PAGES

MISSING

# The Canadian Engineer

ESTABLISHED 1893.

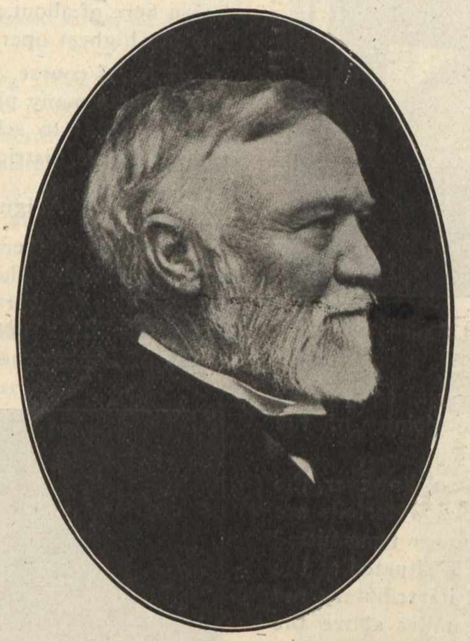
WITH WHICH IS INCORPORATED

THE CANADIAN MACHINE SHOP.

VOL. XIII.—No. 5. TORONTO, MAY, 1906. PRICE 15 CENTS $1.00 PER YEAR.

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

*Longfellow.*



ANDREW CARNEGIE.

Spring has brought on its wings the startling news, that the greatest industrial organization in the world,—the United States Steel Corporation: with its $1,637,811,257—capital, producing about one-sixth of all the iron ore; one-fifth of all the pig-iron; between a third and a fourth of all the steel turned out in the whole world, and employing 180,158 men—is about to lay down a modern steel making plant on the southern borders of Canada. The foundations of this colossal concern were deeply laid with English money; it is a fitting thing, therefore, that at the psychological moment when our immense resources of refractory, magnetic iron ores, have been proved capable of being successfully smelted in the Heroult electric furnace, into rich pig-iron, and on the largest commercial scale, that America should repay the debt it owes to England, by investing, in turn, surplus capital in the development of the industrial resources of the country which the Governor-General, (Earl Grey), recently described in New York, as, "the brightest jewel in Britain's crown."

We can not think of the United States Steel Corporation, without unconsciously associating therewith, the name of the man whose genius planned, and whose wisdom steered it to the supreme position it now holds in the industrial world, namely, Andrew Carnegie; who, in Toronto, on Friday last, delivered his **"First words in Canada,"** and was greeted by the inhabitants of the Queen City, with a heartiness and warmth of public expression altogether worthy of a cultured people; capable of recognizing business genius of the highest order, and of appreciating the noblest example of true philanthropic spirit on the earth to-day. It is true, Mr. Carnegie may now be described as "the retired steel king;" for, at the hoary age of 76, his wonderful exercise of executive ability has given place in the golden sunset of life to a noble mission in the interest of the people, and of universal peace among the nations. Over the entrance to the Reference Library of the magnificent Carnegie Institute, Pittsburgh, is the legend: **"Free to the People."** In perfect accord with this democratic sentiment, were his "first words" delivered at the City Hall. Speaking in reply to Mayor Coatsworth's greeting on behalf of the city; in which reference was made to the $350,000 donation for a free library, Mr. Carnegie, after a general warning against centralization, said:—

"My influence has always been for a modest appearing building, with lots of branches, because it is the branches that reach the masses."

It is quite evident that Carlyle's doctrine of **Individuality,** is fast being displaced by Mazzini's doctrine of **collective humanity.** The day is not far distant, when many an intelligent artizan, who views Andrew Carnegie's acquisition of wealth with distorted perspective; and many a miser who looks with jaundiced eye upon the Laird of Skibo's mode of distributing his great riches, will perceive in his establishment of Reference Libraries, well stored with the latest and best technical literature, calculated to foster a scientific use of the imagination and all imparting that useful knowledge, which is power—one of the wisest and noblest contributions to progress in the twentieth century.

# EUROPEAN HYDRO-ELECTRIC DEVELOPMENT

**French Plants in the Vicinity of Grenoble.**

By Charles H. Mitchell, C. E.

II.

The city of Grenoble lies in the heart of the French Alps. Its 70,000 people are engaged almost entirely in the manufacture of gloves and kindred leather industries, hats, buttons and clasps, linen and silk weaving, wood-working, paper, cement and miscellaneous iron manufactures. In earlier days, many of these industries were operated by small

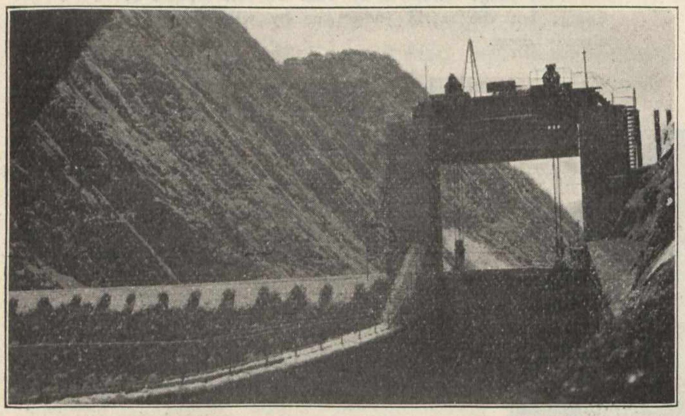


Fig. 1.—Avignonet Dam and Head Sluice.

steam power units, and in the case of paper and cement, by direct water-power, at the waterfalls in the vicinity of the city.

Since the advent of electrical transmission, however, the conditions have changed; now the numerous waterfalls are more advantageously developed and their power transmitted to the city and adjoining towns. Grenoble is situated at the junction of two small rivers, the Drac and its tributary the Isere, both rich in natural power. A few miles above the city, on the Drac, another tributary the Romanche enters, and this, notwithstanding its small size, is the most efficiently worked of the three. On these rivers and within thirty miles of Grenoble are now installed some sixteen hydro-electric and direct hydraulic plants, varying in capacity under normal conditions, from 1,000 to 8,000 horse-power, and having an aggregate power of some 60,000 horse-power.

Under these circumstances, it is not surprising, that when a few years ago the French Government and the people took up the question of investigation of the water-

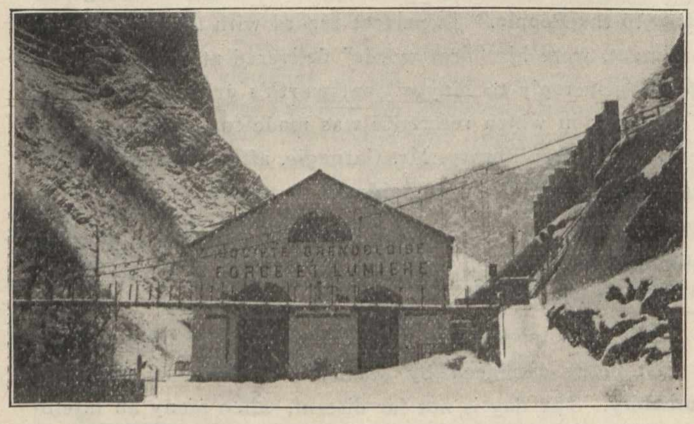




Fig. 2.—Avignonet Generating Station.

powers and hydro-electric resources in the Alps, Grenoble was chosen as the headquarters and centre of operations of the Congress. The work of this body, known as the "Congress de la Hoville Blanche," ("White Coal") has now become world famous and its proceedings, bound in two large octavo volumes, form a most valuable engineering record, describing as they do in detail, the many plants then (1902) in operation and under construction.

The moving spirit of this Congress was M. Berges, of Lancey, a small town in the valley of the Isere, about 10 miles north of Grenoble. He owned several mills utilizing water-power from mountain streams tributary to the Isere, aggregating about 6,000 horse-power; used mainly for pulp and paper manufacture, saw mills, etc., as well as lighting and traction purposes. That he is a pioneer is evident from the fact that as early as 1868, he built the first conduit down the mountain and established a plant at Lancey, under a head of some 600 ft. A few years later, he increased this to 1,600 ft. head, using about 18 cubic ft. of water per second. This plant has continued in operation to the present time with but little trouble from the high head. A second installation here of about 2,000 ft. head remained until a few years ago the highest operated head in the world.

It is, of course, impossible in this article to adequately describe the many plants in the vicinity of Grenoble, all that one can do is to select several of the more interesting as typical of the districts in which they are located.

**Avignonet Station, Drac River.**

The Drac River drains a large area in the higher Alps and flows to the Rhone. Its dry weather flow in midwinter is fed only by springs, and above its junction with the Romanche does not exceed 800 cubic ft. per second. At times of freshet, however, this discharge runs up to the

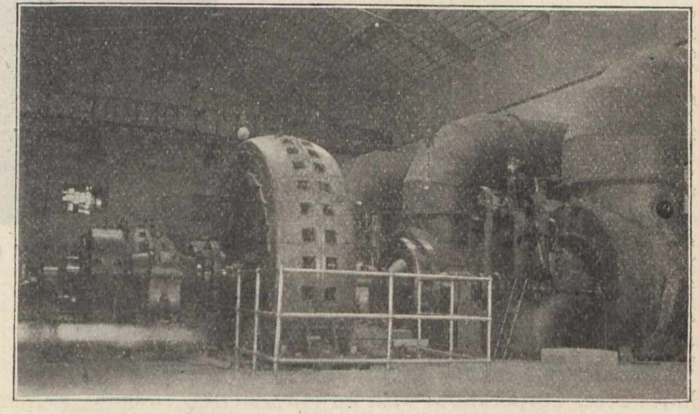


Fig. 3.—Interior of Avignonet Station.

enormous flood of 40,000 cubic feet, a ratio of 1:50, which is most unusual.

The uppermost plant on this river at present is that of Avignonet, situated in a deep and narrow gorge about 25 miles above Grenoble. It is one of three plants owned by "La Societe Grenobloise de Force et Lumiere," and has an output under normal conditions of about 6,000 horse-power. The power is used in Grenoble for street railways and miscellaneous industries; for mines at La Mure, 8 miles away, and for factories at Bourgoin, 60 miles distant.

The general scheme of the plant is that of a dam in the gorge about 3,000 ft. above the station; a tunnel in rock, a forebay cut in the rocky cliff; and penstocks to a generating station in the bed of the gorge; the hydraulic units operating under about 80 ft. head.

The dam is a heavy concrete structure of the over-face type, with a total height of about 65 ft., having exposed faces lined with masonry. On one side is a sluice way closed by a stony gate, about 25 ft. wide by 20 ft. deep. (See Fig. 1.) The dam is seldom over-tapped by floods, the regulation being effected by the stony gate. In front and shoreward of the sluice is the intake, with screens and headgates opening to head face, and being a tunnel, is protected from rock slides, and has a carrying capacity of about 1,400 cubic ft. per second. This tunnel has an overflow regulating weir which discharges into the river at about 200 yards above the station.

The tunnel terminates in a forebay formed in the cliff by excavation and heavy masonry walls, provided with an adjustable weir and spill, and with separate screens and sluice gates to each penstock. The penstocks—five in number, with provision for two more—are 7 ft. diameter, and are fitted with 4 ft. diameter visers below the sluice gates. See Fig 2, in which may be also noticed a light suspension bridge crossing the river at this point.

The generating station is a heavy stone structure, equipped with five units, each of about 1,200 horse-power electrical output, with horizontal shaft, direct connected, at 250 R.P.M. The turbines are double "American" type, built by Piccard Pictet & Co., of Geneva, and are fitted with oil pressure governors, which appear to give good regulation. The generators are by Schneider & Co., of Creusot, 3 phase —the latter being 15,000 volts. Three original units installed in 1901 were formerly wound to 26,000 volts, and intended to operate directly on the line without transformers; but these were found unsatisfactory, hence were rebuilt for 15,000 volts. The transformers are 15,000 to 26,000 volts, air cooled. The interior of the station is shown in Fig. 3.

