least 24 hours is still available to use the stop, thus allowing sufficient time for recharging the batteries. A failure of the buzzer to respond to the test switch in-

against the magnets; if the generator furnishing current is shut down or a fuse blows, the armature falls by gravity to

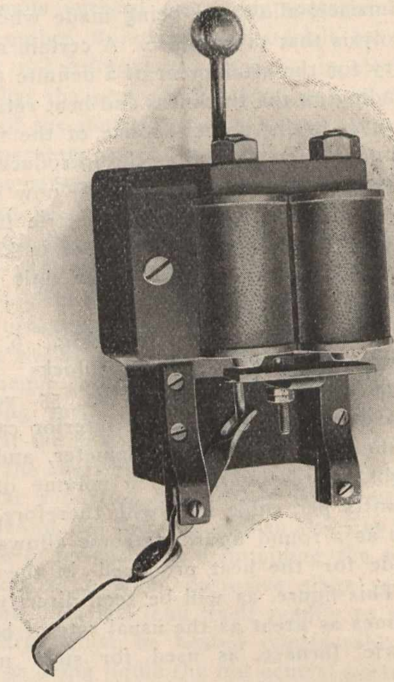


Fig. 3.—Circuit-Breaker Trip.

the battery terminal, and the engine stop system is thus switched on the battery circuit until the service current is again available. This system adds an additional safeguard

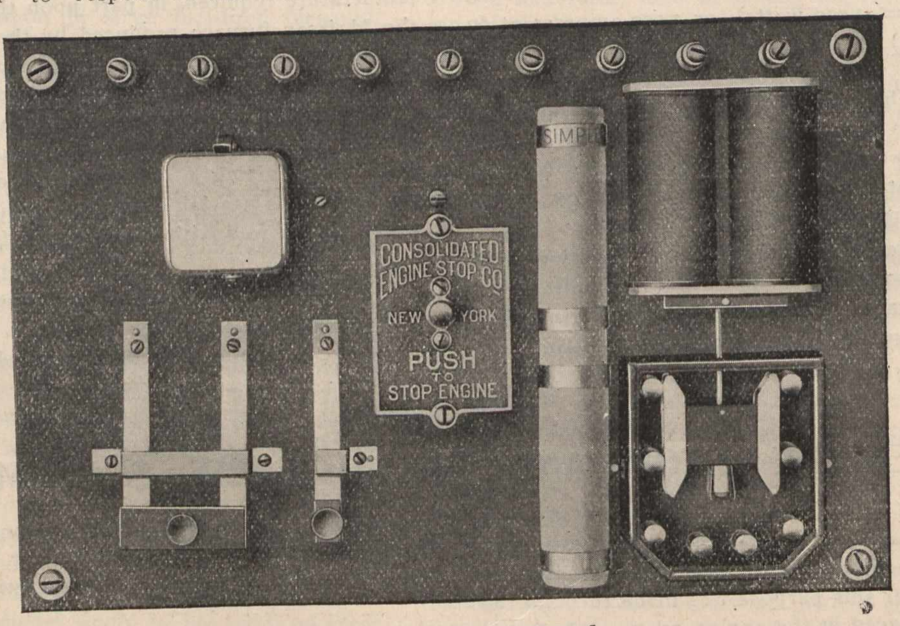


Fig. 4.—Test Switch-Board.

dicates a break in the wiring, but it is possible to shut down the engine either automatically by the Speed Limit, or from any of the other push switches pending repairs to the wires. This is accomplished by throwing the wires from multiple into series for a test, so that though the indication of a break in the circuit is instantly detected, the engine stop system is still in commission. These testing provisions are, it will be recognized, valuable additions to the system, as they insure absolute reliability, since the safety device cannot unknown be crippled by weak batteries or broken wires, but is always ready for emergencies. The most serious objection which can be raised against any safety device, as is appreciated by all, resides in any tendency for the device to become inoperative without that fact becoming known because of lack of use.

There is also another test board in use, substantially the same as the one just described, but with the addition of a solenoid switch, Fig. 4. This is designed for the employment of current from lighting or power circuits to operate the engine-stop, with a battery in reserve, and is adapted for 110, 220, or 550-volt circuits. The voltage is cut down by means of resistance coils on the test board. The current going through the solenoid holds the armature

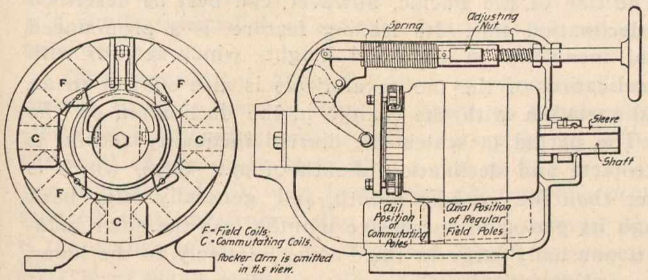
from the fact that there are two sources from which to operate the engine stop. It is particularly desirable in factories where the generator current is not on during the day, since it lengthens the life of the batteries on account of the fact that they need be used throughout only a portion of the time. For further particulars of this excellent system apply to The Consolidated Engine-Stop Company, 130-134 East 12th Street, New York.

❧ ❧ ❧

—A powerful searchlight was recently installed on the Lake of Geneva, Switzerland, at an altitude of 3,600 feet. The searchlight is handled with the greatest ease, sending its powerful rays a distance of over 7½ miles. Objects at 6½ miles can be distinctly seen. The machine providing the power is of 24 H.P., and furnishes a 1,000,000 electric candlepower light. A 40 H.P. motor would give 12,000,000 electric candlepower. The great advantage of this searchlight is that it may be electrically handled in all directions by wire from a distance of 656 feet from the motor car, which transports it and sends it to the required spot. It thus enables the driver and observer to send the rays to any place they desire without being blinded.

LINCOLN VARIABLE SPEED MOTOR

Progression that is real is marked by some achievement that is evident. No matter what the line, the rule is the same. A forcible application of this fundamental is found in a recent variable speed motor built by the Lincoln Electric Manufacturing Company, of Cleveland, Ohio, which, it is claimed, obtains a much wider variation in speed than is possible by the ordinary method of field weakening; ranges up to 10 to 1 being regularly built. The process provides for the withdrawal of the armature from the influence of the field poles, thereby decreasing the field area and magnetic flux, increasing the air gap and resistance, and therefore, increasing the speed. The conical armature used, by effecting a more rapid increase in the air gap, gives a greater increase in speed for a given lateral adjustment than is possible with a cylindrical armature.



The Lincoln Motor Showing Method of Armature Movement.

Fig. 1.

To accomplish this, there has been perfected a thrust bearing that supports the commutator end of the armature, carrying an annular ball-bearing to take both thrust and radial loads. This thrust bearing is actuated by a split lever having a central pull on opposite sides of the thrust bearing; movement of the lever being accomplished by means of a screw mechanism and hand-wheel, as illustrated; a spring around the lever connecting rod being adjusted to balance up the magnetic pull of the armature.

This is a two-wire, direct current shunt wound motor, the same as any ordinary D. C. machine so far as installation is concerned.

As will be seen, this system admits of speed variation **inside** the motor, doing away with the very unsatisfactory electric controller, and its complicated wiring; but necessary in the ordinary method of speed variation by field weakening, added to the necessity of finding room for its accompanying cumbersome resistance. This speed variation is under the immediate control of the machinist, who, with his

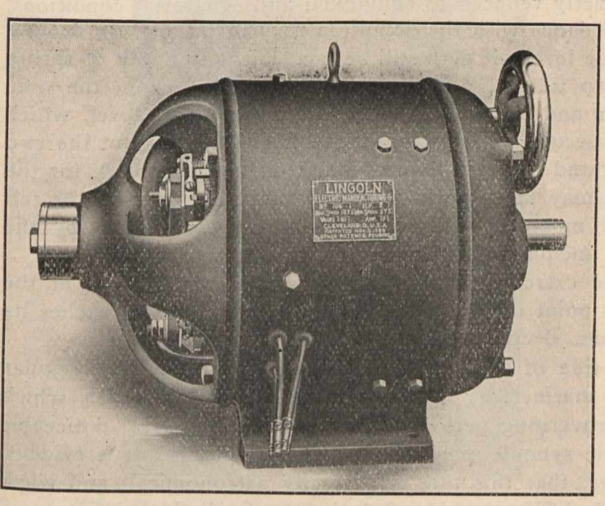


Fig. 2.—Type A, Lincoln Variable Speed Motor.

eye on the tool and his hand on the regulating wheel, can immediately increase or decrease the speed. Gradually, he can increase the cutting speed up to what the work will stand, or, with work of varying diameter, keep his cut at the maximum speed throughout, and this without abrupt changes such as are inevitable where a controller is used. It is all so easy that a man with a spark of ambition will make **an involuntary saving on his product of 10 to 30 per cent. of the labor cost.**

The efficiency is claimed to be high, comparing favorably with good constant speed motors. Efficiency at full load on a 5 H.P. 5 to 1 motor, is said to show by test from 86 per cent. at 300 R.P.M. to 75 per cent. at 1,500 R.P.M., and what is of quite as much, if not more importance is, the statement that it compares very favorably with good constant speed motor practice in the maintainence of any speed under varying load conditions—which is impossible with the ordinary method of field weakening by controller.

The perfecting of this motor was attended with more than ordinary difficulty. It didn't evolve itself. It isn't a

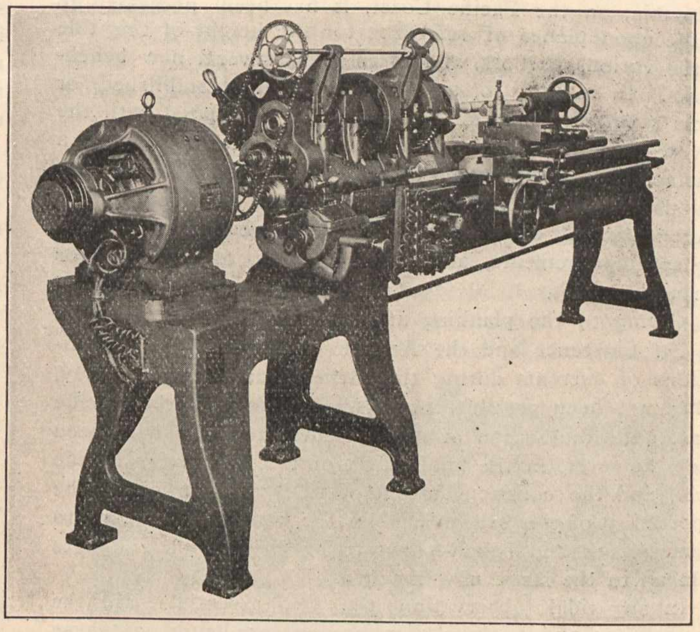


Fig. 3.—Lincoln Variable Speed Motor Applied to Lathe.

"bright idea." Its practicability is heralded to the mechanical world, by its record in actual operation. Every feature: the thrust bearing, the special commutating field into which the armature is drawn at high speeds to insure sparkless commutation from no load to 50 per cent. overload, and the sleeve which carries the pulley or pinion,—allowing the armature to slide through it in its lateral adjustment, were all tested and tried, proven and found efficient, before the Lincoln Variable Speed Motor became a selling reality. A

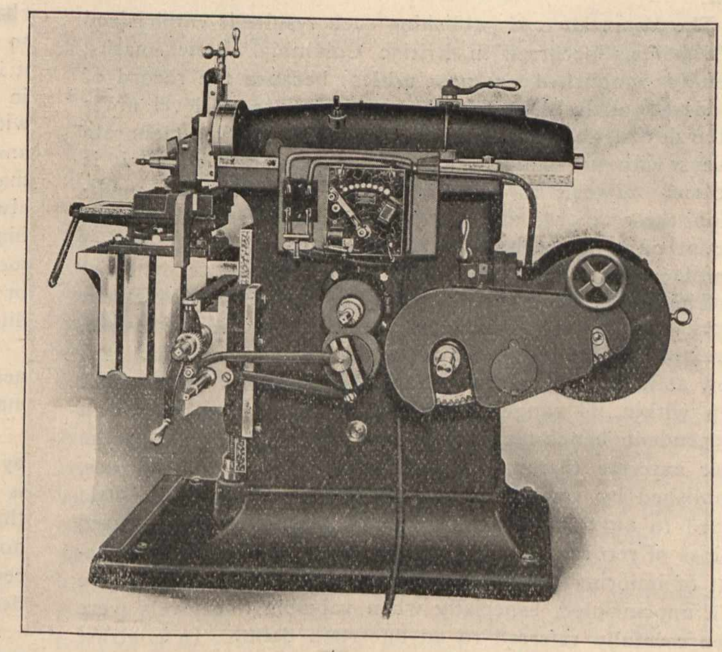


Fig 4.—Two H.P. 5 to 1 Motor, Mounted on 16" Shaper.

special claim for this motor is, that, unlike most variable speed motors on the market, it will run in either direction with equal results. This of itself is a great point of merit, and should commend the Lincoln Variable Speed Motor to manufacturers who have been compelled to procure more complicated and expensive old style equipment, in order to obtain results in this direction. A simple reversing switch with the Lincoln motor does the trick.

TIDE LEVELS AND DATUM PLANES ON THE PACIFIC COAST OF CANADA

By W. Bell Dawson, M.A., D.Sc., F.R.C.S., M. Inst. C.E., Engineer in Charge of the Tidal and Current Survey of Canada.

[A very valuable report has been issued by the Dominion Government, entitled "Supplement No. 1, to the 33rd Annual Report of the Department of Marine and Fisheries: and should be in the hands of every Canadian engineer on the Pacific Coast. The following introductory section, will show the character of this important official document.—Editor.]

In extending the survey of tides and currents to British Columbia, on the Pacific Coast, it has been necessary to decide upon planes of reference for the height of the tide in the various harbors, and to establish several new bench-marks. In doing so, any datum already established, or levels previously determined, have been correlated with the new work, to avoid confusion and to give the tide levels a satisfactory basis from the outset. The levels, which a continuous record of the tide affords, will be valuable for reference in the construction of wharfs, dredging and other harbor improvements, and in city works, as well as for marine purposes.

Owing to the planning and directing of tidal work on the St. Lawrence and the Atlantic coast, and the investigations of currents during the earlier years of this survey, it has not been possible for the writer to visit the Pacific Coast until the season of 1905. Some headway has been made, however, in the publication of tide tables for Pacific ports, and the commencemeent of tidal observations. The opportunity of this season enables the result with regard to datum planes and bench-marks to be given in a complete form up to the stage now reached.

In any tidal observation the two essentials are the correct time and a plane of reference for height, as these are the co-ordinates of the tidal curve. The main object of this survey, as a branch of the Marine Department, is to deal with the time of the tide, since this is the matter of chief importance to navigation, and the question of levels is quite secondary. In the strong tidal currents of British Columbia it is information as to the time of slack water that is most wanted by the mariner. To obtain correct time for the observation is also the greatest difficulty met with on such a coast. But the value of reliable levels, which can only be obtained from tidal observations, makes it seem right to take the additional trouble necessary to secure them.

The importance of publishing such results is emphasized by what has occurred in British Columbia. Bench-marks, carefully established, are now useless because the record of the elevations is lost through fire; the loss of level notes or the destruction of a primary bench-mark leaves elaborate surveys with uncertainty in their datum planes, which it is extremely difficult to redetermine satisfactorily. By publication, these records might have been preserved, and a large amount of good work, and subsequent trouble and expense in replacing it, would have been saved.

The condition of the tide levels, as met with at different places, was strongly contrasted. At some places, of course, there was nothing to refer to; and it was even difficult to know at what level to set a tide scale, so that the tide would keep within its range. The only course was to place an independent bench-mark and make a beginning. At the other extreme there was a redundance of datum planes, established by various engineers and surveyors, with little regard to anything previously done, and often complicated by loss of records. In such a case, to follow the usual precedent of ignoring the past and beginning afresh, would have been unprincipled, especially when valuable tide levels were often carefully referred to an uncertain datum. In contrast with this, the service rendered by Mr. H. J. Cambie, the Resident Engineer of the Canadian Pacific Railway at Vancouver, deserves mention. He has taken the trouble to furnish information regarding levels to the Public Works Department, the British Admiralty, and the city of Vancouver, which has kept the various planes of reference in relation, and has avoided uncertainty and confusion.

Character of the Pacific Tide.—The most important plan of reference which results from tidal observations is undoubtedly Mean Sea-level. To understand the best method of obtaining its value it is necessary to explain briefly the character of the Pacific tides, as at first sight they appear quite irregular.

In all parts of the world the tides are found to accord with the varying movements and distances of the moon and the sun. In the North Atlantic, where they were first studied, it happens that they are chiefly influenced by the moon's phases. It was thus supposed that the primary characteristic of all tides was a marked alteration in height from springs to neaps in the period of the synodic month.

The tide of the Pacific, however, can best be described as a declination tide. Its leading feature is a pronounced diurnal inequality in time and height, which accords with the declination of the moon; and this is also subject to an annual variation with the change in the declination of the sun. The period in which the diurnal inequality recurs is the tropical and declination month of 27.2 days, which is shorter than the synodic month, and generally falls back through its period in successive months. As the solar influence is unusually large in the Pacific relatively to the lunar, the annual variation is the more accentuated.

On the open coast of the Pacific the tide curve is still fairly regular, though showing the diurnal inequality strongly; and in some regions, especially northward, the springs and neaps can be distinguished with little difficulty.

But in the Strait of Fuca, and the region of the Strait of Georgia, which makes up half the coast line of British Columbia, and where all the more important harbors are situated, the appearance of the tide curve is anomalous. The high waters are nearly at the same level; and the range depends upon the amount of fall to low-water, which may be almost inappreciable or very pronounced. During the greater part of the day there may thus be a long stand or only a slight fluctuation near the high water level, with a sharp and short drop to the lower low water, which occurs once in the day. This type only changes to a fairly symmetrical curve when the moon is on the equator, near the line of the equinoxes.

The spring and neap tides are thus reduced to a secondary feature, which is usually obscured by the stronger characteristics of the tide. The "Establishment," which is so well marked in the Atlantic, is here almost illusory; unless it is strictly reduced to equinoxial and equatorial conditions, in accordance with the definition used in France. In dealing with tide levels, it may still be convenient to speak of spring and neap tides, if they are understood to mean the two maxima and the two minima in range or in level, which always occur in the period of the lunar month. But the two highest and the two lowest points on the tide curve for the month, may be as much as five days before or after the full or new moon, as they are so largely occasioned by the diurnal inequality dependent on declination.

The extreme tides of the year necessarily occur at the nearest point to the solstices, at which the moon reaches its maximum declination.

A tide of this character is apt to be termed irregular by the mariner; as the tropical or declination-month, which is its governing period, is less familiar and less noticeable than the synodic month of the moon's phases. It is evident, however, that this tide is perfectly astronomical; and when reduced by harmonic analysis its prediction is just as definite as for any other type of tide.

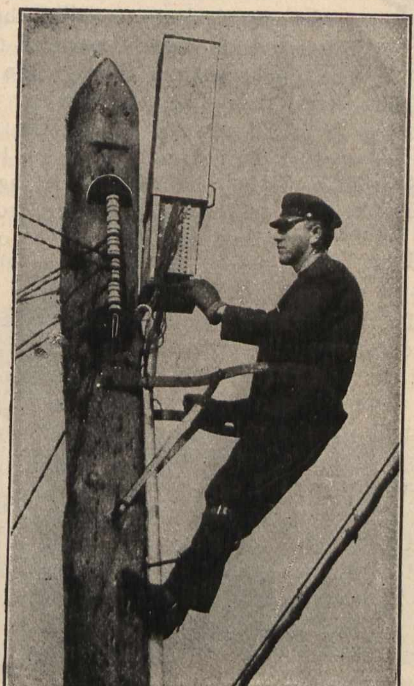
Mean Sea-level.—With a tide of this type, there is a notable difference between the half-tide level, and the true value of the Mean Sea-level. Its only accurate value is the mean ordinate found by the integration of the tide curve, referred to any invariable base line or datum. This mean ordinate fixes the position of the horizontal line which bisects the area of the tide curve; and this also accords with the best definition of Mean Sea-level for any type of tide. We have occasion later on, to point out the importance of adhering to this definition; as the half-tide level may differ a whole foot from the true Mean Sea-level, even in the case of a tide whose extreme range is only 13 feet.

