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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.

JOHN J. MAIN.

In the literature of engineering, the mechanism of the steam engine appeals more to the imagination than do the simpler constructive details of the apparatus in which steam is generated—the boiler. Hence, in the historic account of the evolution of the steam engine from Savery, Newcomen's and Watt's inventions in the nineteenth century, to Parson's turbine in the nineteenth, descriptions of the media in which steam is raised, occupy a very minor place. And yet, the art and skill involved in the design and construction of a waggon, Cornish, Lancashire or tubular type of boiler is by no means to be despised. Many of the deplorable accidents to power plants in days gone by, were directly traceable to the rule-of-thumb methods followed in the laying out of the plates for, and primitive means employed in the construction of, the boilers. In recent years, however, a marked change had come over the scene: boiler making has been reduced to the exactitude and precision of a science. In Canada, this progress has been largely due to the genius and initiative of the engineer whose portrait appears above.

John James Main was born on the Island of Alderney, Great Britain, in 1852. He comes of good artisan stock; for his father was a contracting blacksmith of repute. In 1856 he came with his parents to Canada, settling in Hamilton, Ont. After six weeks, migrated to Montreal, stayed until 1859, when they turned westward, locating in Toronto. His primary education was received in the "Old Country," and Angus, Montreal, P.Q., also Aurora, Ont.: the finishing touches being given at the Barrie Grammar School. At 13, was apprenticed to the machinist trade at Newmarket, under Sam Sykes—an artisan of the old school. He had to get up at 4 o'clock, raise steam, and have shop ready for men at 7. Then breakfast, work, dinner, work until 6 p.m. After 8 months ran away to Toronto. His father sent him back with message for Sykes: "If story told was true, cancel indentures; if not, good thrashing and set to work again." The complaints were true, hence, freedom granted.

Then apprenticed for 5 years in Northern Railway shops —now Grand Trunk Railway. In 1872, joined his father in contract for making crossings, switches and points for two narrow gauge railways—now Midland and Owen Sound branches of the C.P.R. Upon completion of this contract, engaged in boiler making with Dickey, Neil & Co., Beverley Street. Then went to the United States, and worked in Titusville, Oil City, and Erie, Pa. Returned in 1877, to take charge of engine and boiler works of Inglis & Hunter. Superintended this plant until 1880, when he returned to Erie, Pa. But urgent pleas of Mr. Inglis for his return prevailed, and in September, 1881, they bought out the Canada Car Manufacturing Co.'s plant, Toronto, and commenced engine and boiler making—himself upon the percentage basis. In 1895, left John Inglis & Son, and began business for himself, in connection with Polson Iron Works. In 1896, James R. Annet, Joseph Wright, and himself, got control of the Canadian patent rights of the famous "Heine" boiler He became manager of the Canada Heine Safety Boiler Co., and superintendent of the Polson Boiler Works. This boiler business prospered wonderfully. In August, 1906, Mr. Main bought out his partner, Mr. Joseph Wright, and straightway sold out to the Polson Iron Works—becoming third member, and a director of that firm, also Manager of the whole works. It is only fair to say, that when Mr. Main went with the Polson Co. in 1895, the affairs of the Company were at a low ebb. The present successful and prosperous condition of the Company's business is largely owing to his energetic and resourceful co-operation.

Space alone prevents us telling in detail the eventful story of his deeply interesting business career; his struggles to get a technical education; his winning of a Mechanic's Institute three years' scholarship; how he walked three miles three nights a week to evening classes; how the old boiler makers kept the secrets of their laying-out formula up their sleeves, necessitating his wandering into factory after factory, even to workshops in the "States," in order to make himself master of the boiler maker's craft. All this would make a romantic story, as profitable reading as Smiles' "Lives of the Engineers." Although 55, Mr. Main is a fine example of physical vigor and vitality; one of the secrets being his almost life-long abstention from alcoholic drinks and tobacco, and his love of the open air—for he is an enthusiastic motorist. Like Gladstone, he is the happy possessor of the power of compelling sleep at will. As a mechanic, there is probably no man better known in industrial Canada. His pupils are holding responsible positions in almost every workshop in the country.

He is President, Vice-President or Director of 17 different Companies, and has the good-will and respect of every business man and every engineer in the Dominion.

EUROPEAN HYDRO=ELECTRIC DEVELOPMENT

HIGH HEAD SWISS PLANTS.

By CHARLES H. MITCHELL, C. E.

VII.

It is, perhaps, in hydraulic power practice under high heads, that Switzerland has attained her greatest distinction in engineering work. For this special branch, engineers, the world over, seek the advice of her manufacturers and designers, and in many cases purchase their equipment in that country. The latter custom has been quite marked in America during the past ten years, where high efficiency in large units has been desired.

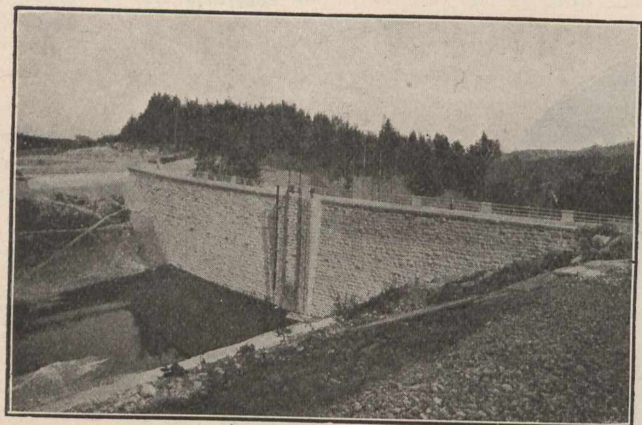

Fig. 1.—Kubel: Reservoir Dam.

Certain localities in Switzerland have been specially developed in this respect, but of recent years, with the advances made in electrical transmission, high head power plants have been constructed in many southern and western localities among the high Alps. These newer installations are all electrical, mainly for light and power purposes thus encouraging manufacturing in the surrounding districts. In the Bernese Oberland, and those districts north of Lake Geneva, new plants are being constantly projected and constructed.

To illustrate this recent development a schedule, based on reports of 1905, is given below, presenting twelve representative plants, which have commenced operation within the past few years. That at Aigle with its head of 3,140'-0" is still said to be the highest in the world.

Principal High-head Swiss Plants.

PLANT AND LOCATION.	Horse Power	Head Feet	Local's served	Miles. Length of Lines	Miles. Max. Trans.	Pop. to be served
Aigle, near Territet ..	2,000	3,140	25	32	15	30,000
Bex, l'Avancon River .	2,400	530	9	40	35	5,700
Engelberg, for Lucerne	8,000	1,030	12	30	23	40,000
Kander, at Spiez	6,000	220	35	150	35	100,000
Kubel, at St. Gall ...	5,600	270	23	32	20	70,000
Montbovon, Saane Rvr.	5,400	220	68	165	35	58,000
Montreaux-Territet . .	3,900	810	12	11	8	30,000
St. Maurice, for Laus'ne	5,200	122	8	50	40	60,000
Thusis, Upper Rhine .	3,580	300	1	2	1	1,300
Vaud at Vallorbe . . .	5,000	770	30	60	30	100,000
Vernayaz, Rhone River..	1,800	1,910	11	25	22	14,000
Wadenswil, Sihl River	2,000	230	18	55	14	34,000

For the purposes of this article the following three typical installations are selected from the above, as embodying interesting features of design and construction.

The Kubel Plant Near St. Gall.

The Kubel plant is situated at Bruggen, a suburb of St. Gall, in north-eastern Switzerland, on the River Sitter. This work, commenced in 1899, and first put in operation in 1901, was constructed to meet the great demand for cheap electric power in St. Gall and the surrounding towns. This region is the main silk and cotton spinning and weaving centre of the country, and consequently has a large demand for small units in motors. St. Gall has a population of about 50,000, and with the surrounding region this plant was, in 1905, serving about 70,000 people in 23 localities. To do this there were 35 sub-stations, with 135 transformers, having an average of about 33 k.w. for each transformer, a total of 4,400 kilowatts.

In general the system of development consists of a series of collecting dams, tunnels, and flumes, bringing water from the upper levels of the tributary streams to a high level valley above the ravine in which the power station is situated. The water is brought down to the station by penstocks and is discharged into the river alongside. In this way 5,600 H.P. is obtained hydraulically under 270'-0" head, and in addition the station has a 1,000 H.P. steam unit as a reserve.

At the present time the water is collected at a point on the Urnasch tributary, about 3½ miles from the station. The first control is by a concrete dam about 12'-0" high and 150'-0" long. At one end of this an intake, at right angles, leads to a head tunnel, and is provided with head gates and a coarse rack. In front and rear of head gates are sluices through the dam 5'-6" and 3'-6" diameter respectively, for draining the stream bed and intake. The head tunnel is driven through rock and is about 15,000'-0" in length with a horse-shoe section, lined with concrete, 6'-0" high inside. This tunnel empties into a reservoir formed by two dams across a valley, transverse to the Sitter River, thus providing a forebay of large area.

The end of the forebay farther from the power station is closed by an earth dam about 1,000'-0" long and 45'-0" maximum height, while the lower end is crossed by a most substantial stone dam, see Fig. 1. The latter dam has a total height of 80'-0", is of gravity type, with a top width of 10'-0" and a bottom width of 50'-0". It is arranged with a low level discharge gate leading to the penstocks, and has an overflow weir in front (left of illustration) which carries surplus water around end of dam. Under working conditions the head water stands from 3 to 5'-0" below the coping.

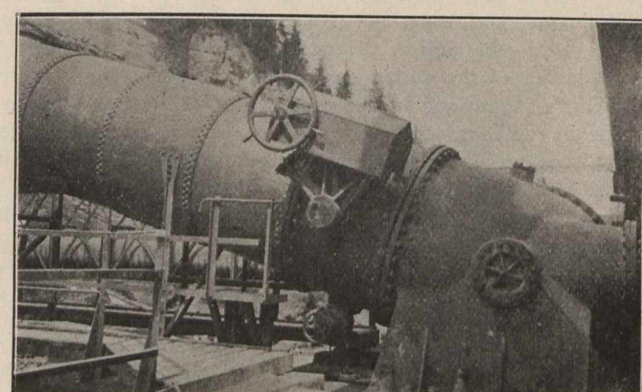

Fig. 2.—Kubel: Abutment of Self-supporting Penstock.

From the dam two steel penstocks 5'-3" diameter lead down the valley and slope to the power station a total horizontal distance of 900'-0". These run side by side and at a maximum slope of 76%. The one first built crosses the Sitter River to the station on a steel lattice bridge, distributing in front of the building into right angle branches serving the wheels. A second penstock, installed for extensions, spans the river without a truss, forming an arch in itself sufficient to carry the combined dead and live loads. This is also connected to the distributing main which supplies 7 units from the two interconnected penstocks. The details of this arched penstock are of special interest and Fig. 2 shows the abutment casting, which serves also as a two way elbow, one side being to the distributor and one to a pound unit.

The power station is a plain, rather American looking, brick building on a concrete foundation, and at the time of the writer's visit, May 1906, temporary extensions of wood had been made pending permanent construction.

The power units indicate an interesting evolution so common in present day practice in power stations the world over. The first hydraulic installation had four 500 H.P. units of single nozzle Pelton type impulse wheels by Escher Wyss & Co. Then one 1,200 H.P. unit of the same type was added. Then came a 1,000 H.P. vertical reciprocating

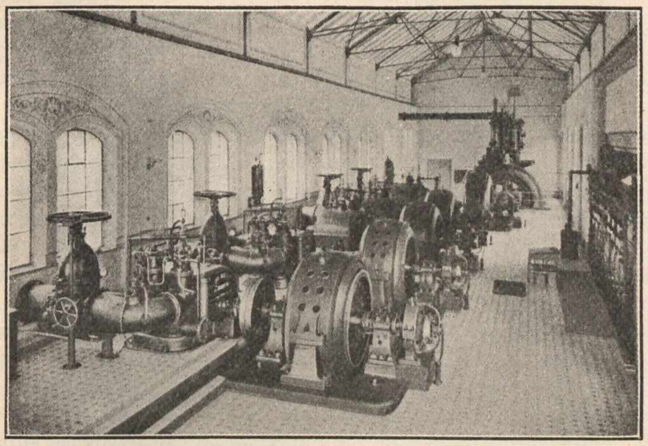

Fig. 3.—Kubel: Interior of Station.

steam engine unit to act as a reserve, due to fear of water shortage. After this more water was secured, a second penstock connected up and a second 1,200 H.P. impulse unit was installed. Early in the present year a third 1,200 H. P. unit, by Theodore Bell & Company was added, but of the Francis reaction type. The change from impulse to reaction is due to the fact that the latter has now attained a stage in design so as to be adapted for heads approaching 300'-0".

The impulse wheels of 500 H.P. have a single tangential nozzle on each of two runners in the same case, while those of 1,200 H.P. have three nozzles on each, or six to the unit. The former revolve at 375 and the latter 300 R.P.M. Referring to Fig. 4, it will be seen that the water is controlled by tips linked to the governor by rocker arms, and that the jets are deflected when not in use. The outside diameter of these runners is 50" and the unit, when loaded, consumes about 40 cubic feet of water per second. Although impulse wheels they are set 20 feet above tail water having draft tubes which are fitted with air valves to admit sufficient air to prevent the water level rising as high as the wheels. The governors are operated hydraulically by means of pressure from the supply pipe with which the governor cylinders are connected by piping. Admission of water to the latter is regulated by a fly ball governor and delay piston.

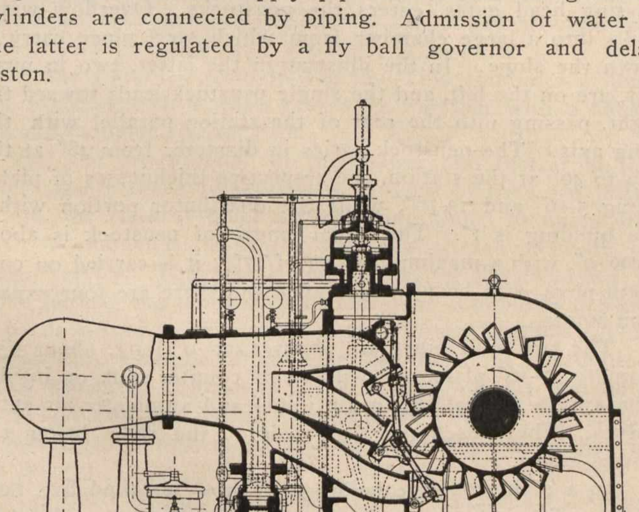

Fig. 4.—Kubel: Section Through 1,200 H. P. Wheel.

In the electrical equipment no particularly unique features are incorporated, as all power is distributed at the generating voltage, 10,000 V., without transformation. The generators are all of the same type of the various powers and are by Lachmeyer & Co., of Frankfort. The exciters are directly connected on ends of generator shafts. The whole station is arranged to run in parallel through either of two bus systems.

In order to form an idea of the cost of such projects, according to European practice, the following approximate figures are given for this particular work, assumed to the end of 1904, when 4,200 hydraulic, and 1,000 steam power was available on the shaft corresponding to about 3,600 kilowatts for delivery.

A. Preliminary, concessions and lands		$170,000
B. General Works:—		
Collecting dam, etc.	$ 15,600	
Head tunnel	146,000	
Reservoir dams	135,000	
Penstocks, overflows, valves, etc.	47,000	
Power station structure	66,400	410,000
C. Hydraulic equipment		29,000
D. Steam equipment		36,000
E. Electrical Equipment:—		
In power station	109,000	
Distribution, transformer stations, etc.	320,000	429,000
Total		$1,074,000

Fig. 5.—Vallorbe: General View of Station.

In the above it must be noted that portions of classes A, B and E are available against extensions so that ultimately the capital cost per kilowatt would be much reduced. Thus while the cost as shown is almost $300 per kilowatt it may subsequently fall to $200 when the plant is developed to its utmost.

The sale of power from this plant is in a flourishing condition and the market has quite exceeded the facilities. For lighting, prices obtained for 16 C.P. lamps are from $2.50 per year for 400 hours to $4.50, using 1,500 hours per year, such as required in residences at all times or in offices and factories until 6 p.m. For motor load, prices are as follows: One H.P. $80 per year; 5 H.P. $65; 10 H.P. $55; 20 H. P. $45; 50 H.P. $36.

The Vallorbe Development.

Vallorbe is a small city in Canton Vaud, situated on l'Orbe River, a short distance north of Lake de Joux, and about two miles from the French frontier. The river empties from the lake, which is 800'-0" above the valley, through an underground passage beneath Mount d'Orzeires, and emerges after its downward rush at the foot of a high cliff, about a mile and a half from the lake. This gigantic bubbling spring is called Source de l'"Orbe—and thence down to Lake Neuchatel the river flows through a deep and beautifully wooded valley, sufficiently picturesque with its cascades and waterfalls, to attract thousands of summer visitors. This is now one of the tourist points on the new Paris-Simplon-Milan line.

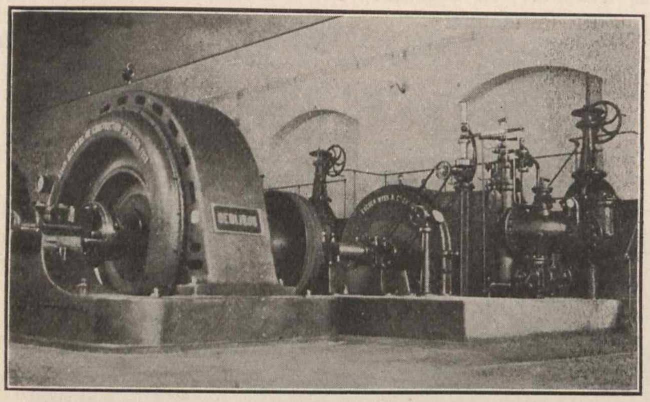

Fig. 6.—Vallorbe: 1,000 H. P. Power Unit.

In the autumn of 1901 the "Compagnie Vandoise des forces motrices des lacs de Joux et de l'Orbe" was formed to develop, generate and distribute electrical energy in the Canton and, as the first of their enterprises, commenced in 1902 the construction of a hydro-electric plant near the "source" called the La Dernier station. This station and its local distributing system were put into operation in 1904, and was soon followed by a second plant, 10 miles lower down on the river, at the city of Orbe, the latter called the Montcherand station. These two plants when entirely completed will deliver for sale about 11,000 H.P., which they consider will be a minimum continuous output. The region in which this is sold is quite large and may be said to comprise all that south-western portion of Switzerland lying be-

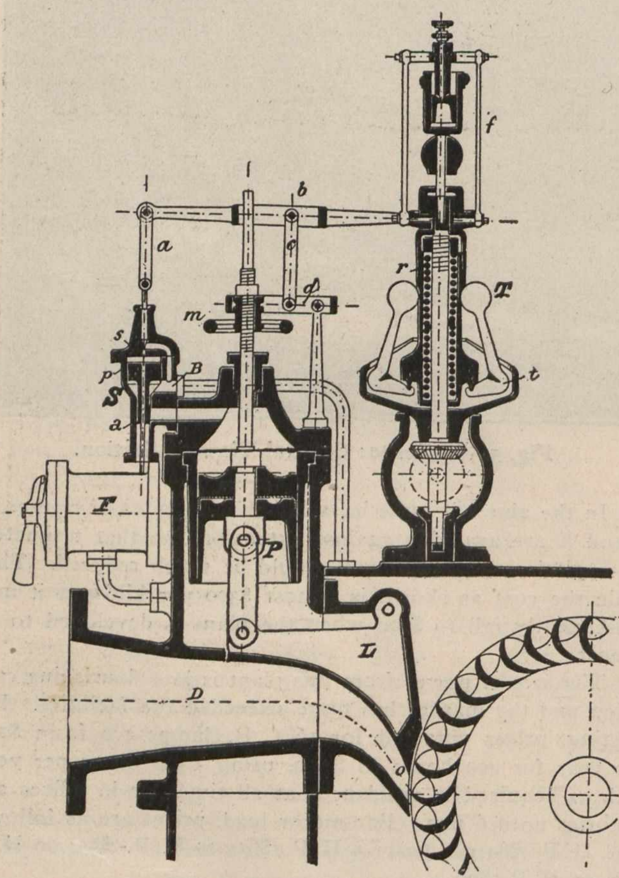

Fig. 7.—Vallorbe: Section Through Hydraulic Governor.

tween Lakes Geneva and Neuchatel (excluding Geneva and district).

The Vallorbe plant has been in operation since 1904 with five units: space and connections are arranged, however, for three more, while ultimate extensions will provide for a total of about 12 units if sufficient water can be secured. The present output of this plant is 5,000 H.P.

Hydraulically this development is most remarkable, owing to the nature of the water supply. Lakes de Joux and Brenet have six and seven surface outlets respectively, but the main discharge is the subterranean river which forms the Orbe. In order to get sufficient water then, all the small surface outlets were dammed, and the lakes were formed into a huge reservoir in which the concessions permitted the fluctuation of the level within limits of 12'-0", artificially controlled. At certain periods of the year these lakes have regularly risen a number of feet, according to a law determined by observations extending over many years. This increase is now partially secured by the new works, and is held up for power purposes. The subterranean flow, however, still proceeds. Hence the development presents the unique feature of being dependent entirely on storage water or such as can be stolen from the natural outlet. Probably when some ingenious Swiss engineer obtains a means of plugging the outlets in the bed of the lake, or can find and tunnel into the subterranean rivers and dam them, the present plant will be developed to much larger proportions.

The water taken at the intake in the lake, after passing racks and gates, is carried by means of a rectangular concrete lined tunnel to a point on the lower hillside, where a forebay and head house are located. The tunnel conduit is 6'6" wide, 7'-0" high and about 8,700'-0" long on a slope of 3%.

In Fig. No. 5 the forebay works can be seen high up the mountain side. Water issuing from the tunnel first passes a course rack, enters a chamber having an overflow weir with

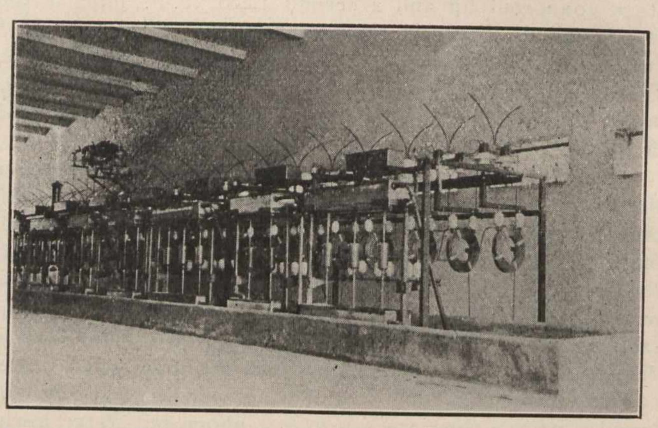

Fig. 8.—Vallorbe: Water Resistance Lightning Arrester.

adjustable crest, then passes through a fine rack and enters a second chamber at right angles to the line of flow, thence passing head gates, enters the penstocks. Overflow water spills into a large chamber from which steel pipes carry it down the slope. In the illustration the latter, two in number, are on the left, and the single penstock leads toward the right, passing into the rear of the station parallel with the long axis. The penstock varies in diameter from 48" at the top to 40" at the station, the respective thicknesses of plates being 5-16" and 13-16", while the distributor portion within the building is 1". The total length of penstock is about 2,000'-0", with a maximum slope of 77%; it is carried on concrete piers with heavy anchorages and there are four expansion joints.

The two spill pipes are about 2,400'-0" long, about 3'-0" diameter, 7-16" plate, and with rivets counter sunk on inside. These have several expansion joints and automatic air entry valves. They discharge water into the river below the power house.

In a plain concrete building are now installed five 1,000 H.P. units and two exciters operating under a head of 770'-0". These units (see Fig. 6) are contained in a room 160'-0" long and 40'-0" wide, while in a central wing are located the busses, switches, switchboards and arresters.

The water wheels are by Escher Wyss & Co., and are very similar to the 500 H.P. units in the Kubel plant, having single nozzles with one runner. A feature of this wheel is its automatic hydraulic regulator, an illustration of which is given (Fig. 7) showing governor and link connection. In plants of this pressure, European builders are using filtered water from the penstock instead of oil as the medium. This involves a mechanical filter on the governor to insure clean water. Escher Wyss have what they call a "revolving filter," F, which can be worked by hand. The cycle of operation from the fly balls to the relay valve, with its fine adjustment to prevent "racing" through the lever system to the regulating valve S, thence to the main cylinder and piston P, and to the throttling lip L, can be readily followed. A pressure regulator is also attached to each unit for relieving sudden excess pressure on the supply pipes and penstock.

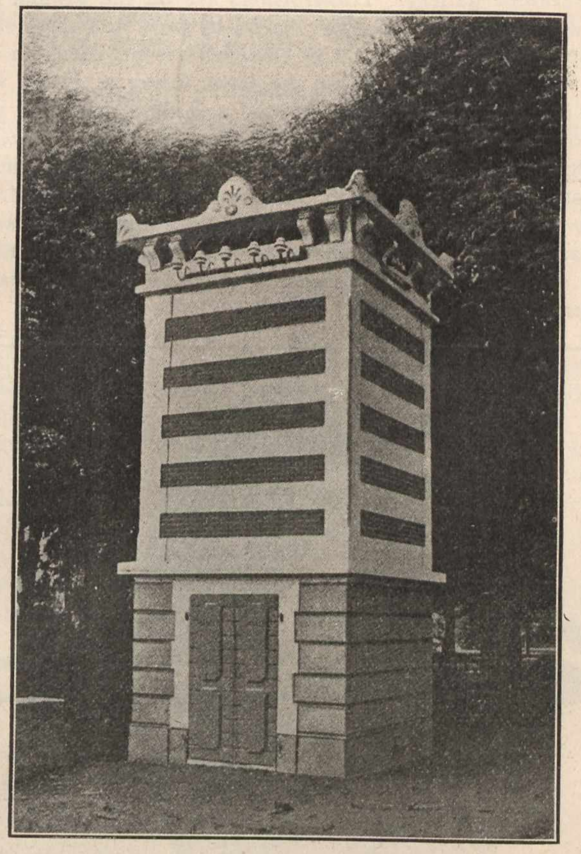

Fig. 9.—Vallorbe: Artistic Isolated Transformer Station.

The generators are built by the Oerlikon shops, and are 3-phase 50 cycles, wound to 13,500 volts at a speed of 375 R.P.M.; they are connected to the wheels with Zodel couplings. The switching is specially interesting, owing to the wide system of distribution, but is simplified by having no transformers. Instrument pedestals of American type are installed, and the chief operator from his gallery can easily control all operations of the station. A unique arrangement of hydraulic jet lightning arresters is installed on a floor above the gallery, shown in Fig. 8. This combines a horn type arrester with a water resistance together with a choke coil and metallic ground wire.

For the distribution of this power and that from the lower station there is planned a network of over 250 miles of line, the farthest point served being about 50 miles distant. A characteristic is the widely scattered network of power service. The total population in the localities is about 100,000, the number of localities or communes designed to be served is 212 with 235 transformer stations. This is a striking example of the extensive detail of distribution which European companies are now carrying out, and both the people and the power companies of Ontario can at the present time benefit materially by following Swiss lead in this respect.

To illustrate this widely scattered market the following table is given, showing the number of localities and respective populations in which the company's franchise permits sale of power for 30 years, subject to state controlled prices:—

10	communes	under 100 inhabitants.	
48	"	from 100 to 200	inhabitants.
55	"	" 200 to 300	"
59	"	" 300 to 500	"
21	"	" 500 to 800	"
10	"	" 800 to 1,200	"
5	"	" 1,200 to 2,000	"
4	"	" 2,000 to 5,000	"

The power in these places is used for lighting, street railways, cement and brick yards, all manner of agricultural needs, such as churning, etc., watch-making, weaving, and miscellaneous shops and industries.

Small transforming stations of standard design, about 10'-0" x 12'-0" inside and 27'-0" high with 3 floors, are erected in many localities. These are built of brick or concrete and are cheap and neat in appearance. Some in city streets and parks are most artistic. See Fig. 9.

Prices are as follows:—For light; 16 C.P. lamps from 400 to 800 hours per year, $3.60; over 800 hours, $4.40. For heating: 8 cents per kilowatt hour. For motors flat rate: on 11 hour basis, less than 1 H.P., $60 per year; 1 to 2 H.P., $40; 9 to 11 H.P., $37; 25 H.P., $33; 50 H.P., $30; 100 H.P., $29. On 24 hour basis add 25% to above figures. For motors on meter rates from 2.5 cents per kw. hour at 1 H.P. down to 1.4 cents at 100 H.P.

The Engelberg Plant.

Among the new Swiss installations that near Engelberg, about 20 miles from Lucerne, stands out most prominently. The construction of this plant was commenced late in 1903, and it was put in operation in the fall of 1905. It is organized by Lucerne promotors and nearly all the stock is owned by the city corporation as a financial investment, but the company is operated privately. The principal market is in the city of Lucerne for lighting and power, and a considerable block is taken for the Engelberg 3-phase electric railway. The interest in this plant is in its modern equipment both hydraulic and electric, and it may be considered an example of the latest European practice.