The transmission line is interesting from the fact that the portion nearer to Grenoble is used jointly by this and another company (Champ Station, described below). The line from Avignonet to Grenoble consists of three circuits carried on iron poles. The towers for the joint transmission line shown on the right hand of Fig 4, are about 40 ft. high above ground, and carry six cicuits of 26,000 volts. These towers are set 6 ft. in the ground in concrete, the cross arms are wood, 10 ft. long, set in an iron framework, and each tower costs, complete, $100. At the junction with the second company, about 8 miles above Grenoble, a special structure (Fig. 4) is erected, and similar ones are also used in the city. Each company has its respective side and interconnecting and sectional switches. The two companies work in harmony, one using the other's wires at times for repair on the other side of the tower.

The snow seen in the accompanying pictures, while common, is unusual to such an extent in this locality. There is no trouble from floating or frazil ice, however, in any of the power plants in the vicinity of Grenoble.

### Champ Station, Drac River.

The Champ Station is situated near a village of the same name, and is about 8 miles above Grenoble, at the junction of the Romanche River. It is owned and operated by the Fure and Morge Co., of Grenoble, and under normal conditions of river has an output of about 6,000 horse-power, which is used for miscellaneous factory power in and near Grenoble. There are upwards of 70 works now connected through about 15 receiving stations. It was first operated in 1902.

The general scheme is quite different from the plant at Avignonet, owing to the nature of the river at this point, which is shallow and flows through a gravel bottom in a wide valley. The intake works are situated about 3 miles up stream and the water is conveyed to the generating station by means of a flume laid underground; the station stands in the flat bed of the valley and the water is discharged through a short canal into the river channel near by.

The intake consists of a submerged dam at right angles to the stream, terminating near the shore, in an intake set parallel to the stream, consisting of submerged arches provided with gratings and sluices. Special precautions were required in this respect to prevent entrance of debris, gravel and stones, of which the river carries considerable. Behind the intake is a headbay 1,900 feet long, acting as a settling basin and provided with over-flows having adjustable crests. At the end is a bell-mouthed entrance to the flume, fitted with a gate having an air inlet behind.

This flume is a most interesting work, about 14,000 feet long, 10 ft. 8 in. interior diameter, laid on a grade to conform to the slope of the river, partly in trench cut, and then filled over with gravel and earth. Its carrying capacity is figured at about 800 cubic ft. per second at a speed of 10 ft. per second. The upper 6,000 ft. being under light pressure, is of concrete reinforced with steel rods. The girth rods, a few inches apart, vary from ½ to 1 in. diameter, and the longitudinal ones from ¼ to ½ in. The whole thickness of shell varies from about ⅞ to 1¼ in. The remainder of the flume is of steel plate from ⅜ to ⅝ in. thick, and the structure throughout rests on a concrete foundation about 12 in. thick. There are three air shafts or visers carried above the head level about 4 ft. diameter along the length to provide against entrained air or collapse when emptying. The most interesting feature of this flume is the terminal air shaft at the generating station, which consists of a vertical prolongation of the steel flume after the penstocks are taken off leading to the turbines. The vertical shaft converges from the 10 ft. diameter to about 5 ft. at the top, a total height above tail water of about 140 ft. The top terminates in an open chamber drained by three down pipes 18-in. diameter leading to outlets in the tail race. The water stands up to about 116 ft. above tail level when the plant is not operating, but when running full load this becomes 100 ft., which is the working head, the difference being friction and entry losses

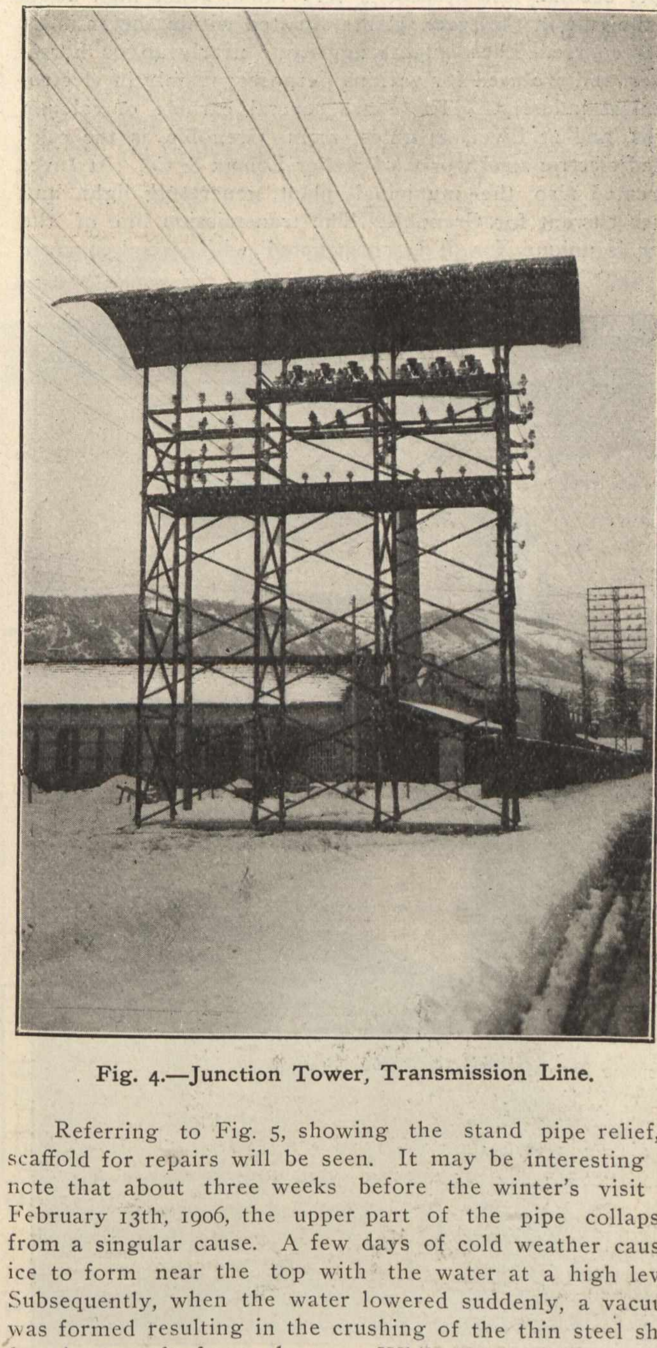


**Fig. 4.—Junction Tower, Transmission Line.**

Referring to Fig. 5, showing the stand pipe relief, a scaffold for repairs will be seen. It may be interesting to note that about three weeks before the winter's visit on February 13th, 1906, the upper part of the pipe collapsed from a singular cause. A few days of cold weather caused ice to form near the top with the water at a high level. Subsequently, when the water lowered suddenly, a vacuum was formed resulting in the crushing of the thin steel shell for about 20 ft. from the top. While this accident might happen in Canada, it is considered as a very unusual occurrence here.

The turbines, five in number are supplied by short horizontal penstocks connecting with the main flume, fitted with butterfly valves. They were built by Neyret-Brenier & Co., Grenoble, and are single wheels on horizontal shafts with cylinder gates, operating at 300 R.P.M. giving 1,500 horsepower. Though several wheels are fitted with simple governors they are regulated by hand, and appear to be fairly steady. In addition to the stand pipe relief, there are automatic relief valves on each turbine, which are also fitted with hydraulic servo-motors operating the distributors and compensating valves, thus shunting the turbines and maintaining a nearly constant flow in the main flume. The attendants say that the normal variation in level in the stand-pipe when operating is about 6 inches.

The generators are by Brown Boveri & Co., of Baden, 1,000 k.w revolving field 3,000 volts, direct connected, and with the switch-board and transformers from 3,000 to 26,000 volts, present no especial features. The transmission lines are described above.

### Gavet Station, Romanche River.

The Romanche River has distinctive features, which are remarkable. Its flow is very small, in dry weather being only about 300 cubic ft.; normal for about 9 months about 700 cubic ft., and flood discharge about 6,000 to 9,000 cubic ft. per second. Its descent is very rapid, hence high heads are the rule in the seven plants situated within the 12 miles of its course. These plants aggregate nearly 40,000 horse-power, and are used for various purposes; mainly in electro-chemical industry. There are several carbide of calcium works, and at Livet, 24 miles from Grenoble, is the celebrated electric steel works of Keller Leleux & Co. At Livet is located also the municipal plant, generating light and power current for Grenoble. The transmission line of the latter is unique, for it is constructed with wood-concrete

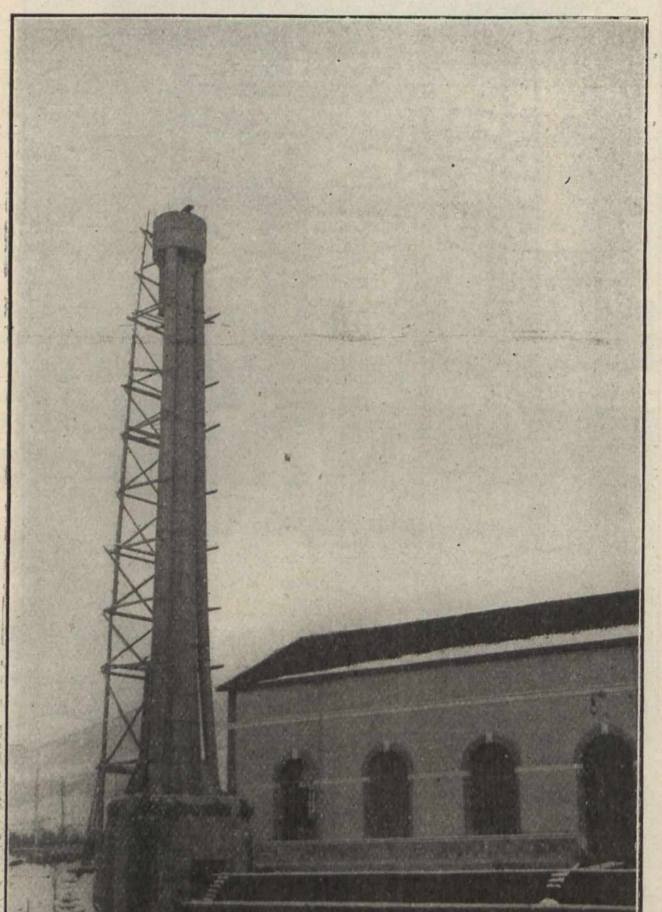


Fig. 5.—Terminal Overflow Pipe, Champ Station.

poles, that is, thin straight cedar poles encased in an envelope of concrete from 1 to 2 in. thick, which in the three years of operation appear to have given entire satisfaction. A careful examination of these revealed no serious cracks and it has occurred to the writer they might be tried with success in Canada, notwithstanding the cold weather conditions.

The Gavet Station, just completed, is situated about 8 miles above the Champ Station, or 16 miles from Grenoble. It also is owned by the Societe Grenobloise de Force et Lumiere, and commenced operations about March 1st, 1906. There are now three units installed, with a total output of about 5,000 horse-power, and provision for doubling this capacity. The low water period of the river, however (about 3 months), gives only about this amount. The power will be used for manufacturing; both mechanical and chemical.

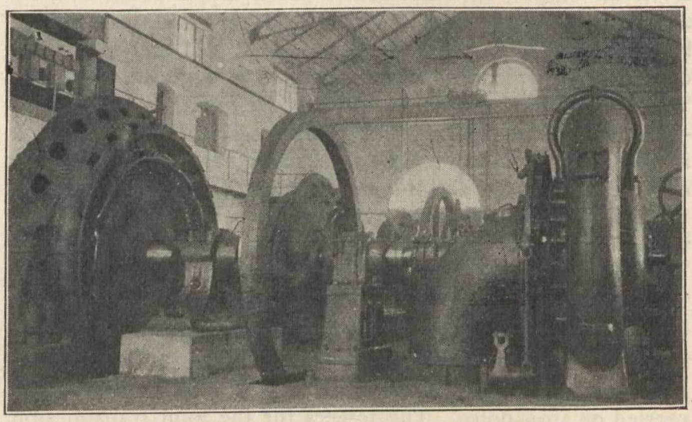


Fig. 6.—Interior Gavet Station.