The advantage of a registering tide gauge is much emphasized with tides of this character. If scale readings are taken by direct observation, which the Admiralty surveyors usually prefer, they must be continuous, day and night, and afterward plotted as a curve; or little use can be made of them except for the reduction of soundings. With a registering gauge, this elaborate and expensive method can be dispensed with. The hourly ordinates of the tide curve throughout the year enable the true value of Mean Sea-level to be readily found; and even with a shorter period, the continuity of the record enables the diurnal inequality to be followed; and if this is known, the average level and the extremes of high and low water and other data, can be correctly determined. The continuous record is equally important with respect to the time of the tide, in which there is a similar inequality of interval; but with this we are not now dealing.

The question of Mean Sea-level is of unusual interest on the Pacific Coast, as there is reason to believe that its elevation is changing. Some indications point to a rise in the level of the coast, at as high a rate as one or two feet per century. It is only from tidal observations properly reduced, that any trustworthy result can be arrived at; and if the change is as rapid as supposed, it will not require an interval of many years to obtain a fair approximation to its amount.

TELEPHONE WIRE DISTRIBUTION: A NEW POLE RACK.

In the old style system of pole ring distribution, a great item of waste was encountered if the wires all led in one direction; then the insulators on one side of the ring were practically useless. The invention illustrated overcomes this mechanical disadvantage and consequent loss in a simple and practical manner. The appliance consists of two supporting end pieces, holding in place a rod upon



The Robinson Distribution Rack, Especially Useful for Taking Off Leads Running from Only One Side of the Pole.

which are mounted a number of porcelain insulators. All "drops" can be easily applied by placing the rack on one side of the pole only if desired, or one on either side if needed.

Another advantage is, that it can be extended to accommodate any number of insulators required. In the illustration a ten-pair rack is shown. If it were desired to enlarge the series to 15 leads 5 additional insulators could be inserted in the middle; or if 20 drops were required, the stands could be lengthened to accommodate 10 insulators on each side. A recent improvement that will commend itself to the construction man is the method of fastening the rack to the pole. The upper and lower pieces are substantial, well-braced malleable iron castings of great strength, with convex surfaces. This makes it unnecessary to gain the pole as the casting conforms to the outline of the wood. This tends naturally to lengthen the life of the pole, since no inner surface is exposed by cutting. In case of lengthening or shortening rack, no blaze is left open to the action of the weather.

The Robinson Pole Distribution Rack is being placed on the market by the W. G. Nagel Electric Company, Toledo, Ohio, U. S. A.

FIRST AID TO THE INJURED.

In January, 1906, we described graphically, with illustrations, how to render first aid to the injured in workshop and factory; we now have pleasure in illustrating a unique Emergency Accident Cabinet of supplies, which should interest every manufacturer who has the welfare of his

First Aid Cabinet.

employees at heart. Many injuries result seriously, and even lives are lost annually, because proper medical attention is not at hand. Through delay in furnishing temporary material and appliances a slight injury may terminate fatally. Liability Insurance does not stop needless pain nor save lives; a good emergency accident cabinet will do both.

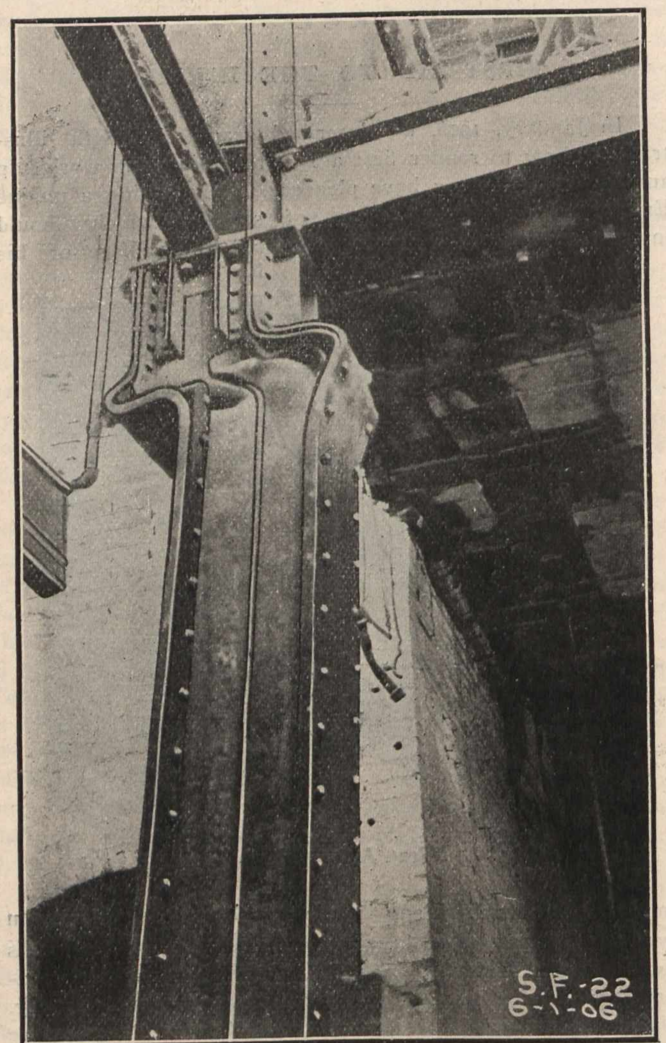
This cabinet contains every article which experience has proved to be necessary in order to antiseptically dress a cut, burn or wound of any kind, received in either office, factory or store, and to prevent blood poisoning, or the serious pathological complications which frequently result from delay. It also includes well-known remedies for relief of simple physical ailments, and thus prevent loss of time.

Contents:—3 rolls Linton bandages, 2 in.; 3 rolls Linton bandages, 2½ in.; 2 rolls cotton bandages, 1½ in.; 2 rolls cotton bandages, 2 in.; 2 rolls cotton bandages, 3 in.; 2 packages Linton gauze; 3 packages absorbent cotton; 2 packages absorbent lint; 1 roll adhesive plaster; 1 package court plaster; 1 pair scissors; 1 8-oz. bottle oil for burns; 1 8-oz. bottle Arnica; 1 8-oz. "antiseptic solution;" 1 jar effervescent head-ache cure; 1 bottle extract of peppermint; 1 bottle extract of ginger; 1 "Kaskola stomach tablets;" 1 bottle Aro. spirits ammonia; 1 cake castile soap; 1 box noncongesto; 1 box carbolated vaseline.

The medicines and dressings are conveniently arranged and instantly get-at-able. The price of the case is only $7, which is the retail value of the articles it contains. "The Canadian Engineer" has one of these useful cabinets in its own office, in close proximity to the printing department. All interested should write to **The Accident Cabinet Co.**, Kalamazoo, Mich., U.S.A.

REINFORCED CONCRETE.

The accompanying illustration indicates the effect of the earthquake in San Francisco on a steel column. The picture was taken in that city by Mr. Frank B. Gilbreth, second vice-president of the Dominion Engineering and Construction Co., Limited, of Montreal: whose name is familiar to architects as the originator of the Gilbreth cost-plus-a-fixed-sum contract system; and who declares that no better advocates of reinforced concrete construction are needed than actual scenes like the one shown. It is from such lessons as the one taught by this twisted column, that the property holders have learned the value of reinforced concrete.



Earthquake Effect on a Steel Beam: Unprotected.

As a result the cry throughout the Western metropolis is, for construction of that material. Mr. Gilbreth has already more than a million dollars' worth of contracts in San Francisco, all specifying reinforced concrete, and other contractors report similar conditions. It is safe to say, that if the column shown in the picture had been constructed of reinforced concrete, photographs taken before and after the disaster would have shown the same solidity and rigidity in position. Mr. Gilbreth reiterates the remark he made shortly after the catastrophe, that San Francisco when completed will occupy a unique position among the cities of the world as the city of concrete.

THE PREMIER LUBRICATOR.

Gas and gasoline engine manufacturers, and many others interested in the lubrication of the cylinders of these engines, will undoubtedly, be interested in the "Premier" lubricator, described and illustrated herewith, which is only one of a variety of specialties in this line, maunfactured by the Lunkenheimer Company, Cincinnati, Ohio.

The "Premier" is made entirely of the highest grade of bronze composition, and the construction is very compact. It was constructed, not only with a view to positive and proper lubrication, but also to readily withstand severe service. It is practically made and nicely finished, and there is positively no liability of its shaking to pieces, owing to the jarring of the engine.

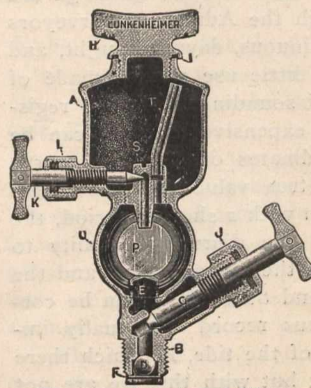


Fig. 1.—Sectional View.

The filling hole is very large, a feature which users will appreciate, especially when the cups are applied to motor boat engines, as it permits the use of a filling can having a large spout. To positively insure a tight joint between the filling plug H and top of cup, the plug is provided with a lead washer I, which material, being softer than the brass upon which it bears, will readily conform to any irregularity that might exist between these bearing surfaces. It is almost impossible for this gasket to wear out, owing to the slight friction it is subjected to, but should the same wear, it can quickly and easily be renewed.

To permit of refilling while the engine is running, the valve C has been provided, which can be quickly closed and opened. The stem of this valve is well packed by means of the stuffing box J.

The regulation of the feed is accomplished by means of the valve K. This valve is provided with a fine needle point, and the thread on the stem is also of fine pitch, hence a very close adjustment can thereby be obtained. The stuffing box L not only serves the purpose of preventing leakage around the valve stem K, but by means of it, the proper amount of friction can be brought to bear on the stem, and thereby prevent the unsetting of the valve.

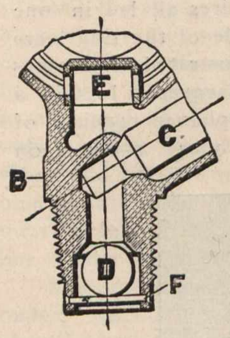


Fig. 2: Detail Sectional View of Shank; Showing Ball Check D, and Baffling Cap E.

The object of the tube T, within the cup A, is to equalize the pressure on the oil, which permits the oil to drop by gravity through the sight-feed and thence to the cylinder.

To provide against the back pressure (which will more or less escape past the pistons) interfering with the proper formation of the drops in the sight-feed and causing the oil to spatter around the glass, the shank B, of the cup, is fitted with a large ball check valve D. It has been found, however, that where the back pressure is unusually great, as in engines with worn piston rings, the ball check does not entirely remedy this trouble. To meet this condition, a baffling cap, E, has been provided just above the valve C. The gases escaping past the ball check D, are effectually muffled and diffused by means of the cap E, and hence the drops form perfectly, drop freely and steadily, and the sight-feed glasses never fill up.

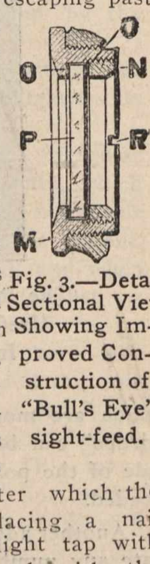


Fig. 3.—Detail Sectional View Showing Improved Construction of "Bull's Eye" sight-feed.

Another important feature is the practical construction of the "Bull's Eye" sight-feed. This consists of the holder M, retaining ring N, two rubber washers O, O, and the "Bull's Eye" Sight-feed Glass P. The sight-feeds are made of a superior grade of glass, and are very thick, so that unless broken by some external cause, it is very seldom, if ever, that they break. Should accident happen them, however, the improved arrangement of holding the glass permits of their easy renewal. It is only necessary to remove the holder M, after which the retaining ring N can be removed by placing a nail in one of the slots R, and giving it a slight tap with a hammer, when it can easily be removed with the fingers.

THE VALUE OF A MINE TELEPHONE SYSTEM.

It is only during the last few years that use of telephones in mines has become common to any extent.

When business men began to realize that the telephone was the greatest modern convenience, the greatest time and labor-saver of any office appliance, they began to look

Fig. 1.—Closed View.

about for new places where the telephone could be employed to lessen work in other lines.

While the telephone was in a state of imperfection its use in mines and in places where the telephone service must be absolutely relied upon, was confined to communication between offices, and to landings in deep shaft workings. During the last few years the manufacture of telephones has greatly advanced and it is now possible to build a telephone which will give perfect service for a lifetime. It is sometimes a little difficult to appreciate the advantages to be derived from the use of telephones in a mine until they have been tried. This is always the case where new improvements are discovered, but the opinion of others who are using telephone systems should be a greater factor as an argument for their use. Any mine superintendent can recall times when he would like to have communicated with the foreman or some workman in the mines, but realizing that the amount of time consumed in sending a messenger to get the employee and the time it would take for the employee to make the trip up the shaft and back to his work, would be a total loss, has either taken the more expensive course of going to the workman himself or allowing the matter to wait until an

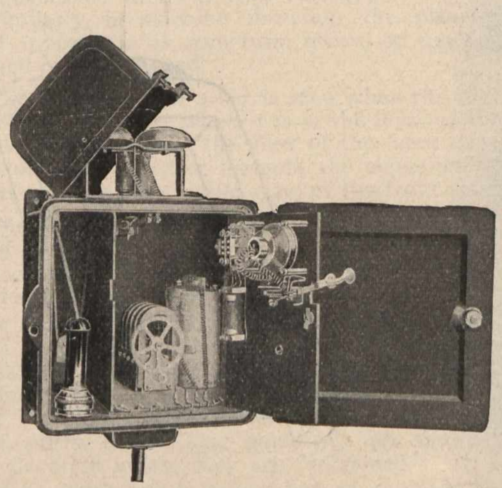


Fig. 2.—The Mine-A-Phone: Open View.

opportunity to talk with the workman without taking him from his work has been offered. In cases like this the value of the mine telephone is felt. Aside from the time-saving feature, the value of a telephone in times of danger, such as floods, explosions and other accidents in the mines, should be considered. In case of accident of any kind, by the aid of a telephone a report can be sent outside immediately and the superintendent can arrange to take care of it without delay. In case of injury to an employee word can be telephoned outside, and by the time the employee is brought to the surface a physician can be in waiting. If the accident be to the working machinery and the services of a force of workmen are required to repair the damage, no time need be lost in despatching a messenger to the superintendent's office. No other means gives the superintendent so complete control over all parts of the mines as a telephone system.

If desired arrangements can be made, as is often done on rural telephone lines built by farmers, to have a signal

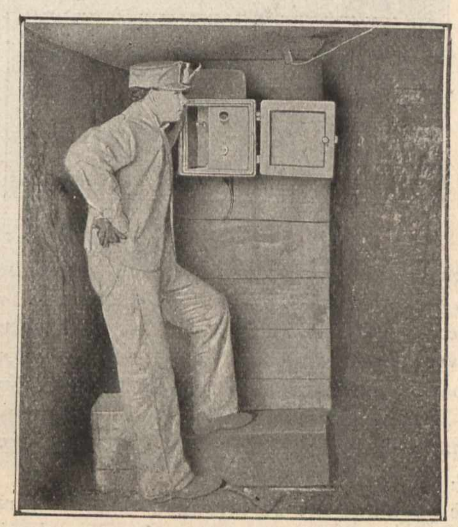


Fig. 3.—Down in the Minc.

which will ring the bell of every telephone on the line, thus an order can be given to every foreman in the quickest possible manner.

The character of a line really determines the extent to which it is economy to install telephones, but even in comparatively small operations, the results shown warrant their use in every case. We have installed systems as small as three telephones. There are no conditions under which a telephone cannot be used. The depth of the shaft, number of telephones required, or any other item cannot enhance the value of the service a properly constructed system will give.

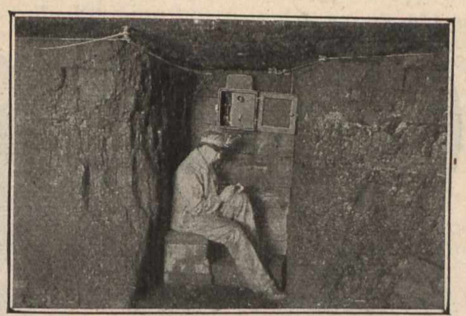


Fig. 4.—In the Shaf .

The Cost.

The cost of constructing a line under-ground is usually less than outside, due to the fact that no poles are required and there are no holes to dig. The wire can be supported directly from the roof of the mine or from the timbers that might be encountered, using porcelain or glass insulators.

We herewith illustrate a few cuts of a modern mine telephone, as manufactured by the Stromberg-Carlson Telephone Manufacturing Company, Rochester, N. Y. In design and construction it is unlike any other telephone. A gradual development in this class of apparatus has taken place, due to our experience in installing these systems under different conditions. Great care and forethought have been spent in the building of this apparatus, fully realizing the very severe conditions to which a mine telephone is constantly exposed.

The apparatus necessary for the operation of the instrument is mounted in a heavy cast-iron box, which is durable in construction and attractive in appearance. The case is treated with a special insulating compound which very effectively preserves it from the weather and dampness and from the acid fumes which are prevalent in the shafts of mines; it also prevents rust and corrosion. The outer door of this

Fig. 5.—In the Shaft.

case closes against a rubber gasket, rendering the enclosed apparatus free from those outside disturbances. Each telephone is equipped with a standard long distance transmitter and receiver, a powerful hand generator induction coil and two dry battery cells. The ringer or bell is mounted in the dome on the upper part of the case with an opening on each side so that a call may be heard at some distance from the telephone.

These openings are so arranged that the ringer is protected from the weather as well as from mechanical injury.

The wiring of the instrument is rubber covered and all joints are soldered. The induction coils, and receiver coils, are boiled in a moisture proof shellac varnish compound and afterward baked, thus rendering the coils absolutely moisture-proof.

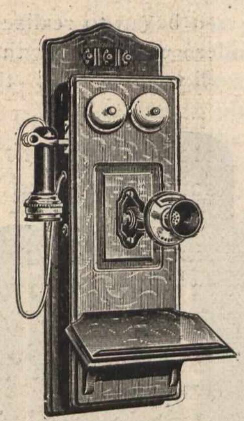


Fig. 6.

The transmitter is supported between four posts being held in place by coiled springs to prevent it from picking up any outside noise or vibrations to which the instrument might be subject, due to its location.

A small cap containing the line binding posts is fastened to the bottom of the case.

Line wires for same are led out through an iron pipe screwed into the cap.

MACHINE SHOP NOTES FROM THE STATES

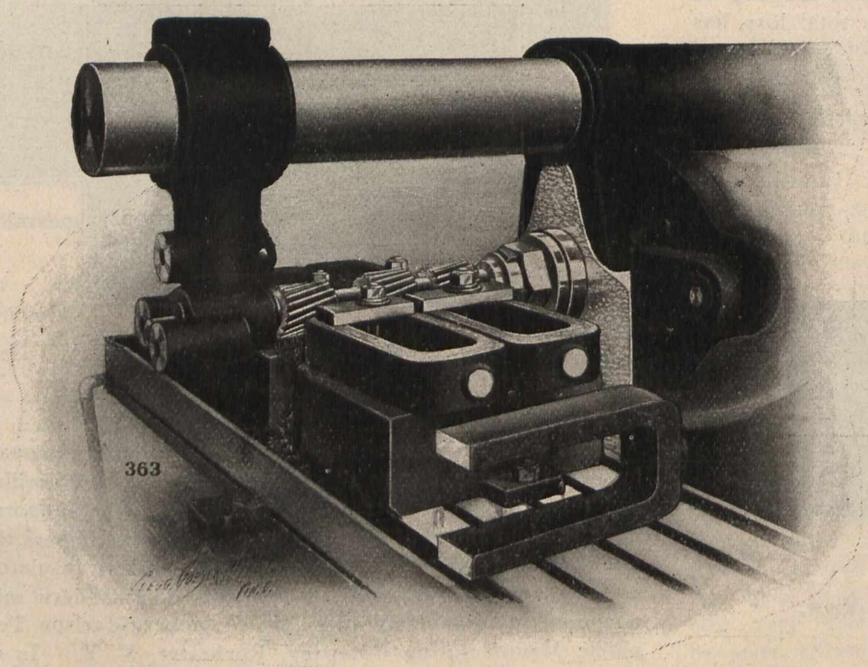
By Charles S. Gingrich, M.E.