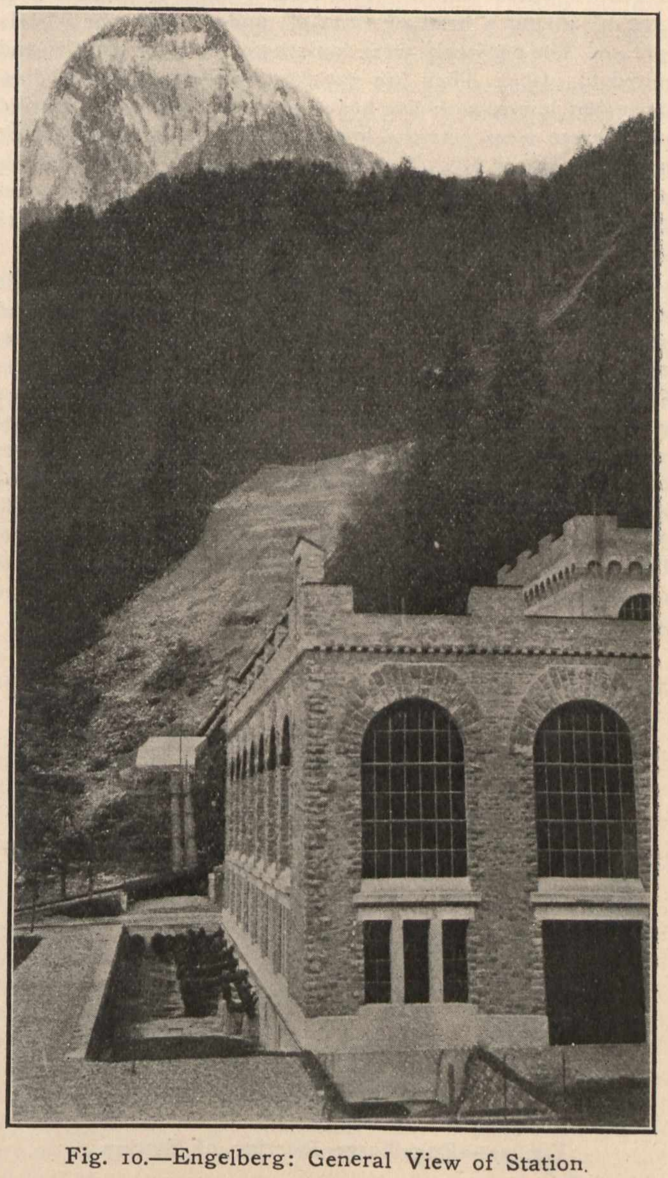

Fig. 10.—Engelberg: General View of Station.

Engelberg, town and district, are well-known to tourists as a summer and winter resort high in the mountains south of Lake Lucerne. The little Erlenbach rises in the hills nearby and forms a small lake before starting down the valley.

This lake provides the head pond of the power works, and is arranged as a storage reservoir. Water is taken through a small intake with gates and screens and is carried through a tunnel 6'-6" diameter about 8,500'-0" long, on a slope of 0.12% to a small reservoir on the mountain side above the power station. This head house is provided with gates and screens and the water feeds into four penstocks each 40" diameter. Two of these tubes are now erected and connected to water wheels. The total length of penstocks is 2,100'-0", giving a head of 1,030'-0", under which the wheels operate. The penstocks were constructed in 25'-0" lengths and bolted in place. They are each provided with five sliding expansion joints, with five heavy anchorages and are carried on concrete piers. At the lower end the sheets are 1" thick and at the upper 3/8". The distributors at the station branch each to 3 units, while the two exciter branches are connected to each tube; each has a butterfly valve, a guard plate, relief and emptying valve. Fig. No. 11 shows this arrangement.

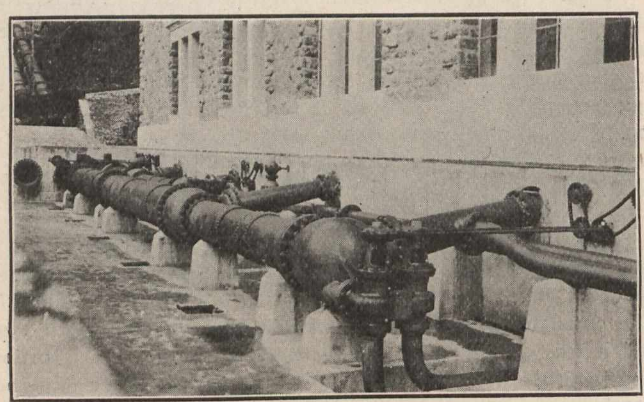

Fig. 11.—Engelberg: Penstock End and Its Distributor.

The power station is a dignified castle-like structure built of limestone, in pleasing harmony with the massive cliffs and tree-clad mountains surrounding it. In the interior, the striking feature is the generous space provided for all apparatus. The generating room does not present the usual appearance of overcrowding, but with very ample floor space and lofty roof and windows. Even the power units look small if not lonely. The roominess of switch-board galleries and switching equipment chambers is quite as well marked as also is the great space allotted to the transformers, arresters, etc. The engineers look upon this as one of the modern features and in fact the writer saw no European plant with greater space given to this apparatus.

Four main power units are now installed, each having a capacity of 2,500-H.P. in the wheels and an output from the generators of 1,500-kw. Two exciter units are operated independently. Another separate unit of 600-H.P. furnishes power for the electric railway.

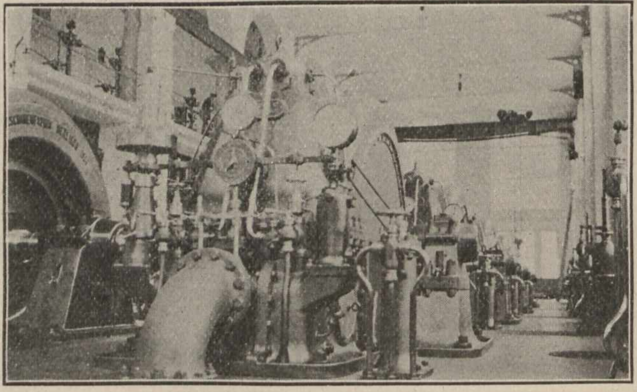

Fig. 12.—Engelberg: Interior of Station.

The water wheels, manufactured by Theodore Bell & Co., Kriens, are the Pelton impulse type with double buckets and side discharge. See Figures 12 and 13. They have one runner driven by a single nozzle having a throttling gate governed by a water pressure governor.

The alternators were built in 1904 at the Oerlikon works and are wound to 6,000 volts at 50 cycles at a speed of 300 revolutions per minute.

Local switching equipment controlling the power units is installed on the same floor as the generators. Shunt regulators for exciters and exciter rheostats are mounted on a mezzanine gallery. Transformers are on the ground floor and consist at present of two banks of three and three single phase with one reserve. Oil switches are provided on both low and high tension sides, the latter being at 27,000 volts. Bus bar compartments on ground and first floor are made thoroughly fire-proof, and in addition to spacious size are particularly well isolated between circuits. The lightning arresters are Siemens Double horn pattern arranged also with water resistance and choke coils connected in series. Distant control in convenient arrangement with centralization of instruments and recording apparatus is a marked feature.

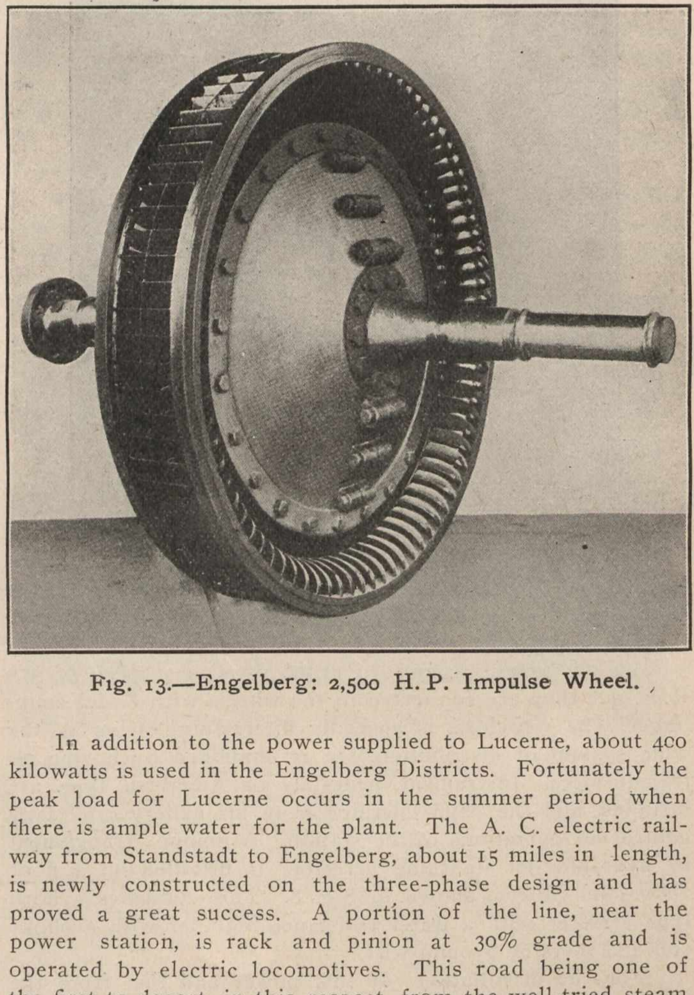

Fig. 13.—Engelberg: 2,500 H.P. Impulse Wheel.

In addition to the power supplied to Lucerne, about 400 kilowatts is used in the Engelberg Districts. Fortunately the peak load for Lucerne occurs in the summer period when there is ample water for the plant. The A. C. electric railway from Standstadt to Engelberg, about 15 miles in length, is newly constructed on the three-phase design and has proved a great success. A portion of the line, near the power station, is rack and pinion at 30% grade and is operated by electric locomotives. This road being one of the first to depart, in this respect, from the well-tried steam engine type.

ENGINEERING WORKS IN CRETE.

The present Government of Crete, purpose to develop the island gradually by the making of roads and bridges, and by the construction of harbor works, railways, and tramways, etc. Provision has already been made for the expenditure required to install a telephone system all over the island. No contracts have been let at present, but the firms who will be first on hand will have the best chance of obtaining the contracts for the other engineering works and supplies which are to follow the development of what is at present almost entirely a virgin field of industrial enterprise.

—Sheet-steel roofing may rust faster than iron because it holds the paint better, and yet steel in other forms, like tubing, may rust no faster than wrought iron. Different steels behave in different ways. Carelessly made steel, containing blow-holes, may rust faster than wrought iron, while carefully made steel free from blow-holes, may rust slowly.

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 V.—PRODUCTION OF IRON AND STEEL IN THE ELECTRIC FURNACE.

(Continued.)

Production of Pig Iron from Iron Ore, Carbon and Fluxes.

The production of pig iron from iron ore in the electric furnace is a proposition of greater commercial importance than the manufacture of tool steel, or even structural steel; but the process is in a less advanced condition. The electrical smelting of iron ores is simple in principle: the ore being mixed with suitable fluxes, as in the blast furnace, and with sufficient carbon to reduce the iron and other materials, and to supply carbon to the pig iron. The electric current is made to pass through the mixed charge, which becomes heated; the iron being reduced and carburized, and the earthy portions of the ore melted into a slag. Less carbon is needed than in the blast furnace; where the combustion of carbon supplies the heat. This saving in carbon will offset a part, and in some cases the whole, of the cost of the electrical energy.

Several furnaces have been constructed for the electrical smelting of iron ores, the most important of these being the Héroult and the Keller ore smelting furnaces, which were illustrated in Article IV.

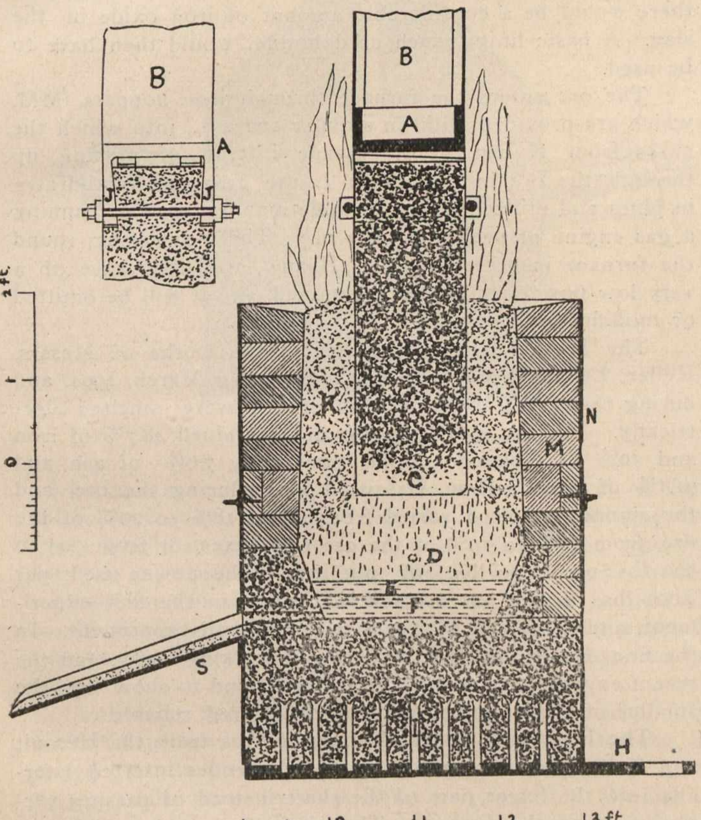

Fig. 22.—Heroult Ore-smelting Furnace.

The Heroult Furnace (Fig. 22) consists of a nearly cylindrical shaft in which a carbon electrode, C, is suspended. The furnace is built inside an iron casing, N, 4'-0" in diameter, bolted to a cast iron bottom plate, H. The lower part of the furnace is lined with carbon, put in as a paste, and this carbon lining forms the lower electrode of the furnace, the current passing between C and G through the melting charge. One cable from the transformer was connected to H, and a number of bolts, I, serve to make better contact between the bottom plate and the carbon lining. The upper part of the furnace is lined with common fire bricks, but the carbon lining is continued to a point a little above the slag level, as it will resist the solvent action of the slag much better than firebrick. The interior of the furnace tapers a little, upwards and downwards from the point at which the brick and carbon linings meet. Two tapping holes are provided, the lower one which leads to the spout S is for the pig iron, and the upper one, D, is for the slag. The upper electrode is supported by the holder, AB, which has already been described (p. 360), and which is suspended by a chain so that it can be raised or lowered; the regulation of the electrode would normally be automatic. The electric current is led to the carbon through the holder AB.

An iron casing is very convenient in the construction of any kind of furnace, but for an electric furnace—using an alternating current the complete iron ring, N, through which the current has to pass—would be very objectionable, as it would increase the inductance of the circuit, thus opposing the passage of the current, and lowering the power factor. On this account, a vertical strip of the iron case, 10" wide, was replaced by a copper plate.

In operating the furnace, the current is started between the electrode, C, and the bottom of the furnace (a little coke could be placed in the furnace, if necessary, to prevent too large a rush of current on making contact), and the ore, mixed with charcoal and fluxes, is fed in around the electrode. The heat generated will heat the charge around the end of the electrode, and as the charge becomes partly reduced and melted it will carry the current more readily, and the electrode can be gradually raised until it reaches its normal position. The part of the furnace between C and G may be considered the zone of fusion, and contains molten pig iron, F, molten slag, E, and a mixture, D, of charcoal and melting slag and metal.

Considering the chemical reactions of the furnace, the ore usually contains iron in an oxidized condition, and the oxide of iron is reduced by the charcoal forming metallic iron and carbon monoxide. This direct reduction by charcoal probably takes place mainly in the lower and hotter part of the furnace, but the carbon monoxide, so formed, is itself a good reducing reagent and reacts with the oxides in the upper part of the furnace, partly reducing these and liberating carbon dioxide, which is again reduced to carbon monoxide by the charcoal in the charge. The reactions may be represented as follows:—

$$Fe^2O^3 + CO = 2FeO + CO^2.$$
$$FeO + C = Fe + CO.$$
$$CO^2 + C = 2CO.$$

It will be seen that the gas escaping from the furnace must be mainly carbon monoxide, and this is more valuable than the gas from an ordinary blast furnace which is largely diluted with the nitrogen from the blast. In the illustration this gas is represented as burning around the electrode, above the charge, but in regular practice it would be employed, probably, to preheat the charge. The carbon monoxide will not reduce the iron ore until the latter has become somewhat heated, and in electric smelting the heat will not penetrate so far up the descending column of ore as it does in the blast furnace, as there is a much smaller flow of gas to carry the heat, and consequently the shafts of electric smelting furnaces will not need to be so high, in proportion, as the shafts of blast furnaces. In figures 22 and 23 the arrangement of the electrodes would also prevent a high furnace from being used, but this can be modified, and the volume of the upper part of the furnace may be effectively increased if the ore charge is preheated by the combustion of the carbon monoxide.

Turning now to the results recently obtained in this furnace, so far as these have been published, Dr. Haanel reports that, in the experimental runs, some 55 tons of pig iron were electrically smelted from hematite, magnetite, roasted pyrrhotite, and titaniferous ores. The furnace worked satisfactorily with all these ores, and pig iron, low in sulphur, was obtained from the roasted pyrrhotite, and other ores of high sulphur content. Charcoal forms a perfectly satisfactory reducing agent, and this is important, since in Ontario and Quebec charcoal can often be produced cheaply from mill refuse, wood or even peat, while coke, suitable for blast furnaces, has to be imported. In this connection, it should be remembered that the coke or charcoal used in a blast furnace must be of good quality, and able to stand the weight of the heavy column of ore without crushing; while in the electric furnace the quality of the reducing reagent is less important, and broken charcoal and partly charred wood was found to serve the purpose. The electric furnace differs from the blast furnace in the absence of a blast of air, and in the possibility of attaining a higher temperature. Both of these differences are advantageous: rendering the former a more powerful reducing medium than the latter. The strong reduction helps to drive the sulphur into the slag, as calcium sulphide, and the high temperature that is attainable allows a very limey slag to be used for the removal of the sulphur. Strongly reducing conditions, although desirable as removing the sulphur, have the effect of increasing the amount of silicon in the pig iron, and iron containing as much as 5% or 6% of silicon was obtained, with only 0.07% of sulphur when smelting the roasted

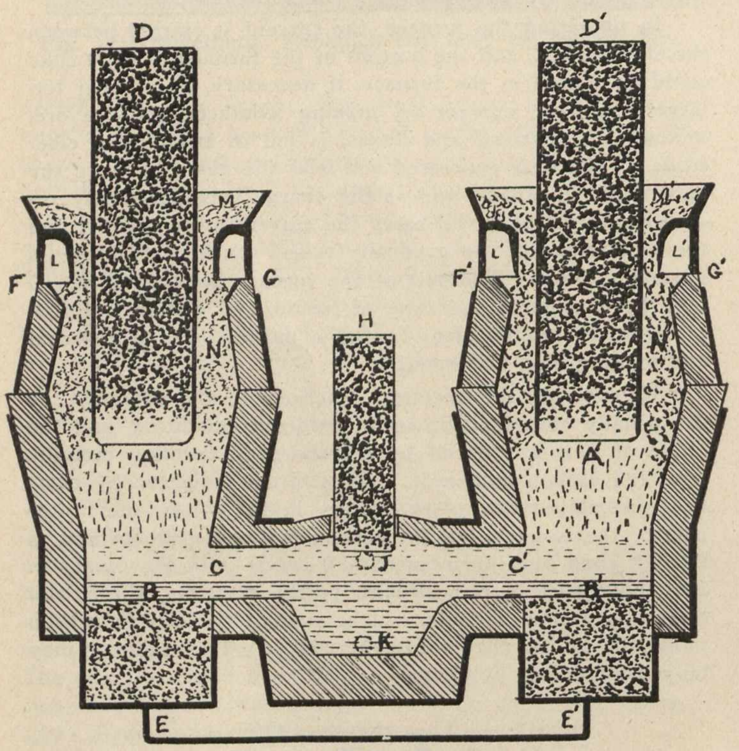

Fig. 23.—Keller Furnace.

pyrrhotite. Dr. Haanel, however, reports that by increasing the limestone in the charge, the silicon in ferronickel pig has recently been lowered to 2%. With less sulphurous ores the iron could be obtained high or low in silicon as desired, as the degree of reduction in the furnace is quite under control.

The consumption of electrical energy, in horse-power years per 2,000 lbs. of pig iron, varied from 0.236 to 0.301 in the reported runs on iron ores, and these figures would enable estimates to be made of the cost of electric smelting under given conditions, though if the carbon monoxide escaping from the furnace could be utilized for preheating the ore and flux, these figures should be materially reduced, and somewhat better results may be expected from furnaces of larger dimensions, and when the conditions for smelting have been more completely ascertained. The amount of charcoal used varied from 25% to 31% of the weight of the ore, which would correspond to about 800 to 1,000 lbs. of charcoal per ton of pig, and the difference between the cost of this and the cost of the fuel used in a blast furnace may be set against the cost of electrical energy.

The Keller Furnace (Fig. 23), differs from the Héroult in having two vertical shafts, NN, communicating below by a passage CC. Each shaft contains a carbon electrode, DD, and the current from these electrodes flows, normally, through the molten metal K in CC, but permanent carbon electrodes, BB, connected electrically by a copper bar, EE, serve to carry the current from one shaft to the other whenever the furnace is empty. H, is an auxiliary electrode which may be employed for heating the metal in K if it should ever become chilled.

This furnace has the advantage of providing a receptacle, K, for the molten metal and slag; the metal being tapped through the hole K, and the slag through the hole J. The receptacle K, corresponding to the fore-hearth or settler of a copper furnace, receives the molten products of two, or even four shafts, thus reducing the labor of tapping; and the use of two shafts, connected electrically in series, enables the current to be employed at a higher voltage than in the case of a single shaft furnace. The working lining of the furnace is made by ramming a mixture of burnt dolomite and tar around a mould, and has been found to stand very well. As the heat is produced in the centre of the shaft, it should be possible, by suitably proportioning the furnace to keep the walls at so moderate a temperature that they might be built of ordinary fire brick, as in the blast furnace. Fire bricks are, however, rapidly corroded, even at moderate temperatures, by slags containing oxide of iron, and would only stand if the conditions were so strongly reducing as to convert the whole of this oxide to metal. It will be remembered that the working lining of the Héroult furnace was carbon, which is infusible and does not corrode unless exposed to oxygen or metallic oxides, such as iron oxide. Such a lining will last if the furnace conditions are strongly reducing, and cast iron is being made, but would not last if it were attempted to produce steel in the furnace, as then there would be a considerable amount of iron oxide in the slag. A basic lining, such as dolomite, would then have to be used.

The ore enters the furnace through iron hoppers, MM, which are provided with an annular space L, into which the gases from N can easily escape instead of passing up through the ore in M. From L the gases are withdrawn in pipes and utilized in any suitable manner, such as running a gas engine or preheating the ore. The iron casing, round the furnace inspected by Dr. Haanel, was the cause of a very low power factor being obtained, and it will be omitted or modified in the future.

The Haanel Commission visited the works of Messrs. Keller, Leleux & Co., at Livet, France, in March, 1904, and during their visit some 30 tons of ore were smelted electrically. The ore was hematite and contained 48.7% of iron and 10% of moisture. Coke, containing 7.6% of ash and 91.1% of fixed carbon, was used for reducing the ore, and the amount required varied from about 18% to 20% of the ore, from 17% to 19% of the ore and fluxes, or from 700 to 800 lbs. per 2,000 lbs. of pig iron. The power used, per 2,000 lbs. of pig, was 0.475 E.H.P. years in the first experiment, and 0.226 E.H.P. years in the second experiment. In the first experiment the furnace was working badly, and the recent experiments at Sault Ste. Marie tend to show that the smaller of these figures may be considered reliable.

The Harmet Furnace (Fig. 29) differs from the Héroult and Keller furnaces in having the electrodes inserted laterally into the lower part of the shaft instead of passing vertically down the furnace. The shaft, S, is enlarged below to allow of the insertion of the electrodes, EE, and the current passes between these through the melting charge, the slag, C, and the molten metal, B. The inclined lateral electrodes will probably be less satisfactory in actual use than a central electrode, because it will not be easy to regulate the current by raising or lowering them as is done in the other furnaces, supporting the electrodes in this position will also be less easy, and the walls will be apt to melt around the electrodes. On the other hand the height of the shaft, S, is not limited, as in the Héroult furnace, by the length of the electrode, and greater opportunity can be provided for the preheating and reduction of the ore. Harmet utilizes the combustible gases escaping from the top of the shaft, for burning, in a separate furnace or calciner, in which the ore is calcined and preheated before charging into the main furnace. Some of the gas is returned to the foot of the shaft, being blown in at this point to supply a reducing gas for converting the iron oxide to metal, and to carry some of the heat from the crucible up the shaft, so as to preheat and reduce the descending ore. The use of the gas to preheat the ore before charging into the furnace is very desirable, but there will be no need to blow gases through the smelting shaft, because reducing gases are always formed here in large amount, and because the combustion of the gas in the calciner would heat the ore to a temperature at which it would begin to be reduced to the metallic state directly it was introduced into the smelting shaft.

Mr. Henri Harmet has written a treatise on the electro-metallurgy of iron, which is printed in Dr. Haanel's European report, and in this he considers every conceivable way in which iron ores can be reduced by the joint use of carbon and electrical heat, but no mention is made of any actual furnace embodying his views—even on an experimental scale.

In the Héroult and the Keller furnaces, which have successfully smelted iron ores on a small working scale, no use has been made—as far as the writer is aware—of the combustible gas, very rich in carbon monoxide, which escapes from the smelting shaft; though Keller intends to employ them for drying the ore. Attempts were made by Héroult in the experiments at Sault Ste. Marie, to utilize these gases by blowing air into the furnace near the top of the shaft, thus burning the gas and heating the descending charge. The arrangement could hardly be expected to work well, as the coke or charcoal and the carbon electrode were also exposed to the blast of air, and the ore was found to become

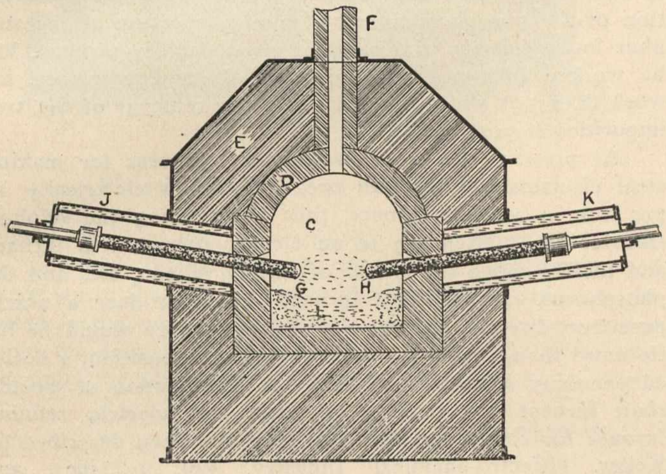

Fig. 24.—Stassano Furnace.

sticky, and not to descend regularly in the furnace. A considerable economy can, however, be made by utilizing the gases which at present escape from the electric smelting furnace, and until this has been effected it will be premature to limit the efficiency of the furnace, as it may be possible to obtain pig iron from the ore with a far smaller expenditure of electrical energy than Héroult or Keller have so far obtained.

Collecting the results that have been obtained in the electrical production of pig iron from the ore, it may be stated that the process is technically successful, and gives better results than the blast furnace in regard to the use of sulphurous ores, titaniferous and similar refractory ores, and ores in a state of powder, such as iron sand or ores which have been concentrated by magnetic or similar processes. The process also allows of the use of inferior and, therefore, cheaper fuel. The power required is about ¼ of a horse-power year, depending on the richness of the ore, and will probably be reduced to a decidedly lower figure. The fuel used for reducing and carburizing the iron is 700 or 800 lbs. of coke per ton of pig, or 800 to 1,000 lbs. of poor charcoal. These figures are also capable of reduction.

Comparing the cost of smelting by the two processes, apart from considerations of scale working, which will at first greatly hamper any electric smelting project, the main items of cost to compare are the fuel and the electric power. Thus in the electric furnace the ton of pig would require, at present, ¼ horse-power year and 700 or 800 lbs. of coke, while the blast furnace would require some 1,900 or 2,000 lbs. of coke. Balancing the cost of ¼ horse-power year against the cost of the coke that is saved, will give a general idea of the prices of coke and power which would permit of electric smelting. Of the other expenses of the two methods, the electric furnace, receiving high voltage current at a certain price, would require transformers and heavy cables from these to the furnace. The carbon electrodes must also be supplied. The blast furnace, on the other hand, has the expense of the blowing engines with their attendant boilers, and of the enormous hot blast stoves for preheating the blast, which will probably at least equal the cost of electrodes, etc., for the electric furnace, when the latter is operated on a fairly large scale.

The furnaces constructed by Héroult and by Keller are so very small in comparison with a modern blast furnace that the general expenses would tell very much more heavily on the electric process. These furnaces moreover could not very easily be largely increased in size, and obviously need a number of improvements before they reach their most satisfactory and economical design. These improvements will, no doubt, accompany a gradual increase in size, and the electric smelting of iron ores will probably become a commercial fact in localities favorable to its operation.

III.—The Direct Production of Steel from Iron Ore.

It is quite possible to produce malleable iron or steel directly from the ore by heating the ore with a limited amount of carbon, enough to reduce the oxide of iron to the metallic state, but without the excess of carbon, which must unite with the reduced iron to make pig iron. The primitive metallurgists obtained wrought iron and steel by reducing the ore in small furnaces, instead of first making pig iron and then turning this into wrought iron or steel as is the present practice. Iron, nearly free from carbon, is, however, very difficult to melt, and in the little forge or furnace of the savage the iron was not melted, but obtained in the form of a solid lump, which was then cut up and hammered into shape; it being often necessary to pull the furnace down in order to extract the bloom of reduced iron or steel. With larger blast furnaces it is possible to melt even pure iron, but the melted iron will rapidly absorb carbon from the fuel employed, and so will become pig iron. It follows from this and other reasons, that wrought iron and steel cannot be made in a blast furnace. In the electric smelting furnace, however, the conditions are different, because, as the heat is supplied electrically and is not dependent upon the burning of fuel, the amount of carbon supplied can be adjusted exactly to suit the chemical needs of the ore, so as to make a carbon—free iron, or any desired grade of steel.

Captain Stassano has effected this in his electric arc furnace (Fig. 24), which resembles an open-hearth steel furnace, the flame of burning gas being replaced by the flame of the electric arc. The furnace consists of an iron casing lined with fire-brick E, and with an inner lining of magnesite bricks, D. An arc is maintained between the ends G and H of two, nearly horizontal carbon electrodes, the holders of which work through air-tight stuffing boxes in water cooled casings, J and K, thus preventing escape of furnace gases, cooling the holders and preventing the oxidation of the external portions of the electrodes. The necessary amount of carbon for making iron or steel is incorporated with the ore in the form of briquettes, which are introduced into the furnace, and heated until the chemical reactions have taken place and the reduced metal has melted. The metal and slag are then tapped out and the operation repeated. The carbon monoxide, resulting from the reaction of the carbon and the ore, escapes from the furnace by the hole F. This waste gas might be employed for drying and preheating the ore.