The headworks are very ingenious, and a type of all plants on this river, which floods quickly and carries large quantities of gravel, etc. The head dam consists of piers and buttresses carrying two steel stony gates (counter-balanced), each about 30 ft. wide and 12 ft. deep, capable of being operated by hand by one man. In front of the dam is a weir parallel to the stream, with its crest about 2 ft. below the top of the gates; behind this is a settling basin having a sluice at the lower end and having a second similar weir on its opposite side. Water, after passing the first two weirs, enters a second elongated basin, having, at the lower end, a third sluice, and, in the side, the head screens leading to the head race, which is provided with a simple gate about 12 ft. wide, 10 ft. deep. This scheme offers two stony and two secondary sluices for normal flood water and permits the passage of abnormal floods over the whole; at the same time it provides settling or catchment basins for gravel. The flume to the generating station consists of a tunnel driven in the rock cliff about 10 ft. square and 7,000 ft. long.

The tunnel terminates in a small covered forebay high up the face of the cliff above the station, having outlets for two penstocks and one spillway. The penstocks—one of which is now installed—follow down the cliff, and are 7 ft. diameter by about 500 ft. long, and each branches to the three main and two exciter units at the rear wall of the station.

The station is of rubble stone, having a generating room, commodious switch-board gallery, wire ducts, transformer and arrester rooms. The writer had the pleasure of visiting the plant on February 14th with the consulting engineer, M. Boissonas, of Geneva, who pointed out many of the new features. On this occasion the units were started on their first long run, for the purpose of drying out the generators and transformers.

Each turbine develops 2,000 horse-power working under a head of 190 ft., and they are of the horizontal shaft, single spiral Francis type, built by Picard Pictet & Co., of Geneva. The distributer gates are swivel style, with an actuating gate ring carried on arms fitted with springs, to positively take up lost motion. The governors are by the same makers, arranged with a new device on the fly balls, to stop petty vibrations. The main shafts have fly wheels (see Fig. 6) and Zodel flexible leather link couplings.

The generators are by Schneider & Co., Champagne, revolving fixed type, three phase, 4,000 volts, 231 amp. per phase. The transformers step up to 26,000 line voltage the same as at Avignonet, with which this station will at times be run in parallel, 24 miles distant. The line is at present carried on wooden poles.

### Power Prices in Grenoble.

Good quality steam coal in Grenoble costs about $5 per ton. The two power companies in the field sell for about the same prices. Those of the Societe Grenobloise are, in general, as follows:—For 24 hours service the average prices (variable on account of distance) are, say for 100 horse-power, $30 per horse-power year, and for 500 horse-power about $26 per horse-power year. In 500 horse-power quantities prices run down as low as $18 for transmitted power and even to $12 at the station. This company has now 15-year contracts for about 15,000 horse-power, with some customers 100 miles distant (by line). In the case of the Champ Company selling upwards of 4,000 horse-power, the average price per horse-power of the output is about $25 on a 12-hour day and $30 on a 24-hour day. Lighting current, sold in Grenoble by the city plant, costs about 12 cents per k. w. hour.

---

# SYSTEM IN INDUSTRIAL ESTABLISHMENTS

BY A. J. LAVOIE.



## THE FOUNDRY.

Article X.

Production Office requisition form No. 29, delivered to the Foundry Foreman's office, contains all necessary information to enable this department to get out work without confusion and with despatch. A glance at No. 29 will show the comprehensiveness of the formal instructions.

Sometimes blue-prints are found necessary to supplement the written instructions. If prints are required, a requisition for same to the Engineering Department, No. 3, will bring the required print, as per chart, form No. 61. Now, the foreman, having everything in hand to prepare the work for his men, a job card is necessary (see form No. 54 and No. 113, and No. 45 and No. 113). These job cards are prepared by the clerk as soon as the requisition (form No. 29) is received in the foreman's office. The clerk has also to handle the stores, attend to tool-room, index patterns, keep record of good or bad castings, etc.; in fact, does all the clerical work required by the Foundry Department.

(This form to be made in triplicate.)

A. J. LAVOIE'S SYSTEM No. 114 FOUNDRY DEPARTMENT No. 7

PREPARED BY ............ Chemistry Office Report Number ............ DATE PREPARED ............

A. J. LAVOIE'S SYSTEM, LONGUEUIL, P.Q., CANADA

Alloy No. ............ Quantity of Metal Required ............ lbs. Cupola No. ............

| Specification of Material, Fuel, etc. | Grade No. | Pile No. | % for each Mater'l | Weight of each Mater'l | Cost per Pound | Cost of Material $ | c. |
|---|---|---|---|---|---|---|---|
| Fire Brick | | | | | | | |
| Fire Clay | | | | | | | |
| Wood | | | | | | | |
| Coke | | | | | | | |
| Flux | | | | | | | |
| | | | | | | | |
| FUEL—Totals | | | | | | | |
| Pig | | | | | | | |
| Pig | | | | | | | |
| Pig | | | | | | | |
| New Scrap | | | | | | | |
| Machine Scrap | | | | | | | |
| Shop Scrap (Turnings) | | | | | | | |
| Bad Castings from Heat No. | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| MATERIAL—Totals | | | | | | | |
| Total Pounds of Iron Tapped | | | | | | | |
| Total Loss of Material in Melting | | | | | | | |
| Blast on hours minutes | | | | Average blast pressure in oz. | | | |
| Blast off | | | | Pounds of metal per pound of fuel | | | |
| Duration of Heat | | | | Cost of good castings per lb. | | | |

CUPOLA HEAT REPORT No.

| Remarks | Weight | Value per lb. | Cost $ | c. |
|---|---|---|---|---|
| Good Castings | | | | |
| Bad Castings | | | | |
| Surplus Metal | | | | |
| Gates | | | | |
| | | | | |
| Total pounds of Iron tapped | | | | |
| **Title of Workman** | **Time taken** | **Rate** | **Cost $** | **c.** |
| Chemist Report No. | | | | |
| Cupola Men | | | | |
| Helpers | | | | |
| Apprentices | | | | |
| LABOR—Totals | | | | |
| Cost of Labor | | | | |
| Cost of Power for driving blower | | | | |
| Cost of Fuel | | | | |
| Cost of Good Castings | | | | |
| Burden No. | | | | |
| TOTAL COST OF METAL | | | | |

APPROVED BY CHEMIST

APPROVED BY FOUNDRY FOREMAN

Printed Black on 20 lb. Fawn Color Bond Paper. Size of form, 6 x 10 inches.

### Labor.

In filling the job cards (form No. 54 and No 113, and No. 45 and No. 113) the clerk must (1) consult the foreman as to which workman is to do the work. Then locate the pattern, and fill in pattern index card, form No. 111 and No. 112. (2) In locating the job card in the selected workman's allotment in the filing cabinet, be careful to so specify the work that when the time comes to pour the metal the workman can get from the cupola the precise metal mixture or alloy he requires. This is of great importance, both as regards quantity and quality of work. (3) The amount of time to be spent on any given work is specified by the workman on job card No. 54 and No. 113, and No. 45 and No. 113, subject to the approval of the foreman.

(The reader may glance over paragraph No. 3, under "The Making of the Pattern," for the use of form No. 45 and No. 113, which is handled similarly to form No. 9 and No. 20.)

### Material.

In the preparation of moulds and cores diverse kinds of sands, facings, etc., are required. The workman, assisted by the sub-foreman, having estimated the probable quantity of materials needed to do his work, the foreman prepares form No. 40 and No. 21, of which the original goes to the Stores and the duplicate to the Cost Office (Department No. 4) the same day. The duplicate, however, should be kept on a separate file in Cost Office until the Stores copy is received, which should arrive before noon the following day; then both copies are regularly filed in numerical order under their job numbers and according to drawing number. In this way a strict detailed account is kept of the material required to make any particular mould or core.

### Metal.

An adequate supply of metals, without waste, is very necessary, and requires to be dealt with in detail. The moulder having the estimated weight of each piece and specification of metal mixture or alloy number on his job card (form No. 45 and No. 113), and knowing the number of pieces he can have ready for pouring at the time the metal will be ready to tap, no person is better fitted than himself to the chemist, or cupola-man, as the case may be, so that he may prepare the weight of metal called for on said requisition. Thus, only the necessary amount of material will be melted—an economical precaution of considerable importance.

A. J. LAVOIE'S SYSTEM NO. 116. This form to be made in Triplicate. ENGINEERING DEPARTMENT NO. 3.

PREPARED BY ........ CHEMISTRY OFFICE ........ DATE PREPARED ........

A. J. LAVOIE'S SYSTEM, ● ALLOY No. ........ ● LONGUEUIL, P.Q., CANADA.

NEW ALLOY NO. ........ Number of sheets required to make Report ........

The above number is to be given on special order from Superintendent, said order to be attached to this sheet. SHEET NO. ........

| Name of Material to be analysed. | To fill our Purchasing Order No. ........ | As per our General Store Requisition No ........ | Chemistry Office Report No. ........ |
|---|---|---|---|

TO BE ANALYSED BY ........ ADDRESS ........

| Test No. | Specification of Test Piece. | Dimensions of Test Piece. | Combined Carbon % | Graphitic Carbon % | Phosphorus % | Manganese % | Sulphur % | Silicon % | Heat or Melt No. | Accepted or Rejected. |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | | | | | | | | | | |
| 2 | | | | | | | | | | |
| 3 | | | | | | | | | | |
| 4 | | | | | | | | | | |
| 5 | | | | | | | | | | |

| Test No. | Process of Manufacture. | Tensile Strength | Elongation per cent. in | Reduction of area per cent | Elastic Limit per sq. inch. | Shrinkage. | Transverse Test. | Deflection Test | Fracture. | Compres'n Test. | Impact Test. | Bend Test. | Drift Test. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | | | | | | | | | | | | | |
| 2 | | | | | | | | | | | | | |
| 3 | | | | | | | | | | | | | |
| 4 | | | | | | | | | | | | | |
| 5 | | | | | | | | | | | | | |

SIGNED BY CHEMIST ........ DATE ........ SIGNED BY SUPERINTENDENT ........ DATE ........

Printed Red on 20 lb. Amber Color Bond Paper. Size of form, 6 x 10 inches.

| DRAWING NO. | PATTERN NO. | MATERIAL | JOB NO. | PRODUCTION LIST NO |
|---|---|---|---|---|
| NAME OF ARTICLE | | | NOS. OF PIECES | WEIGHT OF ONE |

STORE-KEEPER—Please deliver the articles described above to the bearer, credit the Stores Account, and send this card to the Cost Office.

REMARKS:—

A. J. Lavoie's System, No. 40 FOUNDRY DEPARTMENT NO. 7

| DATE ORDER WAS REC'D | DATE ARTICLE WAS DELIVERED | DELIVERED TO WORKMAN NO. |
|---|---|---|
| ISSUED BY FOREMAN | | DELIVERED BY STORE-KEEPER |

Printed Black on 20 lb. Fawn Color Bond Paper. Size of form, 3 in. x 5 in.

TO FOUNDRY FOREMAN—I will have the following pieces ready to be cast to-day at ........ hour ........ minutes, a.p.m.

| Alloy Number | Weight Required | Number of Pieces to be cast | Drawing No. | Pattern No. | Job No. | Production Requisition List No. |
|---|---|---|---|---|---|---|
| | | | | | | |
| | | | | | | |
| | | | | | | |

A. J. Lavoie's System, No. 115. Moulder's Requisition for Metal. Foundry Dept. No. 7.

Date ........ Signed by Moulder ........

Printed Black on 20 lb. Fawn Color Bond Paper. Size of form, 3 x 5 inches.

to fill in form No. 115. The foundry whistle blowing at a certain hour calls all moulders to apply for metal, per form No. 115, and to deliver same at once to the foreman, who will have form No. 114 made out at once by the clerk under his supervision, who in turn despatches requisition No. 114

### Casting.

When the time arrives for the moulders to receive the proper metal to fill their moulds, they should look at the ladle in which it is intended to convey the metal and see that the right alloy number is marked thereon before the cupola is tapped, and then make sure that there is enough hot metal in the ladle to fill the mould.