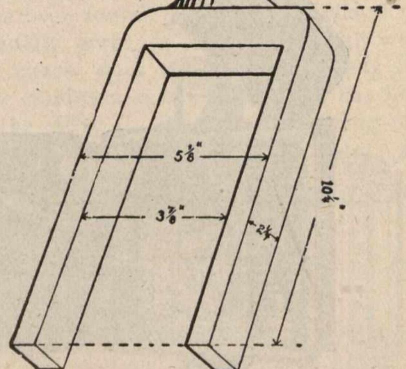
XXVII.

Steam Engine Work.

I have the pleasure of showing through the courtesy of the Frick Company, Waynesboro, Pa., the methods that they use in finishing the connecting rod straps used on their engines. For this purpose one of several styles of straps has been selected as an example. They are milling these straps all over and doing the work in remarkably good time.

The Miller used is a No. 3 Plain "Cincinnati." The first operation is shown in the illustration herewith, and consists of squaring up the ends of straps, four straps being squared up at one time using the vertical feed of the machine. Both sides of the cutters are engaged at one time, that is to say, the down side of the cutter is milling the ends of the two straps shown in the end of the fixtures nearest the observer, and the up side of the cutters is finishing the ends of the two straps at the other end of the fixtures.

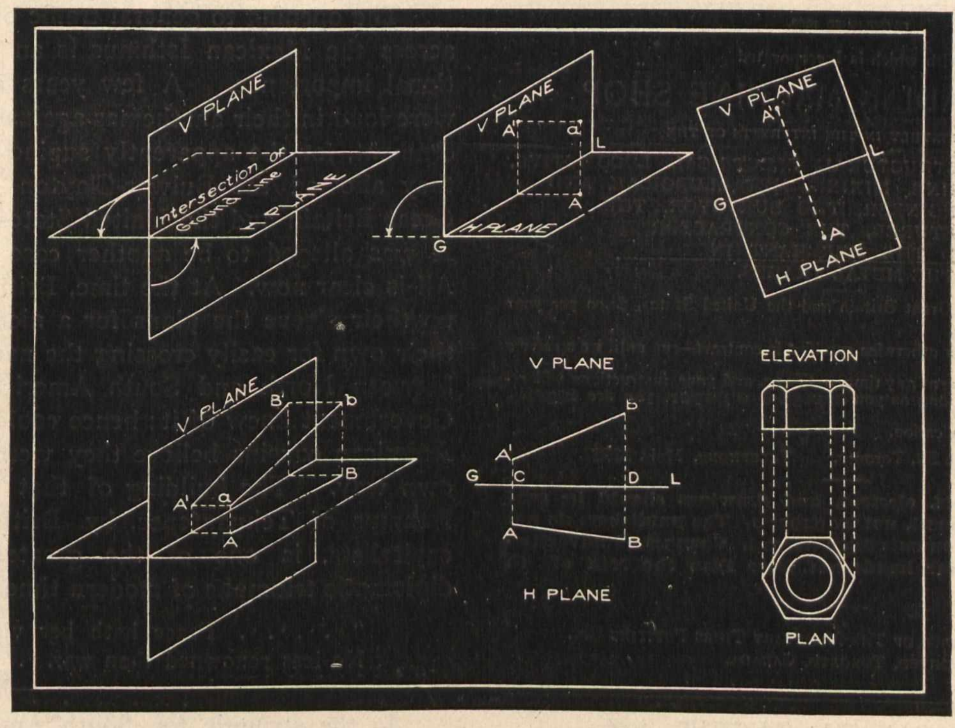




The exact dimensions of the strap are given in the accompanying sketch, showing that the total length of cut, forgings being in the rough, is 2½", total width about 7", and the depth of cut is from ¼" to ⅜". This operation is completed on 16 straps per hour.

I expect to be able to show the method of milling the sides of these straps next month.

EXTRACTS FROM AN ENGINEER'S NOTE BOOK



PROJECTIONS.

If we look directly at the front of a house, we get an idea of its length and height, but we do not know anything of its depth (the third dimension). If we were above the house, we should see its length and breadth, but not its height. Thus it is evident that there is no one position from which we can see the three dimensions at once.*

By applying a few principles, we can make a mechanical drawing which shall represent, on a flat piece of paper, an object just as we should see it looking down upon it, looking at it from one end, from another end, from the front, or from the back.

Views.

Most working drawings give two views, and some give three. These views are:—

The Plan.—The appearance of the object when the observer is looking down upon it. The plan of a house is the view as seen from above; but, as the arrangement of the rooms is the important point, the plan is a representation of the appearance with the roof removed.

Similarly, in machine drawing, the plan may be the actual appearance as seen from above, or some part may be assumed to be removed.

The Elevation—or what is seen when the observer looks directly **at** the object when it is at the level of the eye. The elevation of a house is the view of the front as seen from a slight distance. In like manner, the elevation of a machine or part of a machine is the view of the front side.

The End View or End Elevation—the appearance of the end of the object. This corresponds to an elevation of a house; but in this view, the face selected is adjacent to that used for the front elevation.

In addition to these three views, others show "Sections;" that is, they show what would be seen if the object were cut by a saw or knife. For instance, if the cylinder of an engine or pump were cut lengthwise through the centre, the observer would see the interior of the cylinder, the piston, valves, ports, etc. These parts are not shown in plan or front elevation unless they are "sectioned."

The number and location of these sectional views depend upon the intricacy of the object.

In order that the views may bear an exact relation to one another, as to both size and location, a definite plan is followed while making the drawings. This plan is called **Projection,** which means that lines and surfaces are drawn or projected from one view to another, and the views are projected on to planes.

In mechanical work, it is necessary to have lengths of lines accurate, as well as to give a picture idea. Therefore perspective cannot be used, for it assumes the observer to be at a finite distance from the object. In place of perspective mechanical principles are used; and the object is so drawn that all the lines are proportional to their true lengths.

The Two Planes.

In practically all drawings, more than one view is necessary; and to show these views in proper relation, two imaginary planes of projection are employed. The two planes provide means of fixing the location of a point in space.

If a book is four feet above the floor, you form some idea as to where it is; but if the book is described as being four feet above the floor and two feet from the outside wall, you have a much more definite notion of its location.

Similarly, in projections, the question of a point is described in reference to two planes, and these planes are assumed to be at right angles to each other. One plane is vertical, and is called the **vertical plane,** or, simply, the **V plane.** The other is horizontal—the **horizontal** or **H plane.**

Since the drawing board is flat, we cannot actually have the two planes; hence we imagine them to exist. To get the drawing flat, we imagine the vertical plane **revolved** until it lies in the same plane as the horizontal. This is shown on the blackboard. The line of intersection of these planes is the **ground line.**

Projections of Points and Lines.

To aid you in understanding the principles of projection, take two pieces of cardboard about 8 by 10 inches, and glue a strip of cloth along one of the long edges of each. The pieces will now be hinged. Set them up so that they will be at right angles (approximately)—one of them horizontal, and the other vertical.

Now imagine a point, as at **a,** somewhere near the planes. Look down on the point and mark the point where the line of sight strikes the horizontal plane with the letter **A.** Raise the planes until the H plane is about level with the eye, and look at the point **a;** where the line of sight strikes the V plane, mark with the letter **A'**. If, now, the cardboard plane (the V plane) is revolved as shown, we get the third figure on the blackboard.

Let us consider lines. A lead pencil or a penholder may be used. By placing it in various positions and looking **down** on it, then directly **at** it, you can easily draw its projections on the planes. Place the pencil in the position shown as **a b** in the fourth figure. Look **down** on it, and draw the line **AB** on the H plane. Look **at** it, and then draw the line **A'B'** on the V plane. When the planes are revolved, the two projections will have the appearance shown in the fifth figure. These two projections describe the position of the line. The right-hand end is a distance **B'D** above the H plane, and **BD** in front of the V plane. The left-hand end is **A'C** above the H plane, and **AC** in front of the V plane.

The sixth figure shows the projections of a hexagonal nut. As you see, the nut is made up of lines; and by considering each line separately, the projections are not difficult.
—"Technical World."

* By looking at a corner, we can see the three edges; but two of them, the length and the depth, will appear shorter than they really are. This condition comes under the head of Perspective, which deals with Pictorial, not Mechanical Drawing.

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.

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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 th preceding month.

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TORONTO, CANADA, AUGUST, 1906.

CONTENTS OF THIS ISSUE.

AT THE ELEVENTH HOUR.

Toronto, July 28.—Owing to lack of space, we are holding back until September, article V., by C. H. Mitchell, C.E., on European Hydro-Electric Development: "Latest Italian Plants in Vicinity of Milan." This will be followed by two more on recent plants in Switzerland. The series, when completed, will be the most complete account of the best European installations extant. Mr. Mitchell and party are now enjoying themselves in the Welsh mountains at Bettws-Y-Coed, under the shadow of Snowdon. He will be back to his native land August 4, with the best comparative knowledge of hydro-electric work and long distance transmission of any Canadian Engineer.

Winnipeg, July 27th.—Premier Roblin reports that the Manitoba harvest will be the best in her history, and will tax the transportation companies beyond anything in the past. There will be over a hundred million bushels for export, more than the transportation companies will be able to move in twelve months. The rumor of "rust" given out sometime ago, was the veriest nonsense, as the closest enquiry failed to verify it. The financial market is already going up, and the outlook for industrial development bright.

Montreal, July 26th.—"The friends of the Niagara municipal power scheme are warning people not to place any faith in statements against it, the assurance being given that all such statements emanate from the power combines bureau in Toronto. The weakness of the municipal ownership case is fully revealed by this appeal. The case should be kept wrapped up in cotton batting."—Montreal Gazette.

CANADA LOOKING SOUTHWARD.

The opening to general traffic of the new railway across the Mexican Isthmus is an event of international importance. A few years ago, the croakers were loud in their anathemas against the British Government, for the apparently supine manner in which they allowed the Bulwer-Clayton Treaty between Great Britain and the United States to be ripped up. It was alleged to be another case of "back down." All is clear now. At the time, British capitalists had up their sleeve the plans for a nice little scheme of their own for easily crossing the narrow strip of land between North and South America. The Imperial Government knew of it; hence could afford to let our American cousins believe they were getting all their own way. The building of that railway over the Isthmus of Tehuantepec, by British engineers and capitalists, is one of the greatest technical and diplomatic triumphs of modern times. Truly—

> " . . . . . Peace hath her victories,
> No less renowned than war. . . ."
> —Milton.

In the struggle for South American trade, and trade with Mexico in particular, Canada is destined to play an important part. Indeed the race is already on. It is just a year ago since a monthly steamship service was opened out between Montreal and Mexico, and already the results have been startling. Here is what Mr. D. A. Ansell, the Mexican Consul-General at Montreal says about it:—

> Since the Elder, Dempster Line opened the monthly service with Mexico in July last, the shipments of Canadian products, particularly wheat, have increased so rapidly that it is probable a fortnightly service or larger ships, or both, will have to be put on in the near future. The amount of business that has been opened up during the summer has been far greater than I expected, particularly considering the fact that the line was opened up with scarcely any advance notice whatever.

The steadily increasing exportation of Canadian wheat is the thin end of the wedge. Ere many moons have waxed and waned, agricultural machinery and other lines of manufacture in which the Dominion excells, should find good markets among the teeming millions of South America—with the Tehuantepec Railway as the *Via Media.*

CHEAP POWER: FALLACIOUS FIGURES.

II.

Replies to Critics.

The so-called "cheap power movement" in Ontario, had its origin (July 8th, 1905), in the columns of "The News," Toronto: a philanthropic daily which claims to be specially devoted to the diffusion of useful information. It began with the publication of an interview report, to the effect that a contract had been made between one of the Niagara Power Companies and the Toronto Railway Company for the supply of electrical energy in Toronto at $35 per horse-power. That was the spark which set the Province on fire. And bald though the allegation was, it forms the *raison d'être* of the Hydro-Electric Commission's fallacious Report: as regards Toronto, (see p. 37). There is one kind of "information," of which "The

News" manifestly has a monopoly, viz., half truths—that are sometimes worse than untruths. The omission to state whether the $35 was a "metred," or a "flat rate," is a case in point. No doubt this fatal omission was due to ignorance, but the result has been none the less mischievous, pernicious, pestilential. Had our "Independent" organ of sweetness and light, specifically differentiated, the chances are, that we should never have heard of the Ontario Governmental Commission; costly municipalities commission, and the $17 cheap power campaign, which ended in the enactment of the drastic Coercion Bill.

Our thesis on "Cheap Power," last month, attracted widespread attention. Every important newspaper in the Dominion had leading articles thereon—mostly favorable. Among the exceptions was the "Evening Telegram," (Toronto), July 11th. The mental cripple who writes the editorials in the absence of the editor, favored us with his critical attention: resorting to the small, "your another" style of argument, and charging us with being the—

> Partizan advocate of over-capitalized private ownership and unrestrained monopoly.

and other drivel of a like character.

"The Globe,"—July 7th, wise in its generation, sat on the fence; declaring that:—

> Into the merits of the controversy a non-technical journal cannot think of entering.

And that—

> It is wasting time to discuss now what it costs to develop and transmit power. There will be perfect knowledge on that point when the time for imposing rates on consumers has arrived.

"The News," of July 9th, however, had no such mental scruples as "The Globe," and stepped forward as the unblushing champion of the $17 craze. After a preliminary word about earlier critiques of the Hydro-Electric Commission's figures, the general public were informed, that—

> The first attempt to prove them unreliable is made in "The Canadian Engineer" for July, and the article is sufficiently serious in tone to warrant some consideration.

Then we are asked point blank, this apparently awkward question:—

> Why and how is it that electric power generated at Shawinigan Falls can be transmitted to Montreal, a distance of ninety miles, at $15 per horse-power per annum?

And our innocent literary critic, is evidently content to risk his whole case on this wild throw; for he closes his two-column article with reiteration of that $15 "useful information" from Montreal.

Now, as in the case of the $35 contract in Toronto; so, in the case of this alleged $15 rate at Montreal, we are not informed as to whether it is a 10-hour or 24-hour rate, or whether it is "flat" or "metred;" factors of vital importance if any just comparison is to be made. This fatal omission deprives the alleged $15 Montreal rate of any argumentative value, and entirely rules it out of court. Even the "scholarly," but spineless "Veritas" failed to help "The News" out; in fact he cuts the ground from under our critic's feet entirely, by showing* that there is no parallel between the necessarily costly installations of magnitude at Niagara, with their expensive wheel pits, and mile long tail race tunnels cut through solid rock; and the simple, 40,000-H.P. installation at Shawinigan, with its single transmission line on ordinary wooden poles, costing "practically a half that of the investment contemplated by the Power Commission," and which J. Stanley Richmond has conclusively proved† to be $2,-341,207 in error in one item alone.

* "The News," July 16th, 1906.

Great was the joy of "The News," when "Veritas" came on the scene,—"an engineer of wide professional experience in the United States;"—who straightway proceeded under a sneaking *nom de plume,* to assure the public that "The Canadian Engineer" "has ventured beyond his depth," and then conveniently slips out of danger with this apology:—

> I will, therefore, not occupy valuable space by going into the technical details of the article in question, but should you desire the detailed figures I will be glad to let you have them.

With strange mental obliquity, "The News" thought this ally was blessing his $17 cause, whereas, "Veritas" was evidently laughing up his sleeve all the time; for he concludes his cunningly devised letter, by pointing out a discrepancy in the Report, and showing that the flat rate for 33,792-H.P. at Toronto sub-station should be $18.22, and surprisingly ends thus:—

> The final cost of power to the consumer on this basis will be $27.52 per H.P. per annum, if the entire quantity of 36,272 H.P. be sold, or, if the load factor be 50 per cent., *as in other cities,* the cost will be $55.04 per H.P. to the consumer.

So cheap power in Toronto at $17, has now become $55.04; and yet this special engineering *protégé* of "The News" commenced his letter by agreeing with the editor that power was being delivered in Montreal at $15!

Up to date, no attempt has been made to invalidate the figures set forth in our case against the Hydro-Electric Commission's Report—where it was shown (1) that a reasonable figure at the Toronto step-down station would be $32.50 as against $17; (2) that in the report no allowance was made for step-up transformation, spare plant or "load factor"; (3) that only 8 1-4 per cent. transmission loss had been allowed for between the purchase point at the Falls and the high tension delivery at the outskirts of Toronto; whereas it should be at least 18 per cent.; and (4) in the estimated cost of line transmission apparatus alone, there is an error of $2,341,207.

Until these serious allegations are disproved the Official Report of the Hydro-Electric Power Commission of the Province of Ontario, stands condemned and discredited in the eyes of every intelligent Canadian engineer.

EDITORIAL NOTES.

Diamonds: A New Idea In The Foundry. One of the most interesting things brought out at the recent meeting of the Foundrymen's Convention at Cleveland, was the use of diamonds as cutting tools in the foundry. Every up-to-date foundry is now equipped with machinery for cutting off sinking heads, etc. But skilled mechanics operating these machines are too costly; and yet the economy of these appliances largely depends

† "Monetary Times," May 25th, 1906.

on the skilful sharpening of cutting tools. It was shown that by loosely fitting a diamond in a hole in the steel holder, and then soldering with brass, an extraordinarily effective cutting tool could be provided, which, while costlier than high grade steel tool, does not need sharpening once in six months, hence, the saving in time spent in sharpening, discounts the high first cost, and skilled labor is unnecessary. Canadian foundrymen should keep an eye on the mineral lands south of Hudson Bay, where the geology indicates* that diamonds galore should be found.

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Saskatchewan Government's Progressive Work.

On page 7 of our advertising columns, will be found an official application for tenders by the Department of Public Works, of the Province of Saskatchewan, for a Traffic Bridge to be built across the North Saskatchewan River at Battleford. This steel bridge will be 1,850 feet long, consisting of eight through truss spans: 5 = 250 feet, and 3 = 200 feet long, with 20 ft. roadway, and represents the first of the great public works of the newly formed and enterprizing Provincial Government of the North-West, for opening out the fruitful lands within their territory to commerce and civilization.

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Perfection In Electrical Development At Last.

Barnum once said that the American people like to be fooled. A similar view seems to be held by Cecil B. Smith,—with regard to the Canadian people of south-west Ontario: judged by his speech at Galt, (July 24th), on the marvellous efficiency of modern electrical machinery. Referring to transmission loss, and the contention of one of his critics thereon, Mr. Smith said:—

> "He started off with the calculation of a 50,000 horsepower at Niagara, and said that 10,000 had to be taken off for loss." "That," said Mr. Smith, "was a question of out-of-date machinery; but **modern generators of 10,000 horsepower gave that actual amount.**" ("The Globe," July 25th).

Two Scottish brothers named Smith once wrote a book entitled "Guesses at Truth." This last blow of the "modern" Smith, knocks the classic work of his illustrious ancestors into a cocked hat. The merest tyro in one of our technical schools knows Mr. Smith's *pseudo*-scientific pronouncement to be utterly false. A modern 10,000-H.P. generator will **not** give that actual amount. The best dynamo of magnitude yet designed, will not give 95% efficiency; and the loss increases as the load decreases.† But this hair-splitting point of Mr. Smith's was manifestly intended only to divert attention from one of the serious defects of his fallacious "Report," viz., omission to take into account proper losses in step-up transformation; line transmission; and step-down transformation; given in "Report" as 8¼%; whereas, from Shawinigan Falls to Montreal—84 miles (not 90 as "the News" erroneously states),—it is 18%‡.