Dr. Haanel was unable to see Stassano's furnace at Turin in operation, as it was out of repair at the time of his visit, but he gives a description of the furnace and prints an account of the process written by the inventor. The newer forms of furnace are inclined about 7° from the vertical and rotate slowly round this inclined axis, with a view to stirring up the charge and allowing the heat of the arc to act more freely on the ore. Sometimes three electrodes are used, with three-phase current, and sometimes four electrodes are employed. Stassano gives the following particulars with regard to a furnace of 1,000 H. P. The cost of furnace is $5,000, the output per day is 4 or 5 tons, a current of 4,500 amperes at 150 volts is distributed to four electrodes (2,450 amperes to each electrode). The electrodes are 6" in diameter and 4'-0" or 5'-0" long. A five foot electrode weighs 130 lbs. and costs 3 cents a lb. The consumption of electrodes is 22 to 33 lbs. per ton of product, that is 70 cents to $1 per ton of steel. The lining is of magnesite bricks, and two days are required for repairing the furnace. The lining will last at least 40 days. One man is needed per furnace to regulate the arc; one man for charging two furnaces, and five men for tapping six furnaces. Taking the above figures of 1,000 E.H.P. days for 4 or 5 tons of iron or steel, each ton would need 0.55 to 0.69 horse-power years for its production. Dr. Goldschmidt * investigated the process in 1903 on behalf of the German patent office (Electrochemical Industry, Vol. I., p. 162), and found that it was technically successful, making workably ductile iron with less than 0.2% of carbon directly from pure Italian ores. The power used was 0.43 to 0.46 horse-power years per metric ton of iron. The process was reported as too expensive to compete with existing methods in Germany.

Comparing the direct process of Stassano with the more usual process of smelting first to pig iron, and then refining the iron and making steel, it will be seen that the electrical power needed to smelt ore directly to steel in the Stassano

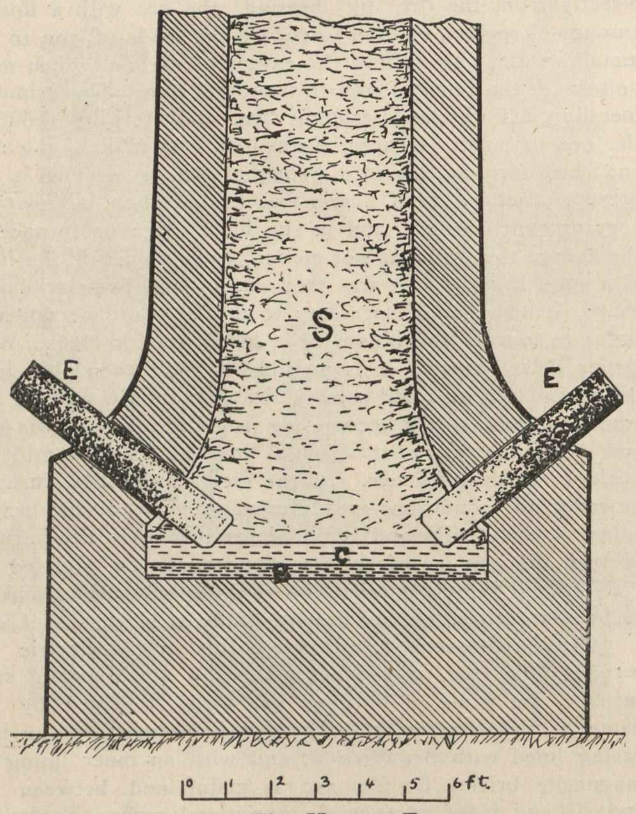

Fig. 29.—The Harmet Furnace.

furnace is about equal to the sum of the power needed for the other two processes, and that his process was used with pure ores; while the indirect method allows of the use of any kind of iron ore. The Stassano furnace is intermittent in action, as each charge of ore must be reduced and melted and tapped before a fresh one can be introduced. Moreover the economy of heat is poor because the heat of the escaping gases is not utilized, and these must escape at a very high temperature, and their chemical energy is not utilized, as it might be, for the reduction or preheating of the ore.

The shaft furnace must always be more efficient than a furnace like Stassano's; but if it were found possible to produce good structural steel from impure ores, in an electric furnace of this type, there might be some hope of its commercial success under favorable geographical conditions. In the blast furnace, the sulphur in the pig iron increases in amount as the proportion of fuel is reduced, because the temperature is lower and the removal of sulphur, as calcium sulphide in the slag does not take place so freely. In the electric furnace smelting for steel there would be far less carbon, which is one factor in the removal of the sulphur as calcium sulphide, but the temperature of the furnace can be higher, and the slag can be made more strongly basic, by larger additions of limestone, so that it may be possible to remove the sulphur while smelting directly to steel. On the other hand, phosphorus is not removed at all in the blast furnace, but in an electric shaft furnace, using a very basic slag and allowing some of the iron to pass into the slag, it might be possible to remove both the sulphur and the phosphorus. If this could be effected, it would be possible to tap steel for rails or structural work directly from the electric shaft furnace, at a cost which would probably be low for such materials, but it would most likely be better, and perhaps the only possible way, to tap the metal into some form of electric open-hearth furnace in which it could be held until analyses had been made, and the composition adjusted to the needs of the occasion. It is obvious that the lining of a shaft furnace for smelting to nearly carbon-free iron, would need to be made of some basic material like magnesite, as the very hot slag, carrying ferrous oxide, would have a severe scouring action on the lining of an ordinary blast furnace. The success of such a method depends, however, upon the possibility of removing both the phosphorus and the sulphur in an electrically smelting shaft furnace, producing a nearly carbon-free iron, and this has not yet been accomplished. Phosphorus can certainly be removed in an electric open-hearth furnace, such as Héroult's steel furnace, and Dr. Haanel's recent experiments have shown that sulphur can be very effectively removed when making pig iron in a shaft furnace. Capt. Stassano removed a good proportion of the phosphorous and a small proportion of the sulphur in his furnace, and obtained a satisfactory product, but he worked with nearly pure materials, and, therefore, his work does not show whether the joint removal of the two impurities is possible.

At present the most satisfactory process for making steel electrically from iron ore, is to smelt electrically to pig iron in a shaft furnace, thus eliminating the sulphur, transfer the molten pig to an electric open-hearth furnace and there remove the excess of carbon, silicon, etc., and the phosphorus. If the shaft furnace could produce a nearly pure iron directly, so that the second furnace would be little more than a ladle for adjusting the composition, a decided economy should be effected. A combination of electric shaft furnace for making pig iron, and electric refining furnace for converting this into steel has been described by Keller. (Electro-chemical Industry, Vol. 1., 1903, and Journal of Iron and Steel Institute, 1903, Vol. I., p. 161.)

In smelting iron ores to obtain a low carbon product, the carbon electrodes, if in contact with the slag or melting ore, will be liable to more rapid corrosion than when smelting for pig iron; on account of the scarcity of carbon in the charge. This difficulty, if it were found to be serious, might be overcome by the use of a furnace like that of De Laval (Fig. 18, p. 216), in which the reduced and melted metal, collecting in two troughs, serves as the electrodes; electrical contact being made with the molten metal by solid rods of the same material. Another plan for avoiding the use of carbon electrodes, is to employ the induction principle. A furnace of this kind has recently been patented by F. T. Snyder. The cost of producing low carbon steel direct from pure Italian ore. In the Stassano furnace has been estimated by Dr. Goldschmidt, who sets the cost of a ton of such steel at $18.80. The furnace does not utilize the heat of the current very perfectly, and with improved furnaces and better conditions for the purchase of general supplies, a lower figure might be expected.

* Electro-chemical Industry, Vol. I., 1903, p. 247.

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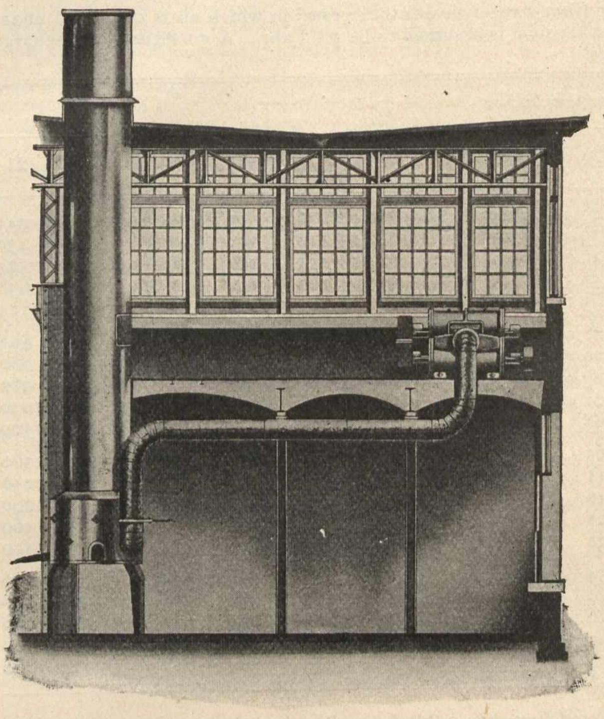
The following is given on the authority of the General Electric Company. Prices in the electrical trade continue to show a distinct upward tendency, in sympathy with the well maintained advance which has taken place in the prices of all raw materials. Orders for future delivery can only be placed in many instances at a considerable advance over present market quotations. The General Electric Company, in common with many other large manufacturing concerns, is announcing a general advance in prices of electrical apparatus and supplies. This will not unlikely be followed by further advances if present market conditions continue.

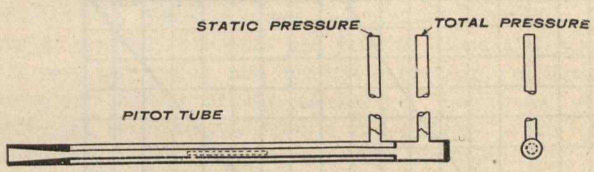
MEASUREMENT OF VOLUME, PRESSURE AND HORSE POWER AT PRESSURES OF ONE TO TEN LBS. PER SQUARE INCH.

Velocity.—The volume of air discharged from an orifice or pipe is, theoretically, equal to the product of the velocity of the air flowing and the area of the orifice. Hence for the



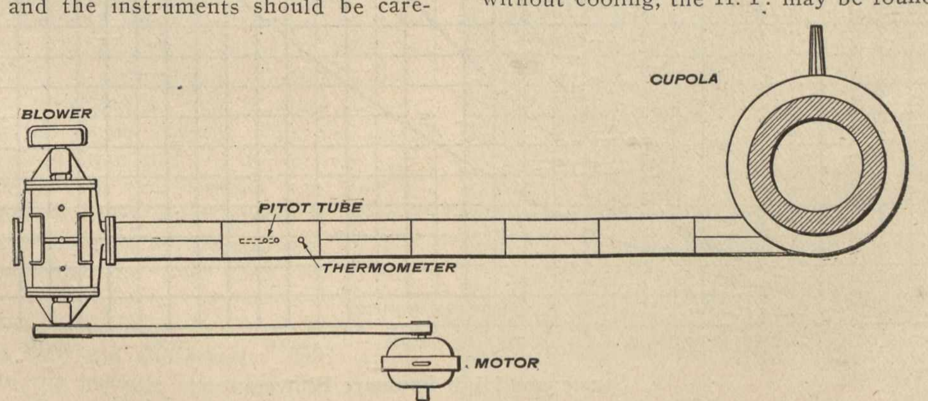
Blower Connection to Foundry Cupola.

calculation of volume, the velocity is an important factor. To determine the velocity, the Pitot tube is commonly used as shown in the accompanying illustration. It should be inserted in the centre of a straight run of blast pipe within about ten feet of the blower. One part of the Pitot tube transmits the total pressure, which is the sum of the static



pressure and the velocity pressure. The other part, in communication with the slots shown above, transmits the static pressure. Evidently the difference is the velocity pressure. Each is connected to a water gauge which should show magnified readings so that the difference may be accurately determined.

Accuracy.—Great care should be exercised in measuring the velocity pressure, and the instruments should be carefully calibrated. In the ordinary blast pipe for conducting air from the blower to the cupola or furnace, the velocity should not exceed two or three thousand feet per minute. As this velocity corresponds to a pressure of only about 0.4" of water, the measurement requires care, but with good instruments the readings will be accurate enough for all practical purposes.



Volume.—The velocity pressure being known, the volume of free air passing through the pipe may be determined from the following formula:—

$$V = av = \frac{60 ac P_1}{P}\sqrt{\frac{2gp}{d}},$$

in which $V =$ the volume of free air in cubic feet per minute.

$c =$ coefficient of Pitot tube, which should be determined for each tube;

$a =$ area of the pipe in square feet,

$v =$ velocity in feet per minute,

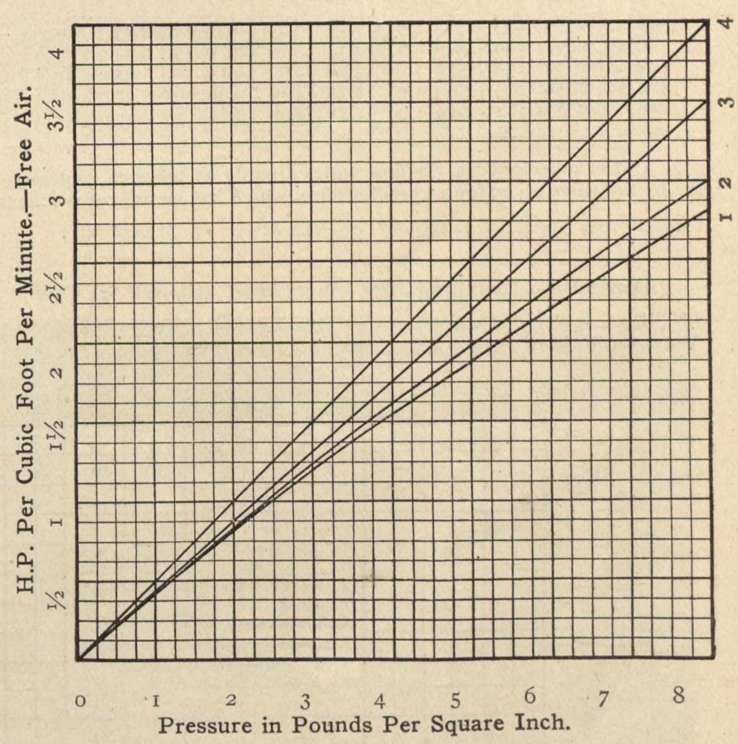
$2g = 64{,}32$,

$p =$ velocity pressure in pounds per square foot; p is the difference between the two pressures observed on the Pitot tube,

$d =$ density or weight per cubic foot of air at pressure, temperature, and humidity at point of observation,

$P_1 =$ absolute pressure of air in the pipe in pounds per square foot,

$P =$ atmospheric pressure in pounds per square foot.



Horse-power.—Assuming that the air is compressed without cooling, the H. P. may be found from the following:

$$\text{Horse power} = \frac{VP\left[\left(\frac{P_1}{P}\right)^{\frac{1}{3}} - 1\right]}{11{,}000}$$

in which $V =$ volume of free air in cubic feet per minute, as found above,

P = pressure of the atmosphere or suction pressure (absolute) in pounds per square foot,

P_1 = pressure of compression (absolute) in pounds per square foot.

Formula No. 1 gives the H. P. required when the air is cooled during compression as in the ordinary air compressor.

Formula No. 2, which has been explained, is used when

FLOW OF AIR THROUGH ORIFICES

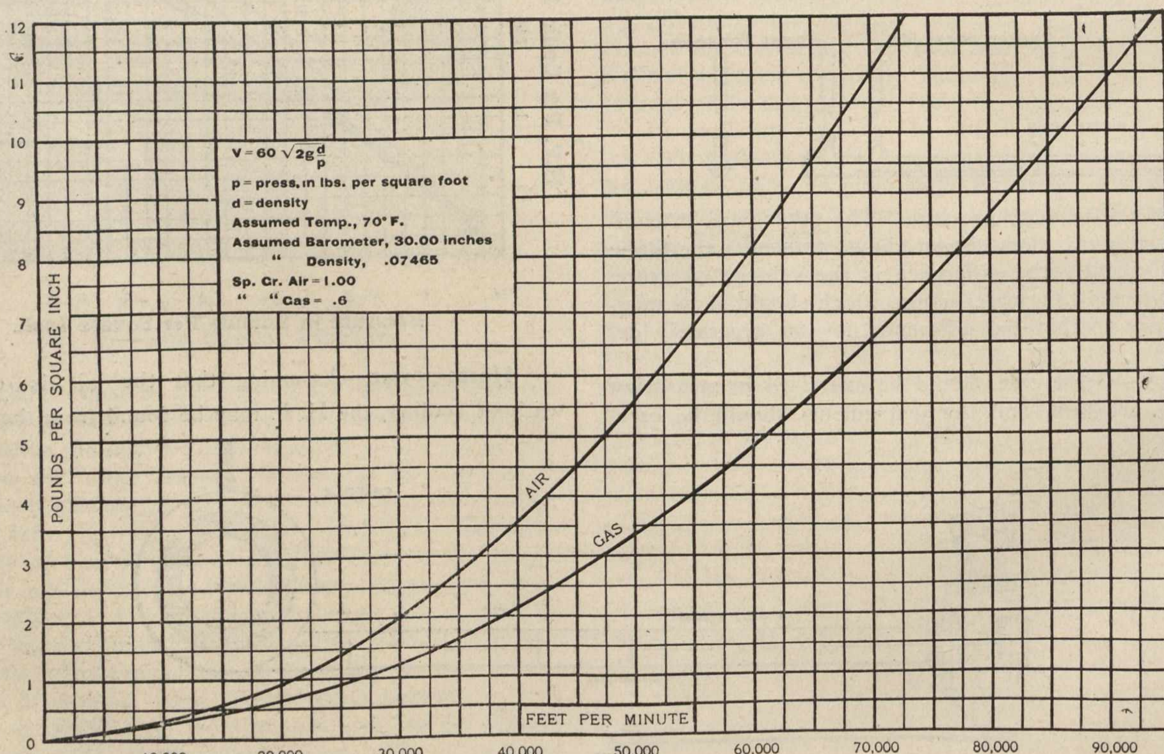
Flow is expressed in cubic feet per minute, and is assumed to take place from a receiver or other vessel in which air is contained under pressure into the atmosphere at sea level (29.92" Bar.) Temperature of air in receiver is assumed to be 50° Fahr. A coefficient of discharge of .60 was used, which is approximately correct for orifices with narrow edges.

Gauge Pres. in Receiver. Lbs. per Sq. In.	Diameter of Orifice in Inches																			
	1/64	1/32	3/64	1/16	3/32	1/8	3/16	1/4	3/8	1/2	5/8	3/4	7/8	1	1 1/8	1 1/4	1 3/8	1 1/2	1 3/4	2	2 1/2
1/2	.0118	.0478	.106	.190	.428	.763	1.73	3.45	6.86	12.2	19.0	27.4	37.4	48.8	62.0	76.3	92.2	110	150	195	345
1	0170	.0686	.154	.274	.615	1.10	2.48	4.37	9.84	17.5	28.6	39.4	53.6	70.	89.1	110	132	157	214	280	437
1 1/2	0211	0855	.192	.340	.775	1.36	3.09	5.44	1.23	21.7	34.0	49.0	66.6	87.	111	135	164	196	266	348	545
2	0247	.100	225	.399	.896	1.60	3.61	6.37	14.4	25.5	39.8	57.5	78.1	103	130	160	193	233	312	409	638
2 1/2	.0280	.114	.255	.453	1.02	1 81	4.06	7.23	16.3	29.0	45.3	65.1	88.7	116	147	181	218	260	355	463	723
3	0311	.126	.283	501	1.13	2 01	4.54	8.03	18.1	32.1	50.1	72.3	98.1	128	163	201	243	289	393	514	803
3 1/2	.0341	.138	310	.550	1.23	2.20	5.00	8.80	19.8	35 2	55.1	79.3	108	141	179	220	266	317	431	564	880
4	0370	.150	336	.596	1.34	2.38	5.40	9.55	21.4	38.3	59.6	86.0	118	153	194	239	289	344	469	612	960
4 1/2	0397	.161	.360	.642	1.44	2.56	5.81	10.3	23 0	41 0	64.0	92.4	126	164	209	256	310	369	503	656	1030
5	.0423	.171	.386	.685	1.54	2.74	6.20	10.9	24.6	43.8	68.4	98.5	134	176	223	274	330	394	536	700	1100
5 1/2	.0450	.184	.410	.727	1.63	2.90	6.58	11.6	26.1	46.5	72.6	105	143	186	236	290	351	418	570	744	1160
6	.0478	.194	.435	.770	1.74	3.08	6.99	12.4	27.7	49.4	77.1	111	151	198	251	308	374	444	605	790	1230
6 1/2	.0501	202	.455	.808	1.82	3.23	7.31	12 9	29 1	51.7	80.7	116	158	207	264	322	390	464	634	827	1290
7	.0538	213	.479	.849	1 91	3.40	7.70	13.6	30.6	54.4	84 9	121	166	217	276	340	411	490	666	870	1360
7 1/2	.0552	.224	503	.890	2.00	3.56	8.07	14.2	32 1	57.0	89.0	128	175	227	290	356	431	512	698	911	1420
8	.0574	233	.523	.925	2.08	3.70	8.39	14.9	33.3	59.3	92.5	134	182	238	302	372	448	535	726	949	1490
8 1/2	.0601	.244	.546	.970	2.17	3.86	8.78	15.5	34.9	62.1	96.8	139	190	248	316	389	468	558	761	994	1560
9	.0634	.255	.570	1.01	2 26	4.02	9.15	16.1	35.4	65.1	101	146	197	260	331	407	489	585	795	1040	1630
9 1/2	.0659	.265	590	1.05	2.35	4.16	9.48	16.6	37.8	67.1	105	152	205	271	344	424	507	607	826	1080	1700
10	0686	.274	609	1.09	2 42	4.28	9.78	17 1	39 0	69 4	109	157	212	281	358	439	526	628	859	1120	1760

For other orifices, the flow varies directly as the area, and may be computed from the table by multiplying the area in square inches by the value given for a $1\frac{1}{8}$-inch orifice, which has an area of one square inch.

Formulas.—Including the preceding, there are four formulas sometimes used in computing the power required. Values obtained from these formulas have been placed in the

it may be assumed that the air is compressed so quickly that it does not have time to cool the atmospheric temperature as in nearly all blower work.



Sturtevant High Pressure Blowers.

form of curves and are shown in the accompanying engraving.

(1) $\text{H.P.} = \dfrac{VP\,e\left(\frac{P_1}{P}\right)}{33000}$ (2) $\text{H.P.} = \dfrac{VP\left[\left(\frac{P_1}{P}\right)^{\frac{1}{3}}-1\right]}{11000}$

(3) $\text{H.P.} = \dfrac{V(P_1-P)}{33000}$ (4) $\text{H.P.} = \dfrac{\text{lbs. per sq. in.} \times V}{200}$

Formula No. 3, the ordinary "hydraulic" formula, is ordinarily used for pressures up to 5 ounces.

Formula No. 4 is frequently used by other makers of positive or rotary blowers, for determining the H.P. required for operating their machines. In this formula V = the volume of air displaced by the impellers, no allowance being made for slippage.

WEIGHT PER CUBIC FOOT OF DRY AIR UNDER DIFFERENT PRESSURES AND TEMPERATURES

ATMOSPHERIC PRESSURE IN TABLE = 29.92 INCHES OF MERCURY

Temp. °F.	Vacuum in Inches of Mercury					Pressure above Atmosphere in Pounds per Square Inch																			Temp. °F.
	10	8	6	4	2	0	.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0	5.5	6.0	6.5	7.0	7.5	8.0	9.0	10.0	
-20	.0602	.0662	.0722	.0782	.0844	.0904	.0934	.0965	.0995	.1026	.1056	.1087	.1117	.1148	.1178	.1209	.1239	.1270	.1300	.1331	.1361	.1392	.1453	.1514	-20
-10	.0589	.0648	.0707	.0766	.0825	.0884	.0914	.0944	.0974	.1004	.1034	.1064	.1094	.1124	.1154	.1184	.1213	.1243	.1273	.1303	.1333	.1363	.1423	.1482	-10
0	.0576	.0634	.0691	.0749	.0806	.0864	.0893	.0923	.0952	.0982	.1011	.1041	.1070	.1100	.1130	.1159	.1189	.1218	.1248	.1277	.1306	.1335	.1393	.1451	0
10	.0564	.0620	.0677	.0733	.0789	.0846	.0875	.0903	.0932	.0961	.0989	[illegible]	.1047	.1075	.1103	.1132	.1160	.1188	.1217	.1246	.1275	.1304	.1362	.1420	10
20	.0552	.0607	.0663	.0718	.0773	.0829	.0857	.0885	.0913	.0941	0969	.0997	.1025	.1053	.1081	.1109	.1137	.1165	.1193	.1221	.1249	.1277	.1333	.1390	20
30	.0541	.0595	.0649	.0703	.0758	.0812	.0839	.0867	.0894	.0922	.0949	.0977	.1004	.1032	.1059	.1086	.1113	.1140	.1167	.1195	.1223	.1250	.1305	.1362	30
40	.0529	.0582	.0636	.0689	.0742	.0796	.0823	.0850	.0877	.0904	.0931	.0958	.0985	.1012	.1039	.1066	.1093	.1120	.1147	.1174	.1201	.1228	.1282	.1336	40
50	.0518	.0570	.0623	.0675	.0727	.0779	.0806	.0833	0859	.0886	.0912	.0939	.0966	.0993	.1020	.1047	.1074	.1101	.1128	.1155	.1182	.1209	.1263	.1318	50
60	.0509	.0560	.0611	.0662	.0713	.0765	.0790	.0816	.0842	.0868	.0894	.0920	.0946	.0972	.0997	.1023	.1049	.1075	.1101	.1127	.1153	.1179	.1231	.1283	60
70	.0500	.0550	.0600	.0650	0700	.0751	.0776	.0802	0827	.0853	.0878	.0893	.0919	.0944	.0969	.1004	.1029	.1055	.1080	.1106	.1131	.1157	.1208	.1259	70
80	.0491	.0540	.0589	.0638	.0687	.0737	.0761	.0785	.0810	.0835	.0860	.0885	.0910	.0935	.0960	.0985	.1010	.1035	.1060	.1085	.1110	.1135	.1185	.1236	80
90	.0482	.0530	.0578	.0626	.0674	.0723	.0747	.0772	.0796	.0821	.0845	.0870	.0895	.0920	.0944	.0969	.0993	.1017	.1041	.1065	.1089	.1113	.1163	.1212	90
100	.0473	.0521	.0568	.0615	.0662	.0710	.0733	.0757	.0781	.0805	.0829	.0853	.0877	.0901	.0925	.0949	.0973	.0997	.1021	.1045	.1069	.1093	.1141	.1190	100
110	.0465	.0511	.0557	.0604	.0650	.0697	.0720	.0744	.0767	.0791	.0814	.0838	.0861	.0885	.0908	.0932	.0955	.0978	.1001	.1025	.1049	.1073	.1121	.1169	110
120	.0458	.0503	.0548	.0593	.0638	.0684	.0707	.0730	.0753	.0776	.0799	.0822	.0845	.0868	.0891	.0915	.0938	.0962	.0985	.1009	1034	.1057	.1103	.1149	120
130	.0449	.0493	.0538	.0583	.0628	.0673	.0695	.0718	.0741	.0764	.0787	.0810	.0833	.0856	.0878	.0900	.0923	.0946	.0969	.1992	.1015	.1038	.1084	.1130	130
140	.0441	.0485	.0529	.0573	.0617	.0662	.0684	.0707	.0729	.0752	.0774	.0797	.0819	.0842	.0864	.0886	.0908	.0931	.0953	.0976	.0998	.1021	.1066	.1111	140
150	.0433	.0476	.0519	.0562	.0606	.0650	.0672	.0694	.0716	.0738	.0761	.0783	.0805	.0827	.0849	.0872	.0894	.0916	.0938	.0960	.0982	.1004	.1048	.1092	150
160	.0426	.0468	.0511	.0554	.0597	.0640	.0660	.0680	.0701	.0722	.0743	.0764	.0785	.0806	.0827	.0858	.0880	.0901	.0923	.0944	.0966	.0987	.1030	.1074	160
170	.0419	.0461	.0503	.0545	.0587	.0630	.0651	.0673	.0694	.0716	.0737	.0759	.0780	.0802	.0823	.0844	.0865	.0886	.0907	.0929	0950	.0972	.1014	.1057	170
180	.0412	.0453	.0494	.0536	.0578	.0620	.0641	.0662	.0683	.0704	.0725	.0746	.0767	.0788	.0809	.0830	0851	.0872	.0893	.0914	.0935	.0956	.0998	.1041	180
190	.0406	.0446	.0487	.0528	.0569	.0610	.0630	.0650	.0670	.0691	.0712	.0733	.0754	.0775	.0796	.0817	.0837	.0857	.0878	.0899	.0920	.0941	.0983	.1025	190
200	.0400	.0440	.0480	.0520	.0560	.0601	.0621	.0642	.0662	.0683	.0703	.0724	.0744	.0765	.0785	.0805	.0825	.0846	.0866	.0887	.0907	.0928	.0969	.1010	200
250	.0370	.0407	.0445	.0483	.0511	.0559	.0578	.0597	.0616	.0635	.0654	0673	.0692	.0711	.0720	.0749	.0767	.0786	.0805	.0824	.0843	.0862	0900	.0938	250
300	.0344	.0379	.0414	.0450	0486	.0522	.0539	.0556	.0574	.0592	.0610	.0628	.0646	.0664	.0682	.0700	.0717	.0734	.0752	.0770	.0788	.0806	.0842	.0878	300
350	.0325	.0358	.0391	.0424	.0457	.0490	.0506	.0522	.0538	.0555	.0572	.0589	.0606	.0623	.0640	.0657	.0674	.0690	.0707	.0723	.0740	.0756	.0789	.0823	350
400	.0308	.0338	.0368	.0399	.0430	.0461	.0476	.0491	.0506	.0522	.0538	.0554	.0570	.0596	.0612	.0618	.0634	.0649	.0665	.0680	.0696	.0711	.0743	.0774	400
450	.0291	.0320	.0349	.0378	.0407	.0436	.0450	.0465	.0479	.0494	.0508	.0523	.0537	.0552	.0566	.0580	.0595	.0610	.0626	.0641	.0656	0671	.0701	.0732	450
500	.0275	.0302	.0329	.0357	0385	.0413	.0427	.0441	.0455	.0469	.0483	.0497	.0511	.0525	.0539	.0553	.0567	.0581	.0595	.0609	.0623	.0637	0665	.0694	500
550	.0262	.0288	.0314	.0340	.0366	0393	.0406	.0419	.0432	.0445	.0458	.0471	.0485	0499	.0513	0526	.0539	.0554	.0567	.0581	.0594	.0607	.0633	.0660	550
600	.0250	.0274	.0299	.0324	.0349	.0374	.0386	.0398	.0410	.0423	.0436	.0449	.0462	.0475	.0488	.0501	.0513	.0525	.0538	.0551	.0564	.0577	.0603	.0629	600

COIN-COUNTING AND WRAPPING MACHINE.