### Cleaning.

Various are the processes of cleaning castings—too numerous to describe in detail; but as soon as the rough sand has been removed the inspector should examine and straightway report as to whether more work in the shape of chipping should be done on them or not, and give instructions as to whether they are to be pickled or sand-blasted, etc., in accordance with the original specification.

### Inspection.

All castings should be inspected before being conveyed to the Stores; and no Foundry work should be accepted by the Stores unless it bears the inspector's mark. Every article should be registered separately on factory inspector's report, form No. 117, which should be made in duplicate, the original being despatched to the inspector's office in the general stores and kept there on a separate file until the specified articles are delivered; serving as a hustler sheet if the articles are delayed in delivery. The duplicate must be sent to the inspector of the Assembling Floor, who should immediately enter the items on his part list, form No. 96, for the purpose already specified. The inspector's report is then returned to the Cost Office, and remains there on a separate file until the original is received from the Stores; thereupon both copies are filed in numerical order under their job number and according to drawing number, thus keeping track of all time spent by the inspector in the critical stage of each article produced. Some articles cost more than others for inspection, and this burden should be charged up against the respective contracts.

### Chemist's Report.

In all large industrial establishments mechanical and chemical tests are a necessity; and this work is done by a qualified metallurgical chemist. Sands, fuels, and metals are analyzed, and materials of which articles and structures have been made are subjected to rigid tests. All this should be done systematically, and records of results carefully tabulated and filed for reference. For this important work form No. 116 has been prepared, and fills the requiremnts for tests made either on the works or by outside private laboratories. The report form may be utilized for material purchased, or prepared on the works. All time and material costs are to be charged to the respective job numbers marked on the requisition, unless otherwise ordered. Each job must stand for its own expense and burden. It would not be right to make one pay for one's neighbor's expenses; the same principle applies to each job made in an industrial establishment.

### Shipping and Storage.

When the inspector has approved and stamped his mark on accepted articles they should be delivered to the Stores instanter, where an inventory of same should be carefully made. The storekeeper must refuse any article not properly stamped by the inspector.

### Cost Records.

On final completion of any particular job, drawings, patterns, special tools, etc., are exchanged by the mechanic

| | | | | | |
|---|---|---|---|---|---|
| Drawing No | Pattern No. | Material | Job No. | Production List No. | |
| Name of Article | | | Department No. | Weight of One | |
| Operation, Name and Number | | | Workman Check No. | Nos. of Pieces Made | |
| Signed by Inspector | | Date | Machine No. | Nos of Pcs. Rejected | |
| Inspection Started | A.P.M. | Inspection Completed | A.P.M. | Purchasing Order No. | Nos. of Pcs. Passed |
| Remarks and Suggestions: | | | | | |
| | | | | | |
| | | | | | "OVER" |

A. J. Lavoie's System, No. 117. Factory Inspector Report. Engineering Dept. No. 3

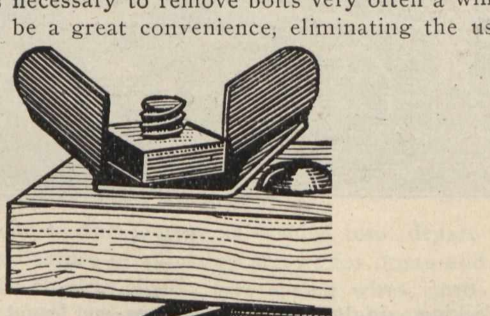
Printed Red on 20 lb. Amber Color Bond Paper. Size of form, 3 in. x 5 in. Padded on bottom only.

for his checks at various places where the above-mentioned articles have been selected, and the job card, form No. 45 and No. 113 is returned by the workman to the foreman's office for approval. Then this form, together with form No. 54 and No. 113, is forwarded without delay to the Cost Office and filed in numerical order under job number according to drawing number.

*(Continued.)*

## COMBINATION WING NUT AND WASHER.

Where it is necessary to remove bolts very often a wing nut is found to be a great convenience, eliminating the use



Combination Wing Nut and Washer.

of a wrench, and thus saving much time. The Aikenhead Hardware Company, of Toronto, have been appointed the sole agents for the wing washer shown in the illustration. The Twentieth Century Wing Washer is one of the latest products placed on the market by the hardware trade. The simplicity of the device is its greatest point of merit. The usual nuts supplied with bolts are not discarded; they are taken off, the wing washer put on, and then replaced, when the wings of the washer take hold of the corners of the nut, and it can be screwed down the same as an ordinary wing nut would be. It is applicable to either hexagonal or square nuts.

Another use to which this wing washer can be put is in connection with round-head screws. By placing the screw through the washer and squeezing the wings together in a vise, they are so made that they will fit into the slot in the head of the screw, and thus form a thumb-piece, whereby screws and bolts can easily be taken out by hand.

Two sizes are already on the market, the ¼-in. size fitting bolts 3-16-in. and ¼-in., and the ⅜-in. size fitting bolts 5-16-in. and ⅜-in.

# CANADIAN SCREW MANUFACTURE

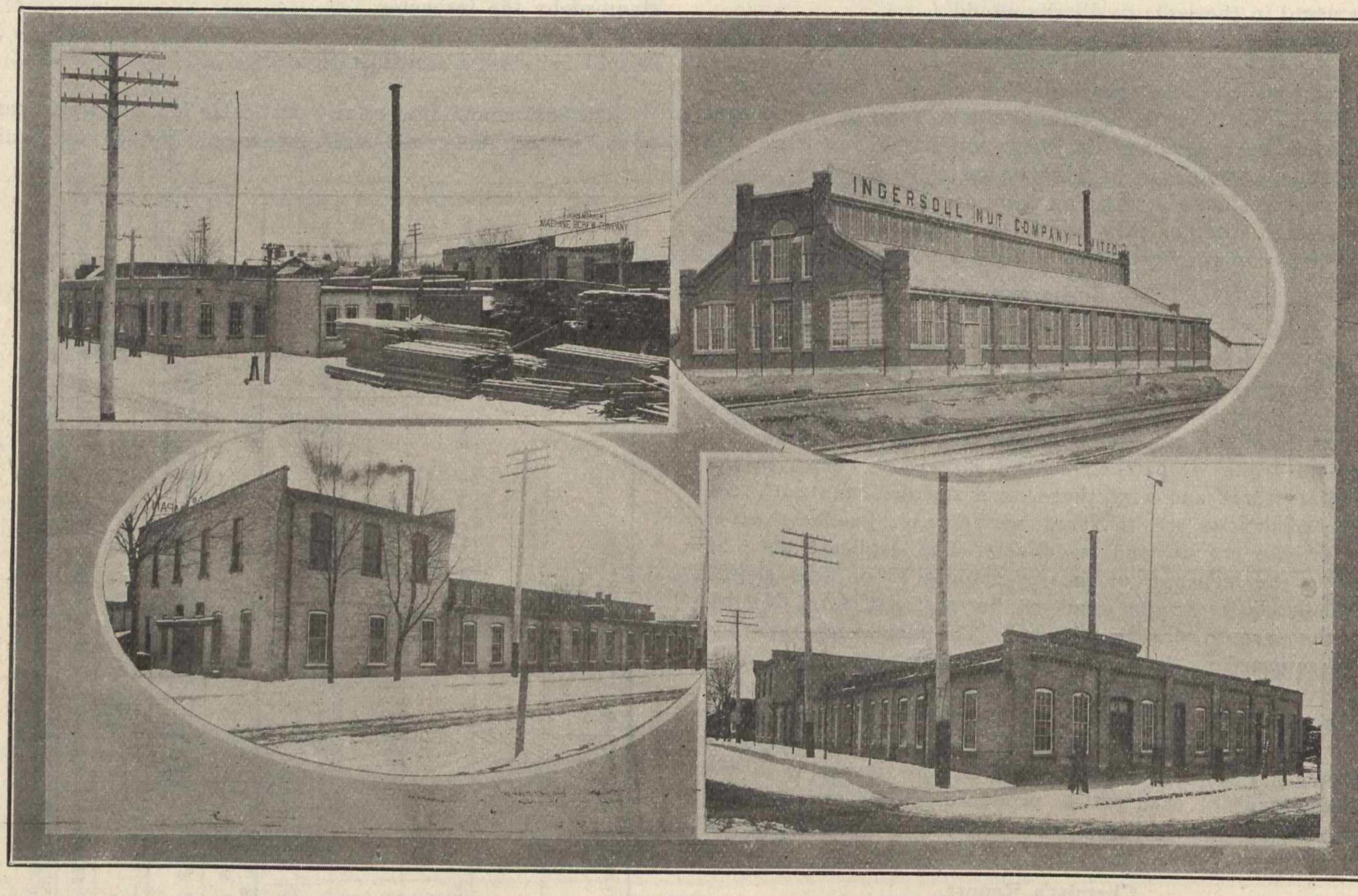



**Fig. 1.**
**The Works of the John Morrow Machine Screw Company, Limited, Ingersoll, Ont.**

The manufacture of screws for engines, electrical appliances, bicycles, printing presses, and the myriad forms of machinery used in the arts and industries has become a business of great importance; and Canada is not lagging behind in this branch of trade, as the following illustrated description of a modern screw-making plant will show:

J. A. COULTER,
President and Manager.
Fig. 2.

In the brisk agricultural town of Ingersoll—population, 5,000—situated between Hamilton and London, in the Province of Ontario and located on both sides of the Canadian Pacific and Grand Trunk Railway tracks, we found the unpretentious plant of that well-known firm, the John Morrow Machine Screw Company. The layout, size and style of the buildings did not impress us with a sense of moderninity; but a critical inspection of the special machines, general equipment, and systematic methods of turning out screws in quantity disarmed all negative criticism. It did not take us long to perceive the secret of the widespread reputation of this firm for high-grade work.

In the brisk agricultural town of Ingersoll—population, 5,000—situated between Woodstock and London, in the Province of Ontario, and located on both sides of the Canadian Pacific and Grand Trunk Railway tracks, we found the unpretentious plant of that well-known firm, the John Morrow Machine Screw Company. The layout, size and style of the buildings did not impress us with a sense of moderninity; but a critical inspection of the special machines, general equipment, and systematic methods of turning out screws in quantity disarmed all negative criticism. It did not take us long to perceive the secret of the widespread reputation of this firm for high-grade work.

Upon entering the low-roofed main building of the screw factory the eye is first attracted to the tool-room on the left, with its series of shelves covered with thousands of taps and dies, all tabulated and kept in systematic order. Dies for bicycle parts worth a small fortune are ranged on these shelves, also lying unused, a relic of the bicycle boom a few years ago. Coming out of this department, the scene shown in Fig. 3 is before us. It is like looking along a narrow pathway through a dense forest, with leather belting for trees. On each side of the longitudinal aisles are ranged innumerable single-spindle, automatic, screwing machines of modern make, with four men to look after twenty-five machines. At the lower end, past the seried line of buzzing,

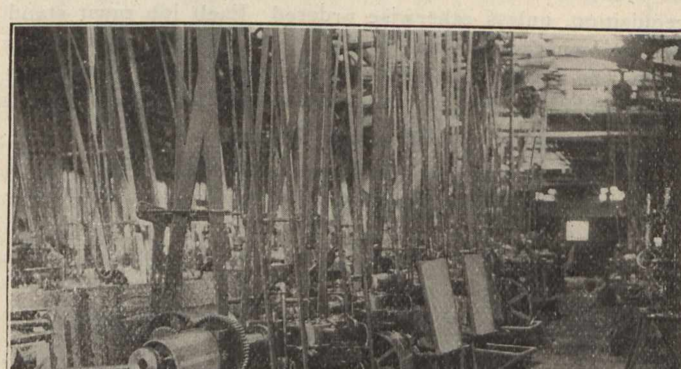


**Fig. 3.**

clicking, single-spindle machines we found ten ingenious five-spindle automatic screw machines (see Fig. 5). These machines are covered by patent rights, and are owned and operated in Canada by this firm only.