Mr. Robert Hammond, the distinguished mining engineer, who has had unique experience of long distance transmission in California—where they transmit electrical energy at 50,000 volts 232 miles—declared recently before a British Parliamentary Committee, that "the bulk of the energy used from Niagara was taken within one mile from the works,—i.e., people found it cheaper to move their factories near to the generating station rather than stay at the end of a long transmission line."

* See U. S. Geological Survey Report, by Dr. George F. Kunz, on "The Production of Precious Stones," 1906, pp. 7-9.

† See "Electric Power Transmission," 4th edition, 1906, by Dr. Louis Bell, p. 59.

‡ See official statement, "The Canadian Engineer," February, 1906, p. 37.

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BOOKS RECEIVED.

City Roads and Pavements.—By Wm. Pierson Johnson. New York: Engineering News Publishing Co. Size 6 x 9, pp. 197. (Price $2 nett.)

Steam Turbine Engineering.—By T. Stevens, C.E., and H. M. Hobart, B.Sc. Toronto: The Macmillan Co., of Canada, Limited, 27 Richmond St. West. Size 6½ x 9¼, pp. 814. (Price $6.50 nett.)

Industrial Furnaces and Methods of Control.—By Emilio Damour; translated by A. L. J. Queneau, B.S. (Paris), E.M., A.M. (Columbia), Consulting Engineer, The New Jersey Zinc Co. New York: The Engineering and Mining Journal. Size 6½ x 9½, pp. 317. (Price $4.00)

Machine Drawing.—For students preparing for the science examinations in technical institutes and evening schools. By Alfred P. Hill. London: P. S. King & Son, Orchard House, Wesminster. Size 11 x 8½, pp. 83. (Price 2s. 6d. nett.)

Metallurgical Calculations.—Part 1, Introduction, Chemical and Thermal Principles, Problems in Combustion. By Joseph W. Richards, A. C.. Ph. D. New York: McGraw Publishing Co., 1906. Size 9¼ x 6¼, pp. 201. (Price $2 nett.)

Iron and Steel Manufacture, the Principles and Practice of.—This work gives sound instruction for technical students, metallurgists, etc. By Walter MacFarlane, F.I.C. London and New York: Longmans, Green & Co., 1906. Size 7¼ x 5½, pp. 249, 96 illustrations. (Price 3s. 6d. nett.)

The Principles of Electric Wave Telegraphy.—By J. A. Fleming, M.A., D. Sc., F.R.S. London: Longmans, Green and Co., 39 Paternoster Row. Size 9 x 6½, pp. 671, illustrated. (Price, 24s., nett.)

Mechanical Draft.—A practical handbook for engineers and draftsmen. By J. H. Kinealy. New York: Spon and Chamberlain, 123 Liberty Street. Size 6⅞ x 4½, pp. 134, 13 illustrations. (Price, $2.00.)

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CATALOGUES AND CIRCULARS.

Screws, Nuts, Bolts, etc.—The Brantford Screw Company, Lmited, Brantford. A very complete and comprehensive catalogue of machine screws, bolts of all kinds, cold-pressed nuts, rivets, burrs, washers and wire. This catalogue is very graphically illustrated, and has a thumb index, which makes it very handy for reference. Size 5 x 7½, pp. 52.

Ice and Refrigerating Machinery.—The Linde British Refrigeration Co., Montreal, P.Q. A profusely illustrated catalogue, describing the Linde refrigerating and ice-making machinery, and giving the principles of mechanical refrigeration. Size 9 x 6, pp. 48.

Electricity in Railway Service.—Canadian Westinghouse Company, Limited, Hamilton. "Electricity in Heavy Railway Service" is the title of an artistic catalogue, illustrating and describing "Westinghouse" electric railway apparatus. Size 6 x 9, pp. 46.

Heating Apparatus.—Sheldons, Limited, Galt, Ont. A lucid description of the apparatus used in what is known as "Hot Blast Heating System," giving some of its more important advantages. Illustrated. Size 5¾ x 7½, pp. 20.

Machinery.—Niles-Bement-Pond Co., 111 Broadway, New York. List No. 12, containing a list of second-hand metal-working machinery, including lathes, planers, shapers, drills, milling and boring machines, punches, presses, etc. Size 4¾ x 7½, pp. 60.

Revolving Field Alternators.—Canadian Westinghouse Co., Hamilton, Ont. Circular No. 1133, June, 1906. Engine type, coupled type, and belted type revolving field alternators are fully described and illustrated in this circular. Size 7 x 10, pp. 16.

Pulverizers.—Abbe Engineering Co., 220 Broadway, New York, N.Y. A very complete catalogue of pebble mills, ball mills, tube mills, etc. These mills are admirably described, and fully illustrated. Size 6 x 9, pp. 92.

Small Tools.—Hamilton Tool and Optical Co., Ltd., Hamilton, Ont. This company has just issued a useful little catalogue of small tools, sensitive drills, milling cutters, reamers and special tools. Size 4½ x 7, pp. 20.

Wood Pulleys.—Dodge Manufacturing Company, Toronto, Ont. Catalogue C 5 comprises a complete list of standard pulleys, bushings, friction clutches and belting the products of the Dodge Company. Size 3½ x 6, pp. 40.

Buyers' Reference.—The July issue of this Buyers' Reference, contains the names of all electric light and power central stations on this continent. The Buyers' Reference Co., Inc., 123 Liberty Street, New York, N.Y. Size 8¼ x 9¼, pp. 114.

Locomotive Tests Pennsylvania Railroad.—A compilation by Dr. W. F. M. Goss, from the recent publications by the Pennsylvania Railroad, describing the locomotive tests and exhibits of that road at the Louisiana Purchase Exhibition, has just been received from the American Locomotive Company. Size 6 x 9, pp. 55.

Rolling Mill Products.—The Peck Rolling Mills, Limited, Montreal. A hand-book of the products of the company, including bar iron and steel, steel plate, railway spikes, ship spikes, horseshoes, wire nails, wire, cut nails, tacks, washers, and horse nails. The book also contains tables of information of use to users of rolling mill products. Size 4¾ x 6½.—86.

Fire-proof Construction.—Trussed Concrete Steel Co., Detroit, Mich. Reinforced concrete, and the Kahn Trussed Bar are dealt with in this publication, based upon practical tests set forth in official reports; and includes comments on the San Francisco disaster. Size 5¼ x 8, pp. 31.

CORRESPONDENCE.

Development of Ontario's Mineral Resources: A Wise Suggestion.

Toronto, Ont., July 12, 1906.

To the Editor, "The Canadian Engineer:"

It is well known that there is an immense mineral district in the centre of the Province of Ontario, extending from Georgian Bay on the west to the St. Lawrence and Ottawa Rivers on the east; in fact, one of the largest deposits of nickle and copper in the world is in this district, as is also the largest known deposit of corundum. Southeast of the above also sodalite, which, when polished, makes a beautiful decorative marble,* now much sought after. In it are to be found many metallic minerals, such as iron, copper, gold, silver, nickle, molybdenum, lead, pitchblende, feldspar, flake and amorphic graphite, fluorspar, pumice stone, lithographic stone, mica, asbestos, talc, barytes, and silver; and in places, precious stones, such as garnets, saphires, amethyst, and rubies.

This district is occupied in many places by settlers holding small farms, and it would be of great advantage to them if a regular prospecting be had of the district, as the opening up and development of portions only of these mineral resources must give large returns to all connected with the work, both from the monies received for the minerals, and from the labor employed in the extracting, handling and carrying of the ore.

The profitable development of these resources may be divided into two branches: (1) The discovery and extraction of the ore; (2) the handling and preparing of the minerals for economic use.

A careful study and investigation of the situation has proven that it is possible to establish a series of agencies throughout this district—where the settlers and prospectors can sell the ores and minerals which may be produced or extracted by them. These agencies would furnish a market. The result of this would be, that many settlers and farmers could, and would, develop many deposits of mica, asbestos, talc, feldspar, etc., which are known to them, but which have been left unworked for want of a local market that would take the product at a regular price.

* J. Pierpont Morgan's private library in New York is decorated with this beautiful material.—Editor.

This would ensure the extraction of much ore that under present circumstances would not be taken out, as there are many deposits which under present circumstances do not warrant outside companies doing the work with the large expenses attending mining operations, yet a settler would be able at times, when he was not busy with his farm, to profitably open up and develop these deposits which are known to him.

Dynamite and supplies could be sold at the agencies, as that is one great obstacle met with in local prospecting and development.

In some cases the result might be the development of large and important mining industries. These agencies could collect ores, keeping the different ores separate, and at regular intervals forward them to the mill, where the grinding and preparing the different minerals for the market would be done.

A sufficient quantity of mineral is now in sight to keep a good size mill busy. A ready market exists to-day for all the mica, asbestos, talc, barytes, graphite, etc.

There is room, and a splendid opportunity for a good plant now. This plan of operation insures great economy of capital, as no large sums are to be expended in opening up or developing one or two prospects, the capital will be put into active use in a commercial way, by using it for buying and treating ores.

There is an ever increasing demand in Great Britain and Europe for the products of this mineral belt, and a systematic working in the manner proposed will aid in making it better known, and tend to increase the investment of capital in Ontario industries.

The profits are large. By carefully sorting mica many crystals may be had which can be cut into commercial sizes and sold at $1 per pound. The waste or cuttings can be ground for lubricants, ornamental wall-paper, paint fillers, boiler covering, etc. Mica can be bought (scrap) for from $5 to $8 per ton, cost of grinding 75c, market price per ton $40. Thumb-trimmed according to sizes from $1,000 per ton up.

Talc $2.50 at the mine, market price $16, and 20 per cent. duty to the manufacturer. The dividends are surely apparent.

The profits of a mineral industry may be seen, when it is understood that the nickle-copper trust of Sudbury commenced business with a capital of $550,000, and the present value is $57,000,000.

I traveled over an area, 10 by 25 miles this summer, containing magnetic and hematite iron;† one deposits 400 feet long x 250 feet wide, assaying 64.26, iron phosphorus a trace, sulphur .04, titanium none; Prof. Chapman, Government assayer. Some spots over the area carried titanium, some sulphur, some phosphorus, some being free from these objectionable qualities. There are miles of timber for charcoal, and splendid water-power for electric smelters.

CHARLOTTE A. BRIDGWOOD.

Cheap Power: Ross & Holgate Protest.

Editor, "The Canadian Engineer":

Sir,—While looking through your very excellent journal of July, 1906, we notice under your editorial columns, beginning on page 263, a very well-written article dealing with the Hydro-Electric Power Commission's report.

We have no comments to make on that article, except as regards the paragraph on page 264, which reads as follows: "And all this, solely upon the questionable authority of two Montreal engineers, possessing only a theoretical knowledge of long distance power transmission."

This paragraph leads us to suppose that you have confused the report of the Hydro-Electric Power Commission with that of the Ontario Power Commission. With the former Commission we have had no connection whatever, but were engineers for the Ontario Power Commission, for whose report we are quite ready to assume the responsibility. As, however, this confusion has arisen, we would suggest that a correction in your next issue is in order.

As regards the gratuitous assumption of "Questionable authority and theoretical knowledge" possessed by the said two Montreal engineers, we might say that our specialty, in which we have had a certain amount of success, is power transmission work, and that among other equipments we

† In the vicinity of Wollaston and Farraday townships rich magnetic iron ores are available.—Editor.

might mention the West Kootenay Power and Light Company's plant, Rossland, B.C., designed and built by us, which is about to commence operation, at 60,000 volts, the highest hitherto attempted. This plant will transmit about ninety miles at present, and probably 200 eventually.

The generators and wheels in this plant, we might say, are larger in size and heavier than those at Niagara, so that, taking this as one plant alone, it appears probable that our "questionable authority and theoretical knowledge" is pretty fairly acceptable to capitalists with money to invest, and we would be glad to know whether there are any reasons other than gratuitous assumptions for making the above statement.*

We note with pleasure that your editorial opinion is not reflected in the columns of your correspondents (see page 15 of the same issue), where we are treated in a most flattering manner in your Rossland notes.

We will look forward to your next issue for some explanation, which we feel is due, not only to ourselves, but to your readers.

Yours very truly,
(Signed), ROSS & HOLGATE.

[*Yes; and the data for our deduction is found in the above letter, which clearly indicates that they have no practical experience of high-tension (60,000 volts) long-distance line transmission, even on the Kootenay plant, B. C., which they cite; since, on their own word, it is not yet in operation. That Messrs. R. & H. are competent Engineers we do not deny: perhaps none better in Canada in their chosen line; when, however, it comes to long-distance transmission of electrical energy, we are justified in reasserting that their opinion is of questionable authority, since it is based on theoretical knowledge only. EDITOR.]

"NAPANOCH" POCKET-KNIFE TOOL KIT.

TECHNICAL EDUCATION: OVERTRAINING IN GERMANY.

Consul Harris, of Mannheim, Germany, says the German Empire is rapidly building up a class of men for whom it has no employment at fair wages, and for whom the demand does not increase as fast as the supply. He cites the opinion of a writer in a leading paper of Mannheim to the effect that technical education in the Empire has been carried far beyond the power to utilize it. The consul writes:

The question of erecting a school for the building trades in Mannheim being at present under discussion, a prominent constructing engineer has contributed an article to a leading newspaper of the city, in which he aims to show that technical education in Germany has gone beyond actual needs. He contrasts the number of those taking such training with the number in other professions, and concludes that the ranks of the technically trained are at present much overcrowded. The following extracts from his article will be of interest. The term "technical high school" used in the article is peculiar to the German school system, and represents the highest grade of technical schools in Germany, of which there are at present ten in the Empire.

Number of Students.

The number of those studying in the technical high schools in Germany in the winter of 1890-91 was 5,432 and in the winter of 1904-5 15,866, or, in other words, there was an increase of about 200 per cent. On the other hand, the number studying theology in Prussia in the winter of 1887-88 was 2,713, and in the winter of 1903-4 1,005, or a falling off of almost one-third. The number of medical students in Prussia in the summer of 1887 was 5,168 and in the winter of 1903-4 3,020, a falling off of almost one-half. In the scientific technical branches of the departments of philosophy in the advanced schools (as the universities), which, as shown by experience, prepare a large percentage of technically trained students, the number of such students in the winter of 1901-2 was 1,100, and in the winter of 1903-4, 3,015. It thus appears that there is a rapid increase in the technically trained that casts into the shade the well-known enormous increase in those trained in legal studies, which in 1889-90 amounted to 2,925, and in 1903-4 to 6,345. From the latter ranks also, it is not to be overlooked, come many of those holding official positions in industrial undertakings.

Conditions in Middle-Class Schools.

Similar conditions are to be noted in the middle and lower technical schools. Thus, in the 22 schools for the building trades belonging to or receiving aid from Prussia, the number of students in the winter of 1902-3 was 4,251 and in the winter of 1903-4 was 5,077, an increase of 20 per cent. in a single year. For a period of ten years this increase would amount to 200 per cent. The number of special schools in the metal industries belonging to or supported by Prussia in 1891 was 9; in the winter of 1903-4 it was 19, an increase of 110 per cent. The number of students in attendance in 1891 was 755 and in the winter of 1903-4 it was 3,010, an increase of 300 per cent. This number is equaled, if not exceeded, by those attending private technical schools. In Saxony, which plays almost the part of an incubator of middle-grade technical students, the number of schools for machine construction in 1884 was 2, with 524 students. In 1902 there were 6 schools, wth 2,687 pupils, an increase of 200 per cent. in schools and 410 per cent. in pupils. The number of schools for the building trades in 1885 was 5, with 469 pupils, and in 1902 it was 10, with 1,342 pupils, or an increase of 100 per cent. in schools and 185 per cent. in pupils.

Effect Upon Wages.

It is apparent that the increase in numbers in the technical ranks has gone far beyond the demand—200 per cent. against about 50 per cent. on the average. The consequence of this overproduction in technical resources is a constantly diminishing rate of wages, as the law of supply and demand applies here as elsewhere. Wage statistics, which were compiled from enquiries made of 20,000 members of the German technical association, and which were presented in the Reichstag by Dr. Heinz Potthoff, a member, show the following picture: Almost one-fourth of all city and other trained appointees receive a salary under 1,800 marks ($428.40) per year, 35 per cent. receive from 1,800 to 2,400 marks ($428.40 to $571.20), only 24 per cent. receive from 2,400 to 3,000 marks ($571.20 to $714), and only 19 per cent. receive over 3,000 marks ($714). It is to be noted that among those considered were a large number of office men who are engaged with public officials, which gives to the total a more favorable aspect, because among officials so employed a rate of salary from 2,100 marks ($499.80) to 2,700 marks (642.60) generally prevails.

From all this it appears that for an increase of technical resources and schools there is at present no pressing demand. There is an increased and, as it were, artificially created proletariat, and the various industries are not in a position to pay for these superfluous powers.

FOUNDRYMEN'S CONVENTION

[Inasmuch as there is no organization of foundrymen in the Dominion of Canada, a report of what is being done in the United States to advance the art of founding in metals, will doubtless be of interest to Canadian Engineers.—EDITOR]

The eleventh Convention of the American Foundrymen's Association, was held at Cleveland, Ohio, June 5th to 7th. Over 800 representatives of the metal trades were in attendance, from all parts of North America. The sessions were held in the Central Armory, near the southern shore of Lake Erie. And an impressive sight it was, to see that large assembly of prosperous foundrymen seated in the middle of what was in reality a huge foundry; for, on every side of the central section of the large auditorium were cupolas; chain and air hoists; moulding machines; sand sifters; core making machines; tumbling barrels; sand blast apparatus; fans; pressure blowers; facings; sands; magnetic separators and crane lifts; Thermit foundry; brass furnaces; moulders' tools; pneumatic chippers; hydrofluoric-acid baths; ferro-alloys; graded pig-irons, coke supplies, etc., in fact every conceivable appliance, tool, and requisite for a modern foundry. A scene typical of the audacity and enterprise of the great Western Republic.

Fig. 1.—Foundry Exhibit in Convention Hall.

Meeting of Foundry Foremen.

On June 4th, the day previous to the opening of the general Convention,—a meeting of the Associated Foundry Foremen was held at the American House, with President David Reed, of Hamilton, Ont., in the chair; the secretary's report showed a total membership of 334; an increase of 77 during the year. The chief subject before this minor convention was the indignant consideration of the serious allegation made in "The Iron Moulders' Journal," that this foremen's association was controlled by the National Founders' Association, and that the foremen were being used against the men in the manufacturers' conflict with the iron moulders' union. The sentiment of the assembled foremen was finally crystallized into a series of resolutions, the heart of which was, that **the object of this Association shall be solely educational.** Officers for the ensuing year were chosen as follows:—President, Hugh McPhee, of Bridgeport, Conn.; 1st vice-president, Hugh McKenzie, of Cleveland; 2nd vice-president, A. T. Williams, of Philadelphia; sec.-treas., F. C. Everitt, of Trenton, N.J. We notice that Canada is unrepresented.

General Convention: Opening Session.