We have been favored by Mr. Edward Van Winkle, Flat Iron Building, Madison Square, New York, with particulars of a unique machine for the rapid, accurate counting and wrapping of coins, invented by C. S. Batdorf: which is destined to rank as a labor-saving device in the business world with the typewriter and calculating machine. The history of previous attempts and failures along this special line is very interesting and profitable reading; as also, is the detailed account of the mechanical operations which result in the accurate registration and delivery of the coins in strongly-wrapped parcels—all done automatically, and withal in a very simple manner.

A complete outfit for the counting and wrapping of coin consists of a coin sorter, and five machines, each adjusted to count and wrap pennies, nickels, coppers, five-cent pieces, dimes, quarters and half dollars respectively. All machines are identical, with the exception of the coin conduit, indicator, paper feed rolls and the driving coin rolls.

Each machine counts and wraps at the rate of seven coins a second, or four hundred and twenty coins (8 to 12 bundles) in one minute. The immense saving of labor is at once realized by making a comparison to hand labor, which can as a maximum, providing no error in count occurs, count and wrap only one bundle per minute. This machine, therefore, will do the work of from eight to twelve men with hand labor, without taking into consideration the loss in time if a miscount is found. The above speed is limited only by the examination of the coin by the operator, as they are fed into the machine from the table upon which they were first deposited.

Experience has proved that three hundred coins examined per minute is a safe and conservative limit which should be expected from the average operator.

It does not require any special knowledge of machinery to operate the machine; a small boy can run it as well as an adult.

The machine is operated by an electric motor of the General Electric type, and since it consumes but 3-10ths of an ampere at 110 volts, it is easily attachable to any standard light socket by means of a connection plug. It is started and stopped by the turn of a button switch.

The length of the package is determined by the thickness of the coin, which varies considerably. The crimp is always brought up tight to the coins by the crimpers, which

Fig. 1.—Coin-counting and Wrapping Machine.

are drawn together by means of a right and left-hand screw. When the crimp is complete the cartridge is thrown out of the machine into a box, which is detachable, and may be filed away in a safe or vault, thus minimizing the labor in handling the coins. The package of coin when shot out of the machine is so securely wrapped, that not one coin can be extracted without destroying the entire package, thus making it impossible to cheat the machine.

The length of the longest wrapper is 7¾ inches, and is 2⅜ inches wide. This size is used to wrap twenty-five cent pieces. The length of the shortest wrapper is 4⅜ inches long, and is 2⅞ wide, and used for fifty ten cent pieces. The economy of paper is only realized when one tries to wrap the coins by hand in a wrapper automatically cut off by the machine.

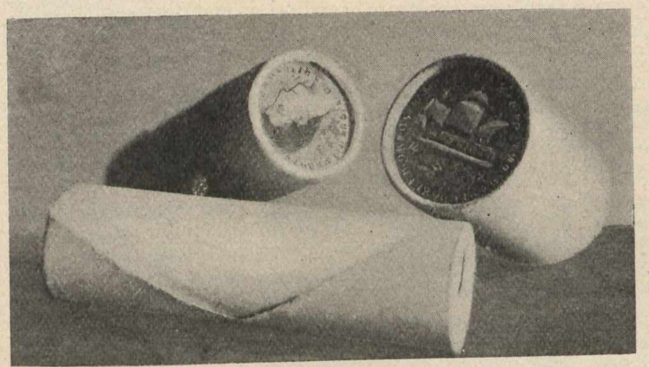


Fig. 2.—Machine-wrapped Coins.

With the coin exposed at each end of the package it is not necessary to print the value of the coin on the wrapper. However, when required, the printing can be done before the paper is put into the machine. Each wrapper, in length, is equal to twice the circumference of the coin which it wraps, and the printing is spaced a distance equal to half the length of the wrappers from one end of the paper to the other; thus, it matters not where the wrapper is cut off the roll of paper, as only one printing is visible on the package.

In large banking institutions and industrial establishments of magnitude, where large quantities of coin are handled, these machines should be of great utility.

MODEL ELECTRIC LIGHT AND POWER PLANT, RECENTLY INSTALLED AT WELLINGTON, ONTARIO.

Designed by J. Stanley Richmond, Consulting Engineer.

The building, illustrated below, encloses what may conservatively be described as the most unique small electric light and power plant in the Dominion. It is a valuable object-lesson for the lesser municipalities in Western Ontario, now so eager for cheap power. The plant is located in the incorporated village of Wellington, Prince Edward County—

a pleasant summer resort on the northern shore of Lake Ontario, with a winter population of about 800—and is owned by W. P. Niles; to whom every credit is due for the inception and financing of this unique provincial enterprise.

General Arrangement of Plant.

The power-house is approximately 70 x 33 feet, the composite walls containing 6 inches of concrete, a two-inch air space and an outer layer of brick, the latter being made from sand procured from the famous sand-hills near Wellington, mixed with one-tenth its weight of cement and air-dried. The plant is designed for two 65-H.P. units, one of which is now installed. The building is capable of accommodating 4 units electrically, = a total of 260-H.P.; but mechanically = to 2 units or a total of 130-H.P. When, therefore, it is found necessary to increase up to 260-H.P. mechanically and electrically combined, a slight addition to the building will be required. The source of power is not "white coal," but black coal, development being by means of a Fairbanks-Morse suction gas-producer set, Fairbanks-Morse gas-engine, and three-wire Westinghouse generator. The electrical plant is such that, with the present and any future equipment, electrical power can be supplied direct to factory motors, street railway motors, or arc lamps and incandescent lights from any one or more of the generators. In this respect, it is the only plant in existence where, besides the full facilities mentioned above, the incandescent lights are run two in series. This principle which entails only ¼ of the capital costs for copper, was developed by Mr. Richmond in large buildings years ago, but he has not had an opportunity of applying it to a public supply plant until this installation at Wellington was undertaken.

Application and Cost of Power.

At the present time the power-house has a full motor load at one of the factories, the rate being $20 per 10-hour H.P. per year. Mr. Niles has also made a five-year contract with the village council for 18 arc lamps at a lump sum charge of $530 per annuu. Stores pay one-half cent per light per night for incandescent lights, while residences pay for those incandescent lights, which are more or less constantly used, a similar rate, and one-sixth of a cent per light per night for those which are used at intervals.

Although the plant has just only been started, about 700 incandescent lights are already installed, with requisitions for about 200 more; while the prospect is that the second unit of 65-H.P. will soon have to be installed. It is interesting to know that the capital cost of the plant with one unit, gives fixed and operating costs which are balanced by revenue resulting from present contracts. And the installation of the second unit will only increase the capital cost 33%, although the capacity of the plant will be doubled; when the return to the owner will give a satisfactory income over and above all costs, fixed and operating.

This Wellington plant, in so far as apparatus is concerned, is essentially similar to the suction gas producer power plant at Berlin, Ontario, although the details of the system are altogether different; while the capital cost per H.P. of the Wellington plant is only one-quarter to one-third that of the total capital cost per H.P. of plant which has been sunk in the Berlin installation up to date.

A special feature about this plant is the absence of smoke, although coal is used. This is due to the fact, that in the suction gas producer system the elements of combustion are all consumed and transformed into potential energy. Note the size of the smoke stack projecting through the roof. Editor.

RAILWAY TELEPHONES.

Up to the present time a telephone system for the dispatching of trains has been considered very expensive, although it is recognized as a most efficient instrument for that line of work. The equipment of a road with a telephone system until recently has necessitated the construction of phone stations at frequent intervals, and the installation of telephones to be kept under lock and key. Each conductor has had to leave his car to get to the phone station, and much valuable time has been lost in this way. Then, again, the wooden structures protecting the instruments are often destroyed, by fire, or storms, and frequent repairs are required, owing to the action of the elements, etc.

A practical telephone man, George H. Metheany, from the interurban district of Ohio, has invented and obtained broad patents on the Lima jack box, for use in steam and electric train dispatching. This jack box enables the train crew to obtain instant connection with the dispatcher without the delay of lock and key and without leaving the car.

Fig. 1 shows the Lima jack box ready for instant use within convenient reach of the car. Fig. 2 shows the ease of "plugging-in" for connection to portable telephone. Fig. 3 shows the parts of the Lima jack box grouped in the order they are assembled. It will be noticed that the spring-jack holder is completely insulated from the outside casing. The spring jacks are made especially heavy, and are mounted on a fibre block. The conections pass through mica bushings, and are soldered to the weather-proof wire on the back of the spring-jack holder. As a still further precaution the jack plug is equipped with a fuse which will blow if a

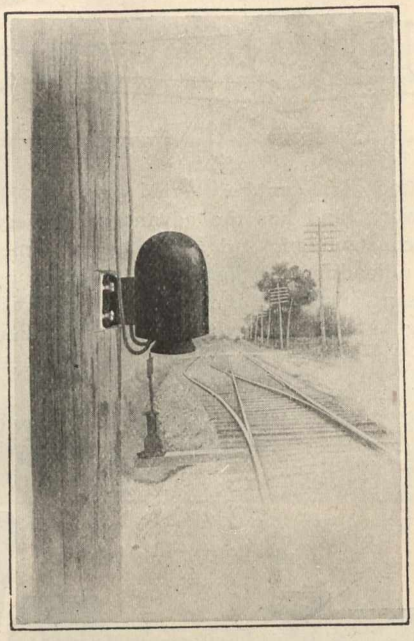


Fig. 1.—Lima Jack Box ready for use.

high voltage were to get through, thus protecting the conductor and his telephone from accident. The plugs have long handles, and are so constructed as to leave no metal parts exposed or uninsulated in the jack box.

There is absolutely no chance of a short circuit or ground. The lock washer shown at the bottom of Fig. 3 securely holds the spring-jack holder in the casing, and cannot be removed without special tools. This prevents the possibility of irresponsible persons tampering with the inside of the box.

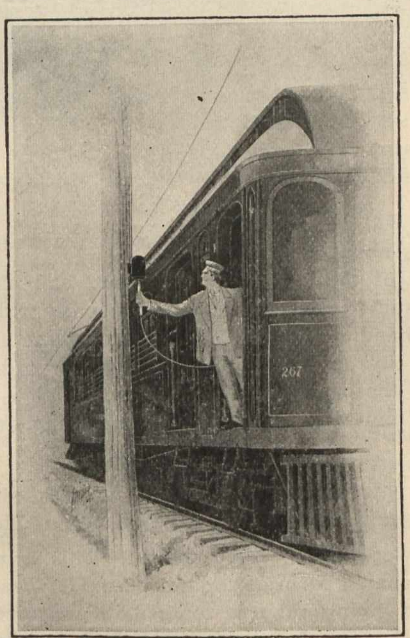


Fig. 2.—Conductor "Plugging In."

Figs. 4 and 5 show a cross-section of the Lima jack box and the way the parts look when assembled. Fig. 4 shows the plug engaged and ready for conversation, the metal ball being displaced. Fig. 5 shows the plug being withdrawn and the manner in which the ball drops back into the opening and closes it perfectly against the entrance of dust, moisture and insects. The cone-shaped mouth of the plug opening guides the plug instantly to its position. This cone-shaped mouth in conjunction with the outer cast-iron shell of the receptacle forms a double petticoat, which effectually shuts off rain, sleet and snow.

The Lima jack box has been in constant use on the lines of the Fort Wayne, Van Wert and Lima Railway Company

Fig. 3.—Parts of Lima Jack Box.

for over a year and a half. One is installed every half mile, so that the crews do not have to go more than a quarter of a mile at any time to obtain instant communication with the dispatcher's office. The boxes are also installed throughout the lines of the Muncie and Portland Traction Company and several others.

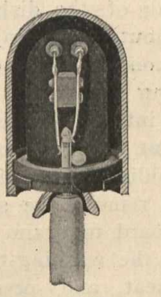


Fig. 4.—Plug Engaged.

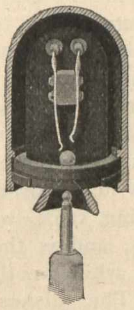


Fig. 5.—Plug being withdrawn.

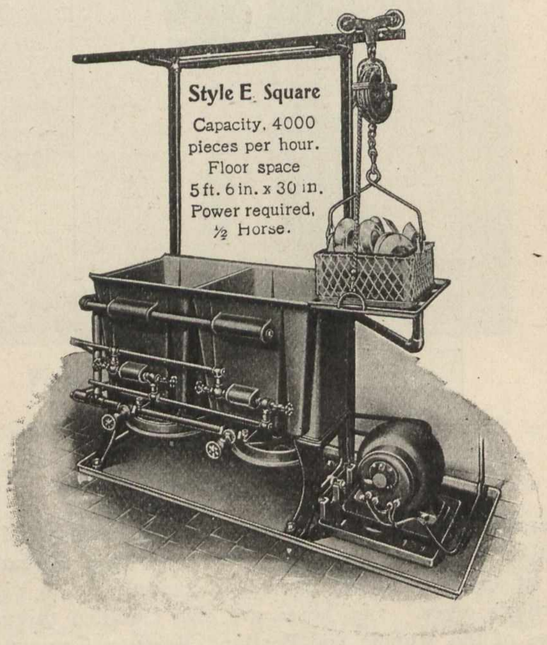
The patents and rights of manufacture of the Lima jack box and plug have recently been purchased by W. N. Matthews & Bro., 203 North Second Street, St. Louis.

THE "VORTEX" DISH-WASHING MACHINE.

The machine illustrated is a remarkable example of the adaptation of means to ends. It is a veritable boon to the modern caterer, and a wonderful labor-saver in all institutions where culinary operations on a large scale are performed. It is a signal triumph of the modern engineer, and destined to be as widely useful as the sewing machine. The "Vortex" machine is the result of fifteen years' experimentation up against chemical and mechanical difficulties, which seemed at the outset almost incapable of solution. The difficulties indicated have all been overcome by the careful selection of metals capable of resisting the destructive influences of oxidation, grinding, galvanic action, etc. In fact, the "Vortex" machine evidences a thorough knowledge of requirements, gained only by long experience, and the result is, that the washing of dishes by this machine is not only a mechanical triumph, but has also converted what was formerly a drudgery into a task that is much more agreeable than many other kinds of domestic manual labor.

The washing action of the "Vortex" is secured by the rapid revolution of a peculiarly shaped propeller (in the bottom of the washing tank) by which the water is sucked down through a circular opening, and then forced outward and upward between an inside shell and the insides of the tank, to be deflected on top of the dishes, and again drawn down through them by the suction of the propeller.

The down-wash scouring action is an ideal one, as there is no dead body of water to obstruct. All the water is in constant, equal and harmonious motion, and, as both the weight of the dishes and the scouring force are in the same



The "Vortex" Dish-washing Machine.

direction (i.e., down), there is no shaking of the dishes—the lightest chinaware can be washed without fear of injury. The dishes are placed in wire baskets, containing wooden interiors, which prevent them from coming in contact with the metal. The basket is first lowered into the washing-tank and allowed to remain there for about twenty seconds. It is next raised and lowered into the scalding water of the rinsing tank, where a couple of plunges remove the soap-suds, and is then left on the draining board to drain and dry, while another basket is lowered into the washing-tank.

The dishes dry from their own heat, and present, without the use of towels, a polish which it is difficult, if not impossible, to attain by hand-work. It is also worthy of mention, that the dishes washed in the machine are hygienically cleaned and thoroughly deodorized; the first, because (it not being necessary for the hands to come in contact with the washing water) strong alkalies can be used to neutralize all animal fats, etc., and the second, because the plunge into the scalding water of the rinsing-tank takes away every taint, another result difficult to attain by hand-work.

This is, indeed, a notable invention, and, apart from its utility, is worthy of investigation by engineers generally, if only for its value under the law of association of ideas.

We are indebted for the above illustration and data to the Hamilton-Low Co., 145 East 42nd Street, New York.

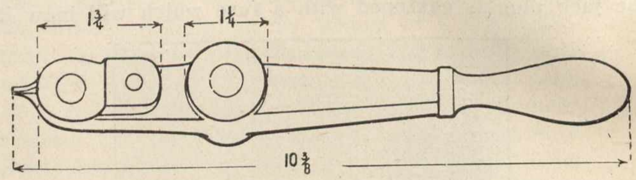
MACHINE SHOP NOTES FROM THE STATES.

By Charles S. Gingrich, M.E.

XXXI.

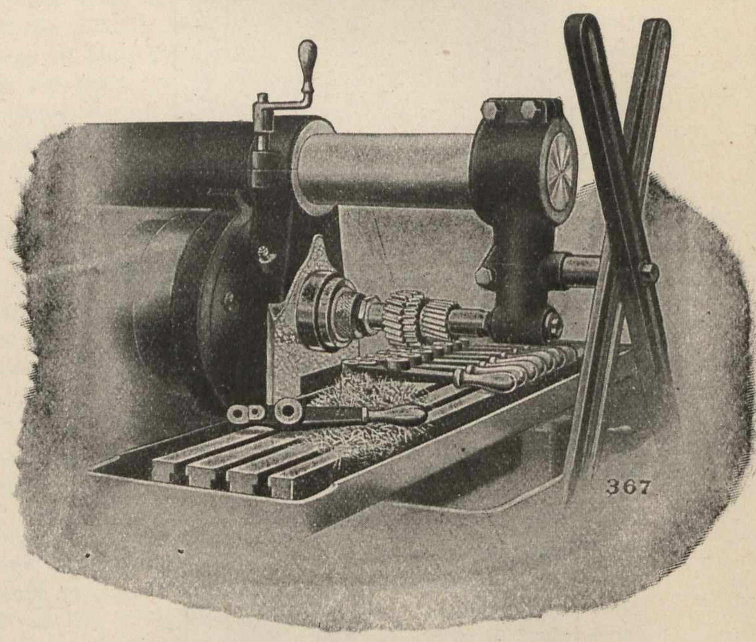
The accompanying illustration shows a very interesting piece of jig milling—interesting because of the great simplicity of the jig, and the very satisfactory results obtained. The sketch shows the shape and gives dimensions of the pieces, which are malleable iron castings, and come to the milling machine with the holes all jig-drilled.

The milling operation consists of facing off the three bosses, which have faces of different heights. The jig consists of a cast iron base, provided with pins correctly spaced and of proper size to snugly fit the two large holes drilled through the pieces, and the pieces are simply set over these pins. Since the cutter when in work has a tendency to push the pieces downward towards the jig, all that the pins are needed for is to prevent the pieces from moving sideways; and they are amply stout enough to do this.



This same plan can be carried out for a large variety of similar work, and has the advantage of very much simplified jig construction, and at the same time permits of filling and unloading the jig in the quickest possible time. In the present instance, the operator removes the pieces from the jig as fast as the cutter traverses them and refills it with new ones, so that the operation is practically a continuous one.

The cutters are 3½", 3⅛", and 2¾" diameter, run 56 r.p.m., feed .033" per turn, giving a table travel of 1.8" per



minute. It will be noted that the cut is 1¼" long and 3" wide, and is about 1-16" deep.

Because of the rapidity of this cut, and also the great amount of time saved because of the ease with which the pieces are handled in the jig, this machine (No. 2 Plain Cincinnati) in the hands of operator of ordinary ability mills 100 of these pieces in two hours, which is an average time of 1.2 minutes each, including handling and chucking.

Oxone.—The Niagara C. E. Co. has recently introduced a new product named oxone. This is made from a specially prepared form of sodium peroxide. Its value lies in its power of giving out free oxygen in presence of carbonic acid gas and water. By this means air in confined spaces may be kept fresh and supplied with O for breathing purposes for an indefinite period, provided, of course, that CO_2 is absorbed in the process.

It will be of great service in dissipating foul air in submarines; miners equipped with oxone will be able to go into drives or slopes without evil effects supervening; firemen at fires will, heedless of smoke and fumes, be able to enter burning buildings, whilst divers will carry their oxygen with them. Oxone should have a great future before it.—"Chambers' Journal."

WITH THE CIVIL ENGINEERS IN THE WEST

By the Editor.

III.

Sept. 11.—Shortly after midnight, we bade adieu to far-famed Winnipeg, and away dashed our special across the fertile belt of the great plain. Break of day found us 265 miles away, at the pleasant divisional point of Broadview (pop. 1,000): near the reservation of the Cree Indians. As our engine took in water, the "boys"—civil engineers, old and young—played ball in the fresh morning air on the prairie. The first sight of the silent brown plains, in

Fig. 1.—Royal Alexandra Hotel, Adjoining the C. P. R. Station, Winnipeg.

autumn—stretching far as the eye can reach—evokes very different emotions from those excited by one's first vision of the deep blue sea. The prairie gives a calm, serene perception almost of infinitude; while the ocean impresses us with an overwhelming sense of the mighty, irresistible forces of Nature. Having filled our lungs with the exhilarating air of the plains, to the dining car we went, and did justice to the rich fare, provided in first class style by the C.P.R. As the train sped along, we caught glimpses through the windows of solitary farmsteads; corrals of cattle; broad wheat fields through which the mechanical reapers were cutting their way, leaving sheaves of golden grain behind; then groups of threshing machines in active operation, sending out through the angular shoot stacks, thin, cloudlike streams of straw, forming the huge mounds which dotted the wide expanse of stubble lands everywhere; while the teamsters could be seen cracking their whips, as they carted the food of the nations to the nearest railroad siding. It was wonderfully interesting, but these isolated objects on the great plains, right and left, only served to impress us with the almost illimitable possibilities of the fertile regions just opening out to civilization.

I found myself relegated to a section of the train made up largely of French-Canadians: among whom were W. D. Baillarge, City Engineer of Quebec—a worthy successor to a worthy sire; C. de B. Leprohon, assistant City Engineer of Montreal—a man of fine æsthetic tastes, and considerable force of character; also, L. G. Papineau, of that city—"the handsomest man in the party"; Arthur Surveyor, of Ottawa —who has just completed survey of the Georgian Bay Canal Route; and J. N. T. Bertrand from the Saginaw region, P.Q.—the authority on the trip in forestry and woodcraft: an ideal chum on a tramp through bush, by lake, or over mountain. The jovial comradeship which existed among this group, recalled vividly the "Three Musketeers." Mentally strong were these men of "New France" all, and the very incarnation of Old World manners and courtesy. One has only to be associated as I was for 21 days, with these cultured French-Canadian engineers from the East, to realize, that they represent not an effete, worn-out civilization; but an aggressive force which will have to be reckoned with in Canadian commerce and industry in the future.

The remainder of this day was spent almost entirely on the train; crossing the monotonous, undulating plains. A brief stop was made at Indianhead—where the Government have a fine experimental farm: an institution which has been of immense practical value to the settlers; for the success of the farming in this district has been phenomenal We also stopped at Regina—43 miles further on. This thriving city of 8,500 inhabitants is the capital of the Province of Saskatchewan, and is destined to be of great commercial importance, since it is the distributing point for the country far north and south. Two miles beyond, we passed the headquarters of the Royal North-West Mounted Police. This fine body of men, numbering 840, is one of the militant organizations of which the country is justly proud. The strong arm of Canadian law in the "wild and woolly West" has become a proverb; and it is all due to this splendid force operating from the handsome military village near Regina. The latest enterprise of this renowned corps is, to act as couriers to the hitherto inaccessible western shores of Hudson Bay. Our next stay was at Moose Jaw (pop. 7,000—another railway divisional point, connected with the "Soo" line on one side, and St. Paul, U.S., on the other. It is situated right in the heart of the ranching country. Fine stock yards are here; while the sidings to these immense yards, and to the grain elevators, together with the inclines to the coal storage bins, represent engineering of no mean order. In fact, one of the younger engineers straightway sent pictures of these works down to Toronto, as a fine example of modern railroad terminal facilities. Municipal ownership has already taken root in Moose Jaw, for the city has its own waterworks and electric light plant. At 5.30 p.m. we adjourned for a short time at the little wayside town of Herbert—where the W. & J. G. Greey Co., of Toronto, are equipping a 100-barrel flour mill. Here the "sports" among the engineers played "duck on the rock"; a grey-haired editor—a veteran cricketer—astonishing the crowd by knocking the pebble off the rock three times in succession. This genial spirit of relaxation was a marked feature of the trip. As the shades of evening fell, and the stars came out, the spirit of reverie came, and one's thoughts wandered to the romantic days when herds of buffalo made dark patches on the plains, and the Indians hunted and lived out their free, nomadic, happy lives. A stray coyote, prairie dog, or carrion crow is about all one now sees of the natural life of the prairies. Everything there in these days is artificial; the white man is fulfilling his manifest destiny —"Westward the course of empire takes its way."

Sept. 12.—Wednesday dawn found us at Gleichen—784 miles beyond Winnipeg, at an altitude of 2,900 ft. and still on the prairie. The atmosphere was hazy, and a white frost covered the bleak landscape. A run of 48 miles, and we stopped at a railroad crossing and hamlet called Mountain

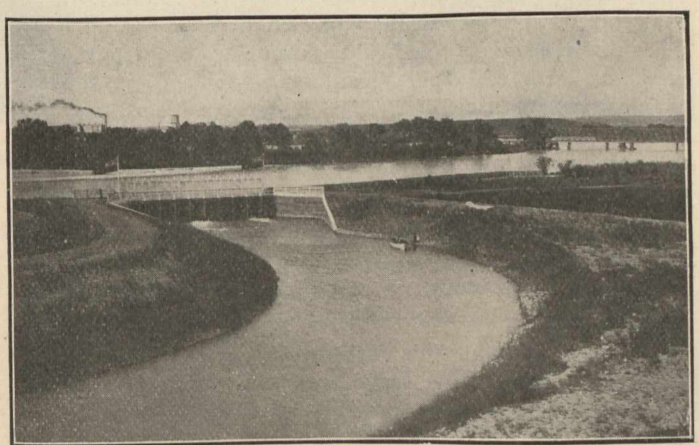


Fig. 2.—Headgates, Main Canal. Calgary in the Distance.

View: about 7 miles by rail from Calgary. Here we were joined by a special car, "Temagami"; containing Mr. Cecil B. Smith and party. Upon disembarking, were met by a deputation from the Irrigation Dept. of the C.P.R., headed by Mr. J. S. Dennis, assistant to the 2nd Vice-President. While waiting for the 22 carriages, which were coming in from all parts of the compass, the haze lifted, and revealed in the distance—over 80 miles away—one of the grandest sights to be seen in Nature, the snow-capped peaks of the

Canadian Rockies, touched by the rays of the morning sun! As we started on our inspiriting ride over the prairie, to inspect the celebrated Irrigation Works, it was a pleasant sight to see the girls riding in to school on horseback from the distant farms; with cheeks like roses. For a technical description of the C.P.R. Irrigation system, we must refer our readers back to our October issue, where this unique piece of civil and mechanical engineering is fully described,

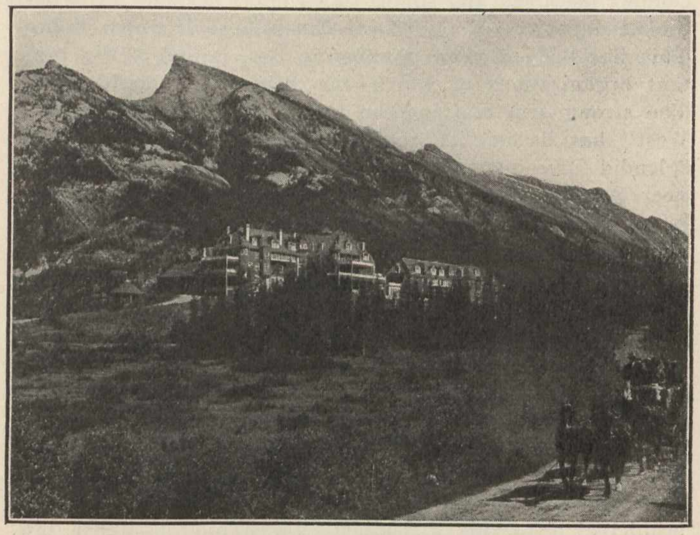


Fig. 3.—C. P. R. Hotel, Banff.

and illustrated by 13 half-tone engravings. The royal manner in which we were entertained in that tent at the field headquarters, will long be remembered.

After partaking of the plentiful, well-cooked, nutritious feast provided, Mr. J. S. Dennis (the authority in Canada on Irrigation), said the area contained in the undertaking comprises a block of 3,000,000 acres: and which, when completed, will be the largest solid block of land under irrigation on the American Continent—twice as big as the next largest in existence. This block of land was granted to the C.P.R., in settlement of the balance of the 25,000,000 acres of land grant due them under their contract for construction of the main line; the even and school sections being included in the grant on condition that irrigation be undertaken within reasonable limits of cost. Irrigable lands are now being sold to farmers at $18 to $20 per acre.