Space forbids description with the minutiæ of a patent paper, but the general features of this ingenious machine are as follows:

A $\frac{7}{8}$-in. bar is inserted horizontally into a tube and fed automatically until it hits a stop, and this determines the length required. It is held there until the chuck, by means of a cam, closes firmly on the iron. Then the head, containing five spindle attachments, begins to revolve, making five stops before effecting the complete revolution; and at the end of the series of automatic movements performs the following operations on the piece of iron already cut to length: (1) rough-turned and necked if necessary; (2) finished to proper size; (3) die takes roughing cut off thread; (4) finishes thread, cuts off, and drops into receptacle below. The whole of these operations—from the rough bar to the finished screw—are performed in $1\frac{1}{2}$ minutes, whereas in the old time it took six minutes. At the time of our visit 1,200 = $\frac{1}{2}$-in. by $1\frac{1}{2}$-in. set screws in a ten-hour day, while a No. 1 machine was producing 2,400 = $\frac{1}{4}$-in. by $\frac{7}{8}$-in. screws in 13 hours, or four times as many as by the old single-spindle machines.

In another section are machines with four spindles for automatically heading screws and bolts; but these are used only in the execution of large orders, hand machines being used in the production of small quantities.

Every evening the day's work is gathered up, delivered to the inspecting-room, and next day the whole of the work is carefully scrutinized, gauged as to length, etc., and stored.

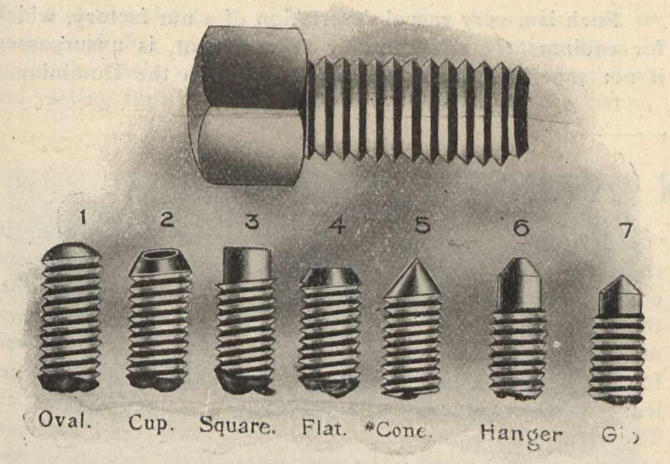



**Fig. 4.**
**Case-hardened Steel Set Screws.**

In the stock-room we were somewhat surprised to find eighty-seven tons of wrought iron to fifty-seven tons of soft steel, and glean that they use 500 tons of wrought iron per year. The general impression is, that the open-hearth, low carbon steel has practically driven wrought iron out of the market. It appears, however, that there is a strong reaction in favor of the old reliable wrought iron, such as the "Best Yorkshire," made from special (cold blast) pig iron, which has undergone a refining process before being puddled in small charges. We understood that the high-grade iron used in the manufacture of screws in this factory is imported from the United States. The reversion from steel to wrought iron is due to the erratic quality of much of the low carbon steel, which is being placed on the market by "tonnage" and "get-rich-quick" methods in vogue. The brand of the steel used by the John Morrow Company is selected for its special suitability in the manufacture of screws. That customers can be supplied with screws made of either iron or steel is a proof of this company's wise adaptability and modern spirit of enterprise.

The upper floor of the factory is divided into departments for the manufacture of adjusting screws for organ and piano stools, 28-in. Dunlop bicycle tyre spring wires, automobile tyres, loose-leaf ledger devices, etc.; all contributing factors to the making up of a successful specialized hardware business.

### Ingersoll Nut Company's New Factory.

When we started out on our journey to Ingersoll it was not with the intention of describing the screw works—worthy of special mention though they are—but to inspect and give our impressions in these columns of the Ingersoll Nut Company's new factory, built in 1905, and now in full swing. We found it conveniently situated on a knoll alongside the Grand Trunk Railway, about 200 yards east of the station. It is an artistically designed and substantially built red brick building, 144 feet long by 50 feet wide A noticeable feature is the excellent provision for light—the side walls seem all windows. Ventilation has not been neglected, for an 18-foot louvre crowns and extends the whole length of the corrugated iron roof, which is supported on wooden trusses, laid with lumber sheathing, and coated throughout with fire-proof paint. Adequate fire protection apparatus has been provided; altogether, this provincial nut factory building gives one an impression of being admirably adapted to its purpose.

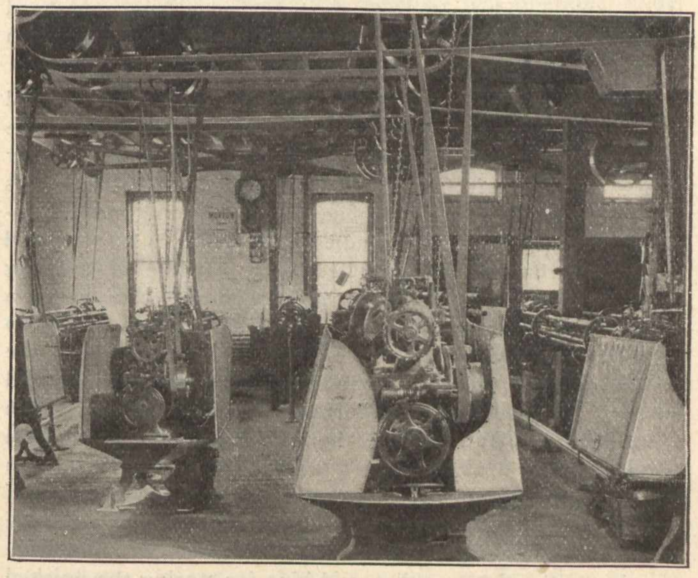


**Fig. 5.**

The power house, 38 feet by 32 feet, is located at the eastern end of the main building, and is equipped with one 80 h.p. 60-in. by 14 ft. tubular boiler, with 26-in. by 60 ft. stack; and provided with vertical steam dome. It is hand fired, and supplies steam to a 60 h.p. Hardiel compound engine, 9 in. by 16 in. by 10 in., operating at 90 lbs. steam and 175 r.p.m. (furnished by A. R. Williams Machinery Co., Limited, Toronto.) A Moffatt water heater, connected Marsh pump, and coal storage compartment completes the power house installation.

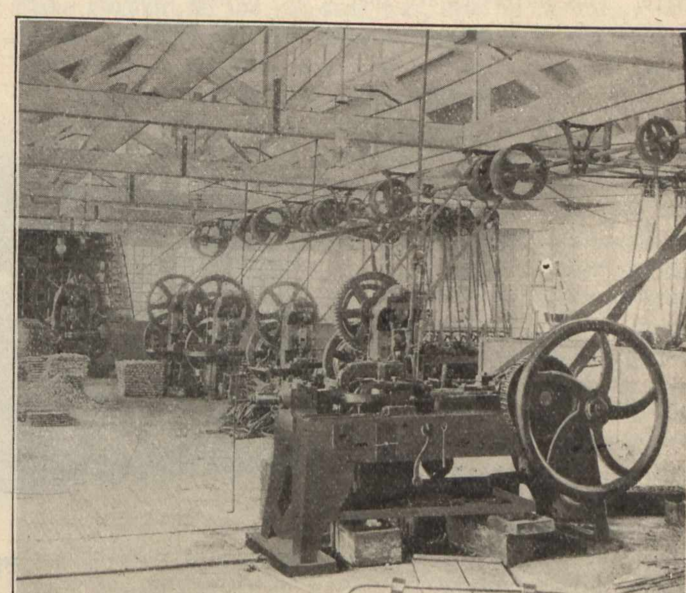


**Fig. 6.**

Entering the factory from the power house, the scene pictured in Fig. 6 meets our view. On the left (not shown) is a fan blower installation, by Sheldon & Sheldon, of Galt, Ont., for delivering cold blast to the heating furnaces. In the foreground is one of a set of heavy horizontal hot pressed nut-forming machines; to the right is the enclosed tool-room, equipped with lathes, drills, shapers, etc.; while beyond, in perspective, are a series of modern, vertical nut-forming machines, capable of cold pressing all standard sized nuts from ¼ in. to 1½ in. It will be perceived that all the machines and appliances are belt driven from overhead shafting, running down to the middle of the building, with hangers suspended from roof trusses.

At the western end is the Storage Room, partitioned off as shown in the view (Fig. 7, taken from within the enclosure, and looking down the shops towards the power house. On the left (unseen) is the office, and between this and the tool-room are two fine modern tools, one a horizontal reamer, with six spindles; the other, a back-geared nut-tapper, having six spindles also, capable of tapping ⅜-in. to 2-in nuts. Beyond the tool-room eastward is a 10-ton shearing machine, also two nut-cleaners and two rumblers for taking the burr off nuts, etc.; while about the middle of shop floor is a modern champering press, and nearby, Dawson heating furnaces, combining to make a specialized plant, which, though small compared with some in the United States and Great Britain, is an interesting example of the almost perfect adaptation of means to ends. Returning to the commodious storage room, we found about 400 tons of high-grade wrought iron. together with other supplies, and bins for storing the finished product. At the north end of this department is a large doorway through which material can be carted to and from the town; while at the opposite end is a doorway of like size, through which the products of the factory can be lifted into trucks on the switch siding and carried by rail to all parts of the country.

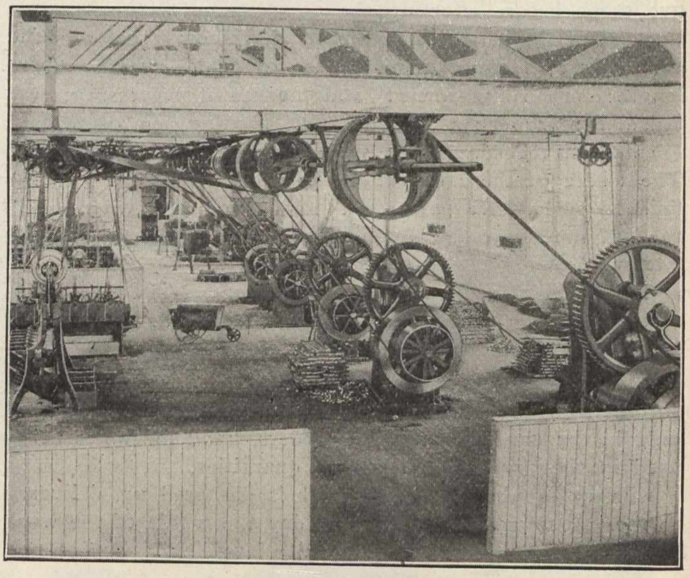


Fig. 7.

Such is a very casual description of a nut factory, which. for equipment and systematic arrangement, is unsurpassed, if not superior, to anything of the kind in the Dominion.

# A "DRY TEST" ON A RIVER DAM

The Otis Fibre Board Company is constructing a concrete-steel dam from 15 to 20 feet high across the Westfield River at Russell, Mass. The work has been carried on through the winter, but is not quite completed. During the "break-up" of the river in the first week in March the dam was subjected to an ice stress so peculiar as to warrant description.

The slope of the deck is 1 on 1, the thickness at the top being 9 in. and at the bottom 12 in. The thickness of the crest is 18 in. The material in the deck is 1-2-4 gravel concrete. The buttresses are spaced on 10-foot centres. The dam stands on a solid ledge, but it is not anchored in any way, depending for its stability as against sliding solely on the roughness of the rock, combined with the high angle of the resultant pressures due to the weight of the dam and the water pressure on it. The resultant angle when the dam is just full is about 30 degrees with the vertical.