At the opening session, the inaugural address was delivered by President Thomas D. West, author of "The Moulder's Text Book;" "Metallurgy of Cast Iron," etc. The burden of which was an eloquent plea for the necessity of reform in technical education and home training, in order to develop practical artizans, and efficient workers. To accomplish this would demand sacrifice, and he eulogized the American Foundrymen's Association, for the noble work already accomplished by the self-denying labors of its members in raising the foundry business in America from a rule of thumb practice, to a practical science; by the members "giving gratuitously to the world their trade secrets and experiences, as well as the results of original research, obtained by great labor, and oftimes at great expense, which but a few years ago—comparatively speaking—all men would have held in strong boxes." Said Mr. West, "There are over 5,000 proprietors of foundries and as many more superintendents and foremen combined with the allied interests, such as chemists, pattern-makers and supply men, that should take great interest in our associations' work. There are many who do take a great interest, and those who do not, would doubtless do so were they to attend one of our meetings, or take the time to investigate the good work that has been accomplished by our members, in helping each other to advance knowledge and skill in the art of founding." . . . "Education," he continued, "is our Association motto, and by making it as practical as possible we can do a great deal toward making this world grow better. This Association and kindred societies will certainly have to labor for more practical methods of instruction if, as a people, we truly desire to develop skill in our artizans, and to obtain the greatest comfort and happiness for the masses. "This," he concluded, "is a condition that can and should prevail throughout the civilized world." (Applause). The report of the secretary-treasurer, Dr. Richard Moldenke, (a man with an international reputation as a metallurgist, to whose self-denying labors, the scientific status of the founder's craft is largely due), showed that the forward movement inaugurated by the American Foundrymen's Association, in 1896, was now spreading over the world: Great Britain having followed their example, and established the British Foundrymen's Association, while branches had been opened on the Pacific Coast and elsewhere. The most notable event of the year being the formal taking over by the United States Government of the Standardizing Bureau, inaugurated by the Association at the Detroit Convention in 1897, and which has proven of great value to founding as well as the iron laboratory." The report refers pleasantly to the introduction of founding as a practical science into Trade Schools, and comments thus:—"We rejoice with them that education is thus making headway, and **we need not fear European competition quite so seriously as formerly.** Let the good work go on, however, it satisfies our pride to have done the preliminary work."

The financial statement indicated an income of $1,540.90, and an expenditure of $1,397.19, leaving a balance in hand of $143.71.

READING OF PAPERS.

Trade Schools.

The first paper read was a committee report on the foundry department in connection with the Carnegie Technical School, Pittsburgh. The work being done was heartily approved by the **select** committee of practical foundrymen; which is worthy of investigation by the authorities at McGill University; Toronto School of Applied Science, and every Technical institution in Canada. In an early issue of "The Canadian Engineer," we purpose describing in detail, and illustrating graphically the foundry department in this celebrated Technical School.

Standard Methods of Analyzing Iron.

The report of the Committee on Standard Methods for the Analysis of Iron: particularly for the determination of total carbon and sulphur, was then read, and should be in the hands of every laboratory chemist; for it is now **Standard.**

Foundry Costs.

The question of costs was dealt with in papers as follows:—

Uniform Practice in Foundry Cost Finding, by Kenneth Falconer, of Montreal, Canada.

The first-named essayist, declared that "In Canada, the basis on which manufacturing expenses are distributed on cost of production is a point regarding which there is little uniformity of practice among the foundrymen, some of them distributing such expenses according to the weight of the output, and others on the labor and material cost of product. While in some foundries the ratio of manufacturing expenses to the number of productive hours' work, irrespective of the wage price per hour, is the plan in vogue." The whole question of foundry costs was relegated to a committee consisting of Kenneth Falconer and Dr. Moldenke, to report at the next annual meeting.

Scarcity of Good Moulders.

This subject was discussed in a paper entitled:—**Good Moulders; Why They are Scarce,** by U. S. McQuillan, of South Norwald, Conn.; who ventured the opinion that the foundrymen of the present day are confronted not with a scarcity of moulders well developed, strong, able and willing to work, but with a scarcity of moulders developed mentally, and who are able and willing to think. He believed that it would be wise for foundrymen to ascertain to what extent they themselves are responsible for the scarcity of good moulders; to learn whether the conditions imposed upon the men working at the trade are such that they have no chance to develop their minds, and whether the straining and crowding that will enable foundrymen to compete with each other at low prices are not factors which tend to get moulders into the habit of disregarding many things so important for the production of quality. Continuing, he said, **that advancement in foundry practice is toward the elimination of heavy physical labor and the introduction of many labor-saving appliances, and recognizing these facts, he believed that the successful foundries of the future will be those in which the greatest amount of hard labor and disagreeable conditions have been entirely eliminated.**

E. H. Williams, in the discussion which followed, emphasized the necessity of inculcating habits of **temperance** among the moulders. He severely criticized the Iron Moulders Union for not insisting more on **character.**

Then followed a valuable paper on, **Recent Methods of Machine Moulding,** by E. H. Mumford, of Philadelphia.

An interesting account by Dr. Moldenke, on foundry tests of coke at the United States testing plant in St. Louis, and discussion thereon, ended the first day's proceedings.

WEDNESDAY MORNING SESSION.

The third session opened with a paper on **The Correct Application of True Burden to Iron Costs,** by E. M. Taylor, of Boston.

Then came an interesting paper, entitled, **Dark Secrets in Foundry Practice,** by W. H. Parry. The reader of this paper is well known as a practical patternmaker, and discussed problems of the foundry from the standpoint of an outsider. He incidentally described the use of diamonds for cutting tools, the diamond being inserted in a steel holder and used as a lathe tool. While the cost of the diamond was much higher than that of a steel tool, the saving in time of sharpening and wear more than compensated for the first expense. J. F. Webb enquired as to the cost of using diamonds for cutting tools, and Mr. Parry replied that it was about $8 to $12 per carat. The stones, however, did not need to be sharpened once in six months. The method of preparing the tool was to make a hole in the steel holder in which the diamond was loosely fitted, and then brass solder was poured around it. The stone was sometimes ground before being placed in the holder and sometimes afterwards. Diamond dust was used for grinding, and cost from $6 to $8 per carat.

James F. Webb's paper on **Multiple Moulds,** was a revelation of what is being done in economic machine-moulding. This was followed by Ralph H. West's essay on **Comparative Design and Working of Air Furnaces.**

Cupola Fluxes.

H. W. Shedd's paper on **Foundry Fluxes,** evoked an interesting and profitable practical discussion. G. M. Thrasher, Jr., chemist of Western Tube Co., Kewanee, Ill., described the conditions under which a cupola was run for eleven hours per day. The flux used was composed of 35 pounds of limestone and 15 pounds of fluorspar to each ton of iron. The amount of coke used was 300 pounds per ton of iron. They found that limestone alone was not adapted to long heats, such as the above, and that the fluorspar was necessary.

J. F. Webb told of the troubles of a foundryman who charged, in a 54-inch cupola, 7,000 pounds of iron to

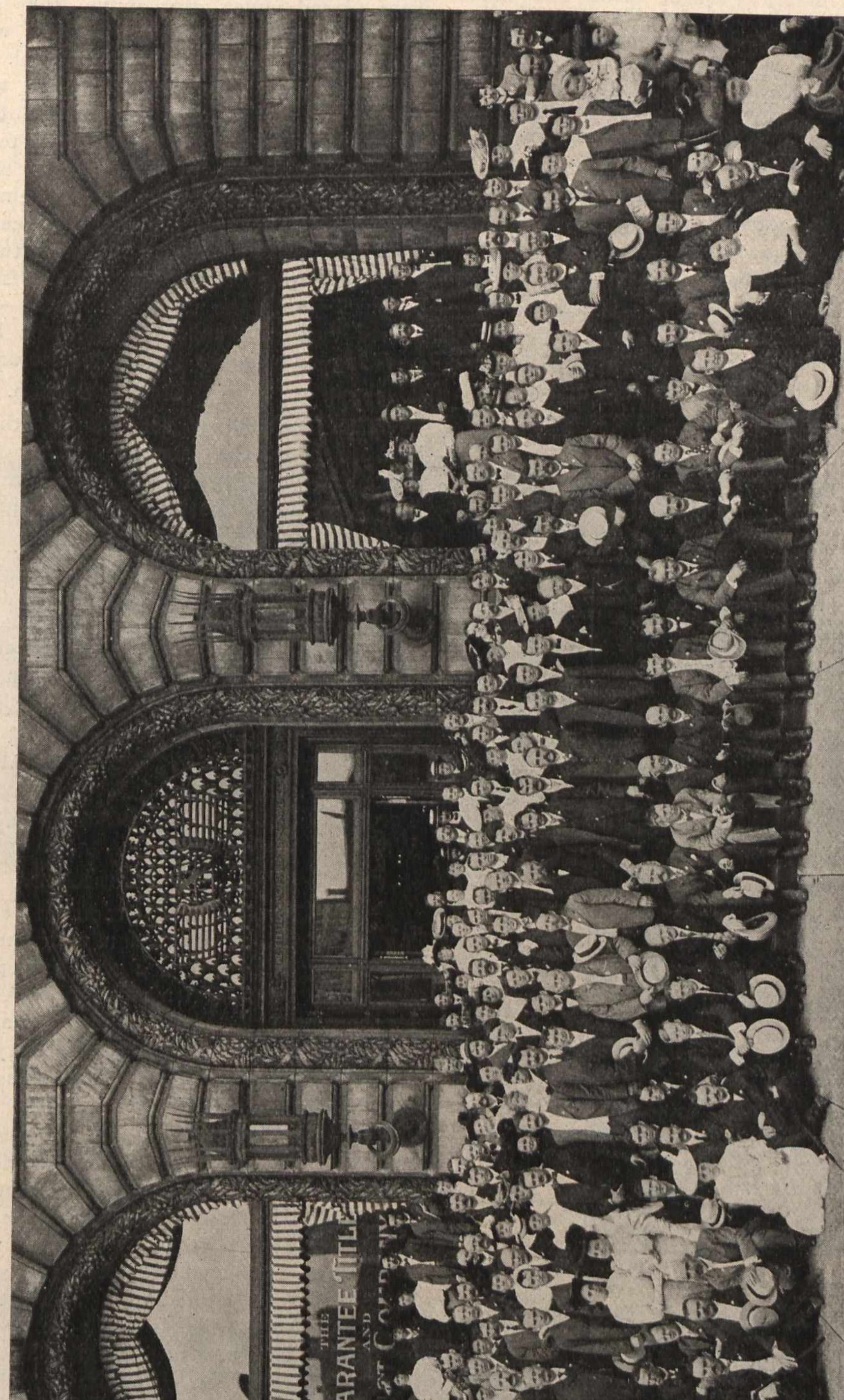


Fig. 2.—Foundrymen and Their Guests at the Cleveland Convention.

1,800 pounds of coke. After the first couple of tons of iron came down it ran cold and Mr. Webb enquired the reason. Mr. Shedd, the author of the paper, said that he thought that too much iron was used for the amount of coke charged, and that not over 5,000 pounds should be used with that amount of coke. Dr. Moldenke agreed with Mr. Shedd that the amount of iron was too great, and said that not over 6,000 pounds should be charged.

Visits to Works.

In the afternoon of Wednesday (June 6) a visit was made to the works of The Brown-Hoisting Machinery Co., East Cleveland, where, almost the entire machinery plant is located under one roof. An operative demonstration of their mammoth cantilever yard crane—which is a type of crane created by this company, and now found all over the industrial world—was very attractive. Their plan of heating the immense construction shop, method of pattern storage, and lavatory system for their workmen were features well worth seeing. From thence, a flying visit was made to the works of The Wellman-Seaver-Morgan Company, where many beheld for the first time a huge electric magnet in the stock yard, rapidly lifting and transporting pig-iron, etc., from the stock piles to the trucks. The iron and steel foundries were minus moulding machines, but Mr. Boyd, the enterprising manager assured us this defect would soon be remedied. The filling of holes in defective castings **by electric arc fusion** was an exciting phenomenon. The party then went by special street cars to the Case School of Applied Science, where an afternoon session was held in the Electricity Hall. The chief event being a illustrated lecture by Prof. C. H. Benjamin, describing the tests and experiments made on the strength of cast-iron during the past ten years. He found that in making a cylinder with flanges heavier than the body, to provide the necessary strength to make up for the bolt holes, that blow holes invariably developed at the junction of flange and body. The blow holes weakened the cylinder so much that fracture always resulted at the neck. In course of time he got a cylinder in which both wall and flanges were of uniform thickness: the requisite strength to compensate for bolt holes being provided for by brackets under the flanges. In no case did these cylinders fail around the neck, but in the manner that they theoretically should, namely, in a straight line parallel to the axis. From the laboratory standpoint these cylinder experiments were very interesting, but no solution was offered as a remedy for the trouble in the foundry. When interrogated, the Professor was unable to say whether the neck fracture was at the top or bottom of the cylinder; whether the moulds had large or small sinking heads; whether on the casting of cylinders **feeding** was resorted to; whether metal chills were placed under and above the flange spaces in the moulds; or whether they were cast with metal at a high temperature or comparatively cool. The only solution offered was that propounded by the writer at the Detroit convention, 1897,* viz.: **equalization of section.** The remainder of the lecture was devoted to experiments on the breaking strength of gear-wheel teeth and the testing of fly-wheels, pulleys and emery wheels to destruction. The wheels were placed in a steel casing and driven by a steam turbine up to any necessary speed for breaking. At some future date we purpose giving the data on these invaluable tests. A hearty vote of thanks to Professor Benjamin for his interesting and highly instructive lecture was tendered.

W. H. McFadden,
President American Foundrymen's Association.

Closing Session.

The concluding session of the Convention, was held on board the steamer "City of the Straits," which started at 9 a.m., bound for a 27 miles trip to Lorain, Ohio, where about 450 disembarked, and inspected the immense ore docks, modern blast furnace plant, and extensive foundries of the National Tube Co. On the voyage a paper was read by G. M. Loudon, entitled, **Core Compounds and Mixtures.**

Election of Officers.

Then followed the election of officers for the year 1906-7:—President, W. H. McFadden, Mackintosh, Hemphill & Co., Pittsburgh; Vice-Presidents, C. J. Cayley, John W. Burr, Stanley G. Flagg, Jr., J. H. Whiting, W. J. Keep, Thomas J. Sherriffs, J. B. Golden, and L. L. Anthes, of Toronto; Secretary-Treasurer, Dr. Richard Moldenke, Watching, New Jersey.

Impressions.

This Cleveland Convention was the most popular meeting ever held in connection with the Association, and its success was largely due to the splendid exhibit of the American Foundrymen's Supply Association, originated by the editor of "The Foundry," Henry M. Lane, to whose executive ability and untiring energy as chairman of the entertainment committee the success of the Convention was chiefly due. The newly elected officers of the Supply Association are: President, Samuel T. Johnson, Obermayer Co., Chicago; Vice-Presidents, S. H. Mumford, Philadelphia, E. A. Kebler, Pittsburgh; and Secretary-Treasurer, H. M. Lane, editor "The Foundry," Cleveland, Ohio. We were greatly pleased to see the founder of the American Foundrymen's Association, John A. Patton, in attendance at the meetings. It must be gratifying to him to know that the seeds he and Howard Evans and others sowed 10 years ago, are bringing forth such rich fruit. The signs are, that W. H. McFadden, the newly elected and worthy President of this powerful organization, will preside at Philadelphia in 1907, over the greatest assembly of foundrymen every held in the world. The Association was founded in Philadelphia May 12th, 1896. S. G.

—The Canadian Rubber Company, of Montreal, have just concluded a deal whereby they obtain exclusive control of rubber advertising in all street cars owned and operated in the principal towns and cities in Canada. This progressive Canadian company are at present running their attractive cards in street cars, advertising their "Keystone" Side Wire Tire, and also calling attention to their general facilities for manufacturing tires for any class of work.

—The J. W. Cregar Agency, The Bourse, Philadelphia, Pa., begs to announce that that agency has retired from business, and that he has accepted a position in charge of the Miscellaneous Department of the Niles-Bement-Pond Company, in Philadelphia, and will be glad to furnish his friends, and the public generally, with the fullest information and prices in regard to metal and wood-working machinery.

* Journal A. F. A. Vol. 2, p. 443.

LEGISLATIVE TOUR IN NORTHERN ONTARIO.

Inspection of Government Lines Forest Lands and Silver Mines in Cobalt Region.

By the Editor.

II.

Diary Continued from Page 271.

May 30th, 1906.—A lovely spring morn greeted us, as we peeped out of the Pullman windows towards the gentle range of wooded hills which look down towards New Liskeard town, and the waters of Lake Temiscaminque beyond. After breakfast we changed into a train made up of settlers' carriages drawn by an engine furnished by contractor, A. R. MacDonnell, for the track further on into the wilderness is only an unballasted contractors' line, hence not safe to carry the special train of heavy Pullman sleepers and dining cars. At 8 a.m. we started on our second days' trip northwards bound for that mystic spot, the "end of steel." Only four or five taking the alternate trip of a sail on the fine steamer "Meteor" of the Lumsden line, over beautiful Lake Temiscaminque. For some 25 miles we travelled pleasantly through deep clay cuttings and rugged gaps blasted out of the solid hill rock by the terrific force of dynamite, which shattered the richly colored granite rocks, hurling the fragments in picturesque disorder down the sides of the ravines below. These numerous ravines were crossed with tressels filled in with earth and broken granite hauled from the rock-hewn excavations. Sometimes we sped through mile after mile of virgin forest, bleached by devasting fires, so that there was very little really large timber, standing, the second growth of smaller trees being of the scrub variety, interspersed with slender masts of white poplar, spruce, birch and tamarack, with here and there a lofty pine rearing his head above the rest. Every now and then we emerged into some pleasant forest glade, revealing far-away valleys, densely wooded undulating hills, and lakes glistening in the sunlight. In one of the long forest avenues, the engine stopped for water, so the party had an opportunity of inspecting the rich, black, loamy virgin soils of these high lands, which some day will grow cereal crops, vegetables and fruits capable of supplying in abundance the markets of Ontario. About 25 miles north of New Liskeard we crossed the Blanche River over the bridge shown.

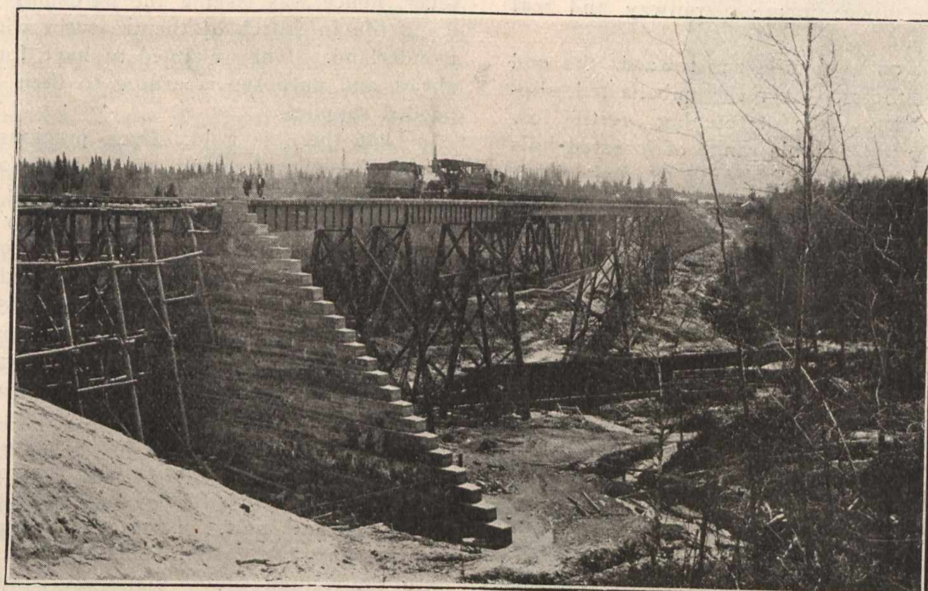


Fig. 1.—Steel Viaduct at White River. By Courtesy of J. B. Tudhope, M.P.P.