The whole Irrigation area is divided—for convenience of administration—into three sections of a million acres each: Eastern, Central, and Western, commencing with the last named, which embraces 967 miles of canals and ditches —and an additional 1,000 miles of lateral ditches will be constructed. Of this western section in South Alberta, 480 miles have been cut, and when completed, 7,235,000 cubic yards of earth will have been removed; and in the mechanical construction of headgates, bridges, etc., 4,550,000 feet of wood used. Assuming a like proportion for the other two sections, a total estimate for the entire project would be as follows:—

Mileage of canals and ditches.	2,900 miles.
Excavation	21,500,000 cub. yds.
Timber and lumber..........	14,000,000 feet B.M.
Estimated total expenditure............	$6,000,000

In carrying out this scheme, a notable departure is being made from other large irrigation enterprises on this continent. The common practice is, to build only the main and secondary canals, leaving it to the purchasers of land in any irrigation district to undertake the construction of the distributing ditches. The C.P.R. builds the distributing ditches also, so that each farmer has the water delivered at the corner of his farm. This important advantage, together with the certainty of water supply, and the sure title thereto, makes the scheme an attractive one to settlers from the irrigated "States" to the South; where there is so much uncertainty about the water supply, and so much litigation in connection with its use. This alluring prospect is doubtless one of the contributing causes of the remarkable influx of American farmer emigrants into the Canadian North-West within the last year or two. A comparison of this great scheme, with irrigation projects now being undertaken by the Federal Government of the United States, under their Reclamation Act, is interesting. In all, 18 projects have been approved by the United States Government. They extend from Montana to California. The total amount of land involved in the 18 scheme is 1,900,000 acres. The largest individual scheme embraces 250,000 acres. The total estimated expenditure to complete the 18 projects is $38,000,000. Of a truth, the C.P.R. have got our American cousins skinned.

All were impressed with the simple design and construction, yet effectiveness of the moveable winches, trip levers, hinges, etc., for operating the head, secondary, and spillway-gates. Mr. H. B. Muckleston, the engineer responsible, is to be congratulated on this excellent piece of mechanical engineering. But it would be unseemly to pick out any part, where the ensemble is of such a high order. The inspection of that great irrigation system was a liberal education in applied engineering.

About 4 o'clock, our 22 carriages dashed merrily into Calgary, "The Sirloin of Canada" (pop. 12,000). The buildings are mostly of sandstone. Its most important industry—according to the Calgary "Eye Opener," is Brewing. The tone of public life is democratic; for American money and manners prevail. A few days previous to our advent, the Governor-General (Earl Grey) stopped at Calgary on his way to Victoria, B.C., and held a reception. **Seven citizens only attended.** The true explanation of this incident, is not found in the following extract from the Chicago "Record-Herald"; quoted in the smartest weekly in the West, the "Eye Opener," Aug. 4:

"Seward's prediction that the Canadian West would be annexed to the United States within 50 years from 1867, may not be fulfilled on schedule time, but apparently is in a fair way of being realized in a not remote future."

In many American minds the above wish is father to the thought; but contact with all sorts and conditions of men, in a 6,000 miles journey through the North-West, constrains me to say with the editor of the "Eye Opener," that this talk about annexation is the veriest "rot." Calgary has no leisure class. The writer attended Earl Grey's reception at Victoria, B.C., and ventures to say, that the plain, busy, dollar-hunting men of Calgary would have been uncomfortable thereat. Just prior to the visit of the Civil Engineers, Sir Thomas Shaughnessy and James J. Hill, visited the "Sirloin" city, and shortly after our departure

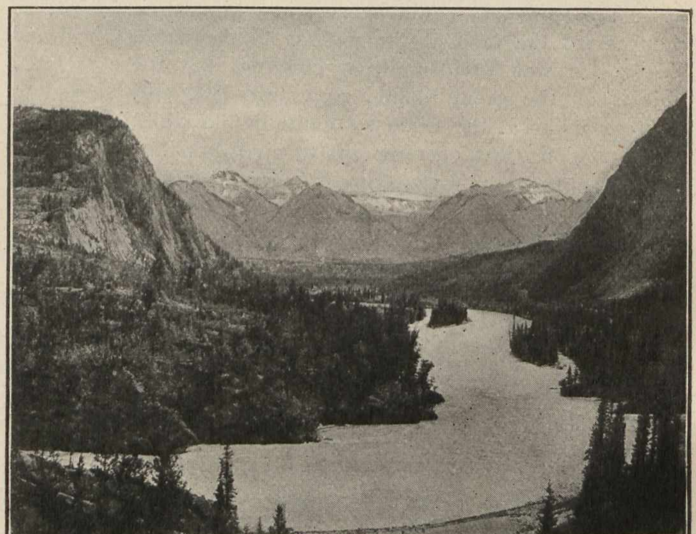


Fig. 4.—Beautiful Bow River at Banff.

towards the Pacific Coast, the Canadian Manufacturers' Association stopped off on their tour. They were received almost frantically. Why? Because they represented dollar-making systems. It was a case of elective affinity. "Time, which treadeth down all things but truth," will adjust the predominant American Colony in Calgary, to the genius and virtues of British institutions.

A run of 20 miles brought us to the fringe of the great plains, with the rushing waters of the Bow River running parallel with the track. Here began our ascent of the series of foothill terraces, which pave the way and prepare the mind for the Alpine wonders beyond. Upon glancing behind, from our altitude of 300 ft. above Calgary, the boundless prairies present a magnificent panorama. Here and there, as far as the eye could see, we beheld prosperous homesteads, well-tilled fields, great herds of horses and thousands of cattle grazing; while nearer, on the terraces and grassy slopes of the rounded foothills, flocks of sheep could be seen fattening on the rich verdure—a pastoral scene never to be forgotten. But soon these visions in which man's hand could be perceived, were displaced by scenes in which the Creator's hand alone could be seen. Thirty-two miles further on we passed a picturesque Indian camp, crossed the Kananaskis River, sped along the northern bank of the Bow River, and soon reached the entrance to the Rockies. Before us a cliff-like range of hills seemed to bar the engine's way. A sudden turn, however, around a corner, and we found ourselves between two walls of vertical rocks, known as "The Gap"—the gateway by which the Bow River passes out of the hills down to the plains. Through this gap we pass, and are introduced with startling suddenness into a scene sublime. We have entered the wonderland of the Canadian Alps. A narrow valley through which flows the Bow River like a silver streak, with mountains on either side. To the right the dizzy heights are bare, rugged, and comparatively even along the summit; like those seen beyond the Selkirks—on the way to Vancouver. On the right, the mountains are broken by jutting crags and irregular promontories rising into the clouds thousands of feet, with lofty summits crowned by everlasting snows. On some of the projecting crags below the summits, white clouds hung picturesquely. Conspicuous were three noble, isolated snow-capped peaks, known as the "Three Sisters"; standing in lofty solitude, sublime and beautiful, at the gateway to the Rockies—like sentinels on guard. The geologists' account of the cause of the jaggedness and fantastic profiles of these mountain giants, and of the enormous crevices in the sides—which throw varying shadows of gorgeous coloring—is interesting: "These mountains are tremendous uplifts of stratified rocks, of the Devonian and carboniferous ages, which have been broken out of the crust of the earth and slowly heaved aloft. Some sections miles and miles of breadth, and thousands of feet thick, have been pushed straight up, so that their strata remain almost as level as before; others are tilted more or less on edge (always on this slope towards the east), and lie in a steeply slanting position; still other sections are bent and crumpled under prodigious side-pressure, while all have been broken down and worn away, until now they are only colossal fragments of the original upheavals. This disturbed stratification is plainly marked upon the faces of the cliffs, by the ledges that hold the snow after it has disappeared elsewhere, or by long lines of trees, which there alone can maintain a foothold; and this peculiarity is one of the most striking and admirable features of the scenery." Further on, at Exshaw, opposite the new Portland Cement Works, we saw a remarkable freak of Nature on the grand scale: a lofty mountain, known as the "Maid of Portland"; so called because the configuration down one side, takes the outline of a sleeping woman. Thirteen miles beyond the Gap, we passed the deserted town of Anthracite, perhaps the most desolate and lamentable scene we witnessed in the West; except the wilderness made by the historic landslide at Frank, B.C., in the Crow's Nest Pass. A few years ago, the rich coal mines at Anthracite made the industrial prospects at this place among the brightest in the North-West. A law-suit arose, however, between Sir Sanford Fleming and mine operators; the mine was closed, the workmen left, and everything is going to decay. This deserted village offers a good theme for a modern Oliver Goldsmith. It was nearly dark when we reached "Banff, the Beautiful"—the headquarters of the Canadian National Park.

Fig. 5.—Lakes in the Clouds: Louise, Mirror and Agnes.

Sept. 13.—The morn rose clear, the skies were bright, as J. T. Bertrand and the writer, trudged through the pleasant leisure town of Banff, to the celebrated C.P.R. Springs Hotel, shown in Fig. 3. Ineffaceable were the impressions of sylvan beauty and scenic grandeur we got that lovely autumn morn at the falls and junction of the rivers in the Bow Valley. The guide books do not exaggerate in claiming that Banff Springs Hotel "commands a view perhaps unrivalled on the American Continent." During the day, the party separated into three excursion groups; one under Professor J. B. Porter, to the C.P.R. coal mines at Bankhead; another under Professor C. H. McLeod, to the observatory on the summit of Sulphur Mountain—alt. 7,484 ft.; and a third took the famous Tunnel

Mountain drive of seven miles. The mining enthusiasts seemed satisfied with their inspection of the anthracite coal workings at Bankhead. The mountain climbers declared that the view from Mount Nebo, over the promised land, was not comparable with the mountain ranges which they

Fig. 6.—Civil Engineers' Party on Great Glacier at Field.

gazed upon that day. While they who took the famous corkscrew drive, along the side of Tunnel Mountain, were charmed with the vistas of valley and Alpine scenery which they beheld: besides, visiting the corral of 2,000 acres, with its growing herd of 76 buffalos—eleven of which are this year's calves—together with moose, elks, mountain lions, wolves, etc., finally inspecting the romantic caves and Hot Springs, where bathers were merrily transporting themselves in the sulphur waters at 120° F. As intimated, Banff, rightly named the "beautiful," is the headquarters of the Canadian National Park; which covers 5,732 square miles—taking in the Rockies from both sides. It is half as large again as the Yellowstone Park in the United States. Wisely guided was the Dominion Government, in reserving for the pleasure and enjoyment of the Canadian people forever, this magnificent domain.

Leaving Banff at 3.10, we travelled 35 miles through the forested Bow River Valley, hemmed in by lofty mountains, rugged, solemn, grand. One, Mount Temple, piercing the clouds at an altitude of 11,626 feet. This wonderful valley has been described by an art critic as, an "amphitheatre of scenic glory." At 4.30, we rode 2½ miles in carriages up a winding pathway, until we emerged from the woods, at the rear of a handsome chalet. Through the romantically furnished rotunda we walked on to the front balcony, where there burst into view, a picture of indescribable beauty and grandeur—Lake Louise! Everyone went into raptures. As for me, it was the grandest vision in Nature, I ever gazed upon. Beside me stood my friend, Charles H. Mitchell—the well-known Hydro-Electric Engineer—who had just returned from an eight months' European tour, ending in Switzerland; also, Miss Edith Paverley, of Scarborough, England,

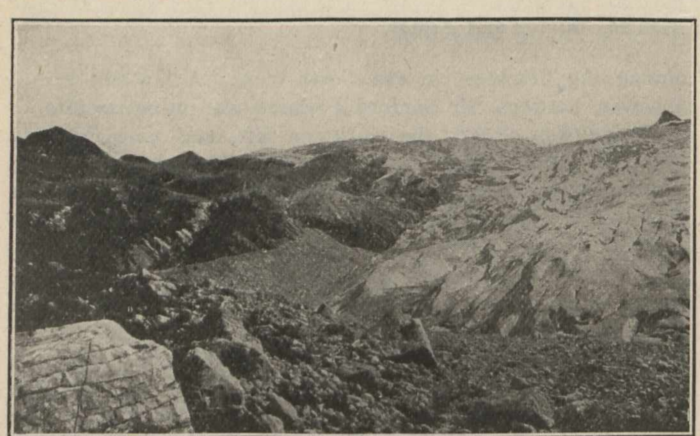


Fig. 7.—View Showing Remarkable Retrocession of Glacier.

a cultured lady, who had recently done Switzerland and the Norway Fiords. Both agreed, that Lake Louise and its picturesque, environing scenery, surpassed anything they had seen on their travels. After gazing spellbound upon the blue lake—(1½ miles long x ½ mile wide x 200 feet deep, altitude 5,645 ft.), shut in by dark, precipitous, forest-clad mountains on either side; with a dazzling blue and green glacier in the background, rising in a pure white snow field into the azure skies beyond; and all mirrored wondrously in the waters before us—we asked a "heathen Chinee" waiter how long it would take us to climb up through the woods to Lake Agnes. "Half an hour," said this Oriental sinner. Several of us started up the narrow, mossy trail. At the end of more than an hour's climb up that 75° path into cloud-land, we met James Kennedy, C.E., and another gentleman returning—they had suffered enough. We trudged on, however, around some huge boulders, and came across Professor J. B. Porter fixing his camera tripod for a picture of the magnificent panorama of the Bow Valley in the distance. About 30 yards higher up, we struck a new trail to the left, and after plodding along a narrow, stony ledge belting some precipitous cliffs, Lake Agnes—calm, serene, peaceful, beautiful, was before us. Bertrand and I drank of its sweet waters. To an engineer with nerves accustomed to the hum and crash of works machinery; or even to the constant noise of city street cars, the solitude in those high altitudes is almost painful. But the general psychological effect of the cosmic emotion excited by the awe-inspiring glaciers, frowning crags and dizzy mountain heights, is to the mind what the ploughing up of the earth in springtime is to

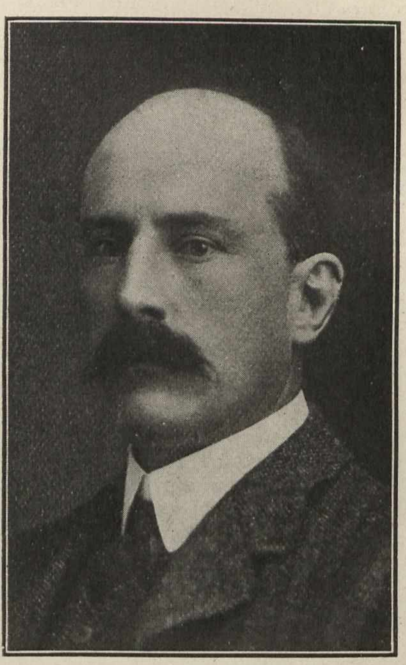


Fig. 8.—J. F. Maguire, Vancouver, B. C.

Nature As we crossed the falls on the trunk of a tree, a dark shadow came over the scene. Looking for the cause up to the hazy mountain peaks, recalled the words:—

> Where storm clouds brood,
> And thunders crash,
> And lightning flashes by.

We were soon covered with snow, and night was coming on, so we hastened down a ladder on the face of the cliffs, and descended rapidly by a narrow bridle path, until we came to Mirror Lake, a beauteous bit of oval water, encircled by lofty forest trees. A sojourn of a few minutes, then down we sped, hungry as hunters, to Lake Louise Chalet—1,000 feet below—as darkness came on. The Chinaman could not be found, but we very readily forgave; for our experiences in quest of the lakes in the clouds, and the noble views we got in those high altitudes, would have pleased greatly, even the 16th century author of "My minde to me a Kingdom is." About 10 p.m., C. H. Mitchell and I walked under the stars down to the train. It was a glorious night—the Milky Way appeared wonderfully near, and it seemed in the solitude of the night, that one could almost hear the "music of the spheres."

Sept. 14.—At early morn, we left Laggan. A six miles' run brought us to the summit of the Rockies, and to the Great Divide, 5,296 feet above sea level. This freak of Nature consists of a stream running down from the mountains, which here divides: the eastern branch flowing on to Hudson Bay; while that to the west feeds the Pacific Ocean. The aspect of the scenery in this region is almost terrible: over eighty glaciers can be seen in a distance of 16 miles. The Kicking Horse gorge and its erratic river flowing west, now displaced the Bow River running east. Several of the moun-

Fig. 9.—Giant Cedar and Fir Trees in Stanley Park, Vancouver.

tains in this stretch are of surpassing grandeur and sublimity. Cathedral Mount, 10,204 ft. high, looms against the sky like the majestic ruins of some noble Gothic fane. As we rode around the immense, precipitous base of awe-inspiring Mount Stephen—10,450 ft. high—a special object of interest on its side—2,500 ft. up—was a silver-lead mine: the first of the series we saw on our trip. Some 31 miles beyond Laggan, we left the Rockies and Canadian National Park behind, entering the region of the famous Selkirks. It would take a Ruskin's pen to describe the matchless grandeur of this mighty range of mountains; and besides, our object has been achieved, if we have been able to convey to our readers—especially those abroad—some reliable impressions of the glorious heritage the Canadian people have in their wonderful National Park.

About mid-day, we reached Glacier House—where the C.P.R., have erected another of their finely appointed hotels. After luncheon, the entire party started on a 30 minutes' walk through a picturesque glen, which suddenly changes into a chilly temperature, opens out, and reveals one of the sights of the world—"the Great Glacier of the Selkirks." To the left, Mount Sir Donald rises 1½ miles into the skies, keeping guard over an immense blue-green sea of ice and snow to the right, which looks like a mighty descending cataract of seething waters, suddenly frozen in its mad career down from the lofty heights beyond. The deep crevices and undulations made shadows, which enabled our eyes to bear the dazzling whiteness of its glittering surface. "This great glacier is said to be greater than all those of Switzerland combined." Although having the appearance of eternity, like the Egyptian Sphinx, it is wasting away, slowly but surely. In the foreground of Fig. 7 is an immense rock with a mark on its face, indicating that the ice field has receded some 500 feet since 1887. Some of the more adventurous spirits climbed 200 to 300 feet up the face of the icy snows, at considerable peril: Miss McLeod, of Montreal, carrying the palm among the ladies.

We purposed in this issue describing the sights and scenes in the Albert and Fraser Canyons, and along the banks of the noble Fraser River. It was also intended to tell the interesting story of our eventful visit to Vancouver, and our meeting with Mr. J. F. Maguire—the Managing Director of the British Columbia Agency Corporation—a sterling business man, who is doing not a little to promote the interests of the prospering Pacific Coast City; together with an account of the Hindoo Sikh colony and their troubles to aclimatize; as well as of our walk through Stanley Paık and inspection of the giant cedar and fir trees—one 15 ft. diameter! Forgetting not our visit to the works of the Pacific Coast Pipe Co., Ltd., where we witnessed the manufacture of the popular wood-stave water pipes. And last, but not least, to describe graphically, the fine Hydro-Electric power station of the Vancouver Electric Light and Power Co. at Burrard Inlet—now under the able superin-

Fig. 10.—Where Vancouver Gets Electric Light and Power.

tendency of Mr. James Milne, late of Toronto; but these things, and many more of deep interest to Engineers and Capitalists with their eye on the possibilities of Canada's wonderland in the North-West, must be reserved for another time and place.

[Note.—We are indebted to the Canadian Pacific Railway Company for the first five photographs illustrating this article.—Editor.]

ENGINEERING SOCIETIES.

Canadian Society of Civil Engineers.—President, H. D. Lumsden, Ottawa; treasurer, H. Irwin; secretary, C. H. McLeod, room 877, Dorchester Street, Montreal.

Canadian Mining Institute.—President, George R. Smith, Thetford Mines, Quebec; secretary, H. Mortimer-Lamb, Montreal, Que.; treasurer, J. Stevenson Brown, Montreal.

Engineers' Society: School of Practical Science.—President, T. R. Loudon, recording secretary, F. A. McGiverin; treasurer, B. W. Marrs; corresponding secretary, C. S. Shirriff.

Engineers' Club of Toronto.—President, F. L. Somerville; treasurer, W. J. Bowers; secretary, Willis Chipman. Rooms: 96 King Street West, Toronto.

Canadian Railway Club.—President, S. King, Montreal; secretary, James Powell, Montreal; treasurer, S. S. Underwood, Montreal.

National Association of Marine Engineers of Canada.—Grand president, F. S. Henning, Toronto; grand secretary-treasurer, Neil J. Morrison, St. John, N. B.

Canadian Association of Stationary Engineers.—President, J. Ironsides, Hamilton; vice-president, E. Grandbois, Chatham; secretary, W. L. Outhwaite, Toronto; treasurer, A. M. Dixon, Toronto.

Toronto Branch American Institute of Electrical Engineers.—Chairman and secretary, R. T. MacKeen; vice-chairman, R. G. Black.

Canadian Electrical Association.—President, A. A. Wright; first vice-president, R. G. Black; second vice-president, John Murphy; secretary-treasurer, C. H. Mortimer.

Foundry Foremen's Association.—J. F. Gaffney, The Allis-Chalmers-Bullock, Limited, secretary and treasurer, Montreal; A. Chase, Sawyer & Massey Co., secretary and treasurer, Hamilton.

Association of Ontario Land Surveyors.—President, J. W. Tyrell, Hamilton; chairman of council, G. B. Kirkpatrick, Toronto; secretary-treasurer, Killaly Gamble, Toronto.

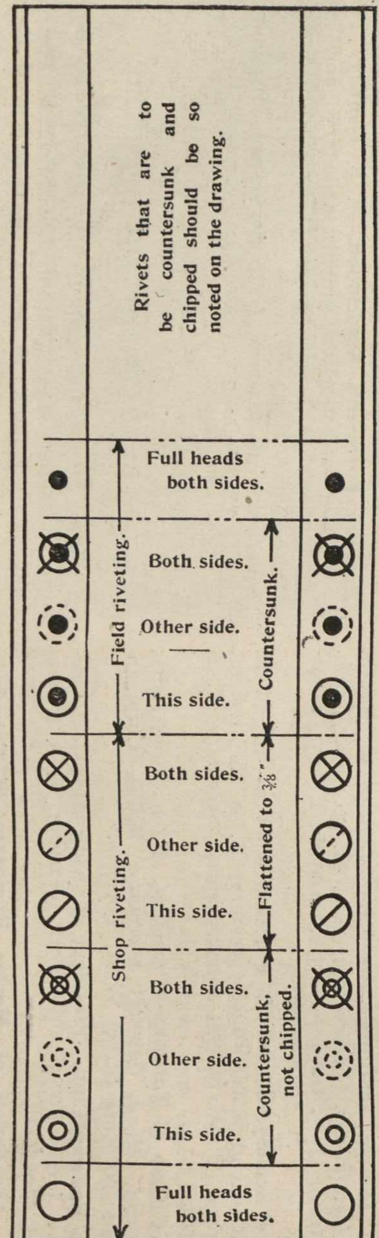
TREATMENT OF IRON ORE.

Two Australian inventors have found a new process for the continuous treatment of iron ore, which is to be exploited throughout the world. It is a process for directly converting the ore into malleable iron or steel, and is said to effect a saving of twenty-five per cent. After the ore is concentrated it is passed through a revolving cylinder and brought into contact with the deoxidising gas; thence it falls into a bottle of molten iron and is converted into steel or malleable iron, the whole process being automatic.

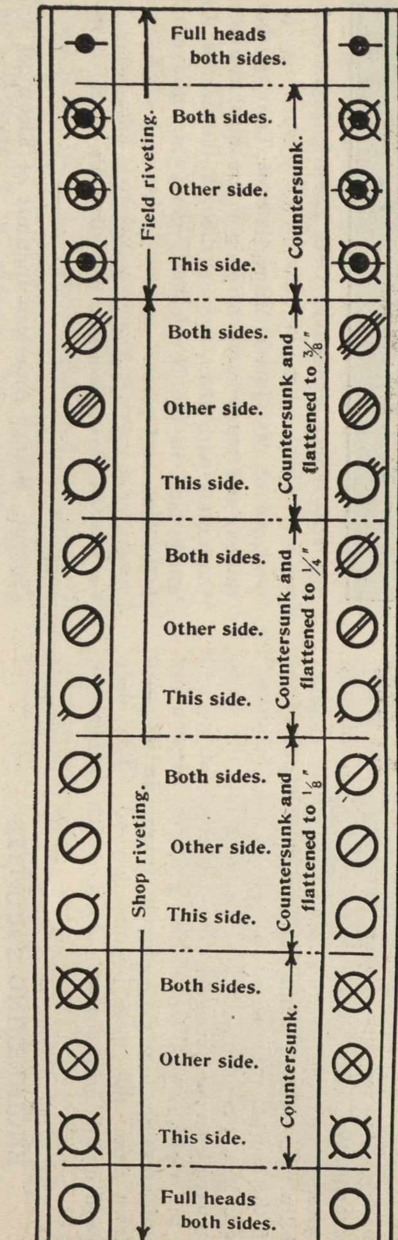
DRAUGHTSMEN'S PAGE

CONVENTIONAL RIVET SIGNS.

American Bridge Co. Standard.

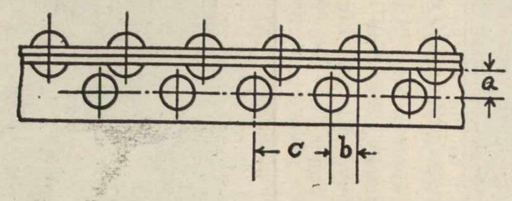


Carnegie Standard.



Vertical and horizontal center lines should run through rivets.

Rivet Spacing.

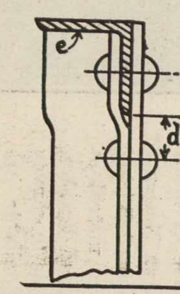


WHEN A IS	FOR RIVET DIAMETER OF 3/4" b INCHES	7/8" b INCHES
$1\frac{1}{8}$	$1\frac{1}{4}$	$1\frac{3}{8}$
$1\frac{3}{16}$	$1\frac{3}{16}$	$1\frac{5}{16}$
$1\frac{1}{4}$	$1\frac{1}{8}$	$1\frac{1}{4}$
$1\frac{5}{16}$	$1\frac{1}{16}$	$1\frac{3}{16}$
$1\frac{3}{8}$	$\frac{15}{16}$	$1\frac{1}{8}$
$1\frac{7}{16}$	$\frac{7}{8}$	1
$1\frac{1}{2}$	$\frac{3}{4}$	$\frac{15}{16}$
$1\frac{9}{16}$	$\frac{5}{8}$	$\frac{13}{16}$
$1\frac{5}{8}$	$\frac{3}{8}$	$\frac{11}{16}$
$1\frac{11}{16}$	0	$\frac{1}{2}$
$1\frac{3}{4}$	0	$\frac{5}{16}$

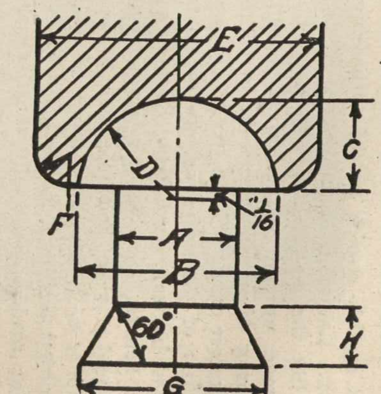
MINIMUM RIVET SPACING.

SIZE of RIVET	$\frac{1}{4}$	$\frac{3}{8}$	$\frac{1}{2}$	$\frac{5}{8}$	$\frac{3}{4}$	$\frac{7}{8}$	1
MINIMUM DIST. FOR C	1	$1\frac{1}{4}$	$1\frac{3}{4}$	2	$2\frac{1}{4}$	$2\frac{5}{8}$	3

Rivets in Crimped Angles.



When angles are "crimped" to fix the chord angles on a girder or elsewhere, the distance *d* should be $1\frac{1}{2}$ plus twice the thickness of the angle *e*.



Standard Rivets and Dies.

A	B	C	D	E	F	G	H
$\frac{3}{8}$	$\frac{11}{16}$	$\frac{9}{32}$	$\frac{11}{32}$	1	$\frac{1}{8}$	$\frac{5}{8}$	$\frac{3}{16}$
$\frac{1}{2}$	$\frac{7}{8}$	$\frac{3}{8}$	$\frac{7}{16}$	$1\frac{1}{4}$	$\frac{5}{32}$	$\frac{13}{16}$	$\frac{1}{4}$
$\frac{5}{8}$	$1\frac{1}{16}$	$\frac{15}{32}$	$\frac{17}{32}$	$1\frac{1}{2}$	$\frac{11}{64}$	1	$\frac{5}{16}$
$\frac{3}{4}$	$1\frac{1}{4}$	$\frac{9}{16}$	$\frac{5}{8}$	$1\frac{3}{4}$	$\frac{13}{64}$	$1\frac{3}{16}$	$\frac{3}{8}$
$\frac{7}{8}$	$1\frac{7}{16}$	$\frac{21}{32}$	$\frac{23}{32}$	2	$\frac{7}{32}$	$1\frac{3}{8}$	$\frac{7}{16}$
1	$1\frac{5}{8}$	$\frac{3}{4}$	$\frac{13}{16}$	$2\frac{1}{4}$	$\frac{1}{4}$	$1\frac{9}{16}$	$\frac{1}{2}$
$1\frac{1}{4}$	2	$\frac{15}{16}$	1	3	$\frac{5}{16}$	$1\frac{15}{16}$	$\frac{5}{8}$

By Courtesy of the "Draftsman."

The Canadian Engineer.

ESTABLISHED 1893.

With which is Incorporated

THE CANADIAN MACHINE SHOP

ISSUED MONTHLY IN THE INTERESTS OF THE

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

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

Subscriptions—unless otherwise specified in contract—run until we receive a specific order to stop.

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Vancouver Office: Northern Bank Building, Hastings Street. General Agent for British Columbia and Western Alberta (including Calgary and Edmonton):—The British Columbia Agency Corporation.

Address all business communications to the Company and not to individuals. Everything affecting the editorial department should be directed to the Editor.

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

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TORONTO, CANADA, DECEMBER, 1906.

CONTENTS OF THIS ISSUE.

"The Canadian Engineer" desires to give more prominence to engineering works in Canada; while not neglecting developments in other countries.

For this purpose the proprietors invite the co-operation of regular subscribers, and the large number of frequent readers of the paper, and will welcome informative matter on every kind of engineering progress,—blue prints; photographs; and working drawings of work, projected, begun, and approaching completion; new machinery and tools; enlargements of old businesses and establishing of new; changes of officers; letters discussing questions of current interest to civil, mechanical, electrical and hydraulic engineers.