The general cross section of the dam is fairly illustrated in Fig. 1. Temporary waste-gates were left in four of the bays to carry the water during construction. A mile and a half above this dam is another dam, followed by a series of dams for many miles up the river, each creating a pond of moderate extent. The Westfield River is notoriously "quick," and a warm rain the first week in March broke up the river throughout its length. The ice in the numerous ponds passed over the several dams comfortably, but when the basin formed by the Otis dam was reached there was not water sufficient to float the ice, and the entire basin for a mile and a half became packed with the accumulated ice from the whole river above, which lodged against it. The river slowly rose, as the waste-gates were insufficient to carry the flow, until the true water level was about half way up the deck of the dam. Under these conditions the pond would extend back but a few hundred feet. At that point the pressure of the ice, urged by the quick water above the pond, became so great as to force the accumulation of ice over the dam as shown in the illustration. Hundreds of thousands of tons of ice, from 12 to 15 inches thick, was *pushed over* the crest of the dam while the water flowed through the gates beneath. The concrete was so hard and the slope so easy that after the ice subsided not even the mark of a scratch was to be discovered on the deck or crest. The probability is that an ordinary solid dam having a vertical up-stream face would have given way under the enormous strain of a "dry test" such as this, as there was no water to float the ice over the crest. Un-

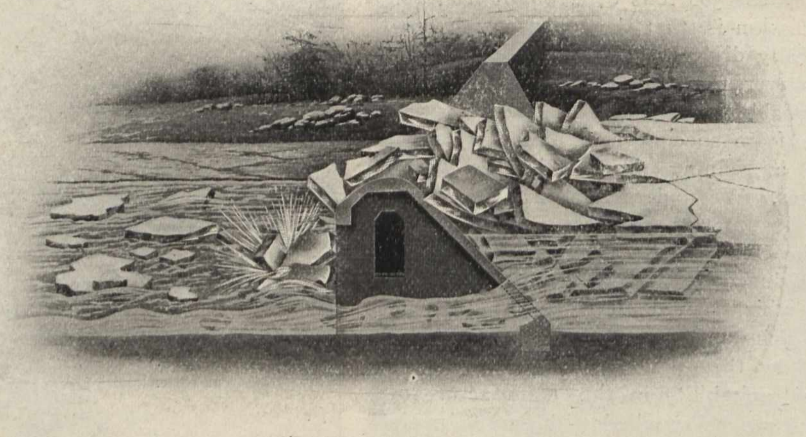


Fig. 1.

fortunately, the heaviest part of the ice "shove" took place in the evening, and before morning the river had commenced to recede. Two or three days later the photographs were taken, during which time the river had gone down to near its normal level and the ice had slipped back on the dam.

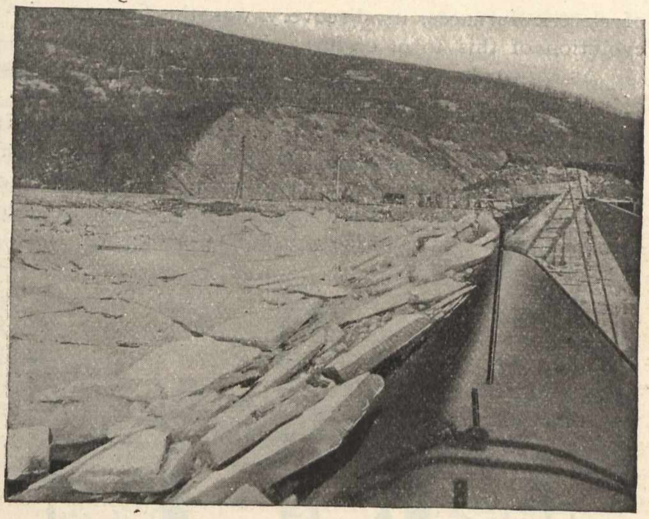


Fig. 2.

Fig. 2 shows the crest of the dam a few days after the ice gorge, and Fig. 3 gives some idea of the accumulation of ice in the basin above the dam, it being 10 to 15 feet deep, and resting for the most part on the bottom of the river.

Fig. 3.

During the same thaw a similar dam, 28 feet high, for the Cairo Electric Light Co., at Cairo, N.Y., was subjected to the same character of test, the ice in that case being heavier, but not as great in quantity. Unfortunately, photographs of the Cairo dam were not available.

## A NEW TEST OF DIXON'S FLAKE GRAPHITE.

**Made by Prof. Goss of Purdue University, and Demonstrating its Value as a Lubricant and its Mechanical Affinity for Metal Surfaces.**

The Lubricating Mixture.—In considering the manner in which the graphite under test should be applied in lubricating the rubbing surfaces of the testing machine, it was deemed desirable to use as light an oil as was available, since by so doing but little lubricating effect would be realized from the vehicle and the maximum service would be secured from the graphite. An attempt to use water proved unsatisfactory because of the tendency of the rubbing surfaces to corrode under its influence, and kerosene was finally adopted as the most convenient and the most satisfactory vehicle. Throughout the test the lubricant employed has been either kerosene, or mixtures of kerosene and Dixon's Flake Graphite.

Kerosene as a Lubricant.—Before attempting any work with graphite the value of the vehicle was first determined. That this might be done, the machine was operated under kerosene lubrication for a considerable period, the pressure between the rubbing surfaces being gradually increased as they became more worn in service, the effect of the process upon the co-efficient of friction being noted. This process of wearing down rubbing surfaces in the presence of kerosene involved more than 600,000 revolutions of the test machine. The heaviest pressure that could be sustained by the rubbing surfaces under this lubrication was fifty pounds per square inch of surface, and the lowest co-efficient of friction developed was .00547. This record was accepted as representing the performance of kerosene as a lubricant.

After the 633,287 revolutions involved by the process described in the preceding paragraph, a mixture, by weight, of two parts kerosene and one part Dixon's Flake Graphite was made. This mixture had the consistency of thin paste when stirred, but the flakes of graphite quickly settled when permitted to stand at rest. The immediate effect of applying this mixture as a lubricant was to increase the co-efficient of friction, but this in its maximum effect was momentary. Without change or any modification of the lubricating mixture, the co-efficient of friction rapidly fell, first to the value given by the kerosene alone, and then to still lower limits, so that after 10,000 revolutions, occupying a period of something less than thirty minutes, the co-efficient of friction, under the influence of the mixture of kerosene and Dixon's Flake Graphite, became 83.9 per cent. of that obtained from the use of kerosene alone. Conditions thus secured were continued during more than 400,000 revolutions of the test machine, for the purpose of determining beyond doubt the minimum co-efficient of friction under the conditions stated, subsequently the pressure between the rubbing surfaces was increased by increments of ten pounds, until a maximum of 110 pounds per square inch had been secured. Beyond this limit lubrication failed. The observations show that as the pressure was increased, the co-efficient of friction diminished, the minimum value being 00296. The immediate effect, therefore, of adding Dixon's Flake Graphite to the kerosene was, first, to permit an increase of load from fifty pounds per square inch to 110 pounds per square inch, that is, an increase of 120 per cent.; and, second, a reduction in the co-efficient of friction from .00547 to .00296, that is, a reduction of 45.9 per cent.

Endurance of Flake Graphite.—Having secured these results, it was next sought to ascertain the endurance of the graphite as a lubricant. This was done by removing all graphite from the machine and by rinsing all parts involved, including the rubbing surfaces, with kerosene, after which the machine was operated under a pressure of 100 pounds per square inch in the presence of kerosene alone. Under these conditions, the lubrication was aided by such particles of flake graphite as naturally adhered to the rubbing surfaces. It was expected, however, that these particles of flake graphite would sooner or later disappear and that the conditions would return to those originally found for the kerosene alone. Each morning the rubbing surfaces were removed from the machine and all parts carefully rinsed for any particles of graphite, and the work of the day proceeded, usually to the extent of 150,000 revolutions. After eight day's running and 978,000 revolutions, no diminution in effect could be discovered. Both the capacity of the bearing and the co-efficient of friction developed remained unchanged. A miscroscopic inspection of the surfaces showed the presence of flake graphite upon them. Whether the amount was sufficient to account for the results obtained, or whether in the earlier stages the presence of the graphite served to control the finishing of the metallic surfaces to permit them to give highly satisfactory results, are questions which can not be determined. The probability is, however, that without the graphite the results would not have been secured.

# THE ELECTRIC FURNACE: ITS EVOLUTION, THEORY AND PRACTICE

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



## Introduction.

The rapid growth of the electric furnace makes it increasingly difficult for the metallurgist to keep in touch with its recent developments. A few years ago it was a scientific curiosity; now it threatens to rival the Bessemer converter, the open hearth steel furnace, and even the blast furnace itself.

The halo of romance that has always surrounded electricity in all its forms, has caused the wildest schemes to be originated, and has given them a hearing; while on the other hand, even practicable electric smelting processes have been considered visionary.

In this series of articles, it is the author's purpose to trace the evolution of the electric furnace from its simplest beginnings, and to set forth as briefly as is consistent with clearness, the more important facts relating to its theory and practice.

It is not intended, however, to attempt a description of all the electric furnaces that have been invented and tried, but rather to set forth clearly the fundamental principles of this form of furnace; to show its various uses; to indicate its limitations, and, if possible, to be of some assistance to those who wish to design electric furnaces, or to judge of the feasibility of schemes involving their use.

The scope of the treatise may be gathered from the following syllabus:—

1. History of the electric furnace.
2. General description and classification of electric furnaces.
3. Efficiency of electric and other furnaces, and relative costs of electrical and fuel heat.
4. Electric furnace design, construction and operation.
5. Production of iron and steel in the electric furnace.
6. Other uses of the electric furnace.
7. Probable future developments of the electric furnace.

## Article I.—History of the Electric Furnace.

The electric furnace is of comparatively recent origin. The first, of any practical importance, was constructed by Sir W. Siemens in 1879, in which he was able to melt some 20

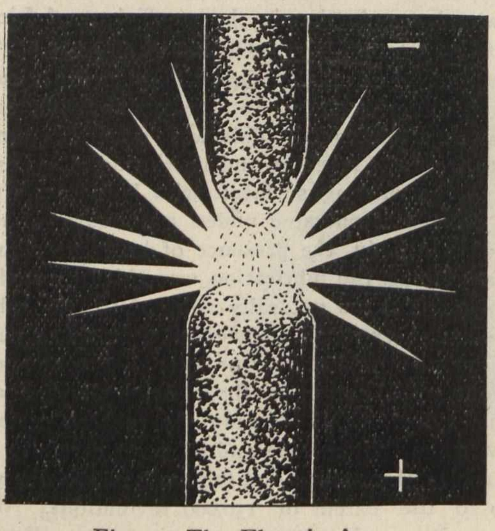



Fig. 1.—The Electric Arc.

pounds of steel and 10 pounds of platinum. Since that time the development has been rapid.

The beginning of the electric furnace may, however, be traced much farther back than this. In 1800—only a few months after Volta's discovery of the electric battery—Sir Humphrey Davy, experimenting with the new battery, produced the first arc light between carbon points; and since the electric arc is the source of heat in one important class of electric furnaces, its discovery was the first step in the evolution of this form of furnaces.

As shown in Fig. 1, the electric arc consists of a flame of vaporized carbon, extending from one carbon pole to the other. When an electric current meets with resistance, it is transformed into heat, and as the carbonaceous vapour offers a considerable resistance to the electric current which flows across the arc, a very high temperature is produced; high enough to melt, or vaporize any known substance.

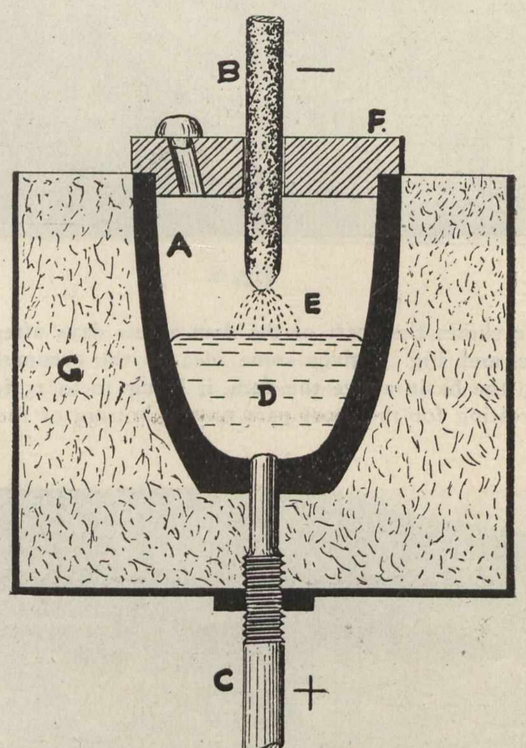



Fig. 2.—Siemen's Vertical Arc Furnace.