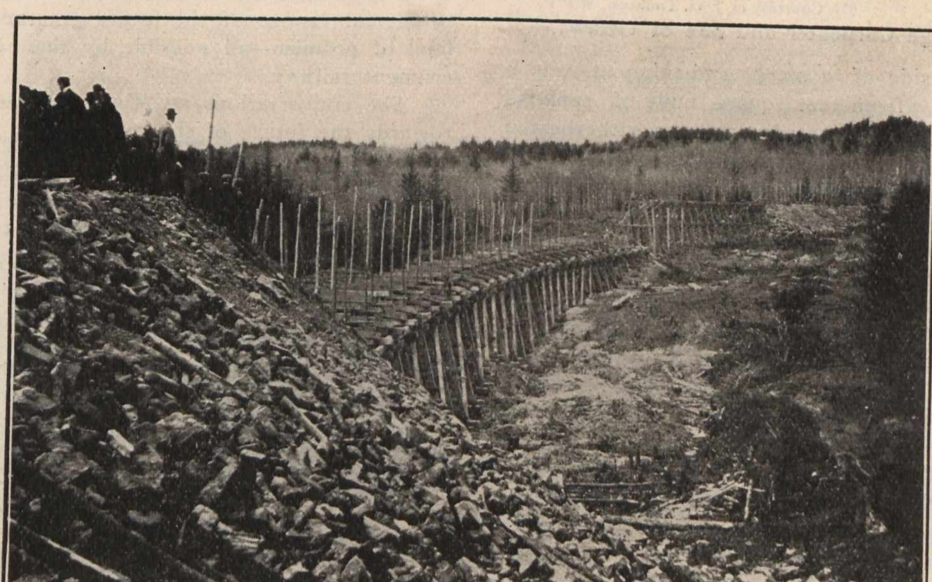


Fig. 2.—End of Steel. By Courtesy of J. B. Tudhope, M.P.P.

This steel bridge is typical of the structural engineering which has been put into the building of this Government railroad. On the northern side of the river we found the new town of Englehart, named after one of the three Railway Commissioners. Here is to be the divisional headquarters of the new railroad. Either Haileybury or New Liskeard would have made ideal locations for the divisional point; in fact both towns entered into hot rivalry for the prized centre; and so fierce did the battle rage, that the Commissioners were constrained to decide upon a neutral location, hence, selected the spot on the north side of Blanche River. At the time of our visit there was nothing but a small cluster of log houses for the division officers to live in; a small general store and a restaurant. The place is environed with nothing but primeval forests, and yet, two weeks prior to our advent, $27,000 was realized from the sale of town lots! One 66 x 200 in the centre of the prospective town was purchased by a Toronto capitalist—with experience in the section—for $640! And this in the wilderness, where the precise location can only be determined by the compass and surveyors skilled in forest work. Plant a saloon and the adjoining property goes down; locate a railway and real estate instantly goes up.

At 11.45 we started on a 52 mile run towards the end of steel. Exciting was the trip over the unballasted, slippery, greyish, clay road. Wide stretching fertile low lands lay on either side, and a noble range of forested hills fringed the horizon on our left. Suddenly the train came to a standstill. Our engine disconnected and dashed ahead alone, for a construction train a mile or so beyond had been derailed. One train had been off the tracks four times the day before! So in glorious weather, most of the party got out and tramped the ties northward. We had not trudged far, however, ere an incident occured which would have filled the heart of John Ruskin with delight.

By Courtesy of J. G. Tudhope, M.P P.

Fig. 3.—Mr. George Carpenter and Son of Ottawa.

Perched on the side of a steep embankment, was a box-like shed, perhaps fifteen feet square, built of saplings and covered solely with black tarred paper: a weatherbeaten shanty, ready to tumble into the stream below.

"Who could live in such a God-forsaken place?" cried one of the well-fed, well-dressed men, as he picked his way in shiny patent leathers over the muddy ties. As he spoke there came the sound of a woman's voice singing—singing with happy, musical voice, in this wilderness and solitary place; and utterly regardless of our presence. The men on the tracks looked in. She was a plump, healthy woman, with rolled-up sleeves, showing muscular, bare arms; washing dishes over a tiny cookstove in one corner of the little cabin, and singing "In Dear Old Georgia" as she worked.

There was no other woman within twenty-five miles, and mighty few along the whole fifty-two miles of new road. She was living in a one-room box, with walls of tarred paper, with no one to talk to from morn till eve, in a practically uninhabited country; yet she sang as she went about her work!

A mile ahead in a cutting through high ground, we came across a construction gang putting in a new siding, and an interesting sight it was to see these navvy groups, comprising all sorts and conditions of men, from the stumpy, swarthy Italian, to the slenderly built, sunburnt, athletic college graduate. The latter **gathering pointers**, and not afraid of roughing it in search of practical experience. Here the train caught up to us, and we started on our journey again, passing through numberless gaps and formidable rock-hewn cuttings; for the country in this section is of the wildest and most rugged description: almost mountainous. The engineering problems, we beheld, would have been almost impossible of solution before the discovery of dynamite and the invention of giant steam shovels. Finally, at the end of 52 miles, we steamed into the picturesque construction camp—Boston—and in a few minutes stood at the "End of Steel," admiring the scene pictured in Fig. 2.

As we gazed, an elderly man, accompanied by a youth, came in sight, and as they trudged up the valley, carrying prospector's packs, axe and gun, were recognized as Mr. George Carpenter and son of Ottawa, who had just tramped in through the forests from Abittibi Lake in search of supplies. This gentleman is a well-to-do citizen of the capital, but like thousands more had caught the Cobalt fever, hence was risking the hardships and vicissitudes of camp life in search of the treasures which abound in this wonderland. They claimed to have found **gold** ten miles ahead, and purposed returning to their claim after getting needed supplies.

That there is gold, silver, precious stones—and even diamonds—in this region, can not be doubted. Dr. George F. Kunz, the mineralogist of Tiffany & Company, New York, in an address before the New York Academy of Sciences, recently, declared that the geological formations south of Hudson Bay bear all the indications for finding diamonds. He said that since 1830 about 200 small diamonds, ranging from one-half the size of a pea to that of a hazel-nut, had been found in various parts of the United States, where they were presumably deposited by glaciers. He further explained, that in an early period in the history of the world two glaciers descended over the continent of North America, and that one of these glaciers came directly south from James' Bay over Lake Superior, upon what are now the States of Indiana, Michigan, Wisconsin, and Ohio. He believed that this glacier carried into the United States diamonds from a northern source yet undiscovered.*

Standing at the "End of Steel," therefore, looking across that tresseled valley towards James' Bay—no very great distance away—knowing the predictions of science as to diamonds, listening to the enthusiastic story of that gray-bearded man and his son as to gold, hearkening to the reports of others as to the finding of minerals having all the characteristics of the Cobalt silver field, together with rich iron ores of commercial value, it was surely not strange that some of us turned towards the construction camp that morning with vividly working imaginations and wonderful visions of the future greatness of this veritable land of promise—all possible by the building of the Government railway.

The conversations at "End of Steel" naturally turned towards the future of the railway, and the general verdict was that it must go to James' Bay.

Contractors' Headquarters Camp.

The whole party was entertained to a substantial dinner in the well-ordered construction camp, as the guests of the contractor, Mr. E. R. MacDonnell. While the second 60 were waiting for their share of the good things, some inspected the farm, general store, and popular restaurants, while others strolled into the bush, in the pine woods which environed the camp, and were surprised to find delicious wild strawberries and wild flowers in abundance. Among those waiting were Judges Anglin, Garrow, and Osler. The last named—as shown in Fig. 4—was standing on a commanding knoll, viewing the landscape o'er. Nearby, playing with a kitten, was a little girl, evidently the pride of the camp. Noticing that the venerable Judge was standing, the child tripped to the log house, brought a chair, and in the most charming manner invited him to be seated, then making a dainty salaam ran back to her mother. This pretty idyll of child courtesy in a rough camp, was too good to be left untold.

The picturesquely situated construction camp at "Boston": with its commodious, well-built log houses and workmen's cabins, located on high-ground near the railway, and faced on the opposite side of the track by the general stores, restaurants and music hall—in tandem, is an interesting sight to the town-bred engineer. It is not sur-

* See U. S. Geological Survey Report (1906) on "The Production of Precious Stones," by George F. Kunz.

prising that this strenuous open air life, has an almost irresistible charm for the stalwart, bronzed, cultured young civil engineers, and rougher railroading pioneers who greeted us cheerfully and light-heartedly that bright spring day.

Contractor MacDonnell has—in addition to his competent engineering staff—over 1,000 men engaged in the construction of this section of the line to and beyond the Height of Land: laying down steel tracks at the rate of a mile per day. In one week they calculated to run over the tressel shown in Fig. 2; and in two months over the Height of Land—which is 8 miles beyond the tressel—to Twin Lake, a distance of 34 miles. By autumn it is expected to reach McDougall's chutes or falls, a total distance of 105 miles from New Liskeard. A completed line from this latter place—over the rich glacial clay belt plateau divided by the Height of Land ridge, and across the sloping plains down to the mouth of the Moose River, the nearest available harbor at the southern end of Hudson Bay—would not be more than 280 miles, as the crow flies. When this laudable enterprise is carried out, as it doubtless will be, not only will a fertile region be opened out to cultivation, but the Province will have an available sea coast of over 200 miles in extent, and a fish food industry second to none in the world!

Looking back over the 165 miles of railway we had traversed from North Bay to the End of Steel—with its 1½ miles of timber tresselwork—mostly filled; its 2 = 500 feet permanent bridges over the Wabis; 2 = 650 ft. and 566 ft. expensive steel viaducts across the White and Blanche Rivers: all laid with 80 pounds low phosphorus steel rails, "made in Canada," with specially hardened and toughened heads to suit the extreme climate of Northern Ontario; and perceiving the substantial manner in which the permanent way and its general equipment had been constructed and laid down: added to the unerring instinct displayed in the selection of routes calculated to do the greatest ultimate good—we are constrained to say, that from the engineers' standpoint, the Temiskaming and Northern Ontario Railway is a creditable piece of work, and places the consulting engineer responsible for the planning, designing and construction of the line, viz., Mr. Cecil B. Smith, in the front rank of modern railroad engineers.

Homeward Bound.

While chatting in the contractors' office with Mr Archie McGougan, the energetic divisional engineer, we heard the melody of a familiar air played on a fine-toned piano in a restaurant at the foot of the wooded hills opposite. Geology, mineralogy, engineering, all went to the winds at this touch of civilization in the wilderness, and

Fig. 4.—Judge Osler.

Boston Creek almost became the land of the Lotus-Eaters. So charmed were three of us with Miss Macdonald's brilliant *technique*, that time passed unheeded. Suddenly the shrill toot of the engine whistle reverberated through the valley, and we just had time to rush out of the parlor, scramble over log piles and climb aboard, as the train moved out—homeward bound (3.45 p.m.). Psychologically this was the critical stage of the tour. But all the indications the writer beheld on the faces of that distinguished company of Ontario statesmen, lawyers, men of letters and scientists were prophetic, that the rich experiences which had just reached their climax in the construction camp at the End of Steel, would bring forth good fruit in the coming years.

H. C. Maisonville,
Secretary to the Minister of Public Works.

Tempting, it is to dwell on the sights we saw, and incidents, we noted on our pleasant journey homeward: how we changed to our Pullmans at New Liskeard; how, at sunset, we stopped at Haileybury and found this beautifully situated town in the sulks, disrespectful, unhospitable; how, next day (May 31st), we inspected the mine of the Arsenical Development Company, where gold, silver and arsenic are found; how we sailed 30 miles over lovely Lake Temagami, with its 1,493 islands in a length of 50 miles, and which the Americans have discovered; how, after a delightful sail of 15 miles, we disembarked at a romantic isle upon which is located the famous Temagami Inn, owned by Dan O'Connor, who generously entertained the whole party to lunch; how, afterwards, one group sailed 15 miles in view of landscape scenery of bewitching loveliness to Lady Evelyn's Lake and Hotel, also owned by the "king of Temagami," while a second group visited historic Bear Island, and there inspected the celebrated Hudson Bay post under the escort of Mayor Farr, of Haileybury, who at one time was the factor of this trading station; and how, on returning to the train, well travelled men pronounced this region to be an Earthly Paradise. All this, told in graphic detail, would make an interesting story for a popular literary magazine, but "The Canadian Engineer" can not dwell further on this untechnical phase of the trip, and can only conclude by saying, that the excursion party returned safe and sound to Toronto, on Friday morning, June 1st, at 9.30: having had three days and four nights of delightful travel and profitable investigation in the primeval forests, on the rich mineral lands, and over the beautiful lakes of Northern Ontario.

As the train approached Toronto the party expressed their unqualified satisfaction in the terms of the following resolution:

Moved by J. R. Dargavel, M.P.P., seconded by J. B. Tudhope, M.P.P.:

> "That we deeply regret the absence of Hon. J. O. Reaume, Minister of Public Works, and more particularly by reason of the illness that has made his absence necessary, and sincerely trust that his illness will be of short duration and his recovery will be permanent as well as speedy. Our thanks are cheerfully tendered the T. and N.O. Commissioners, who were assiduous in making our tour pleasant and profitable, and also to Mr. H. C. Maisonville, Secretary to the Minister of Public Works, on whom devolved most of the work of organizing the tour, and who performed his exacting duties cheerfully and satisfactorily."

Thus ended pleasantly this memorable tour of the Ontario northland.

"I hear the tread of pioneers,
Of nations yet to be:
The first low wash of waves where yet
Shall roll a human sea."

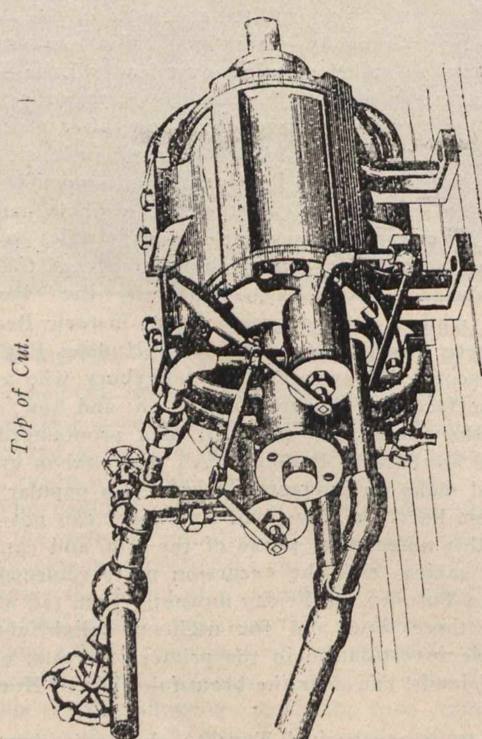
INTERNATIONAL PATENT RECORD

Dominion Houses of Parliament.

CANADA.

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

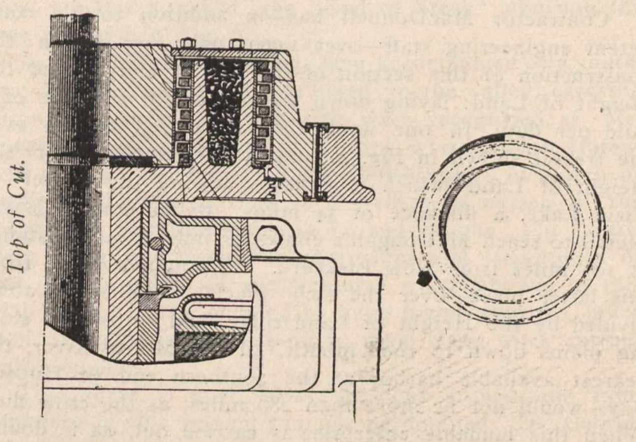
Rotary Engine.—H. M. Lofton.—96,821.—The invention consists in having the casing of the engine provided with opposite concentric portions and eccentric portions between the said concentric portions, a piston circular in cross section fitting the concentric portions of the casing having a plurality of slidable blades set in radially arranged slots in the said piston. The slidable blades are held in contact with the surface of the casing by steam pressure, the steam being inlet through the centre of the said piston. Suitable throttling valves are arranged on the casing to control the inlet and out-



96,821.

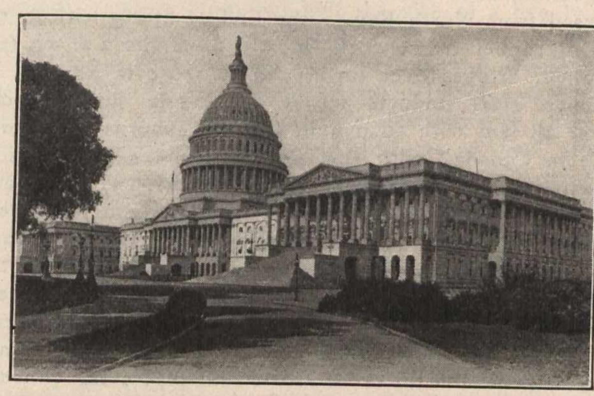
let of the steam to the steam chest for driving the engine, and a branch is provided from the main inlet and has a suitable controlling valve to control the inlet of steam for operating the piston blades subsequent to the opening of the main outlet thus the steam operates the slidable blades and holds them tightly to the inner periphery of the casing before the steam has passed through the steam chest to operate the driving of the engine.

Flexible Connection and Suspension Devices for Gearless Motors.—The Canadian Westinghouse Co., Limited.—96,949.—A wheel mounted on the truck axle having a plurality cylindical chambers, the axes of which are substantially parallel to the wheel axis. A sleeve loosely surrounding the axle is provided with hollow cylindrical bosses that project into the chambers in the wheel, helical springs are placed over the said bosses, each turn of the springs being off-set from the adjacent turn so that each of the turns is eccentric with reference to the others and the whole fit within the said cylindrical chambers. The bosses are hollow, and are filled



96,949.

with a lubricating material to lubricate the spring in each casing.



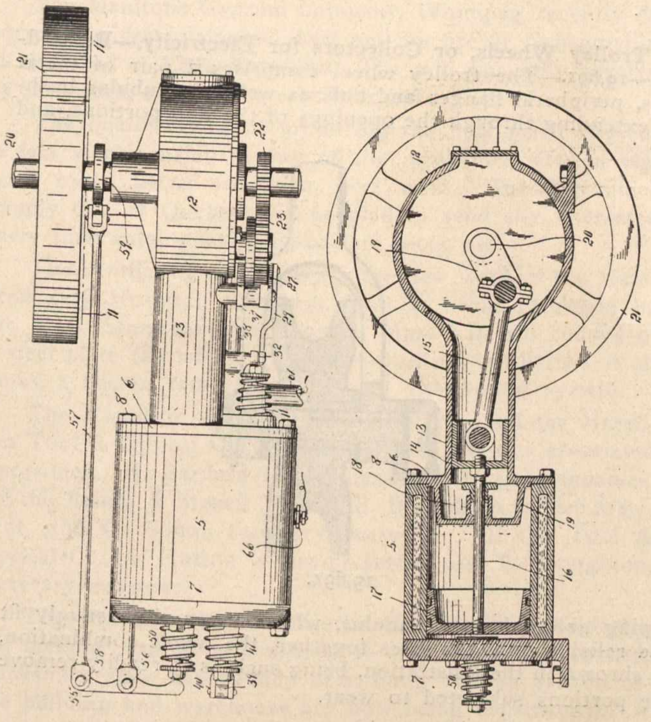
Capitol, Washington, U. S. A.

UNITED STATES PATENTS.