It is the business of "The Canadian Engineer" to keep pace with growth in every theoretical and practical branch of the profession. Whatever demands upon time, space, and frequency of publication and enterprise generally are made by the effort to do this, they will be met.

GEORGIAN BAY CANAL: A VAST ENTERPRISE.

Three engineering projects of great magnitude are before the world at the present time. (1) The Panama Canal—controlled by the United States Government; (2) the English Channel Tunnel—which is to occupy the attention of the British Parliament during the present session; and last, but not least, the proposed Georgian Bay Canal in Canada; a deep-sea ship waterway starting from the north-east shore of the Georgian Bay, up the French River, across Lake Nipissing through a land-cut to the Ottawa River, then down stream past the Capital, into the St. Lawrence at Montreal. The water route will cover a distance of 425 miles, having a minimum width of 300 feet at the bottom; with a depth of 20 feet of water at the sill, and 22 feet at the reaches. In all, 32 miles of waterway will have to be cut; the Ottawa River will require some dredging, while for the rest of the 425 miles, beneficent Nature has prepared the way. The general engineering features of this magnificent project—which is to cost $100,000,000—are of absorbing interest. Here is a graphic description by Mr. James A. Malcolm, the able manager of the New Dominion Syndicate, Limited:—

"For want of a better word we call our project a canal, but it is scarcely a canal. A canal ordinarily gives one the impression of a few feet of stagnant water, with half-loaded coal barges upon it, but this is a system of internal navigation for ocean-going vessels—a waterway created by Nature and presenting no physical difficulties—the linking together of existing deep and navigable stretches of lakes and rivers by means of only 33 locks, including double locks, which is a very small number for a distance of 425 miles, and which prove how carefully, ably, thoroughly, and well our survey work has been carried out. The canalization will be mostly of the vicinity of the locks and the summit level, and, when complete, will enable ocean-going steamers of 8,000 to 10,000 tons burden, drawing 20 feet of water, attaining a speed of eight to ten knots an hour, to sail from Chicago, Duluth, or any other lake port and proceed right through to any European port, or vice versa from any European port right into the industrial heart of America. Five years will be occupied in construction. As we have something like 1,000,000 water horse-power available—a most valuable asset (the Government engineer estimates 1,250,000 horse-power)—all the locks will be operated electrically, and the entire distance of 425 miles will be lighted at night in a like manner, so as to more effectually cope with the enormous traffic we anticipate. By this means, and owing to the fact that we are more than well provided with water at the summit level, 8,000 to 10,000 ton steamers will be easily cleared through the locks every five minutes, day and night, without interruption. While commenting on the inexhaustible amount of hydraulic power we own, I would like to remark that in the opinion of engineers it is not impossible that the railroads contiguous to and converging on the canal, like the Canadian Pacific Railway, the Grand Trunk, and others—which, owing to superabundance of traffic, now no longer seriously oppose us—will be electrified to a great extent in the near future, and the necessary energy for the same will have to be largely derived from our waters."

The question now arises, what are the commercial advantages which compel confidence in this stupendous engineering enterprise, and warrant the investment of $100,000,000 capital?

A glance at the map of North America shows, that the route of the proposed waterway is the key to the transportation problem of the great North-West. Official returns indicate that the tonnage on the great lakes from Chicago, Duluth, etc., in the United States; and Fort William, Port Arthur, etc., in Canada, amounts to nearly 50,000,000 tons per year: several times greater than the traffic through the Suez Canal. It is conceivable that this traffic over the lakes could be greatly increased. The annual exportation of grain from the United States amounts to 2,223,000 bushels, and of meat 1,000,000 pounds; three-fourths of which moves to New York by rail, and less than one-fourth from Chicago to Buffalo by water. Now the Georgian Bay Canal would inevitably capture the greater part of this enormous eastbound traffic. We have only to state certain facts and the reasons for this optimistic belief will be obvious. The distance from Chicago to Buffalo via the Great Lakes is 900 miles, and from Chicago to Montreal by way of the proposed canal 905 miles. Up to this point the conditions are equal. But it is just here, where the Canadian route commences to have an overwhelming advantage. By the American route, the freight has to be trans-shipped from Buffalo to New York by rail,—which costs more than from New York to Liverpool—and then from New York by water again across the Atlantic. Whereas, by the proposed Canadian route there will be no break in the passage from Chicago to Europe; and a saving in time of 72 hours and a distance of 500 miles each way; besides a saving in the cost of rail trans-shipment between Buffalo and New York! Mr. James J. Hill, President of the Great Northern Railway, one of the greatest living authorities on transportation; and whose name is a name to juggle with in the Canadian North-West just now, made the following pronouncement before the Merchants' Club of Chicago, November 11th:—

> What would it mean to Chicago were such a canal constructed, with a depth of 20'-0" as planned, so that vessels could load at your docks and sail direct for Montreal or Quebec, and bringing ocean-going ships practically as near the upper lakes and the west as Buffalo is now? Your packing house products could be loaded in Chicago on specially constructed ships and sent direct to any ocean port in the world. Your grain could be delivered alongside ocean ships at Montreal or Quebec for little more than it now costs to Buffalo.

Such, briefly stated, are the chief engineering and commercial aspects of this great transportation scheme.

Never did industrial enterprise of magnitude start out with greater promise of success. It is estimated that on a yearly shipment of 750,000,000 bushels of wheat alone, there would be a saving to the western farmers of $15,000,000; while to miners, manufacturers, lumber men, etc., the saving would be enormous. With these alluring prospects of business, there ought to be no doubt about the earning power of the canal. The interest on $100,000,000 at 4% would be $4,000,000. As Mr. Malcolm says:—"This does not strike one as an impossible profit to earn, having regard to the magnitude of the business to be done, which is now admitted and appreciated by all the leading commercial, financial, shipping and railway men as well in Europe as in America." Inasmuch, therefore, as the projectors have the cheapest, coolest and quickest route to the Atlantic to offer to the Westerners, the canal is bound to be prosperous from the beginning. Our American cousins are sure to fall in line, for the scheme has behind it what George Washington once advised, namely, "the cement of self-interest."

The project had its inception in England in 1898; commencing with the incorporation of the New Dominion Syndicate, Limited,—the moving spirit being Mr. R. W. Perks, M.P., England. The Dominion Government passed a Bill in May, 1906, renewing the old charter rights of the company, and giving statutory powers to raise the necessary funds—$150,000,000—to carry out the work and provide for all contingencies. A two years' survey has just been completed. Plans signed by the late Mr. G. Y. Wisner, C.E., of Detroit, and checked by Mr. H. A. Purdon, C.E., a distinguished British Engineer, and others, will be submitted for approval to the Canadian Government straightway. So that in a short time work will be started on the Georgian Bay Canal—one of the greatest engineering enterprises of the age.

HAVE WE REACHED FINALITY IN MODERN MACHINE DESIGN?

In the design of modern tools for the machine shop, it would almost seem that we have reached finality as regards the application of the principles of mechanics to the performance of certain lines of work. Even the advent of high-speed cutting steel has not brought out any new types in boring mills, planers, lathes, drill presses, etc., only the strengthening of a housing here, the bracing of an arm there, or the thickening of some manifestly weak part to resist the abnormal stresses induced by the new conditions of increased speed and power. An analogous case is that of the blast furnace. For over 300 years there has been little change in the general type, of "a circular column swelling in diameter from both extremities." The aim of the metallurgical engineer has been to economise power, labor and material; hence, the regeneration of waste gases; introduction of high pressure blast, and utilization of slags as fertilizers for the fields, or, for the making of concrete for foundations, or bricks for the structure of buildings and public works. The art of the machine tool designer seems now to be directed along similar lines, viz.: economy of power, labor and material. Shortly before 1892, the Iron & Steel Institute met at Pittsburgh. A number of British Ironmasters, led by Andrew Carnegie, were inspecting the famous Braddock Rolling Mills of the Carnegie Steel Co. Standing before a roughing mill, William Whitewell, of Stockton-on-Tees, with watch in hand, found that a large ingot made 9 passes in 1¾ minutes. He told Mr. Carnegie that at Middlesborough, England, they made a like number of passes on a similar mill in 1½ minutes. The next week a well-known firm of rolling mill builders, Pittsburgh, received an order from the Carnegie Steel Co. for a new mill, which must make 9 passes in 1¼ minutes: and **for every man displaced, were to receive a bonus of $1,000.** The old mill was torn out; a new one making 9 passes in 1¼ minutes installed in place thereof. Rolling mill types have not changed, but great economies in operation have been made, and the policy of a bonus for displacement of manual labor, and substitution of automatic machinery has worked wonders. The rolling mill department of a Carnegie Steel Co.'s plant, is now almost as devoid of life as the north-east shore of Lake Superior. About all the visitor sees now within the walls of a roughing, or finishing mill at Braddock or Homestead, is a raised platform, on which are a series of levers being operated by an intelligent boy; manual labor has vanished, automatic machinery does the work. This train of thought was evoked by the contemplation of the combined boring, drilling and tapping machine illustrated on another page. It bears out our contention, that machine tool designers are not inventing any new types, but having perfected existing standards, are directing their constructive skill towards combinations of several existing types: the objective being increased facilities and the saving of manual labor. It is this dearth of new ideas in machine design and construction that is giving technical journals, devoted almost exclusively to the description and illustration of machinery, the appearance of a mere catalogue. "The Canadian Engineer," perceiving this danger, has been giving prominence recently, to the newer and more progressive phases of engineering: Hydro-electric plants; electric furnace; suction gas-producers; steam turbine; concrete-steel construction; telephony; etc. At the same time, whenever anything new was heard of in the shape of labor-saving appliances, we have endeavored to be among the first to tell the advantages thereof to our readers. We had in view a series of special articles on the fixed types of machines, showing their latest improvements and application in modern machine shop practice.

The phenomenon of the gradual but constant displacement of labor, and substitution of automatic machinery in the domain of industry, is an appropriate study for the sociologist and philosophical historian.

* * *

EDITORIAL NOTES.

A New Motive Power: Coming Events Cast Their Shadows.

In the theoretical exposition of Radio-activity, Canada—in the person of Professor Ernest Rutherford, of McGill University,—stands in the front rank. Lord Kelvin's graceful allusion to the work of the Montreal Professor—in his recent controversy with Sir Oliver Lodge, proves our assertion. It would seem, however, that, in the practical application of radio-activity to the mechanic arts, England is likely to achieve in the twentieth century what James Watt did with his steam engine, and Henry Bessemer did with his Steel Converter in the nineteenth. Although it is at the present time only in the prophetic and hinting stage, even such a staid and conservative authority as "The Times" (London), in its Engineering Supplement, gives credence to the report. The announcement was made on October 27th, at the Manchester Association of Engineers, by Mr. W. H. Hunter, C.E., in his inaugural address. He said:—

> Who could say that the stores of latent energy in regard to radio-active bodies demonstrating the transformability of elementary matter, and demonstrating further that stupendous stores of energy are latent in the radio-atoms themselves might not one day be converted into stores of motive power. In the meantime, I speak with some measure of confidence when I say that it is possible that at no distant date the engineering world will be startled by the revelation of a discovery relating to motive power of such sort and of such far-reaching consequences that if I were permitted to describe it to you to-night you would agree that it may of itself go far to establish the proposition I have submitted to you this evening.

This declaration reminds us of the tall Yankee, who, after listening to Henry Russell's famous song, "There's a good time coming, boys," got up and said, "Mester Russell, you've bin a singin 'There's a good time comin, boys,' and I guess we appreciate thet, but would you kindly name the date!" The engineering world is eagerly expectant; for the "portentous announcement" was made not by an enthusiastic amateur, but by a trained engineer of first-class standing in his profession.

* * *

Problem of Power For Small Municipalities.

We note that Brockville, Ont., is dissatisfied with the answer they have received from the Hydro-Electric Power Commission of Ontario, with regard to their application for electric power. "The Canadian Engineer" is not concerned about politics, nor the devious ways of politicians; but we are concerned with industrial economics, hence, advise the authorities of Brockville to send a deputation down to Wellington-on-the-lake, to investigate the new power plant there. We venture to predict they will find a solution of their troubles. "White coal" is not the only source of cheap electrical energy.

* * *

Cheaper Coal For Canada.

At midnight on October 31st, the new British law abolishing the export duty on coal came into force. Our newspaper exchanges report, that the next day hundreds of steamers sailed out of England for foreign ports, carrying with them heavy cargoes of Welsh and Durham coal. Some of these vessels have already discharged their valuable freight on Canadian docks. Had this event happened three months ago, the deplorable shutting down of the Sydney blast furnaces and steel rail mills, owing to disagreement about coal prices between the steelmasters and coal owners, would doubtless have been averted; for healthy competition works wonders.

We may expect in a short time, to see rich, steam-raising British coal delivered in Eastern Canada in surprising quantities, and at reasonable prices. This should mitigate somewhat the serious, but truthful allegation made recently by Mr. Ramsay MacDonald, the English Labor Member of Parliament; who declared, after a run across the Dominion and back, that "Canada is rapidly becoming the dearest country in the world to live in." One necessity of life should be cheaper this winter, namely, fuel, to warm the homes of the people. A spurt should also be seen in the new Suction Gas Producer business, which is becoming so popular just now: and should become increasingly so, in view of the facts set forth in our brief description on page 444 of the electric light and power plant at Wellington.

* * *

BOOKS RECEIVED.

A Guide to Electric Lighting.—For the use of householders and amateurs. By S. R. Bottone. London: Whittaker and Co., 2 White Hart Street, Paternoster Square. Size 4⅞ x 7¼.- pp. 226, illustrated. (Price 1s. net).

The Marine Steam Turbine.—A practical description of the Parsons Marine Turbine. By J. W. Sothern, Mem. Inst. of Eng. and Shipbuilders in Scotland. London: Whittaker & Co. Size 5¾ x 8½.- pp. 163. (Price 6s. net).

Elementary Principles of Continuous Current Dynamo Design.—By H. M. Hobart, B. Sc., M. I. E. E., Mem. A. I. E. E. Toronto: The MacMillan Co, of Canada, Limited, 27 Richmond Street West. Size 6¼ x 9¼.- pp. 220 106 illustrations. (Price $2.00 net).

Economics of Road Construction.—By H. P. Gillette. New York: The Engineering News Publishing Co. Size 6 x 9¼.- pp. 49. (Price $1.00 net).

Batter Tables.—For 192 batters from 1/16", ⅛", 3/16" to 12" per foot, giving altitude and hypothenuse in feet and decimals of feet, for any base measured in feet, inches and sixteenths. By C. G. Wrentmore, Assoc. Mem. Am. Soc. C. E. New York: Engineering News Publishing Co. Size 8½ x 10.- pp. 200 (Price $5.00 net).

Modern Gas and Oil Engines.—A practical treatise on. By Frederick Grover, A. M. Inst. C. E. Manchester: The Technical Publishing Co., 287 Deansgate. Size 5" x 7⅜". pp. 372. (Price 5s. net).

The Theta-Phi Diagram.—Practically applied to steam, gas, oil and air engines. By H. A. Golding, A.M.I.M.E. Manchester: The Technical Publishing Co, 287 Deansgate. Size 5" x 7⅜". pp. 126. (Price 3s. net).

Modern Steam Turbines.—Vol. 1. The Schultz Turbine. By Arthur R. Liddell. London: A. Owen & Co., 28 Regent St. Size 9¼" x 6¼", pp. 73.

The A. B. C. of Patents.—A synopsis of the patent, trademark, designs and copyright laws in Canada and the United States; with a short reference to patents in the principal foreign countries. By F. B. Fetherstonhaugh, M. E., Toronto. Fetherstonhaugh & Co., 25 King St. W. Size 5"x 7½", pp. 32. (Price 50c.) (Clients may procure this publication free of charge.)

NEW PUBLICATIONS.

Hydro-Electric Power Commission.—The third report of the Ontario Power Commission is now off the press. It deals with the Lake Huron and Georgian Bay District. Size, 7" x 10¼", pp. 29.

The Sanitary Journal of the Ontario Board of Health,—being parts I. and II. of the 25th annual report. The work includes reports on sewage systems, laboratory reports, reports on contagious diseases, etc. It also contains a special article on vaccination, and small-pox.

CATALOGUES AND CIRCULARS.

Primary Batteries.—Canadian General Electric Co., Toronto. It is said that Edison Primary Battery delivers the greatest amount of energy for the least cost. A booklet received is devoted exclusively to this type of battery. Size, 3½ x 6¼, pp. 16.

Electrical Directory.—The October issue of the Buyer's Reference is to hand. It contains a complete list of electrical dealers and contractors, giving their addresses and the special lines in which they deal. Published in January, April, July and October, by the Buyer's Reference Co., 123 Liberty St., New York. Size, 8½ x 9½, pp. 146.

Presses, Dies and Special Machinery.—E. W. Bliss Co., Borough of Brooklyn, N. Y., have sent us one of the finest catalogues we have received for some time. Nearly every kind of machine which they manufacture is described and illustrated in this catalogue, presses, shears, drop hammers, etc. It is printed on the best coated paper and bound in good cloth binding, with the title in gold. Size, 5½ x 7½, pp. 578.

Air Compressors.—Chicago Pneumatic Tool Co., Chicago, Ill. The many types of the Franklin Air Compressor are set forth by the best work of the engraver's and printer's art, in a high class catalogue recently published. The catalogue contains much data of value to users of compressed air. Size, 6 x 9, pp. 116.

Motor Controllers.—Canadian Westinghouse Co., Limited, Hamilton, Ont., have recognized the need of an automatic device to control the speed of electric motors, and as they are now in a position to supply same, they have issued circular No. 1136, which describes the device in full. Size, 7 x 10, pp. 10.

Direct Current Motors.—Canadian Westinghouse Co., Hamilton. Circular No. 1138 describes and illustrates direct current motors of large capacity. It also contains a list of circulars now in force. Size, 7 x 10, pp. 11.

Steam Traps.—The Joseph Dixon Crucible Co., Jersey City, N. J., publish a very interesting pamphlet on the subject of steam traps. It is an illustrated description of the several varieties, with valuable suggestions by W. H. Wakeman, expert steam engineer and author of well-known books on steam engineering. Size, 5¼ x 7¼, pp. 29.

Cooling Towers.—The De La Vergne Machine Co., New York, N. Y., has just issued a folder describing the Klein Water Cooling Tower. Size, 6 x 9, pp. 4.

Automatic Vises.—The Pittsburgh Automatic Vise and Tool Co., Pittsburgh, Pa. Automatic double and single swivel vises, as manufactured by this company are set forth in an artistically arranged catalogue. Size, 6½ x 4, pp. 28.

Sawmill Carriages.—The Wm. Hamilton Manufacturing Co., Peterborough, Ont. An illustrated catalogue descriptive of sawmill carriages, and their equipments, also husk frames and fittings, which is being distributed by this company, has been sent to us. The catalogue is well designed, and printed, and should be in the hands of everyone interested in this class of machinery. Size, 6 x 8¾, pp. 40.

Nernst Lamps.—Nernst Lamp Co., Pittsburgh, Pa., have just published, through the Westinghouse Company's Publishing Department, a pamphlet describing the new Pennsylvania Terminal, New York City. It outlines briefly the architecture of the building, and its lighting system. Size 4½" x 6", pp. 16.

Air-Brake Equipments.—Westinghouse Traction Brake Co., Pittsburgh, Pa. Bulletin T 2001, gives publicity to straight Air Brake equipment, schedules S. M. -1, S. M. -2, and S. M. -3. These air brakes are adapted to electric railroading. Size 8½" x 11", pp. 12.

Steel-Concrete Chimneys.—Weber Steel-Concrete Chimney Company, Chicago, (Toronto office, 116 Home Life Building), have sent in an illustrated pamphlet showing some of the tall chimneys they have erected. Size, 4" x 9", pp. 47.

Consolidated Type Freight Locomotives.—A pamphlet just published by the American Locomotive Company illustrates and describes Consolidation locomotives weighing more than 175,000 pounds. It is a sequel to the pamphlet issued in October presenting designs of this type weighing less than 175,000 pounds. In the pamphlet 28 Consolidation locomotives built for various railroads and ranging in weight from 175,000 pounds to 250,000 pounds are illustrated, and the principal dimensions of each design given. This is the fourth of the series of pamphlets which is being issued by the American Locomotive Company to include all the standard types of locomotives. The series now covers the Atlantic, Pacific and Consolidation types. Copies of these pamphlets may be had upon request.

CORRESPONDENCE.

"One man's word is no man's word,
Justice needs that both be heard."

956 Nicola Street,
Vancouver, B. C., Oct. 31, 1906.

The Editor "The Canadian Engineer:"

Dear Sir,—The enclosed circular received to-day, but have not filled in same, because I am a subscriber and believe I have several months yet to run before renewing. If not, kindly put my name down for another year, and oblige.

Yours truly,
ARTHUR E. HEPBURN.

P. S.—I may add that I enjoy thoroughly your journal and would not miss being a subscriber for treble the amount.

A. E. H.

ON PUMP SLIPPAGE.

By W. Perry, Hydraulic Engineer, Montreal.

It is well-known that if a pump is in thorough order, it should discharge within 2% of its standard capacity. Less than that would be rather too tight a fit, and may, if run dry for a few minutes without catching its water, develop slight friction, expand the piston or plunger, and allow the metal to cut. If, however, a pump is put together in a thoroughly practical manner there will be no trouble. I have had them run on a slippage of 1¼% on an 18, 10, 12 Underwriter steam pump; but I find from many tests of steam pumping plants, that the engineers in charge knew nothing of any such thing as slippage: i.e., water passing from one side of the piston or plunger to the other, taking it for granted that what the eye does not see is not likely to give trouble. I find by personal interviews with pump men about this slippage question, that they have not given this very important matter the consideration in the practical operation of pumping machinery that it demands. If engineers in the different pumping stations and factories would give this subject serious attention, a considerable economy of power fuel would be realized. I had occasion to test a waterworks plant in a small town near Montreal with the following results. Various tests were made in the different parts of the town, and under 80 lbs. pressure with a pump in one of the best locations we threw two 1" streams. This was the best that could be done with a Duplex, double-acting steam pump, 10" water cylinder, 13" stroke, capacity per stroke 4.42. Running at 50 revolutions this pump should deliver 884 gallons per minute, but allowing 2 per cent. for slippage, would deliver 874.68 gallons per minute, and throw three good 1⅛" streams for fire service. Returning to the pump house, I had the engineer close off the main valve leading to the town, put on the 80 lbs. water pressure, and the pump made 18 revolutions per minute, equivalent to 318 gallons slippage per minute. This 318 gallons per minute slippage would take a 40 H. P. boiler to run a steam pump delivering that quantity of water, costing at lowest figure $9 per 24 hours. I have with very few exceptions ever gone over a steam pump but the water end has been in a bad state of repair: valve, springs and spindles gone, some valves too soft, some too hard. I do not for a moment find fault with the builders of the different styles of steam pumps. It remains for the men in charge to see that all this loss is avoided, and it can, by being carefully watched. I have made tests of steam pumps before and after repair, as follows:—

Before Repair.	After Repair.
40% shippage	1.30%
50% "	1.25%
60% "	1.25%
70% "	1.25%

Now why this state of affairs should occur is easily explained:—

Carelessness, this can be easily detected by closing off valve on discharge pipe, and setting the relief valve to 100 lbs. or more, as circumstances call for, and the slippage can be easily detected. Revolution counters are supposed to figure out accurately the number of gallons pumped per 24 hours. The following incident occurred some time ago. The counter gave revolutions per minute, and upon this data 1,500 gallons per minute were supposed to be displaced. It was decided that house-holders were using too much water and meters were to be used when it was found that there was a 30% slippage. After new plungers were put in, the pump was operated with only 1½% actual slippage, under 104 pounds pressure; the meters were discarded. At the annual meeting of the American Waterworks Association held at Boston in July last, a paper on this subject was read, but in the absence of Mr. A. L. Holmes, was not fully discussed. I made some remarks in connection with pump slippage, and hope at the next meeting in Toronto in 1907 that this very important phase of hydraulic engineering, namely, pump slippage, will be thoroughly investigated by the members.

W. PERRY, Hydraulic Engineer,
The John McDougall Caledonian
Iron Works Co.,
Montreal, Que.

THE CHEMISTRY OF HYDRAULIC CEMENTS.

By John Waddell, B.A., D.Sc.
School of Mining, Kingston, Ont.

The chemistry of ordinary hydraulic cement may be most easily approached by a consideration of the production and setting of plaster of Paris.

Calcium sulphate is found in two mineral forms: one, anhydrite, is simple calcium sulphate, $Ca SO_4$; the other, gypsum, is calcium sulphate along with water $Ca SO_4, 2H_2O$. Gypsum is perfectly dry, the water not showing as such until the substance is heated, when water is given off in the form of vapor. The crystalline character of the gypsum is lost and the mineral changes to a fine powder. The water in gypsum is, therefore, called **water of crystallization.** If anhydrite powder is mixed with water it does not solidify into a compact mass; in other words, does not as the original gypsum. Thus, the paste made by mixing the powder with water becomes after a short time as hard as the natural mineral, and a plaster cast is practically a piece of gypsum. The process of setting seems to be that the plaster partially dissolves in the water mixed with it, and soon hydrated crystals of gypsum separate out. These crystals interlace, as may be seen by examining a thin section under the microscope, and thus the mass is compacted.

The advantage of using plaster of Paris instead of the original gypsum is, therefore, twofold. It allows of the employment of a thin paste, which can be run into moulds, and so may be made into any shape much more readily than would be possible by chiselling solid gypsum. The thin paste may also be used to fill in the irregularities between two adjacent surfaces, and on setting, cement them together.

The setting of ordinary mortar is somewhat similar to the setting of plaster of Paris. Mortar is a mixture of lime, water and sand. Lime is obtained from limestone by driving off carbon dioxide at a high temperature. When the lime has been slaked it is made into a paste with water, and is mixed with sand. The setting does not take place until the water has to a large extent evaporated, and then the carbon dioxide of the air unites with the lime, forming carbonate of lime. The carbonate is not produced to any considerable extent so long as the lime remains wet, and hence mortar does not set under water. Limestone, from which lime is obtained, is carbonate of lime, and, therefore, in the setting of mortar the original substance is reproduced just as in the case of plaster of Paris, the difference being, that in the former case the substance driven off and reabsorbed is carbon dioxide; in the latter case the substance driven off and reabsorbed is water. The sand in mortar takes no part in the chemi al action; it merely prevents too great contraction during the process of drying and changing into carbonate, and thus avoids cracking. There is the interlacing of crystals of carbonate of lime, which binds the particles of sand together and makes the whole mass compact, just as in plaster of Paris there is interlacing of crystals of hydrated sulphate.

In order to understand the process of manufacture and the setting of hydraulic cements, it will be advantageous to consider what happens when limestones of different gradations of impurity are burned. Pure limestone, as has been already stated, is calcium carbonate, and when it is raised to a red heat it begins to lose carbon dioxide, though for complete decomposition a higher temperature is in practice necessary. The decomposition is aided by a current of air or steam. The "quick" lime thus obtained is white, and on addition of water it becomes hot, swells up and falls to a fine powder, thus forming slaked lime. Lime which slakes in the manner described is technically called "fat lime." If the limestone contains any considerable quantity of clay and other impurities, the lime obtained does not slake in the above manner. The slaking is slow; the lime does not develop much heat, and does not fall to powder in the same way. It is called lean lime. If the clayey impurities are sufficient, the lime assumes hydraulic properties; that is, it hardens by the action of water, and tends to set under water. The setting, in this case, is not mainly if at all due to the absorption of the carbon dioxide, with the formation of the original carbonate, but the silicates formed by the action of the clayey matter on the lime, combine in some way with water, producing a more or less compact mass. The more impurities up to a certain limit, the more rapidly does the lime harden. Hydraulic limes contain generally from 18 to 25 per cent. of clay, free silica, combined silica, iron oxide and alumina, and sometimes magnesia and alkalies. The burning must be done slowly; otherwise the carbonate may not be decomposed without fusion of the mass, and the temperature should be no higher than just sufficient to expel the carbon dioxide. The impurities in the limestone under consideration do not furnish enough silica to replace all of the carbon dioxide, and thus there is an excess of lime.

The transition from hydraulic limes to Roman or natural cements is very gradual. Typical natural cements are made from limestone containing a larger proportion of clayey and other impurities than the limestone from which hydraulic limes are made, and the temperature at which the burning takes place is usually higher. The temperature must, however, not be sufficient to fuse the mass. The product thus obtained can scarcely be called lime. It does not slake on the addition of water, but if it is ground into fine powder and then mixed with water, it combines with the water and sets. The place in the United States where the natural cement industry has been best developed is Rosendale, N.Y., and in this country natural cements are sometimes called "Rosendale," just as in Europe a common name is "Roman." Rosendale limestone contains a large percentage of magnesia, and the cements made from it naturally have a large magnesia content. A number of the other well known natural cements are of a similar composition, and hence the opinion was formerly prevalent, and still continues to a certain extent that a large proportion of magnesia is essential in a natural cement, though in a Portland cement it is inadmissable. It can, however, be shown that magnesia in natural cement, merely takes the place of lime, and that if the 30 per cent. of magnesium carbonate, which is naturally present in Rosendale limestone were replaced by calcium carbonate, the burnt rock would possess equally good hydraulic properties; if, however, the silica and alumina of the clayey constituents were absent, the burnt rock would not possess hydraulic properties, but would be merely a magnesian lime.

No limestone is perfectly uniform in any considerable quantity, and, hence, natural cements cannot be perfectly uniform. Portland cements differ from natural cements partly in that the calcium carbonate and the clayey materials are more thoroughly mixed, partly in that the burning takes place at a higher temperature. The thorough mixing permits a more complete burning, because in natural cement, if semi-fusion takes place, there are apt to be enclosures of unburned calcium carbonate, but in Portland cement the mixture is so intimate that the carbon dioxide is expelled at the same time as the combination of the lime silica and alumina takes place, and there are no such enclosures.