In the direct current arc the positive carbon is hollowed out by the current, and becomes intensely white hot; presenting the dazzling bright light with which we are acquainted. The arc light is, in fact, a miniature electric furnace, of the arc type; and produces a temperature not much inferior to that in any modern electric furnace. It has been supposed that the hollowing out of the positive carbon, is due to an electrolytic conveyance of carbon from the positive to the negative electrode; but recent experiments appear to show, that any electrical transfer of carbon is in the other direction, being a stream of electrons from the negative electrode, like the kathode discharge in a vacuum tube. The bombardment of the positive carbon by this stream of electrons, generates so much heat, that the electrode becomes white hot and rapidly evaporates, thus producing the characteristic crater like form.

This explanation appears to fit in well with the appearance of an arc that has been drawn out to a little more than its normal length. The arc (which should only be observed through a dark colored glass screen) will be noticed to stream freely from the tip of the negative electrode, and its starting point on this electrode is unaffected by drafts or magnetic influences. The current passes with difficulty on to the positive electrode, and does not always select the point nearest to the negative electrode, but, is blown about and wanders over a considerable area of the electrode. The temperature of the hottest part of the positive carbon in the electric arc has been measured, and is considered to be about 3,700° C. (6,700° F.), which is twice the temperature of melting platinum, or melting quartz, and more than twice the temperature of the open-hearth steel furnace.

In the use of a direct current arc for lighting, it is usual to make the upper carbon the positive electrode, in order to throw the greatest illumination downwards. In Fig. 1 this arrangement has been reversed, and in this position the positive carbon serves as a miniature cup in which any substance can be placed in order to study its behaviour at these high temperatures.

The writer has used an arc like this with the addition of a small cylinder of refractory material, around the lower carbon, and with this simple apparatus was able to repeat some of Moissan's well-known experiments on the production of the diamond.

In another form of electric furnace, the heat is produced by the passage of the electric current through a solid or liquid conductor. This method of producing electrical heat is typified in the common incandescent lamp. The earliest use of this method of heating was in 1815, when W. H. Pepys solved an important question in regard to the nature of steel by means of a miniature resistance furnace operated by a battery. He placed some diamond dust (a pure form of carbon) in a cut in a piece of wrought iron wire, and passed an electric current through the wire; thus heating it to redness. The iron absorbed the diamond dust and became converted into steel.

Although the principle of electric heating had thus been discovered early in the century, very little progress was made with the practical application of this heat until the discovery of the dynamo. Among those who attempted to utilize electrical heat in small furnaces, with the aid only of powerful electric batteries, may be mentioned—Napier, who, in 1845, produced a small arc in a plumbago crucible, intending to reduce certain metals from their ores; Deprez, who, in 1849, made a small tube of charcoal, about an inch long, and heated it electrically; and Pichou, who, in 1853, described a furnace (probably never constructed) for the reduction of metallic ores, heated by a series of electric arcs. Joule and Thompson also attempted to utilize the high temperature of the electric arc.

Until the invention of the dynamo, in 1867, experiments requiring any considerable amount of electrical power could only be conducted at great trouble and expense by means of electric batteries. Sir W. Siemens, with the aid of the dynamo, began in 1878-9 to experiment on the electric furnace, which he used mainly for melting metals. The form of furnace usually associated with his name is shown in Fig. 2, and consists of a crucible A of graphite or similar refractory material, and of two rods, B and C, for leading in the current. The lower rod was made of metal, and fitted into the base of the crucible, while the upper was of carbon,

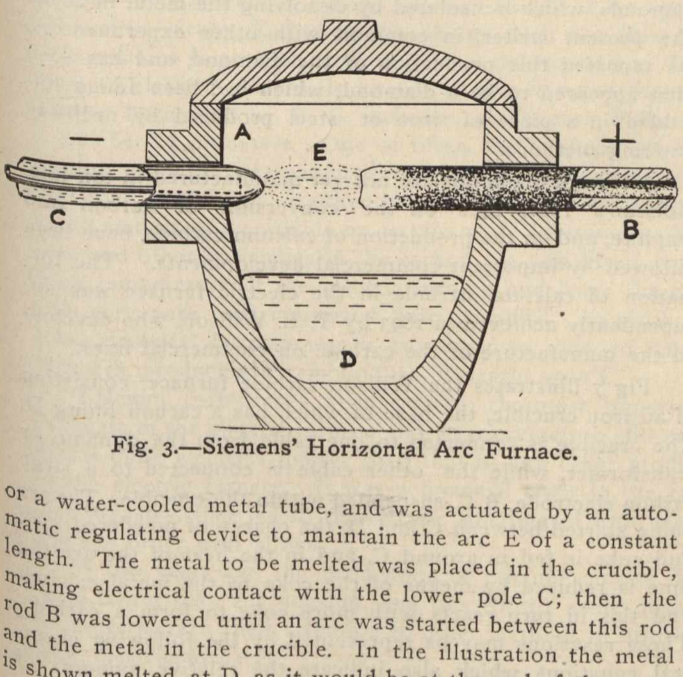



Fig. 3.—Siemens' Horizontal Arc Furnace.

or a water-cooled metal tube, and was actuated by an automatic regulating device to maintain the arc E of a constant length. The metal to be melted was placed in the crucible, making electrical contact with the lower pole C; then the rod B was lowered until an arc was started between this rod and the metal in the crucible. In the illustration the metal is shown melted, at D, as it would be at the end of the operation.

The positive pole is always hotter than the negative pole; for this reason, the metal to be melted is made the positive pole of the arc. A lid, F, was provided with a hole for observing the operation, or making additions to the charge, and a protecting covering, G, was arranged to reduce as far as possible the radiation of heat from the crucible.

In this furnace he was not only able to melt several pounds of steel, and platinum, but even to vaporize copper which had been packed with carbon in the crucible.

Siemens also invented a furnace having horizontal electrodes, as in Fig. 3. In this furnace the arc passes between the two electrodes, C and D, and heats by radiation, the material contained in the crucible. In both furnaces he pro-

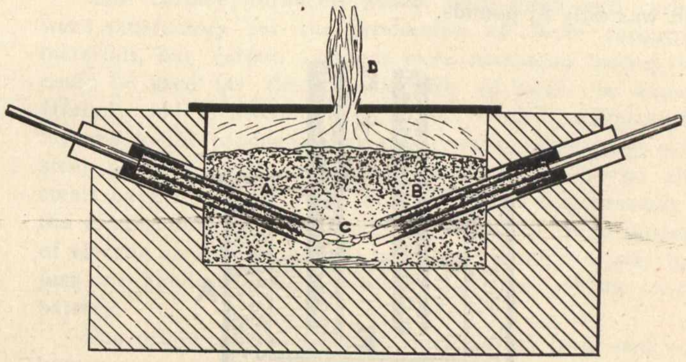



Fig. 4.—Cowles' Furnace for Aluminium Alloys.

vided water-cooled copper electrodes for the negative pole of the arc, to avoid the wasting that takes place when carbon electrodes are used. In Fig. 3, the negative electrode, C, consists of a copper tube closed at one end and cooled by water, which is introduced by a smaller pipe inside it. The positive electrode, D, is a hollow carbon rod, and through it a neutral, or reducing gas, can be introduced into the furnace.

In 1883, Faure patented an electric furnace of the resistance type, the heat being generated by the passage of the current through solid conducting rods imbedded in the hearth of the furnace, on the same principle as the electric cooking stove.

The resistance type of electric furnace was made a commercial success by the brothers, E. H. and A. H. Cowles, whose inventions were described in 1885. They passed the electric current through coarsely powdered coke, which became heated in consequence. This new method was used for a variety of purposes; one of these being the production of aluminium alloys by heating a mixture of alumina and carbon with copper or some other alloying metal.

Fig. 4 represents the Cowles furnace for aluminium alloys. It consists of a rectangular brick chamber fitted with inclined carbon electrodes, A and B, and filled with the mixture of alumina, carbon and copper. The electric current flows between the electrodes through some pieces of retort carbon, C, and thus heats the charge, which, when heated, carries part of the current. The gases resulting from the chemical reaction, escape and burn at D, and the molten alloy collects at the bottom of the furnace.

In 1886, Hall, and in 1887, Héroult patented electric furnaces for the production of aluminium, and their processes, as now used, consist in passing an electric current through fused compounds of aluminium; the electrolytic action of the current liberates the aluminium from these compounds, and the heat of the current keeps the material fused.

Fig. 5 may be considered to represent either the Hall or the Héroult furnace. Each of these consists of an iron tank A, lined with carbon, B, and provided with a number of carbon rods, C, which dip into the fused electrolyte, E, contained in the tank. The carbon rods are made the positive and the tank the negative electrode. The electrolyte consists chiefly of cryolite, and alumina—the purified ore of aluminium—is added at intervals. The electrolytic action of the current splits up the alumina into aluminium and oxygen; the former collects in the fused state at the bottom of the tank, while the latter is liberated in contact with the carbon rods, and consumes them. The loss of carbon being about equal in weight to the aluminium produced.

It will be noticed that while the apparatus resembles Siemens' vertical arc furnace in general appearance, no arc is formed in this case. The current flows through the electrolyte from the carbon rods to the melted aluminium, and in doing so produces enough heat to keep the cryolite in a state of fusion, at a temperature of nearly 900° C. (1,600° F.)

All the aluminium at present produced, comes from the electric furnace. During the year 1904 the output of aluminium in the U. S. A. alone amounted to 8,600,000 pounds; whereas, in 1883—before the electrical process was invented —it was only 83 pounds.

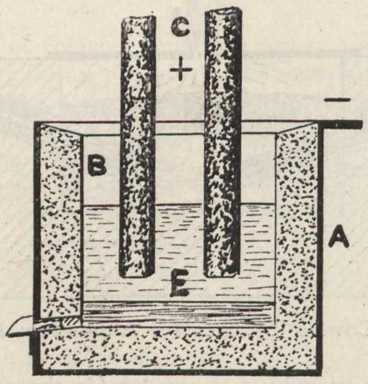



**Fig. 5.—Hall's Aluminium Furnace.**

The next stage in the history of the electric furnace is marked by the classical experiments and researches of Henri Moissan. These researches were commenced in 1892, and had for their objective the manufacture of artificial diamonds. Moissan worked in accordance with scientific method, and, although his researches were not conducted with a view to technical results, his unique experiments have given a great impetus to the commercial use of the electric furnace, as well as establishing on a scientific basis our knowledge of chemistry at the high temperatures used in the electric furnace.

Fig 6 indicates the type of furnace he usually employed. It consists of two blocks of limestone, A and B, and two carbon rods, C and D, to which the electrical connections are made. A cavity is hollowed out in these blocks and the material to be heated is placed in a crucible, E, of carbon or

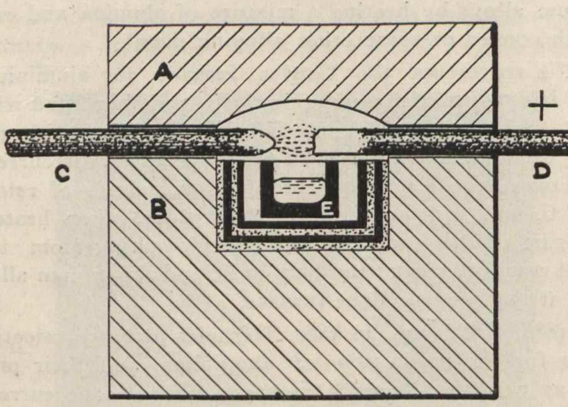



**Fig. 6.—Moissan's Furnace.**

magnesia. As even lime melts and volatilises at the temperature of this furnace, a lining of alternate layers of carbon and magnesia was arranged as shown in the figure, in order to withstand, as far as possible, the heat of the arc.