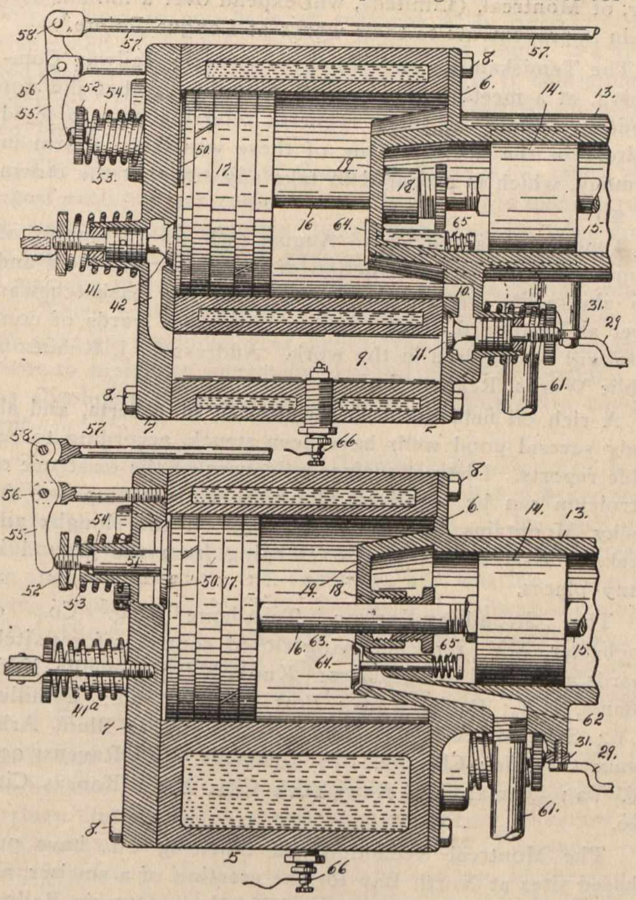
Specially selected and abridged by Messrs. Siggers and Siggers, Patent Attorneys, 918 F. Street, N. W., Washington, D.C., U.S.A.

Explosive-Engine.—Martin C. Kessler, Denver, Colorado.—824,936.—This invention relates to improvements in explosive-engines, my object being to provide an apparatus of this class which shall be more efficient than those heretofore in use.

The distinguishing feature of the invention consists in the employment of chambers located outside of the piston-chamber, in which chambers the gas or explosive mixture is compressed during the movement of the cylinder-piston in one direction. In the improved construction a single cylinder is employed, and there are two auxiliary chambers located adjacent the cylinder-chamber, the auxiliary chambers being alternately in communication with the cylinder-chamber. In the construction there is an explosion for each complete reciprocation of the piston. During the movement of the piston in one direction the gas or explosive mixture is compressed in one of the auxiliary chambers, the piston being driven in this direction by the force of an explosion which has taken place in the other auxiliary chamber. During the movement of the piston in the opposite direction the exhaust takes place—that is to say, the products of combustion are forced out of the cylinder-chamber by the piston through a valve controlled exhaust-port, the exhaust-valve being mechanically opened at the proper time to permit this result. At or about the time the exhaust is completed an explosion takes place in the auxiliary chamber, where the gas was compressed by the first forward movement of the piston, again driving the piston forward and compressing the gas in the auxiliary chamber, in which the first explosion took place. Then during the next rearward stoke of the piston the exhaust again takes place and this operation is continued. It will thus be seen that as the gas is compressed entirely outside of the cylinder-chamber the piston is allowed to travel practically the entire length of the cylinder-chamber, since it is not necessary to leave any space between the piston and the cylinder-head for compressed gas, as in ordinary constructions. Moreover, the explosion may be so timed as to take place in either auxiliary chamber before the valve controlling the inlet from the auxiliary chamber to the cylinder chamber has been opened, and the opening of the valve may be so timed as to allow the force of the explosion to act on the piston at any desired point of its stroke regardless of the exact time when the explosion takes place.



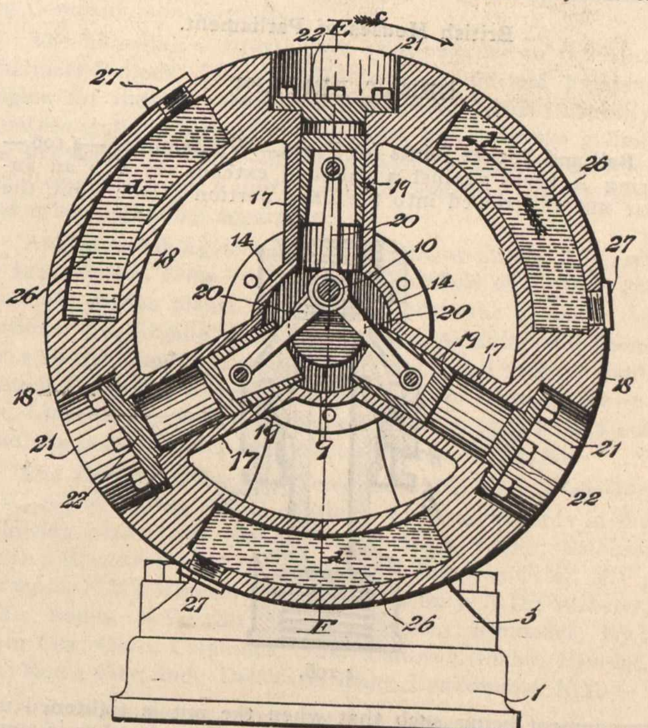
It includes a cylinder, a piston therein, a crank-chamber, a crank-shaft therein, a suitable connection between the piston and the crank-shaft, the cylinder being provided with suitable inlet and exhaust passages, the said passages being both open during the rearward movement of the piston and both closed during the forward movement thereof, two auxiliary chambers located in suitable proximity to the cylinder, each auxiliary chamber having a passage leading from each of its extremities to the corresponding extremities of the



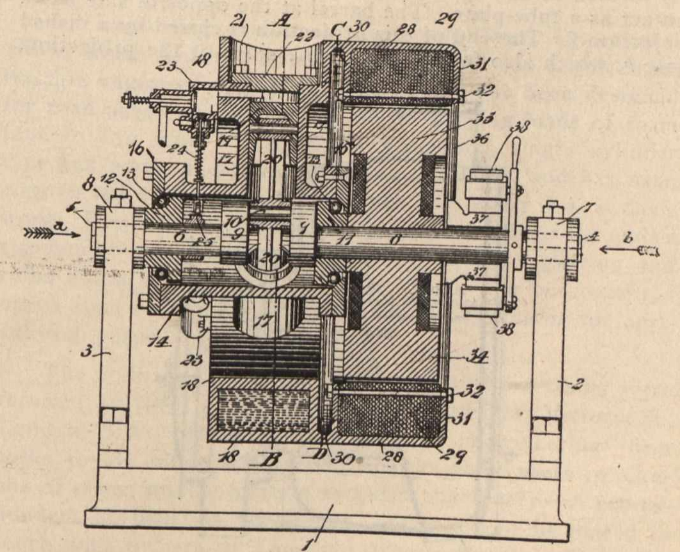
824,936.

cylinder, one of these passages for each auxiliary chamber being an inlet-passage, and the other passage being an outlet-passage, normally-closed valves mounted at one end of the auxiliary chambers to control the inlet passages to said chambers, and valves located at the opposite extremities of the auxiliary chambers for controlling the exit-passages, a lever for controlling each pair of valves, a cam-gear actuated from the crank-shaft, and suitable connections between the cam-gear and the valve-operating levers whereby the inlet-valve of either auxiliary chamber and the exit-valve of the other auxiliary chamber are open at the same time, the other two valves in the meantime remaining closed.

Dynamo-Motor.—Edward W. Fahl, Shirley, Ind.—824,-922.—This invention relates to a dynamo or electric generator or a motor therefor, which motor is so constructed that the greater mass of the motor and the dynamo or generator is concentrated in the revolving mass, and said motor and generator are so connected and the weights or masses thereof distributed to render the running of the motor steady and uniform. The object of this invention is to construct a compact electric generator and its motor to form practically a single self-contained machine and connect them in such a manner that a minimum space will be occupied by the ele-



mentary machines thus combined to form a single machine, also to construct the motor itself in such a way that the mass of the motor will be approximately concentrated in that portion of the motor corresponding to the fly-wheel thereof, also to provide a compact cheap, self-contained, directly-connected and driven electric generator particularly adapted to produce electricity for smaller plants or domestic purposes. I obtain these objects by means of the combined electric generator and motor illustrated in the accompanying drawings, in which similar numerals of reference designate like views throughout the several parts.



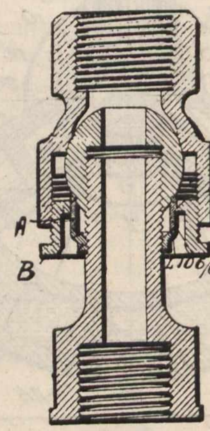
824,922.

It consists of a fixed or non-revoluble crank-shaft, the crank thereof, a crank-shaft-supporting frame, a crank-inclosing casing revolubly mounted on said shaft, a series of cylinders equally spaced around said crank-shaft casing, and extending radially therefrom, and an integral exterior rim connecting the outer ends of each of said cylinders, and each of said cylinders connected to said fixed crank-inclosing casing of an armature secured to said motor to revolve therewith, and a fixed magnet situated within said armature and carried by said shaft.

British Houses of Parliament.

GREAT BRITAIN.

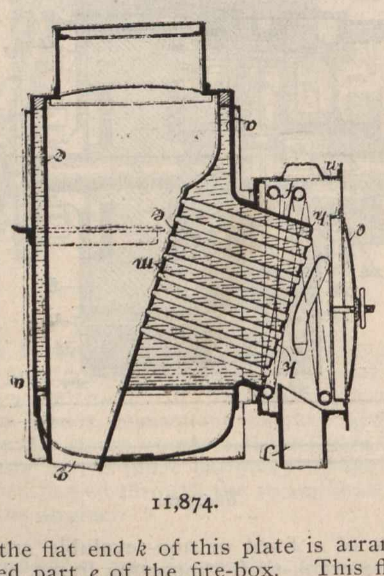
Ball and Socket Joints for Pipes.—Windemuller.—4,106.— A ring A bears against a ball and extends through an annular nut B screwed into the fixed portion of the joint, the



4,106.

arrangement being such that when the nut is tightened up the packing material situated in the stuffing chamber is compressed, but the ring is unacted upon.

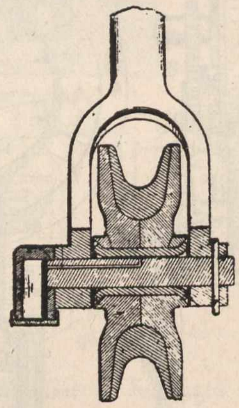
Boilers.—Beyer, Peacock, and Co., and H. A. Hoy, Manchester.—11,874.— This invention relates to fire-tube boilers of a type which is partly on the lines of a locomotive and partly on the lines of a vertical boiler. This boiler is specially intended for use in supplying steam to steam-engines employed for driving self propelled vehicles. The barrel *a* encloses the stream and water space of the boiler, and is provided at its lower end with the fire-box *c*. A flattened part *e* is formed at one side of the fire-box, which flattened part can act as a tube-plate. The barrel at the opposite side has a projection *f*. The end of this projection is closed by a dished plate *h*, which also forms part of the sides of the projection.



11,874.

The plane of the flat end *k* of this plate is arranged parallel to the flattened part *e* of the fire-box. This flat end *k* is circular, and forms a tube-plate, from which fire-tubes *m* extend to the flattened part *e* of the fire-box. A smoke-box *n*, preferably of cylindrical form, is arranged round the flange of the dished plate *h*. This smoke-box is provided with a suitable chimney *j*, and has a vertical door which can be opened for inspecting the tubes or for cleaning or other purposes. Fuel can be fed on to the grate through the opening *q* provided at the top of the fire-box; and through this opening, which is normally closed by a door, the whole of the grate can be inspected. The inner-end of the fire-tubes can also be seen from this opening. The smoke-box door *o* can be readily opened when desired for inspection or cleaning of the tubes.

Trolley Wheels, or Collectors for Electricity.—Richardson.—19,691.— The trolley wheel comprises a pair of metal discs, peripheral flanges and hub, as well as a tubular bushing extending through the openings of the hub portions, and



19,691.

having grooved wear annulus, whose outer sides snugly fit and reliably hold the discs together, the whole combination, as shrown in the illustration, being such as to readily remove the portions subjected to wear.

INDUSTRIAL NOTES.

The Dominion Tar and Chemical Company shipped six hundred barrels of pitch to South Africa.

It is announced that the Locomotive & Machine Company, of Montreal, (Limited), will expend over a million dollars in improvements to their works at Longue Pointe.

The Temiskaming and Northern Ontario Railway Commission, at a meeting held recently, considered, but did not definitely dispose of three requests referring to projected smelters in the north. One of these was from a firm in Germany, which is prepared to take any site that the crown will give.

Tenders are asked, up to August 13th, for the supply of all material and the construction of eight concrete piers and two abutments for a traffic bridge over the Saskatchewan River at Battleford, Sask. About 5,000 cubic yards of concrete will be required in the work. Address T. J. Robinson, Public Works, Regina, Sask.

A rich oil field has been discovered in Alberta, and already several good wells have been struck, according to reliable reports. Distinct surface evidences of the existence of petroleum can be found all along the eastern slope of the Rocky Mountains, also oil indications on the sloughs and creeks. Natural gas is also escaping from the ground in many places.

The Stromberg-Carlson Telephone Mfg. Co., of Rochester, N.Y., reports having closed contracts for switchboards at the following places:—Knox, N.D.; Lowville, N.Y.; Adams, N.Y.; Paola, Kans.; Fort Wayne, Ind.; Camillus, N.Y.; Superior, Wis.; Holloway, Minn.; Pine Bluff, Ark.; Sioux City, Ia.; Chicago, Ill.; Louisville, Ky.; Ravenswood, W. Va.; Dundas, Ill.; New York City, N.Y.; Kansas City, Mo.

The Montreal Reduction and Smelting Co., have purchased sites at North Bay for the erection of a smelter, and have applied to the Toronto and Northern Ontario Railway Commission for construction of sidings in connection with their works. Another firm with wide experience in the southwestern States and Mexico, and with large interests in Arizona, have also interviewed the Commission with regard to the establishment of a smelting plant at Cobalt, which they purpose shortly to undertake. Their experience has been with arsenical and silver ores, and they are impressed with the suitability of Cobalt for such an enterprise.

Ottawa is to have a new foundry and machine works at the corner of Wellington and Lyons Streets. Local capitalists are interested, and a site has been secured for $8,000.

The Manitoba Gypsum Company, Winnipeg, recently reported the destruction of their mill by fire at Gypsumville, at the head of Lake Manitoba. The mill was fully covered by insurance, and will be rebuilt at once.

The qualifications of producing the best machinery, or in fact workmanship in any of the mechanical arts is just good tools, better workmen, best work. The Mechanics Supply Co., of Quebec, will be glad to send any interested party their catalogues of up-to-date tools, etc.

The ventilating apparatus for the new ward of the Hamilton City Hospital, Hamilton, Ont., is being furnished by the B. F. Sturtevant Co., Boston, Mass. It will consist of a steel plate fan which will insure positive ventilation at all times, a heater, tempering coil, and distributing system.

The Hamilton Stamp & Stencil Works, and the Hamilton Tool & Optical Co., Hamilton, Ont., are now associated companies. H. Barnard is president of the two companies. Of the Stamp & Stencil Works, B. Broughton is vice-president, and G. Gomm secretary-treasurer. Of the Tool & Optical Co., A. Hutton is vice-president, and B. Broughton, secretary-treasurer.

The Brandon Machine Works Co., Limited, Manitoba, are making extensive additions to their works. A new blacksmith shop has already been built, and an $18,000 office building and warehouse are now being constructed. A new foundry will be erected in the near future. The plant at the present time is being run to its utmost capacity in the manufacture of gasoline engines (designed by G. W. Thexton, M.E.), and important western contract work.

During the recent convention of the International Railway Master Boiler Makers' Association held at Milwaukee, Chas. F. Taylor, Jr., Superintendent Long Island Railroad at Morris Park, N.Y., said:—"In speaking of progressive tools, I suppose you have all seen the Allen riveter. We drive up all the back heads and all the mud rings. We have used that over a year, and find we do not have to calk a mud-ring rivet. Before I came away we put in 110 rivets in about two hours."

The Foos Gas Engine Company, Springfield, Ohio, the largest exclusive gas engine factory in the world manufacturing stationary and portable electric light engines, also sawing rigs and special outfits, have just purchased $20,000 worth of machine tools, consisting of lathes, planers, boring mills, etc. Their business so far this year shows an increase of 50% over any previous year, and as their output is not sufficient to meet the increasing demand for their engines, it was absolutely necessary for them to get this extra equipment.

The Grand Trunk Pacific Terminal Elevator Co. is a newly incorporated concern, with a total capital of $5,000,000, with its chief place of business at Montreal. It has been incorporated to carry on an elevator and warehouse business. The incorporators of the company are Charles Melville Hayes, railway president; W. Wainwright, railway director; Alfred Peter Stuart, merchant; William Hodgins Biggar, King's Counsel, Montreal; and Nicholas Bawlf, merchant, Winnipeg. The company will build two terminal elevators, one at Fort William and one at Tiffin.

It is said that George Patterson Murphy, son of Mr. Denis Murphy, one of the commissioners of the Temiskaming and Northern Ontario Railway, and John P. Dickson, secretary of the Canadian Railway Accident Insurance Company, of which Mr. Denis Murphy is president, are two of the principal incorporators of the Right of Way Company, an Ottawa syndicate, which has secured a valuable mining franchise from the Temiskaming & Northern Ontario Railway Commission. The company in which the son and the business associate of Commissioner Murphy are interested has secured the mining privileges along the right of way of the railway between the 101st and the 105th miles, that is, in the Cobalt district. The franchise is for 999 years. The company pays a spot cash bonus of $50,000, and agrees to pay royalties on all minerals found.

The property of the Ottawa Furnace & Foundry Company, which has been in liquidation for some time, was sold reecntly for $47,500.

The Smart-Turner Machine Co., Limited, Hamilton, have received an order for a Standard Duplex Dump, from the Polson Iron Works, Limited, Toronto.

The German-Canadian Smelting & Refining Company, Limited, has been granted a charter by the Ontario Government to carry on operations of a mining, milling, reduction and development company. The share capital of the company is $1,000,000, divided into 10,000 shares of $100 each. The head office of the German-Canadian Smelting & Refining Company is in Toronto.

The following contracts have been awarded to the Allis-Chalmers-Bullock, Limited, Montreal:—Municipal pumping engine for the Corporation of Fredericton, N.B.; capacity, 1,500,000 gallons for ordinary service, and 4,000,000 gallons for fire service. Also complete municipal lighting plant for the Corporation of Kenora, Ontario, including switchboard and other accessory apparatus.

At the recent Agricultural Show held at Derby, England, in June, twelve firms competed in the trials of suction gas producer engine plants. The gold medal was given to the National Gas Engine Company, Limited, Ashton-under-Lyne, for a 20-H.P. engine with electric ignition and suction plant, costing $1,132.38. The silver medal went to Crossley Brothers, Limited, Openshaw, Manchester, for a 15-H.P. gas engine, the cost of which with suction plant, is $874.80.

The Stromberg-Carlson Telephone Mfg. Co., Rochester, N.Y., report having closed contracts for switchboards in the following places:—St. James, Minn.; Stites, Idaho; Palouse, Wash.; Weatherford, Tex.; Seattle, Wash.; Rochester, N.Y.; Syracuse, N.Y.; Minneapolis, Minn.; Carbury, N.D.; Webster, N.Y.; Sodus, N.Y.; Mt. Vernon, Wash.; Eminence, Ky.; Plain City, Ohio; Columbus, Ohio; Caldwell, Idaho; Esmont, Va.; Rome City, Ind.; Delaware, Ohio; Lyndonville, N.Y.

A peculiar use to which the new waterproof paint now being placed upon the market by the Electric Cable Company, of 17 Battery Place, New York, has been applied, is on wooden reels. It has been found that such reels on which wire and cable is wound for shipment sometimes take up eight to ten pounds of water when exposed to the rain or to damp weather. Considerable annoyance has been caused by the discovery of this fact by the purchaser who weighs the reels upon delivery. The application of this waterproof paint has been found to prevent this absorption of water.

An interesting exhibit at the recent Royal Agricultural Show, which has just been held at Derby, was a petroleum traction engine of 25-B.H.P. The engine has been designed for road purposes, and is capable of carrying loads of from four to five tons. It is of the horizontal, single cylinder type and works at 300 revolutions per minute, and has been constructed to carry sufficient fuel and water for a day's work. Power is transmitted to the driving wheels through a regimental expanding clutch and intermediate gearing and roller chain, to the rear axle. The engine can be converted into a road roller or an ordinary stationary engine for agricultural purposes.