One of the best definitions of Portland cement is the following: "Portland cement is an artificial product obtained by finely pulverizing the clinker produced by semi-fusion of an intimate mixture of finely ground calcareous and argillaceous material, this mixture consisting approximately of one part of silica and alumina to three parts of carbonate of lime, or an equivalent amount of lime." It will be noticed that emphasis is laid upon the **thorough** mixing of the calcareous matter, which may be in the form of ordinary limestone or chalk or marl, with the argillaceous or clayey material, which may be in the form of clay or shale or slate, and in order to thorough mixing it is necessary that the materials shall be finely ground. The different constituents are ground separately, then mixed in the proper proportions, and then properly burned to a semi-fused mass. The burning must be done in such a manner that the mass obtained will be as uniform as possible. The various processes are not to our purpose just now, suffice it to say, that the most satisfactory has proved to be in the rotating kiln, the fuel employed being coal dust carried into the kiln by a blast of air, which provides oxygen for the combustion. The clinker produced is harder and more vitreous than that of natural cement, and it needs to be ground more finely. From 90 to 95 per cent. must be capable of passing through a hundred mesh sieve.

A very important condition is introduced by the higher temperature at which the burning takes place. As has been stated, natural cements frequently contain large quantities of magnesia but in Portland cement the magnesia content must be kept low, more than 3 per cent. being decidedly injurious. The reason is that magnesium silicates and aluminates formed by burning at a lower temperature react with water, and set, whereas, the substances produced at a higher temperature do not. Calcium silicate and aluminate do not lose their hydraulic properties if formed at a high temperature, but have them rather increased, and a Portland cement, while it does not set so rapidly as natural cement, has greater strength.

A good Portland cement is a mixture of calcium silicate and aluminate. A small quantity of magnesia may be allowed, a small quantity of iron, a small quantity of alkali, but their presence is no advantage, and any considerable amount of these impurities is detrimental. A cement might be made from a pure calcium silicate of proper constitution, but such a cement could not be fused at a temperature possible under the circumstances, and the presence of alumina is practically necessary. The best proportions are that the weight of lime is equal to 2.8 times the silica, together with 1.1 times the alumina. The proportion of calcium silicate and calcium aluminate may vary within narrow limits, the composition of the cement being expressed by the formula $x(3CaO, SiO_2) + y(2CaO, Al_2O_3)$. The equivalent of lime in the silicate is three times that of the silica, and the lime in the aluminate is twice that of the alumina, so the equivalent of lime in the cement will be between two and three, and the best proportion is said to be that shown by the ratio $\frac{CaO}{SiO_2 + Al_2O_3} = 2.75$. If iron is present, ferric oxide plays the part of aluminium oxide.

The method in which setting takes place is somewhat similar to that of plaster of Paris, though not nearly so simple. There seems to be some doubt as to the precise result, but hydration certainly takes place with the formation of crystals. It is said that under the microscope crystals of calcium hydroxide are seen to grow rapidly and the grains of cement appear to swell, forming a mass of amorphous particles.

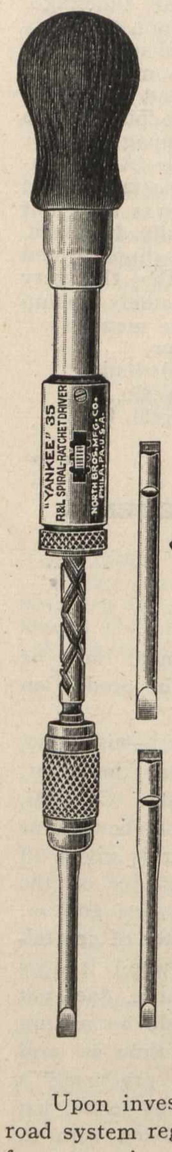
Very probably the reaction is something like that represented by the equations:—

$$2Ca_3SiO_5,\ 9H_2O = 2CaSiO_3,\ 4Ca(OH)_2,\ 5H_2O.$$

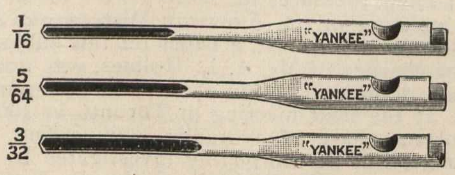
$$Ca_2Al_2O_5,\ 2Ca(OH)_2,\ 10H_2O = Ca_4Al_2O_7,\ 12H_2O.$$

If reference be made to the proportion of calcium silicate and aluminate in cement it will be seen that if the reaction is exactly as above more lime would be produced by the decomposition of the silicate than would be used in the formation of the more basic aluminate. The lime, however, appears to be in an insoluble condition, since it does not give an alkaline reaction to phenolphthalein. The subject still requires investigation, though the general principles are pretty fully understood.

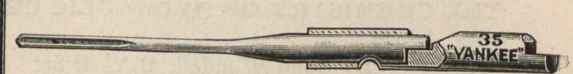
SPIRAL-RATCHET SCREWDRIVER.



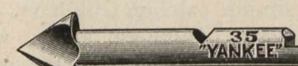
In view of the demand for a lightweight spiral-ratchet screwdriver, North Bros. Manufacturing Co., Philadelphia, Pa., have designed and are manufacturing the tool illustrated. It will be found of special value to



electricians, cabinetmakers, carpenters and mechanics having a large number of small screws to drive. It is small enough to be carried in the pocket, being only 7″ long closed, and weighs, complete, less than 7



ozs. It has a double ratchet, and will drive screws in or pull them out, and is so arranged that it may be used as an ordinary screwdriver, either closed or extended. The convenient size and weight of this tool



should commend it to many. The length of the driver, with bit in chuck, is 9⅛″, closed, and 12½″ extended. Two screwdrivers, three drills and one countersink are furnished with the outfit.

Upon investigation by the chemist of an extensive railroad system regarding the best protection of structural work from rust, it was found that the value of the various paints used was directly dependent upon the size of the particles of pigment, that is to the fineness to which it had been ground. It is a common idea among paint users that grinding in oil is preferable to dry grinding. Experiment, however, showed that dry grinding, especially when combined with floating to remove large particles, was much more efficient than the same grinding done in oil.

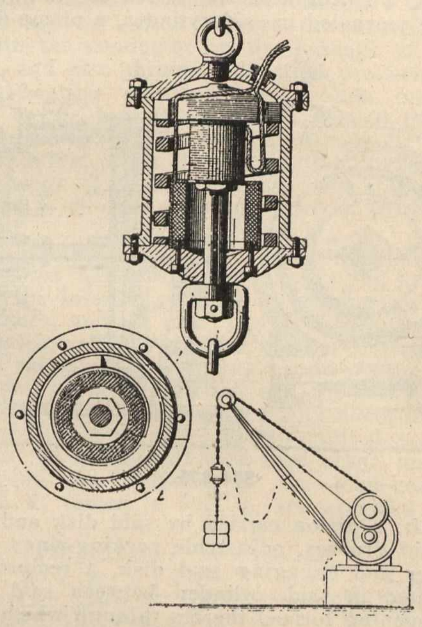
INTERNATIONAL PATENT RECORD

Dominion Houses of Parliament.

CANADIAN PATENTS.

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

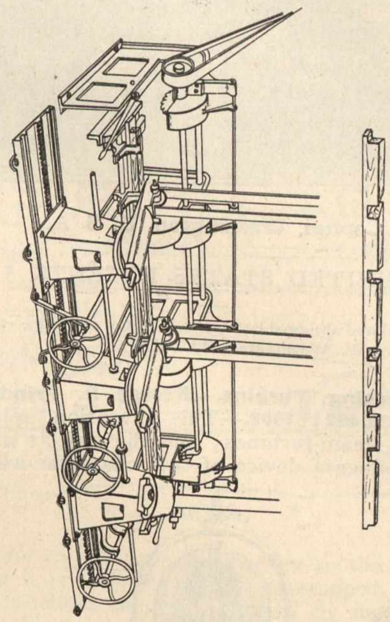
Electric Weighing Apparatus.—99,297.—The invention consists of a cylindrical casing adapted to be supported from the top and a pair of solenoids arranged within said casing, one of the said solenoids being secured to the lower portion of the casing, and the other supported upon a spiral spring, and adapted to enter the aforesaid solenoids from the upper end. A weight-supporting member is secured to the end of the latter solenoid, and projects downwardly through the bottom of the cylindrical casing, the spiral spring supporting the said solenoid supporting the weight



99,297.

put upon the weight-supporting member. The upper solenoid has an alternating electric current passing through it to induce the current in the winding of the other solenoid in proportion to the extent to which the upper solenoid enters the other, and the lower solenoid is wired to an electrical measuring device to indicate the variations in the induced current upon a dial, thus indicating the weight of the material weighed by the extent to which the upper solenoid is drawn downwardly against the spring tension into the lower solenoid.

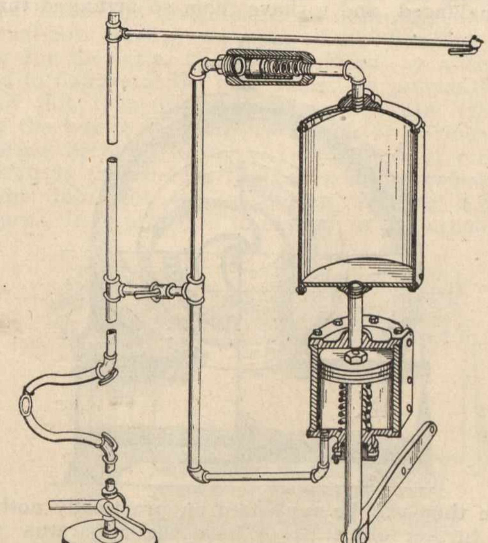
Gaining Machines. — Alexandre Leclair. — 98,337. — A perspective view of an improved gaining machine is shown, designed to simplify the finishing of belt rails used in car construction, and without changing the position of the said belt rails in the carriage of the machine before finishing the necessary number of cuts. The machine is constructed on a plurality of standards, with a saw and knife shaft journalled therein, the knives being suitably covered. Under these knives a carriage is arranged, to which the rail is secured. The carriage is then propelled forward on the standards under the knives by means of one of three hand-wheels to give the rail four rightangular cuts, after which it is returned to its outward position and locked. Adjustable pedestals are arranged on a bed-plate in front of the machine, and surmounted by crowns, which may be moved by another of the hand-wheels and a set of bevel gears inwardly over the table, bringing rotating knives, which are mounted in said crowns into contact with the belt rail to make the necessary angular cuts therethrough. It will be thus seen that the two operations, namely, moving the



98,337.

table under one set of knives, and then moving the knives journalled in the crowns over the rail, is all that is necessary to make a complete belt rail.

Air-Brakes.—Charles S. Jackson.—93,977.—The illustration shows an improved system for air-brakes, where the only exhaust occurs at the engine. It consists essentially of the brake cylinder, with a piston spring held therein, and an auxiliary cylinder arranged in proximity to said brake cylinder, and having suitable pipe connection therewith connected to this auxiliary cylinder is the operating valve. This valve is of a very simple construction, and is essential in the operation of the device as normally when the air pressure is on the train line; the valve is lifted from its seat, which allows the air to enter the by-pass and fill the auxiliary cylinder, and from there into the operating end of the brake cylinder. At the same time, however, the air is allowed to enter by a suitable pipe into the opposite end of the brake cylinder, thereby balancing the piston until the air from the train line is released, when the air exhausts from one end of the brake cylinder by the above mentioned pipe, and at the same time the valve is dropped to its seat, which closes the by-pass and retains the pressure of air in the auxiliary cylinder. This pressure now acts on the operating side of the brake piston and sets the brakes. To release them it is only necessary to allow the pressure to enter the train line, when the pressure in the brake cylinder is again balanced.



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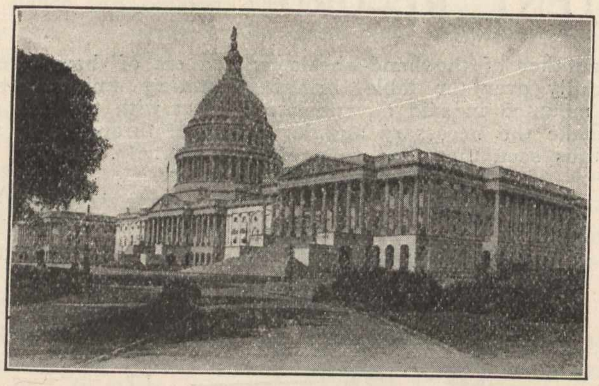
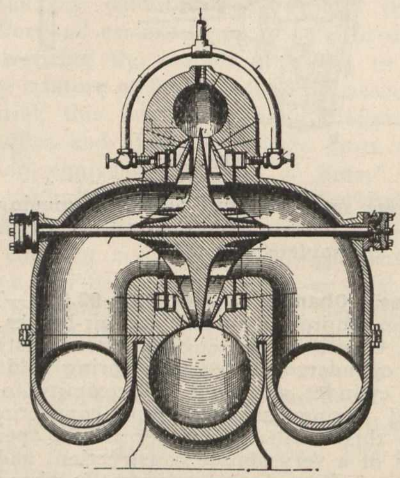


Capitol, Washington, U. S. A.

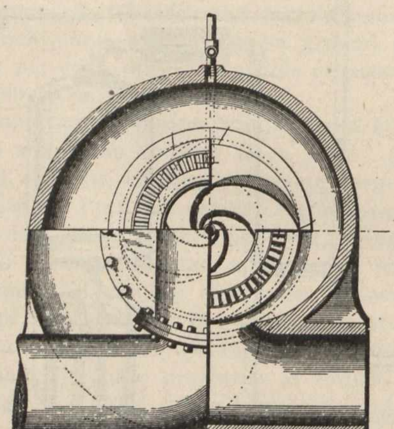
UNITED STATES PATENTS.

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

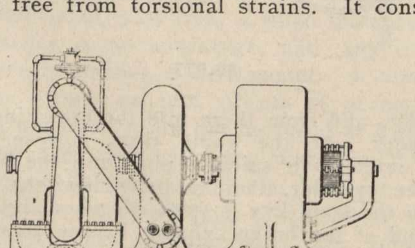
Self-Condensing Turbine.—Roscoe S. Prindle, of New York, N.Y.—833,482; 1906.—This invention relates to improvements in steam-turbines; and the objects of the invention are to produce a device of this character which may be



driven at the very highest possible speeds, dependent only on the tensile strength of the material, to practically do away with friction, to have the running parts accurately and automatically balanced, and to have them so arranged that when



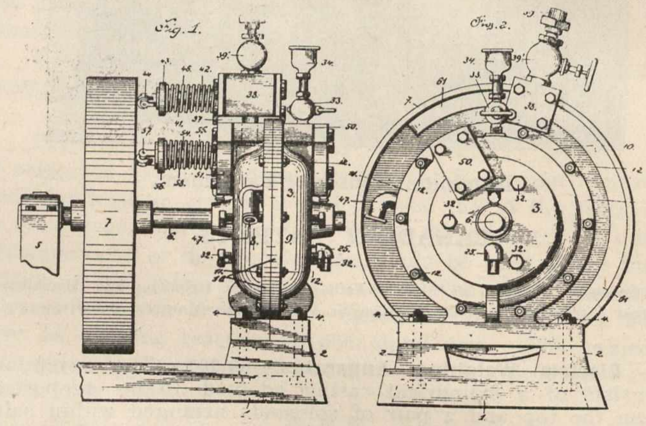
in rotation they will be supported on practically nothing but fluid. A further object is to have the apparatus self-condensing and free from torsional strains. It consists of the



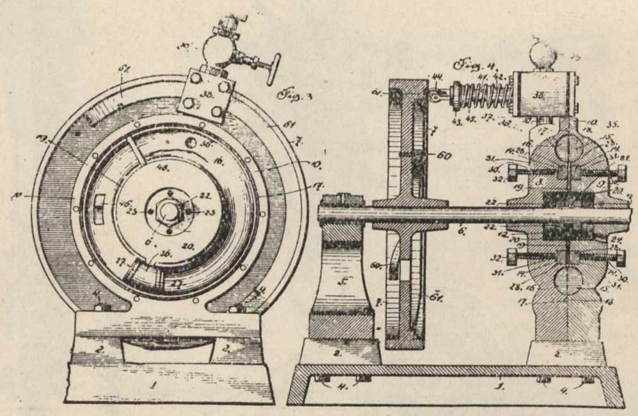
833,482.

combination of a steam-turbine and a centrifugal pump, the steam-turbine wheel and pump-runner being made in a single unitary structure, and including pump-vanes and turbine-vanes located symmetrically with respect to a central plane, said combined structure being provided with steam-vanes and pump-vanes on each side of said central plane, whereby a perfect balance is maintained.

Rotary Engine.—Stefan Lach, Allegheny, Pa.—834,675; 1906.—This invention relates to certain new and useful improvements in rotary engines; and the invention has for its primary object to provide an engine from which a greater efficiency is obtained than engines of a reciprocating type. Another object of this invention is to provide an equally-balanced engine which will be positive in its action, simple in construction, and free from injury by ordinary use. My invention aims to provide an engine from which a maximum



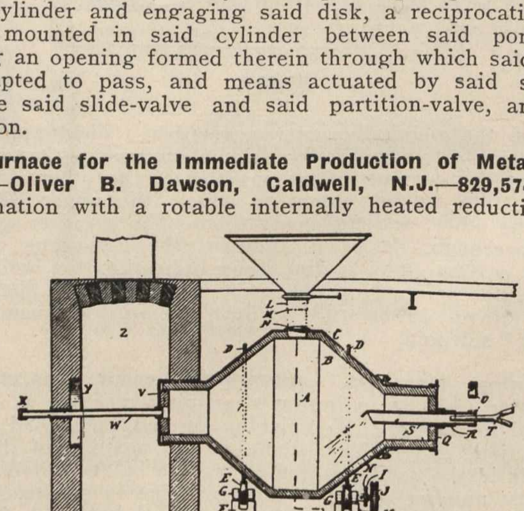
amount of energy can be obtained from a minimum expenditure of fuel, this being accomplished by dispensing with fly or balance wheels and with any friction that may exist between the operating or movable parts of the engine. It comprises a two-part cylinder, the parts of said cylinder having confronting circumferentially-arranged grooves formed therein, inlet and exhaust ports communicating with said grooves, a spring-held slide-valve controlling the inlet-port, a shaft journaled in said cylinder, a piston-disk carried



834,675.

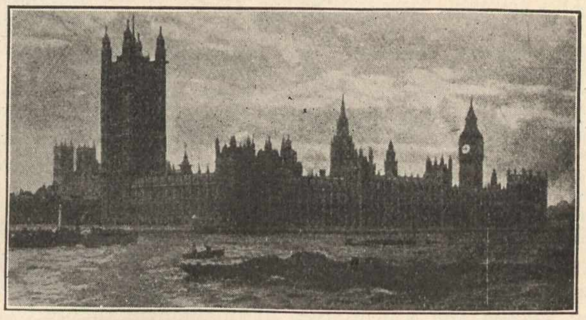
by said shaft, a piston carried by said disk and adapted to travel in said grooves, adjustable packing-rings mounted in said cylinder and engaging said disk, a reciprocating partition mounted in said cylinder between said ports, and having an opening formed therein through which said piston is adapted to pass, and means actuated by said shaft to operate said slide-valve and said partition-valve, and said partition.

Furnace for the Immediate Production of Metal from Ores.—Oliver B. Dawson, Caldwell, N.J.—829,574.—The combination with a rotable internally heated reduction fur-



829,574.

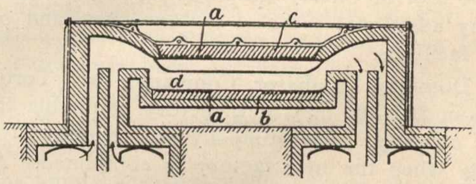
nace, means adapted to deliver the heating flame to any part of the charge or hearth, a gas-mixing chamber and means for regulating the character of the flame.



British Houses of Parliament.

GREAT BRITAIN.

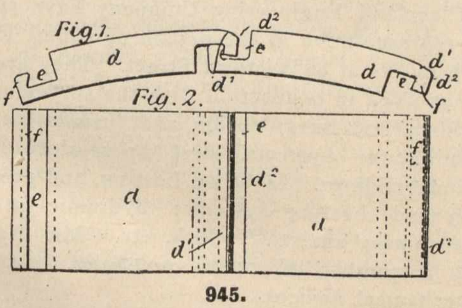
Electric Furnaces.—T. Parker, London.—14,884; 1905.—This invention relates to furnaces, and has for its object to provide a furnace adapted for electrical resistance and inductive heating for the refining of steel and for the smelting of nickel and other metals. Electric conductors **a** of carbon or other suitable conducting material are provided beneath the surface of the bottom **b** of the furnace, and are laid spirally so as to give the maximum induction effect to the charge of molten metal in the furnace. On the passage of



14,884.

an alternating current through the conductors thus provided, the furnace will be heated through the incandescence produced within the conductor on the passage of the current through it, and also through induction producing magnetic and current-heating effects in the molten metal. In its application to the furnace illustrated, it will be understood that the electric heating is designed principally for the final stages of refining, when the heat of the furnace or gas is no longer used. The conductors **a** may also be provided upon the top **c**, or even upon the sides **d**, of the furnace.

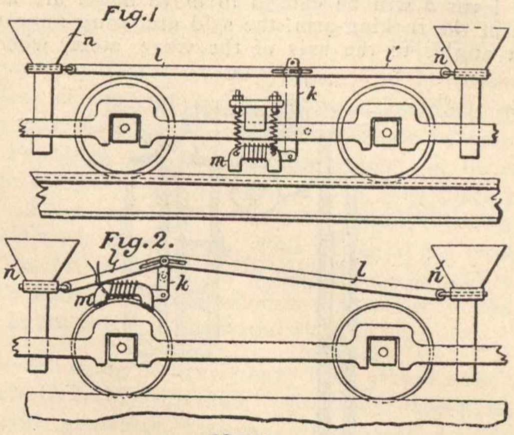
Casting Cylinders.—H. A. Hoy, Manchester.—945; 1906.—This invention has reference to means for hardening and toughening the interior surfaces of steam-engine and other cylinders, tubes, and the like. In carrying the invention into effect, in the casting of a cylinder there is employed, as usual, a perforated metallic barrel, having a band or wrapping of hay, straw, or other suitable material, and super-imposed thereon a thickness of loam; but the essentially novel feature of the invention consists in the use of small chills **d**, so constructed that they can be interlocked with each other, and be wound spirally around the periphery of the loam-coated barrel. These chills **d**, shown in Fig. 1, are provided with inter-



945.

locking recesses **e** and projections **f** at each end, and are preferably rhomboidal in shape and curved to the periphery of the loam-coated barrel. The first of such chills is secured by pegging or otherwise, the remaining chills, owing to their rhomboidal shape, and the interlocking means provided, can be secured to each other and wound spirally round the loam-covered cylinder and the clothing of chills be completed at one operation. The last of the series of chills **d** is secured to the loam barrel by pegging or otherwise. In order that the chills **d** may be used upon a loam-covered barrel of smaller diameter, the part marked **d1** of the chill is curved inwards so that the edge **d2** shall not be proud when the clothing of the chills is contracted in diameter.

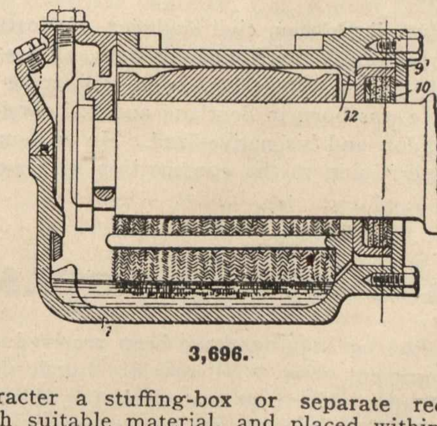
Sanding Gear.—M. Cummins, Manchester.—10,644; 1905.—This invention relates to means whereby a magnetic device or a solenoid acting as a valve, or attached either directly or indirectly to the sand-valves of the sanding gear on tramway carriages, can be operated for the purpose of sanding the rails at and from either end of the vehicle by the motor-man using either the front or the rear controller when applying the rheostatic electric or magnetic brakes while the car or vehicle is running either forward or backward. For this purpose, the braking current is used for actuating the magnet which opens the sand-valves. By operating the sand-valves with a magnet energized and regulated to release the sand below the wheels by the current that causes skidding, the sand is allowed to fall on the track, increasing the friction between the wheels and the rails, thereby preventing skidding, and allowing the motors which



10,644.

are generators to consume the energy in the moving car or vehicle until it is brought to rest or stopped. One or more magnetic appliances **m** are supported by means of springs attached to the truck-frame directly over the rails or over the wheels, and these magnetic appliances are connected to the sanding gear **n** by a lever **k** and rods **l, l1**, so that when the magnet or magnets is or are energized by the current from the motors operating as generators they are drawn to the rails or to the wheels, and caused to move a sufficient distance out of their original positions by the progressive or by the retrograde movement of the vehicle to open the sand-valves, so that the rails will be sanded in advance of the wheels irrespective of the direction in which the car or vehicle might be running.

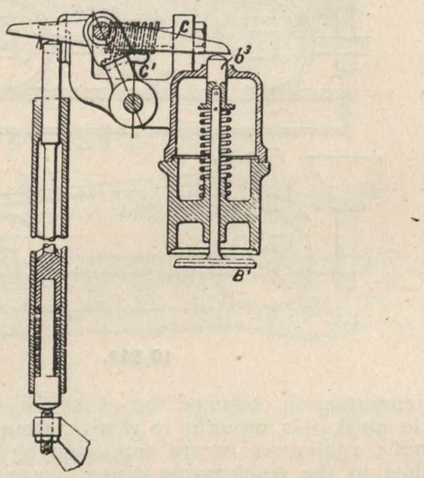
Axle Journal-Boxes.—E. Peckham, London.—3,696; 1906.—The present invention relates to improvements in the construction of journal-boxes for the axles of railway, tramway, and other vehicles, and the object is to construct a journal-box which is effectively closed against the admission of dust or grit, and also to prevent the escape of the oil or lubricant from the box. The invention is an improvement of the type of journal-box having an open back adapted to contain packing for the axle, and to be closed by a disc or plate fastened to flanges of the box-casing. In previously proposed boxes of this type no adequate means are employed for causing the box to be perfectly closed, or to remain so after the bearing becomes worn, without periodical readjustment. The result is that unless the boxes are attended to almost daily, the lubricant will ooze out, causing a waste and annoyance. It is proposed to employ in a journal-box of the



3,696.

above character a stuffing-box or separate receptacle **10** packed with suitable material, and placed within the open chamber or recess **91** formed at the rear end of the journal-box casing **1**. The flat surface of the receptacle **10**, which is brought into contact with a machined flat surface **12** of the casing being given a smooth finish, to correspond with the smooth finish of the surface of the casing, a sliding movement of the stuffing-box is allowed, when the bearing wears without opening a way for the oil to escape. The improved box will, therefore, remain perfectly closed for a considerable time with practically little or no attention. Besides possessing the merit of efficiency, the improved journal-box is simple of construction, and consequently less costly to manufacture.

Variable Lift-Valves.—The Wolseley Tool and Motor-Car Company, Limited, and R. R. Brown, Birmingham, and L. Silverman, Crayford.—16,436; 1905.—This invention relates to mechanism for controlling the variable lift of mechanically-actuated admission valves of internal-combustion engines, especially those used on motor-cars or boats. In valve-operating mechanism, according to this invention, a lever **c**, which transmits motion by the push-rod **b3** to the stem of the inlet or admission valve **B1**, is pivoted in a rocking-arm **c1**, which in turn is pivoted to the valve-casing, the arrangement being such that by moving the rocking-arm **c1** about its fulcrum the fulcrum of the motion-transmitting lever **c** will be caused to move in an arc about the fulcrum of the rocking-arm, the said arc being approximately at right angles to the axis of the valve stem, whereby the



16,436.

position of the ends of the motion-transmitting lever relatively to the push-rod and the stem of the valve will be varied, not only as regards the actual points of contact of the lever with respect to the push-rod and the stem of the valve, but also as regards the distance of the lever itself from the said points of contact, in accordance with the extent of movement of the rocking-arm. Any appropriate means may be employed for enabling the driver of the vehicle to actuate the aforesaid rocking-arm; for instance, the free end of the latter may be formed with a segmental rack gearing with a worm carried by an axle suitably arranged to be turned by the driver. Obviously, if the engine comprises more than one working cylinder, there would be a corresponding number of the aforesaid motion-transmitting levers which would all be actuated simultaneously from one or more of the aforesaid rocking-arms.

OBITUARY.

Freeman B. Talbot, ex-county engineer of Middlesex, died at his home in London, Ont., on Wednesday, October 24th, after an illness of only ten days.

D. J. Russell Duncan, civil engineer, of Keating & Duncan, engineers, died on November 12th, at his residence, Rowanwood Avenue, Rosedale, from an acute attack of diabetes. He was born in Scotland and had carried on business in London and his native land. He was an expert on matters appertaining to the construction of sewers.

INDUSTRIAL NOTES.

The following inquiries have been received at the Canadian Government office, 7 Victoria St., London, S.W., England:—A Staffordshire firm manufacturing chains for engineering and other purposes desires to get into touch with Canadian buyers.

From the City Trade Branch, 73 Basinghall St., London, E.C.—A Sheffield company, manufacturing cutlery of all descriptions, is open to appoint suitable Canadian resident agent.

Toronto:—

A compound duplex pumping engine is being placed in the Continental Life Building by the Smart-Turner Machine Company, of Hamilton.

The United Zinc Company, of Boston, will establish a factory here. They will locate on the south side of Adelaide Street, west of York, and will employ 20 men at first.

An organization meeting of the railway engineers was held at the King Edward Hotel on Nov. 9th; the meeting was well attended, and a constitution was adopted and a set of by-laws formulated.

The plant of the Standard Bolt and Screw Company of this city, has been purchased by the John Morrow Machine Screw Company, of Ingersoll. The plant was valued at about $28,000, and will be used to supplement the purchaser's plant at Ingersoll.

The Foster-Cobalt Mining Company, has purchased from Allis-Chalmers-Bullock, Limited, of Montreal, through their Toronto office, a mining plant including an "Ingersoll" straight line air compressor, 7 "Ingersoll" rock drills of the latest model, 3 "Lidgerwood" hoisting engines, 2 boilers, 2 sinking pumps, ore buckets and other apparatus.

Commissioner of Industries, Thompson, has recommended that a breakwater be extended out into the Bay from a point about opposite the foot of Parliament Street, and that the stretch of water between this piling and the present one at the foot of Cherry Street be filled in. This will provide many additional acres of factory sites, and offer good shipping facilities.

The Dominion Radiator Company, of Toronto, will spend about $200,000 on a new factory of double the present factory's capacity. The company will employ from 500 to 600 hands when the new factory is completed. A site has been secured on Dufferin street near the Canada Foundry, south of the C. P. R. tracks and some distance north of the present factory, which is for sale.

The Stromberg-Carlson Telephone Mfg. Co., of Rochester, N.Y., has moved its Toronto office from 18 Toronto Street to 60 Front Street West. Mr. Gibson, their Toronto representative reports continued demand for telephone material, and their new premises will permit greater facility for the display of a full line of samples. A large stock will also be kept on hand, so that customers will be able to have their orders filled more rapidly.

The Engineers' Club, decided on Thursday evening, November 8th, to sub-let their rooms at 96 King Street West, to the Toronto Branch of the Canadian Society of Civil Engineers, one meeting a month to be held by the members of the society. The members of the Engineers' Club, who are not members of the C.S.C.E. are to become associate members, and with this be afforded the privilege of attending the monthly meeting of the Toronto branch of the society.

The Cleveland Engineering Company have appointed a Canadian representative in the person of Albert E. Hawker, M.E., with offices at 86 Victoria Street. They are prepared to carry out work in connection with the surveying and laying out of railway lines; design and installation of waterworks and sewer systems, steel or reinforced concrete bridges, and buildings. Lighting, heating, and power plants; ventilating and heating systems; hydraulic propositions; survey of mines; analytical work, etc. Mr. Hawker also represents a number of other companies, manufacturing special mechanical devices.

General:—

The Robb Engineering Co. has received an order from the Allis-Chalmers-Bullock Co., for three 125-horse-power engines for the C.P.R. Hotel, Vancouver, B.C.

Rhodes, Curry & Co., Amherst, have placed the order for the boilers for their new Rolling Mills with the Robb Engineering Co. There will be four boilers of 150-horse-power each.

The production of the various departments of the Dominion Iron and Steel Company during the month of October, was as follows:—Coke, 34,400 tons; pig-iron, 23,325 tons; ingots, 25,425 tons; blooms, 22,553 tons; rails, 12,621 tons; rods, 4,214 tons.

The Mowry Lock Nut Co., are being offered strong inducements by Sydney, C.B., to establish their works in that place.

The H. W. Johns-Manville Co., New York, have opened a branch office at 315 Equitable Building, Baltimore, M.D. This has been done owing to the increasing business in that vicinity.

The Cape Breton Technical School, Sydney, C.B., was formally opened on November 5th. The opening address was delivered by Dr. J. E. Woodman, of the Dalhousie School of Mining.

The Link-Belt Company has recently opened an office at No. 913 Missouri Trust Building, St. Louis. Mr. E. C. Berghoeffer, an engineer of long experience with the Chicago house of the company, is in charge.

British Columbia is to have another large lumber mill. The Columbia River Timber and Transportation Co., Ltd., capital, $500,000; the mill will be located at Arrowhead, and the office of the company will be at Revelstoke.

American bolts and nuts are not giving satisfaction in Australia, according to Consular reports, the English thread Whitworth being preferred to the United States standard. Complaint is also made that the fitting of nut and bolt is not as tight as in the English product.

The Maple Leaf Rubber Company, of Port Dalhousie, Ont., with a capital of $300,000, and employing four to five hundred hands has been purchased by the Canadian Consolidated Rubber Company, of which Major George W. Stephens, M.L.A., is president, and D. Lorne McGibbon, managing director.

At the annual meeting of the Alberta Railway & Irrigation Co., Col. Wodehouse said he estimated the net profits for the year at $343,960. After paying interest on 5 per cent. debentures there remained a balance of $47,225 against $21,000 last year. The minimum selling price of irrigated land is now $20 per acre.

Port Arthur has secured two new industries. The Miesel Manufacturing Co., will establish a works for the manufacture of agricultural and mill machinery, employing about 500 men; and the Seamen-Kent Co., will erect a large factory for the manufacture of hard-wood, house building material. About 100 men will be employed.

The Mond Nickel Co., Sudbury, Ont., have purchased two 150-horse-power induction motors. One will drive a compound duplex "Ingersoll" air compressor, and the other operate a reversible double friction drum "Lidgerwood" hoisting engine. The complete equipment will be built by Allis-Chalmers-Bullock, Limited, of Montreal.

The Arthur Koppel Company, the well-known manufacturers of portable industrial narrow-gauge railroad material who have offices in New York and Chicago, have opened a new sales office in Pittsburg, Pa., 1601 Machesney Building, 4th Avenue. This will become the main office for the trade in the Western and Southern States.

John Murphy, the Government Electrical Engineer, was upheld in his recent suit against the Ottawa & Hull Power & Manufacturing Co., for infringing his patents for combating frazil ice. By the terms of the judgment validity of the patents is admitted. It is understood that a substantial sum has been paid by the Power Company for the use of the patents.

Hon. Walter Scott is quoted as saying that the people of Saskatchewan are facing the question of freezing to death. He says: "There is not a ton of coal in the province, owing to the Lethbridge strike, and the misery will be great unless the strike is settled right away. We must get fuel, no matter what it costs. We must have coal, and will have to get it from Fernie, from the C.P.R., or wherever we can."

The Gilson Mfg. Co., of Port Washington, Wis., are building a branch plant at Guelph, Ont. The company has met with considerable success, owing to the many features which make their engines attractive for unskilled operators. These engines are easier to operate, more economical and efficient than many others, and as they are sold at an exceptionally low price, they should meet with the approval of the Canadian market.

Carman, Man., is to have a new industry, the Commercial Cement Co., Limited, 640 acres of rock land has been purchased, and the company is about to erect a modern cement plant. The temporary offices of the company will be at 220 McDermot Ave., Winnipeg.

Messrs. Isaac and Honeyman started a small foundry in Nelson, B.C., about six months ago, when casting was done only six or seven times a month. Now casts are being made daily, and they are increasing their accommodation by about 50%, and owing to the rush of orders it has been found necessary to start a branch at Greenwood, where they will be turning out castings by the first of the year.

The Canada Tin Plate Company, of Morrisburg, Ont., have four of the eight mills they are installing, near completion, and it is expected that the whole will be running about February, 1907. About 1,000 men will be employed, and the company will manufacture its own black plate and sheets. They expect to be able to supply the whole of the Canadian trade in tin plate. This is one of the most important of the newer industries in the Dominion, and is the first tin plate plant to be established in this country. The opening should be an event in industrial Canada.

The following contracts have been placed with the Allis-Chalmers-Bullock, Limited, Montreal:—600-K.W. water wheel type generator, exciter, switch board, etc., for an addition to the electric light plant, Port Arthur. The plant at present consists of two 250-K.W. alternating current generators, and one 250-K.W. direct current railway generator, which are all of the "Bullock" type. A Pumping Plant consisting of an 8" single stage turbine pump, driven by a 70-H.P. induction motor for the Canadian Copper Co., of Copper Cliff. A 12¼" x 18" Ingersoll Air Compressor, driven by a 50-H.P. induction motor for the Calumet Mining and Milling Co., Calumet, Que. A mining plant, consisting of one-half duplex "Ingersoll" Air Compressor Rock Drills, hoisting engine, ore buckets, etc., for the Northern Pyrites Company of Dinorwic, Ont.

On Monday, October 22nd, the Winnipeg City Council and Water Commission, upon the invitation of Mr. Cecil B. Smith, Chief Engineer of the new power plant Commission, visited the proposed site of the Hydro-Electric Power plant at Pointe du Boise Falls. The party had some startling experience on the spot. Two of the aldermen got into the water and were nearly drowned, while towards the end of the visit the commissariat played out, and famine stared the visitors in the face; but the result of the investigation was that Mr. Smith's scheme was enthusiastically endorsed and the following consulting board and working staff were straightway appointed: Prof. Louis Herdt, of McGill University, Montreal; H. N. Ruttan, City Engineer, Winnipeg; and Wm. Kennedy, Jr., of Montreal. Prof. Herdt is recommended as electrical engineer, Col. Ruttan as hydraulic engineer, and Mr. Kennedy as mechanical engineer. The working staff is as follows:—W. M. Scott in charge of field, with ten or twelve assistants. Mr. Scott is now actively engaged in the preliminary survey and lay out at the Falls. The office staff are:—Chief Designer—R. D. Johnson, late chief designer to the Ontario Power Co.; Chief Electrical Designer—E. B. Merrill, late construction engineer Niagara Power Co. In addition to the foregoing, an able staff of assistants have been engaged, Norman Gibson, O. H. Mitchell, C. R. Holden and Edgar Guy. Mr. Smith has estimated the cost of the new power plant at $3,250,000, including the cost of transmission line and buildings. This will provide something like 17,000 horse-power, which can be increased, if necessary, to 60,000-H.P. The consultation board are of opinion that sufficient power can be developed at Point du Boise Falls, for Winnipeg city requirements, for many years to come. A tramway has been surveyed between Pointe du Boise and Lac du Bonnet, which will be 22 miles long. The transmission line will be 75 miles long in a northeasterly direction. Pointe du Boise is 22 miles from Lac du Bonnet, where an immense power has been developed for the Winnipeg Electric Street Railway and the Winnipeg Electric Light and Power Company, both Mackenzie and Mann syndicates.

Muirhead & Black's elevator at Fort William was destroyed by fire on November 11th. The total loss will go over $20,000, with $10,000 insurance.

An International Exhibition of Tools used in various trades will be held at the "Palais van Volksvlijt," Amsterdam, Holland, from August 15th to September 15th, 1907.

C. E. Shedrick, manufacturer of electrical measuring instruments, heating devices and scientifical supplies, of Sherbrooke, Que., has organized an incorporated company of the name of Shedrick, Rigby, Limited, with headquarters at 157 Craig Street, Montreal. The business will be conducted on a much larger scale than heretofore.

The export duty on coal by the British Government has been abolished, the abolition of the duty taking effect on October 31st. On November 1st hundreds of British steamers sailed for foreign parts, loaded with English coal. Some of these were destined for Canada, so that we may now expect to see Welsh coal laid down in surprisingly large quantities in Canada. Naturally the abolition of the heavy export duty demanded by the British Government has prevented the export of coal in any considerable quantities.

A new metal, called monel, which is expected to cause something of a revolution in the industrial world, is being produced at the works of the Canadian Copper Company at Sudbury. It is cheaper than nickel and it is claimed that it possesses all the qualities of the former. Monel is a compound of copper, nickel, iron, and one or two other minerals which are found in the district, and its importance lies in the fact that it is much cheaper than nickel, it is less liable to rust and will serve all the purposes for which nickel is at present used. The new metal is said to be of equal ductile strength with nickel and to possess all its other essential qualities, but it is not yet claimed that it will serve the purpose of nickel steel used for armor plate.

At a recent meeting of the Toronto Board of Trade the following resolution was passed re Technical Education:—"The Dominion Government appoint a commission to report on the best method for establishing a comprehensive national system of technical education, to provide Canadian industry and commerce with trained assistants from amongst the Canadian people, and thereby aid in developing Canadian industries." The board accepted the report in full, and a copy will be forwarded to Sir Wilfrid Laurier. One clause in the report reads: "Providence has endowed us with resources no other nation possesses. Shall it be said of us that we cannot develop our inheritance for want of expert artisans. And yet it must be confessed we are at present in such a position."

TELEGRAPH AND TELEPHONE

Radio-Telegraphy is the new term given to wireless telegraphy by the International Convention.

The Thorold Board of Trade is considering the question of having a private telephone system for the town.

Marconi's latest scheme is the building of a station at Cottam, Italy. The station will be a very powerful one for communication with Argentina. It will be ready for trial in about a month.

The city of Windsor has renewed the franchise of the Bell Telephone Company for five years. The company has agreed to give the city six free telephones, and to pay $750 per year for the five years.

The Bell Telephone Company are rapidly extending their long-distance system throughout the West, and already Manitoba is thoroughly covered. Next year Battleford will be connected with Winnipeg, and by 1908 Edmonton, Calgary, and Macleod will be on the wire.

MARINE NEWS.

The biggest boat ever built in Toronto, a car ferry for the Grand Trunk Railway Company, is to be launched at the works of the Canadian Shipbuilding Company.

Plans are under way for the construction of a $4,000,000 lock on the United States side of the Sault Ste. Marie Canal. It is proposed to build a lock 1,350′-0″ long, 75 to 80′-0″ wide, and 20′-0″ deep; to be built just north of the present lock.

The Dominion Government will erect a lighthouse at the entrance to Prince Rupert, the Grand Trunk Pacific terminus on the British Columbia coast, to warn navigators of the presence of a dangerous reef in what looks like the safest of waters.

J. M. Ross, of Sydney, N.S., who is interested in the Dominion Iron and Steel Co., says that the company are having two steamers built in the Old Country, for the purpose of carrying their products from Sydney to Port Arthur, for shipment to the Canadian West.

RAILWAY NOTES.

It has been definitely decided to make Prince Rupert the western terminus of the Grand Trunk Pacific.

The Intercolonial Railway shows a surplus of $56,899 upon its operation for the fiscal year up to July 1st.

The net profits of the Guelph, Ont., street railway for the past fiscal year were $7,487. The line is municipally owned.

The C.P.R. has secured control of the Georgian Bay and Seaboard Railway, and also of the Lucknow Railway Company.

The earnings of the Toronto Railway Company for the first ten months of the year are $2,539,623, an increase of $288,865, or 12 per cent.

The Grand Trunk Pacific has decided upon the Yellow Head Pass as the one which it is to use to reach the Pacific Coast. This has been done after careful surveys. The Government will be asked to approve this pass, which will give a grade through the Rocky Mountains of about four-tenths of one per cent.

The first of the Canadian Northern Trains to make the journey between Parry Sound and Toronto, reached here on November 11th. President William Mackenzie, third vice-president, D. B. Hanna, Frederic Nicholls, Noel Marshall, A. W. Smith, Superintendent F. M. Spaidal, and other officials of the road accompanied the train.

The C.P.R. will apply at the next session of Parliament for power to build a line west from Weyburn, Sask., on the Soo line, a distance of 100 miles. This company has also given notice of an application for permission to construct, on the proposed Moose Jaw northerly extension, a junction with the terminus of the Lacombe branch of the Calgary and Edmonton railway.

MINING MATTERS.

Gold assaying $45 to the ton has been found at Birling, on the C.N.R., five miles west of North Battleford.

The shaft of the silver Queen is now down 140 feet, and the showing at this level is 18 inches of high-grade ore.

A very rich vein, four inches wide, has been discovered on the Gilpin property, and is principally native silver.

It is stated that the Port Arthur Silver District is similar in geological formation to Cobalt, and that it will become a big silver camp.

It is stated that William Everett, of the Michigan 'Soo,' has sold to the Timmons Mining Syndicate, of Cobalt, a tract of twenty acres, practically undeveloped, for $70,000.

Demand for shares in Cobalt mines is now appearing in London and Paris. If Cobalt shares come to be quoted in European centres it will create a new activity in the demand.

Gold placer diggings have been discovered just east of Maidstone, Sask. A number of claims have already been staked, and it is thought that big companies will be formed to operate the properties.

McCormack Bros., of New York, have purchased the McLeod-Glendenning Mine at $600,000.

Gold has been discovered at Lardes Lake, 25 miles north of New Liskeard, near the provincial boundary. The discovery is said to be of considerable promise.

It is stated that an agreement has been entered into by the Ontario Government and the holders of the O'Brien Mine property at Cobalt, by which 25% royalty will be paid to the Government, in return for the title of the property.

It is reported that two valuable discoveries of minerals have been made within a hundred miles of Montreal. One is extensive finds of uranium and pitch-blende, the mineral from which radium has been extracted, and the other a large deposit of graphite some three miles from the railway.

Anthony Blum, principal owner of the Laurentian Mine, stated recently that a cash offer of $2,000,000 has been refused for the property. Mr. Blum would not take $5,000,000 for the controlling interest, and says he would not be surprised at a $25,000,000 gold production in the future.

Natural gas has been discovered in large quantities near Merlin, Ontario; after drilling into the gas rock for only two or three feet, the gas pressure tested between 1,000,000 and 1,100,000 cubic feet per day. Drilling had to be suspended in order that the boiler could be moved further from the gas.

According to F. C. Denis, of the Geological Survey, there are incalculable quantities of coal in Western Canada yet undeveloped. He says that if the development of the coal industry is to be taken as indicative of the prosperity and development of that region, then the progress being made is almost unprecedented.

The first car-load of silver ore that has been shipped from Port Arthur in several years, was shipped on November 1st. The ore was taken out of the West End Silver Mountain, and will be shipped to the Omaha smelters where it will be treated. This is the first of many shipments that will be made from the famous mine.

The Beaver people made a valuable discovery on their property, but, it is stated, omitted to comply with practically all the requirements of the Mining Act as to "staking." F. E. Macdonald made a subsequent discovery, and fully complied with the "staking" requirements. He has entered an action to set aside the application of the Beaver Company.

The J. B. No. 2 property has been bought by B. B. Harlan, of Toronto, for a little over $250,000. The mine will be placed on the market under the name of "The Little Nipissing Cobalt Silver Mines, Limited." About $55,000 worth of shares have already been disposed of, and $100,000 is the amount which will be issued at first. The capital stock is $650,000 in shares of $1 each.

The Montreal Reduction and Smelting Company's smelter at Cobalt is moving along rapidly towards completion, and already considerable ore has been offered for treatment. J. H. Brown, chief engineer of the company, who has had an extended experience in mining and smelting, says that the Cobalt District is one of the richest mining countries he has seen, and that half of its value is not known yet.

C. E. Smith, of Brockville, who is prospecting on Calumet Island, has found such promising traces of zinc, lead and copper that he entertains little doubt that productive mines will be discovered before spring, the mineral area is 700 acres in extent, and if the ore is found in any considerable quantities Mr. Smith says he will erect a mill of 200 tons daily capacity on the island. In the event of his doing so, about 500 men will be required for the concentrating process.

The Commission appointed to look into the zinc industry, whose report was published recently, has established the fact that zinc could be produced in British Columbia in considerable quantities. It is estimated that over 12,000 tons, or four times the amount annually consumed by the Dominion could be obtained in the districts of Ainsworth and Slocan. By employing perfected methods, we would be able to furnish all the zinc required by Canada. The cost of extraction from the ore is estimated at $2.50 per ton.

The output of the metaliferous mines, and works of Ontario, for the nine months ending September 30th, according to returns made to the Bureau of Mines, are as follows:—

	Quantity.	Value.
Gold, ounces	2,015	$34,377
Silver, ounces	2,542,827	1,609,554
Cobalt, tons	138	110,400
Nickel, tons	8,037	2,856,233
Copper, tons	3,900	600,000
Iron ore, tons	93,159	117,166
Pig-iron, tons	208,094	3,191,200
Steel, tons	123,257	3,059,070
Zinc, tons	691	13,830

These figures indicating the production for 1906, will be much larger than any previous year, showing a considerable increase for those of the same period in 1905. The silver, cobalt, and arsenic given in the above table are all the product of the Cobalt silver field. The nickel entirely and nearly all the copper are from the Sudbury district, and the iron ore is the product of the Helen Mine at Michipicoten.

PERSONAL

An important appointment has been made to the staff of Manitoba Agricultural College in the person of A. R. Greig, B.A.Sc., who will occupy the position of chief engineer and lecturer in mechanics.

John H. Fell, son of the late John B. Fell, C.E., of Mont Cenis' Tunnel fame, and other noted engineering works, has gone north, on location surveys for the Bracebridge (Muskoka) and Traders Lake Railway. The clearing and rock-cuts for this new railway are to be at once commenced.

G. P. Cole is another McGill man who has returned to Canada after practical experience in the larger field of the United States, having been appointed by Allis-Chalmers-Bullock, Limited, of Montreal, to superintend the designing and construction of electrical transformers. He entered McGill University in 1897 taking, first, arts, and later electrical engineering, graduating B.Sc. in 1903. Last spring he obtained the higher degree of M.Sc. After leaving college he entered the employ of the Wagner Electric Manufacturing Co., St. Louis, where he became assistant chief engineer.

H. A. Burson has recently been appointed Chief Engineer of the Packard Electric Co., Limited, St. Catharines. The company is making extensive alterations in its works, not only with a view of increasing the output of the present lines of manufacture necessitated by the rapidly growing demand, but also to add other lines of apparatus which will in due course be offered to the trade. Mr. Burson graduated in Electrical Engineering at McGill in 1901, receiving the degree of B.Sc., and from 1901 to 1903, was demonstrator in the Department of Electrical Engineering under Prof. Owens, and received the degree of M.Sc. for original research work. In the spring of 1903 he went to the Bullock Electrical Mfg. Co., at Cincinnati, where he was associated with B. A. Behrend, Chief Engineer. In 1904 he was appointed Chief Electrical Engineer of the Allis-Chalmers-Bullock Co., Ltd., Montreal.

MUNICIPAL WORKS, ETC.

The Strathcona, Alta., Council have passed a by-law authorizing the issue of debentures for $35,000 for an electric light plant.

The Guelph, Ont., Light and Power Committee have recommended the installation of an ammonia plant in connection with the gas works, at a cost of $2,000.

Lindsay, Ont., water commission will submit a by-law to the ratepayers, providing for the issue of debentures to the amount of $20,000, for a proper system of filtration in connection with the town water system.

The Prince Albert Board of Trade is initiating a movement, urging both the provincial and Federal Governments, to take action to prepare the Hudson Bay route for navigation.

The Nepigon Pulp and Paper Company has made a proposal to the town of Port Arthur, whereby they will supply power for $15 per horse-power per annum, for 3,000-H.P.; 7,000 additional to be supplied at $20.

Saskatoon has in view the putting in of a power plant. Figures have been furnished by H. B. Proudfoot, Civil Engineer, regarding the damming of the Saskatchewan; he says that $250,000 will give a 20' 0" dam, providing 10,000-H.P. Other engineers will be consulted.

It is stated by Hudson Bay captains that the bay is navigable from midsummer until December. The dangerous month is July, owing to floating ice. After this is past there is nothing to prevent ocean steamers running from Fort Churchill to Europe, until Christmas.

The Siche Gas plant recently installed at Massey, Ont., has proved a complete success. Massey is the only town in the world lit with a gas plant having no gasometer and no storage. The gas is made second by second, as used, and the plant does not require more than two hours' attention weekly by one man.

The Woodstock water and light commissioners are considering the feasibility of arranging for Niagara power for pumping the city water. Mr. E. Richards, an engineer on the staff of the power commission, has prepared a very interesting statement in regard to the matter which clearly shows that the plan is practicable. According to the estimate there will be a saving of about $4,000 per year in the cost of operating the waterworks department. If the plan is adopted it will largely increase the demand for electrical power in Woodstock.

LIGHT, HEAT, POWER, ETC.

The C.P.R. have made arrangements with the Kakabeka Falls Power Company, for 1,000-H.P., for use in their works at Fort William.

Work has been commenced on the designing of the power plant at Point du Boise, R. D. Johnson is the hydraulic engineer, and P. H. Mitchell will have charge of the electrical work.

Niagara power was received at the transformer station on Davenport Road, for the first time on November 19th. The power came over the transmission lines of the Toronto and Niagara Power Company.

A big enterprise is being undertaken in the Yukon by Dr. A. S. Grant and M. A. Fuller. It is the supplying of electric power for power purposes, dredging, and lighting. They are also arranging for the supply of coal for fuel. $300,000 has already been spent, and it is stated that $500,000 more will be spent.

The Otonabee Power Co., of Peterboro, has tendered for the lease of dam No. 4 on the Otonabee River, belonging to the Dominion Government, and has notified the City Council that if the tender is accepted it will be prepared to sell to the Coates Manufacturing Co., or any other industry locating in that city 500 horse-power at $15 per horse-power.

An enquiry into the amount of power available on streams throughout Canada will be asked for by the Canadian Manufacturers' Association. A committee has been appointed to bring the matter to the attention of both the Dominion and Provincial Governments. The statistics asked for will be the amount of water supply on the streams which can be used for power purposes at low water periods. A record of this would be of great assistance to the manufacturers. At present the Ontario Hydro-Electric Power Commission is performing the work for Ontario, and has already published a number of the results of its enquiries.

NEW INCORPORATIONS.

Dominion.—Canadian Refining Co., Ottawa, $2,000,000; H. Roy, Ottawa; F. W. Rolt, Rossland, B.C.; J. G. Gosselin, Notre Dame de Stanbridge, Que.; E. Hoffman, New York, N.Y.; R. Dieffenbach, Newark, N.J.; J. J. Fleutot, Frank, Alta.

Upper Ontario Steamboat Co., New Liskeard, $99,000; T. S. Brickenden, F. W. Hendry, M. R. Jennings, G. C. Banks, F. L. Smiley, New Liskeard.

The Leitch Collieries, Ottawa; $1,000,000; D. H. MacMahon, A. A. Baylie, E. Seybold, J. Gibson, W. C. Perkins, J. G. Gibson, H. H. Williams, Ottawa.

Ontario.—The Sherman Cooper Co., Toronto, $40,000; W. S. Cooper, H. B. Odell, A. M. Witmer, J. B. Howse, J. Batho, Toronto.

The Colonial Mining Co., Cobalt, $100,000; J. Shilton, W. H. Wallbridge, J. C. Macklin, C. E. Kelly, F. B. McLean, Toronto.

The Waterloo Mining Co., Berlin, $200,000; R. T. Winn, I. M. Clemens, New Hamburg; A. S. Greene, J. A. Scellen, Berlin; J. Rock, Buffalo, N.Y.

The Heathcock Mining Co., Dresden, $100,000; J. B. Webster, J. Turner, H. Bishop, D. B. Wallen, Dresden; W. Mills, Ridgetown.

The Volcanic Oil & Gas Co., Chatham, $300,000; D. A. Coste, Port Colborne; H. D. Symmes, Niagara Falls; J. T. O'Keefe, J. G. Kerr, Chatham; T. E. Ogden, Buffalo, N.Y.; C. J. Near, Raleigh.

Larder Lake Gold Mining Co., Haileybury, $500,000; A. T. Budd, J. F. Gillies, Haileybury; G. M. Petrie, F. Pottage, P. J. Montague, Toronto.

The Superior Dock Coal and Metal Co., Sault Ste. Marie, $75,000; F. A. Lucas, J. N. Oldham, A. Spencer, L. Head, E. Latimer, Sault Ste. Marie, Ont.

The Rochester-Cobalt Mines, Cobalt, $1,000,000; N. S. Scott, F. B. Sanders, S. W. Parsons, F. L. Cody, F. C. Becker, F. H. Baer, J. H. Van Derveer, Cleveland, Ohio.

The New York Cobalt Silver Mines, Toronto, $1,000,000; J. Lewis, W. Hogan, F. Watt, J. J. Hubbard, H. S. Pritchard, Toronto.

The Cobalt Portage Mines, Toronto, $1,000,000; J. Lewis, W. Hogan, F. Watt, J. J. Hubbard, H. S. Pritchard, Toronto.

The Northern Ontario Consolidated Copper Co., Sault Ste. Marie, $1,500,000; J. N. Oldham, C. A. Paul, A. D. McNabb, C. S. Hodgins, D. B. McKenzie, Sault Ste. Marie.

The Nipissing Power Co., Toronto, $100,000; J. D. Montgomery, E. R. Lynch, A. Scott, E. McLellan, J. P. Crawford, Toronto.

The Marvel Acetylene Generator Co., Brantford, Ont., $10,000; A. J. Moore, F. W. Moore, A. E. Scanlon, C. W. Ellis, P. Holt, H. S. Broughton, J. Elliott, Bradford.

The Manhattan Cobalt Mining Co., Toronto, $100,000; J. W. Coffin, New York; D. Urquhart, A. McGregor, H. W. Page, B. W. Essery, Toronto.

Little Nipissing Silver Cobalt Mining Co., Toronto, $650,000; R. W. Eyre, E. E. Wallace, G. H. Sedgewick, A. T. Struthers, W. H. Syms, Toronto.

The Leach Concrete Co., Toronto, $10,000; R. Leach, W. Leach, R. W. Eyre, E. E. Wallace, H. M. Sinclair, Toronto.

Victoria Silver Cobalt Mines, Toronto, $1,000,000; T. H. Brush, New York; J. H. Stowe, L. A. Gemmell, H. A. Beatty, Toronto.

The Ontario Nickel Co., Worthington, Ont., $1,000,000; H. H. Dow, W. L. Baker, Midland, Mich.; W. S. Gates, Worthington, A. E. Convers, G. E. Collings, Cleveland, Ohio.

Green-Meehan Mining Co., Limited, Toronto, $2,500,000; C. W. Kerr, C. S. MacInnes, C. C. Robinson, M. Gleeson, A. E. Lloyd, Toronto.

Crude Oil, Gas and Power Co., Windsor, Ont., $100,000; W. H. Leith, H. J. Boerth, N. P. Hickey, W. T. Greenwood, Detroit, Mich.; C. L. Meyer, Windsor, Ont

The British Canadian Engineering Co., Toronto, $250,000; J. H. Sutcliffe, E. S. Sutcliffe, R. Williamson, H. A. Munro, M. C. McConnel, Toronto.

Alpha Chemical Co., Berlin, Ont., $75,000; W. J. Moody, H. Pearce, D. Moody, P. S. Pearce, A. T. Moody, Berlin.

New Brunswick.—Willard Kitchen Co., $50,000; W. Kitchen, Kingsclear; H. G. Kitchen, I. E. Burden, Montague Bridge, P.E.I.; J. H. Barry, T. W. Kitchen, Fredericton.

B. F. Smith Co., $15,000; B. F. Smith, Florenceville; G. F. Burt, J. Keswick, H. D. Keswick, D. Keswick, Hartland; K. M. Smith, Florenceville.