The following inquiries relating to Canada trade, were received at the Canadian Government Office, 17 Victoria St., London, S.W., recently.—A Yorkshire Engineering firm seeks to get into communication with likely users in Canada of stone, marble, granite and slate machinery.—A correspondent at Brussels, (Belgium), has asked to be placed in touch with owners of Canadian asbestos mines.—From the city trade branch, 73 Basinghall Street, London, E.C.—A North Country manufacturer of agricultural machinery and implements would like to get into correspondence with a Canadian firm prepared to undertake the introduction of his manufactures.—A Yorkshire company manufacturing beltings, ram and pump leathers, india rubber goods, packing, etc., is prepared to appoint suitable Canadian resident agent.—A London firm handling copper, lead, and antimony ores and metals, will be pleased to hear from Canadian producers who can ship actual supplies.

A convention of Ontario Retail Hardware and Stove Dealers' Association, will be held in Toronto, on September 4th and 5th.

The Denver office of the Allis-Chalmers Company has been removed to the McPhee Building, 17th and Glenarm Streets; and their El Paso office to the Guarantee Trust Building, rooms 301-306.

The Hamilton Tool and Optical Co., Limited, Hamilton, announces that they are prepared to manufacture patented articles, fine instruments, dental tools, rifle sights, machine parts, gears, ratchets, etc., advertising novelties, jewellers' specialties, steel stamps, embossing dies and die-sinking in its various branches.

The Defiance Iron Works, of Chatham, and the Toronto Gas and Gasoline Engine Co., have agreed to amalgamate, with a capital of $500,000. Each branch will continue its own local business. The Toronto concern will make the main parts of the engines at present made by both companies, while the Chatham Company will make the castings, etc.

A new concern called the Calgary Pressed Brick and Sand Stone Co., Limited, expect to be turning out pressed brick of a quality unsurpassed on the American continent shortly. The authorized capital, $100,000, has been subscribed by Calgary people and eastern Canadians. The president is E. H. Crandell, and the managing director, George A. Sharpe.

At the first regular meeting in July, of the Canadian Association of Stationary Engineers, Toronto No. 1, the following officers were appointed: President, John W. Marr; vice-president, W. S. Butler; secretary, W. E. Archer; financial secretary, W. C. Tait; treasurer, C. Moseley; conductor, F. Stubbs. The annual reports, which were presented at this meeting, show Toronto No. 1 to be in a flourishing condition.

The accident, which occurred on July 2nd, to the American boat train conveying passengers from Plymouth to London, has proved to be one of the most disastrous which has happened in this country. As yet the Board of Trade inquiry has not been held into the cause of the catastrophe, but there is little doubt that it was due to the train travelling at too great a rate of speed round the curve at the east end of Salisbury Station platform. The regulations laid down by the London and South Western Railway does not admit of trains taking the curve at more than thirty miles an hour, it is reported that when wrecked the train must have been travelling at double that speed.

The Strangen-Wick Railway Company, which operates a suburban line near the city of Stockholm, the capital of Sweden, has contracted with the Westinghouse Electric & Mfg. Co., of Pittsburgh, for the electrical equipment of the cars to operate this road, with the single-phase system. This recognition of the superiority of American electric railway apparatus is the result of an elaborate test instituted by the Swedish Government about a year ago. In this test, manufacturers of electrical railway systems from America and Europe entered into competition, and the palm was finally awarded to the Westinghouse Company, which was then given an order for an alternating current single-phase locomotive. The order from the Strangen-Wick Company calls for the same type of electric railway motors.

MARINE NEWS.

Plans have been prepared for the sea wall from Spadina Avenue, Toronto, to the new fort; cost $75,000.

Sir Douglas Fox, past president of the Institute of Civil Engineers, London, has been invited to prepare plans for a channel tunnel. Parliamentary sanction for the scheme will be sought in the next session.

Plans have been about completed by the C. P. R. for placing an up-to-date excursion steamer at Vancouver next summer. The boat will be devoted exclusively to the handling of excursions. It is expected to be ready for service by the middle of May next ear.

It looks as if the Dominion Government is taking into its serious consideration the question of the construction of a new Welland Canal, as a staff of Government surveyors is at work surveying the Government property from the mouth of the canal at Port Colborne to the outlet at Port Dalhousie. Those who claim to know say that a good portion of the old Welland Canal, now hardly used at all, will be utilized. The new canal will be of 24 foot depth, deep enough for the largest boats.

RAILWAY NOTES.

The Brandon, Saskatchewan & Hudson Bay Railway Company, Brandon, Man., will erect a new station to cost about $30,000, at that place.

The Canadian Pacific Railway are about to make a test of a smoke preventer on one of their yard locomotives in Toronto, with a view to its adoption.

It is rumored that George H. Shaw, traffic manager of the Canadian Northern Railway, Winnipeg, is to be given charge of all lines of road with offices in Toronto.

Work on all the new branches of the C. P. R. throughout the West is being pushed forward as rapidly as possible. No less than nineteen new lines are being constructed and by the end of the year hundreds of miles of new road will be ready for operation and thousands of acres of fertile soil will be ready for settlement.

The Temiskaming and Northern Ontario Railway Commission, with the approval of the Government, has entered into a contract, extending over a period of years, to draw logs from the Dominion Government's Lake Temiskaming wharf at Lake Haileybury, to the sawmill at Latchford. This will necessitate a spur line of one and one-half miles from the wharf to Haileybury to give connection with the main line.

The location of the route for the Grand Trunk Pacific Railway between Winnipeg and Portage la Prairie has not yet been decided on. Three trial lines have been run and the matter of selection is now being considered by the directors. Their decision may be announced any day, and it may be three months hence before they take the public into confidence. No construction work has yet been done on the line east of Portage la Prairie.

The Windsor, Essex & Lake Shore Radial Railway, which has been having trouble with its Windsor franchise on account of the council's insistence on the use of girder rails, has just secured a franchise in Leamington, where the road was temporarily held up. The council there wanted a line built to the lake, a distance of about a mile. The road objected, but a compromise was finally reached by which the railway agreed to make the desired extension within five years.

The Canadian Northern Railway Company has just ordered 550 new box cars to be delivered in time for the moving of the wheat crop of this fall. The companies who are in the contracts are: Rhodes, Curry & Company, Amherst, N. S., 250 cars; Canada Car Company, Montreal, 200; Crossen Car Manufacturing Company, Cobourg, Ont., 100 cars. This order is in addition to the 1,600 cars ordered of the new stock, with 50 additional locomotives, will be placed on the lines in Western Canada. The total cost a few weeks ago from Canadian companies and nearly all of new stock is nearly $4,000,000.

The work of piling telephone and express business on the Railway Commission has commenced. Already a considerable number of requests for ratification of express rates are in the secretary's hands, while hundreds of applications for telephone connections are in and thousands soon will be filed. The Bell Telephone Company alone has sent in several hundred applications, and independent companies are busy. No addition has been made to the staff or to the premises of the Railway Commission, which found its railway work quite as much as it could handle, and it looks as if it will be overwhelmed with routinne business.

Work has been commenced on the Owen Sound and Meaford Company's new road, connecting these two towns.

A big merger has been put through which will bring under one management the Montreal Park and Island Railway, the Terminal Railway, and the Montreal and Suburban Railway.

The promoters of the Hamilton & Brantford Railway realize that they cannot complete the road by November 1st, as the franchise calls for, and they have asked for an extension of time till July next.

The Grand Trunk Railway has awarded the contract for the construction of twenty large passenger locomotives to the American Locomotive and Machine Company. Ten of the locomotives will be built at the company's Canadian plant at Longue Point, and the remainder at Schenectady, N. Y. The locomotives will cost $350,000.

On May 11th the Western Ontario Pacific Railroad Company received their charter from the Dominion Government permitting them to build a line of railway from some point at or near London, passing through the counties of Middlesex, Perth, Huron and Bruce with terminus on Lake Huron, at some point in Bruce County.

Plans have been perfected by the Canadian Pacific to construct a bridge near Lethbridge, Alberta, which will be an engineering marvel, and probably will be ranked as one of the world's wonders. The plans call for a structure slightly more than a mile long and 300 feet above the water level. The Canadian Pacific bridge will span the Belly River, and is to be built for the purpose of shortening the route between Lethbridge and Macleod.

It is reported that the Great Northern and Northern Pacific are to join in building a mammoth hotel in Vancouver to cost three-quarters of a million, each paying half.

It is rumored in well-informed political circles that the Provincial Government realizing the great importance of opening up Northern Quebec had under serious consideration the assisting of the construction of a railway to James Bay that would pass through and tend to develop the mineral resources of the Chibugamoo district north of Roberval. It is said that the Government is now awaiting the full reports in regard to the mineral discoveries of the Chibugamoo, together with the result of Hon. J. B. Prevost's investigation of the county, who will leave Quebec during the first week of August on the trip.

Two of the eight parties engaged in the survey of the two routes for the National Trans-continental through New Brunswick have reported, and the others are expected to turn in the results of their work shortly. It will take some time for the engineers to reduce the field notes to a statement of quantities and estimates of cost so that a choice can be made between the "river route" and the "back route." It is expected that late in September or early in October the commissioners will be in a position to recommend to the Government the letting of a contract on one of the routes. About the same time it is probable tenders will be invited for the construction on another section of the line between Winnipeg and Quebec. This will be to the north of Lake Superior, where the facilities for getting the supplies in are considered fairly good.

MINING MATTERS.

The output of the Dominion Coal Company for June was not up to expectations, accounted for in chief part by the scarcity of labor, or to be specific, of loaders in the mines.

All authorities agree that the Yukon output for the present year will beat all records for the camp and many are of the opinion it will amount to $25,000,000 worth of gold. Latest advices from the outlying camps show that the season so far has been a most favorable one and the clean-ups are realizing far more than was expected.

The iron ore deposits at Arisaig, N.S., and vicinity, are to be thoroughly explored by an expert for the purpose of ascertaining the extent of the beds.

Gold finds are reported from Lake Opasatica, almost eighty miles due north of Cobalt. Dozens of prospectors have gone up from Cobalt and hundreds are rushing in from all points of the compass.

Within the past few months more money has been expended on additions and improvements at Reserve Mines than during all the years the Dominion Coal Company has held the property. The expenditure in effecting the improvements lately completed will foot up about $80,000.

Messrs. Arthur J. Lippens, of London, and H. M. Lippens, of Paris, with Mr. A. Fieux, a French engineer, state that they have found the precious metal, radium, in the mica district around Murray Bay. The syndicate purchased an extensive mica property in that district from an American syndicate.

One of the most encouraging finds of the season was made recently about three-quarters of a mile east of Portage Bay in the Montreal River. This is in the famous Coleman township. The samples brought in were pure native silver. A small find of ruby silver has also been made on the Montreal River, between Gillies' depot and Latchford.

The Canadian Consolidated Mines at Trail, B. C., are now using a Westinghouse electric locomotive for hauling cars to and from the mines, as well as three Westinghouse 1,250 k. w. transformers. The company find that the use of electricity for power and haulage increases the output of the mines, and actually decreases the operating expenses.

There is every probability that cobalt will be discovered on Vancouver Island. The recent finds of silver-cobalt ores on Wallace mountain, west fork of Kettle River, lead to this supposition as every other mineral so far found in British Columbia has been located in that semi-submerged range of mountains of which Vancouver, Queen Charlotte and adjacent islands are merely the apexes rising above the sea.

The work of the opening of a new iron mine at the eastern end of Belle Island began a short time ago, several men being engaged on the work. There is a big deposit of ore there, but the companies are short of men, and the work cannot be rushed as they would wish. There are 1,500 men engaged with the two companies, but they could take 1,000 more. Kem Lee is bossing the 32 Chinamen on the island.

A deal involving the Alpha, Beta, Black Bear, and Blue Grouse copper claims on Vancouver Island is pending and will be completed within the next twenty days, says the Nanaimo "Herald." Through Messrs. F. G. Amess & Company some New York capitalists have obtained the option of purchasing the claims for $100,000. The ore which has been assayed was taken from the surface and runs $34 to the ton in copper. The expert who examined the mine for people who hold the option on the claims, says they are the richest he has seen, and that the main body of ore will average 23 per cent. copper. One also carries gold and silver in small proportions. If the New York men buy the claims, a smelter will be erected to treat the ore at the mines. This will be easy to do as the ore has been pronounced self-fluxing by the assayer.

LIGHT, HEAT, POWER, ETC.

Electric power is now being delivered in Syracuse, from Niagara Falls, a distance of 150 miles.

The International Railway Company has petitioned the Dominion Government for permission to develop 10,000 H.P. at its local station, and also be allowed to transmit the power to the American side. The waterworks board of Niagara Falls has also applied to the Government for a similar grant.

It is stated that power from Niagara Falls will be delivered in Toronto by October 1st to supply the street car system, and for power and lighting purposes.

The Electrical Development Company and the Cataract Power Company are said to have about come to an agreement concerning the territories to be respectively occupied by each. This will tend to prevent undue competition. E. R. Wood, W. R. Brock, and A. M. Grenfell, London, England, have become directors of the company. A meeting of the shareholders will be held on August 7th to authorize the purchase of bonds and stocks in the Niagara Falls Transmission Company, a subsidiary company, organized to transmit power to New York state. A controlling interest will also be acquired in the Albion Power Company, and the Niagara Falls Gas and Electric Company, which will give the company the right to sell current for light, heat and power in 27 towns and villages in New York State.

PERSONAL

David Benzy, of Toronto, has been appointed City Engineer of St. Catharines, at a salary of $1,500 per annum.

Mr. Geo. Y. Wisner, one of the representatives of the United States on the International Waterways Commission, died at his home in Detroit on July 4th at the age of 65.

H. F. Ball, superintendent of motive power of the Lake Shore and Michigan Southern Railroad, has accepted the vice-presidency of the American Locomotive Company.

Mr. D. C. Dewar, Montreal, manager of the Bell Telephone Company, died at his home in Montreal on July 12th. Mr. Dewar was a faithful officer of the company, and his death is much regretted.

Hon. W. Templeman has assumed control of the Geological Department, in addition to his duties as Minister of Inland Revenue, an order-in-council having been passed transferring that department to him.

MUNICIPAL WORKS, ETC.

Belleville, Ont., council will expend $25,000 on gas plant extension.

The Chesley, Ont., council is considering plans for the installation of a system of waterworks.

Port Arthur is about to engage an engineer to report on Dog Lake Falls and Current River Development.

Tenders are asked, up to August 6, for destructors for the city sanitary department, Edmonton, Alta. G. J. Kinnaird, secretary-treasurer.

The sum of $8,000 will be expended on a pumping station and other improvements to the Magog, Que., waterworks system, which will be taken over by the town.

The first step towards a municipally-owned power plant for Winnipeg was taken recently, when a committee recommended to council that the city engineer be instructed to survey a right of way from Lac du Bonnet to Point de Blois Falls, a distance of 20 miles, at an estimated cost of $2,000, for an electric tramway to cost $10,000 a mile.

TELEGRAPH AND TELEPHONE

The Bell Telephone Company, Toronto, will erect a new building at the cost of about $40,000.

The Canadian Pacific Telegraph Company have now completed the wiring between Montreal and Winnipeg, specially designed for their telegraphophone system, under which two messages each way, one by 'phone and the other by telegraph, can be transmitted at one time.

The Century Telephone Construction Company, of Buffalo, N. Y., have recently made an extension to the switchboard of the Ithaca Telephone Company, Ithaca, N. Y., of four (4) positions, common battery. They are installing a complete, common battery equipment at Attica and Friendship, N. Y., and have recently completed the installation of a common battery, four (4) party, selective board at East Aurora, N. Y.

NEW INCORPORATIONS.

Ontario.—Amalgamated Cobalt Mines, Limited, Toronto, $1,000,000. W. R. P. Parker, G. M. Clark, T. C. Russel, Ethel M. Lindsay, and J. Lees, Toronto, Ont.

The Wabi Cobalt Silver Mining Co., Limited, Cobalt, $500,000. J. R. Gamble, T. Langton, Jr., G. Kerlty, W. A. Marsh, and J. Martin, Cobalt, Northern Ontario.

Cobalt Diamond Drilling and Development Company, Limited, Toronto, $50,000. S. Jenkins, D. P. Broker, G. J. Ashworth, S. Jenkin, and Mary Lambert, Toronto, Ont.

The Supreme Heating Company, Limited, Owen Sound, $200,000. S. J. Parker, A. J. Ross, W. Taylor, and A. G. MacKay, Owen Sound, Ont.

Para Docks, Limited, Toronto, $17,500,000. J. S. Lovell, W. Bain, R. Gowans, E. W. McNeill, W. F. Ralph, S. G. Crowell, and W. Gow, Toronto, Ont.

The Northern Engineering & Supply Company, Limited, Fort William, $100,000. J. Crerar, J. A. D. Vickers, W. J. Ross, A. A. Vickers, J. T. Horne, J. M. Patton, and G. F. Mackenzie, Fort William, Ont.

The Joliette Chemical Company, Limited, Joliette, $10,000. J. T. Gaudet, R. W. Gibson, E. Prevost, Marie Anne Leprohon, and Etta C. Irwin, Joliette, Que.

Para Construction Company, Limited, $2,000,000. J. S. Lovell, W. Bain, R. Gowans, E. W. McNeill, W. F. Ralph, S. G. Crowell, and W. Gow, Toronto, Ont.

Canadian Newcomb Motor Company, Limited, Montreal, $600,000. W. F. Borland, D. MacDonald, W. J. White, F. L. Wanklyn, and P. F. Richardson, Montreal, Que.

The German Canadian Smelting and Refining Company, Limited, Toronto, $1,000,000. F. F. Philips, J. E. Morden, L. Shunk, and J. R. Roaf, Toronto, Ont.

Dominion.—Grand Trunk Pacific Terminal Elevator Company, Limited, Montreal, $5,000,000. C. M. Hays, W. Wainwright, A. P. Stuart, W. H. Biggar, and N. Bawlf, Montreal, Que.

The Script Weight Recorder Manufacturing Company, Limited, Joliette, $49,000. S. P. Champoux, J. M. Tellier, L. V. Labelle, L. P. Deslongchamps, and G. Chevalier, Joliette, Que.

Turrett Crown, Limited, Toronto, $125,000. A. W. Mackenzie, D. B. Hannan, L. W. Mitchell, G. G. Buel, and G. F. Macdonald, Toronto, Ontario.

Canadian Newcomb Motor Company, Limited, Montreal, $600,000. W. F. Borland, D. MacDonald, W. J. White, F. L. Wanklyn, P. F. Richardson, Montreal, Que.

The Magdalen Islands Development Company, Limited, Montreal, $2,000,000. W. F. V. Atkinson, C. E. Archibald, J. W. Pyke, S. A. Finley, D. J. Spence, J. R. Hyde, H. M. Marler, and W. G. Tait, Montreal, Que

The Clark Automatic Lock-Nut Company, Limited, Montreal, $500,000. J. D. Good, E. James, W. J. Henderson, J. Rockwell, and E. Languedoc, Montreal, Que.

New Brunswick.—The Dorchester Foundry Company, Limited, Dorchester, $25,000. W. M. Dowd, H. R. Hicks, A. McDonald, A. Chisholm, A. Richard, and N. Hicks, Dorchester, New Brunswick.

Manitoba.—Meisel Manufacturing Company, Limited, Winnipeg, $250,000. Hon. M. M. Arbuthnot, T. L. Metcalfe, and R. M. Meisel, Winnipeg, Manitoba.

Northern Constructions, Limited, Winnipeg, $150,000. E. S. Estlin, G. W. Jones, J. J. Borebank, W. Ramage, and J. R. Higgins, Winnipeg, Manitoba.

Souris Construction Company, Limited, $10,000. F. W. Downs, T. L. Arnett, J. H. Arnett, E. B. Arnett, and M. L. Hewer, Souris, Manitoba.