In some of these experiments Moissan converted two or three hundred electrical horse-power into heat, in a furnace of only a few inches internal dimensions. At the enormously high temperature of his furnace everything melts or volatilises. Carbon is the most refractory substance known and even that turns to graphite and volatilises; magnesia, another very refractory substance, melts at the highest temperature of the furnace and vaporises. Lime, quartz and alumina all melt and boil in the furnace. Copper, gold, iron, and, in fact, all the metals can also be melted and boiled away in the electric furnace.

An improved form of the Moissan furnace has recently been described (Engineering, March 23, 1906) in which an electric current of 1,000 amperes at from 50 to 150 volts is employed. In the case of direct current this would mean 70 to 200 horse-power, and while this is not quite as much as Moissan sometimes used, it is more than is often available for scientific experimental work. In such a furnace it is easy to produce a temperature more than double that usually obtainable by the combustion of fuel, and it is, therefore, an invaluable apparatus in the hands of the metallurgist and the chemist.

Moissan also experimented on the reduction of metals from their oxides and found, as had, indeed, been stated by Dr. W. Borchers in 1891, that carbon will reduce any metal from its oxide at the temperature of the electric furnace. Not only will carbon reduce any metal from its oxide, but at this high temperature, carbon will also combine with the metal itself to form a carbide. The production and properties of many of these carbides were studied by Moissan.

One of the most spectacular of his experiments was the production of the diamond. This is a crystallized form of carbon, and if we only knew a suitable solvent we might hope to crystallize carbon as diamonds. Moissan found such a solvent in iron and certain other metals. In the electric furnace these metals dissolve notable quantities of carbon,

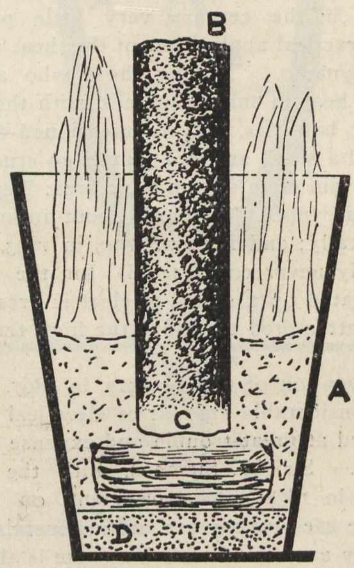



**Fig. 7.—Willson's Carbide Furnace.**

and by cooling them under suitable conditions Moissan was able to obtain some of the carbon as microscopical diamonds, which he isolated by dissolving the metal in acids. The present writer, in common with other experimenters, has repeated this production of the diamond, and has seen what appeared to be a diamond, which had been found imbedded in a piece of iron or steel produced by ordinary smelting methods.

Although diamonds are not yet manufactured in ton lots, Moissan's researches on the conversion of carbon into graphite, and on the production of calcium carbide, have been followed by important commercial developments. The formation of calcium carbide in the electric furnace was independently achieved in 1893 by T. L. Willson, who developed the manufacture of the carbide on commercial lines.

Fig 7 illustrates the Willson carbide furnace, consisting of an iron crucible, the base of which has a carbon lining D. The crucible is connected to one cable from the dynamo or transformer, while the other cable is connected to a large carbon electrode, B C, suspended within the crucible. The arc being started between C and D, the charge of powdered lime and coke is fed in around C, and in the heat of the arc the lime is reduced by means of the coke to the metal calcium and this in turn reacts with more coke to form a carbide. These reactions may be represented by the following chemical equations which also indicate the relative amounts of lime and coke to use in the charge:—

$$CaO + C = Ca + CO.$$
$$Ca + C_2 = Ca\ C_2.$$

The calcium carbide, when formed, is fusible at the temperature of this furnace, and forms a pool beneath the electrode B, and by gradually raising this electrode, a mass of carbide is built up. When the crucible is nearly filled, the operation is stopped and the crucible allowed to cool before turning out the block of carbide. The carbonic oxide produced by the reaction, escapes and burns in the upper part of the crucible, as indicated in Fig. 7. Many other forms of carbide furnaces have been devised, and are now being operated on a large scale; some of these being intermittent like the Willson furnace, whilst others are continuous in action. The world's production of calcium carbide in 1904 amounted to 90,000 tons. The value of calcium carbide depends, as is well known, upon the ease with which it acts upon water to form the valuable illuminating gas acetylene.

Another important carbide, produced in the electric furnace is carborundum, a carbide of silicon, SiC. It was accidentally discovered by Acheson and Edison in 1893 while attempting to make artificial diamonds in the electric furnace. It is made by placing a mixture of sand and coke with smaller amounts of sawdust and salt in a firebrick chamber, and passing an electric current through a core of carbon placed in the middle of the charge. The sand, in the charge, becomes reduced to silicon, and combines with carbon to form carborundum, which at the high temperature (nearly 4,000 C.) of the furnace, assumes a beautiful, iridescent, crystalline form, and has such extreme hardness that it proved to be a very valuable abrasive; and is now widely used as a grinding agent in the metal trades and other industries. It is also useful as a refractory lining for electric and other furnaces, and as a deoxidizing addition in the manufacture of steel.

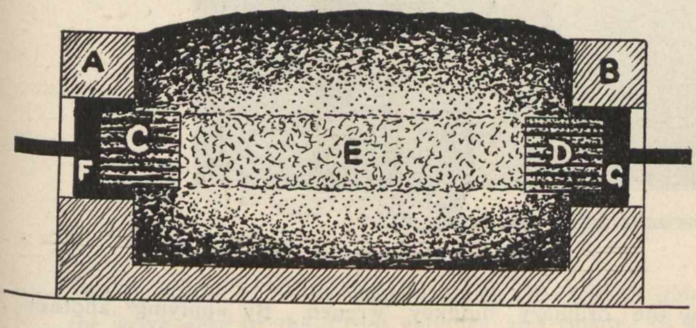



**Fig. 8.—Acheson's Carborundum Furnace.**

The furnace employed is shown in Fig 8, and consists of two permanent end walls, A and B, which support large bundles of carbon rods, C and D, in heavy bronze holders, F and G. The current is carried between C and D by a core of broken carbon E, and as the charge does not fuse this core remains in position until the end of the operation. This type of electric furnace is known as the Acheson furnace, having been used by E. G. Acheson, at Niagara Falls, for a number of processes. One of these, the artificial production of graphite, was patented in 1895, and consists in heating coke, anthracite or other form of carbon containing a small amount of iron oxide or certain other substances. The iron and other impurities in the carbon are volatilized at the high temperature of the electric furnace and leave the carbon very pure and converted into graphite. As much as 1,000 electrical horse-power is consumed in one of these furnaces, producing a temperature of nearly 4000°C.

Calcium carbide has been one of the most important products of the electric furnace and its manufacture still consumes more electrical power than that of any other product of the electric furnace. It was a financial crisis in the carbide industry, that led to the electric smelting of iron, steel, and the other iron alloys.

A few years ago the production of calcium carbide became larger than the demand, and this forced some manufacturers to turn their attention to other methods of utilising their electric furnaces.

With this object experiments were made in France and elsewhere about the year 1900 on the production of ferro-chrome, ferro-silicon, and the other ferro alloys; and these experiments were so successful that not only have the new processes been able to compete with existing methods, but in the case of ferro-chrome at any rate, the electric product has captured the market.

The ferros are alloys of iron, with manganese, chromium, silicon, or some other metal, and they usually contain a notable amount of carbon; being, in fact, cast iron, in which part of the iron has been replaced by another metal. Some of these are used in the production of open-hearth and Bessemer steel, and others for the production of special alloy steels. Other ferros which have been made are ferro-nickel, ferro-tungsten, ferro-titanium and ferro-molybdenum.

The carbide furnaces, which were lined with carbon, were satisfactory for the production of these carburized materials, but certain changes were necessary before they could be used for the manufacture of steel. In France, Héroult, and in Sweden, Kjellin succeeded in adapting the furnace to the production of good quality steel from scrap steel, pig iron, etc.; and good crucible and special alloy steels have for some years been produced commercially in the electric furnace. The original patents of these pioneers of electric steel-making were taken out about the year 1900, just one hundred years after the discovery of the voltaic battery.

The origin of the electric smelting of iron ores was, however, somewhat earlier than this. In the year 1898 Captain Stassano, in Italy, patented his electric furnace for smelting iron ores, and in the following year demonstrated the working of his process. Quite a sensation was produced by his experiments, as, although it was not surprising to learn that iron ores could be smelted by electricity, the ordinary price of electric power was so high that it appeared preposterous to attempt to use it in competition with coke in the blast furnace.

It is a matter of general knowledge that the retail price of any commodity is higher, and sometimes even several times as high as the wholesale price, or the cost of production; but it was probably not generally realized until quite recently that the small consumer of electric light pays about one hundred times as much for electricity as the actual cost of producing it from a good water-power. This enormous difference had given an exaggerated idea of the costliness of electrical power, and was, no doubt, largely responsible for the skepticism with which Stassano's early experiments were received. These experiments of Stassano, although not as yet commercially successful, have, no doubt, impressed on many minds the financial possibility of electric smelting in general, and a large crop of such processes has followed.

Some other furnaces suitable for smelting iron ores are those of Keller, Héroult and Harmet, which will be considered in detail in a later article.

In conclusion, we come to the appointment of a Canadian Commission under Dr. Haanel, in 1903, and their visit to Europe early in 1904. Dr. Haanel was so well satisfied with the possibility of smelting iron ores in countries where coal was scarce and water-power was abundant, that he is now engaged in experiments on electric smelting at Sault Ste. Marie.

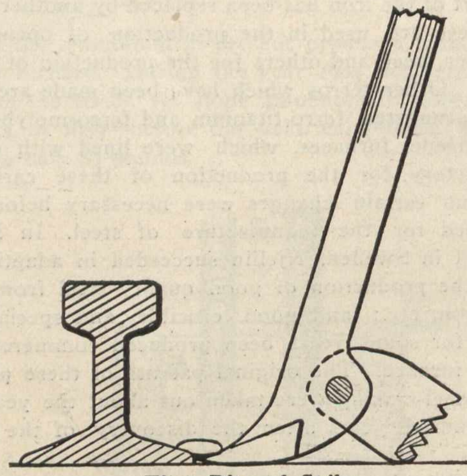
In the preliminary official report issued (February 24, 1906) it is claimed that these experiments have proved conclusively that the refractory iron ores of Canada can be successfully reduced in the Héroult electric furnace, and that the "process admits of immediate commercial application."

In this attempt to take a bird's-eye view of the evolution of the electric furnace, many important processes and well-known names have been omitted, and even the chronological order has been sacrificed in order to secure some degree of continuity.

Among other processes that have been omitted may be mentioned the electrolytic production of sodium, caustic soda and other alkali and alkaline earth metals; the electric furnace production of phosphorus, carbon bisulphide and glass, and the electric smelting of ores of zinc, lead, copper, and arsenic. It is intended to describe these and other processes in the following articles in which will be set forth in detail the various types of electric furnaces and their application in the great electro-chemical industries and in the new era of iron and steel manufacture which is just dawning.

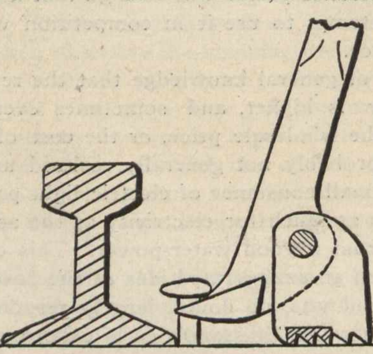
## THE NORTON SPIKE PULLER.

This claw bar is similar to the ordinary appliance used on railways for pulling spikes, but differs in the addition of a trig or foot block at the heel, which serves as a fulcrum after the spike has been started, making it possible to pull



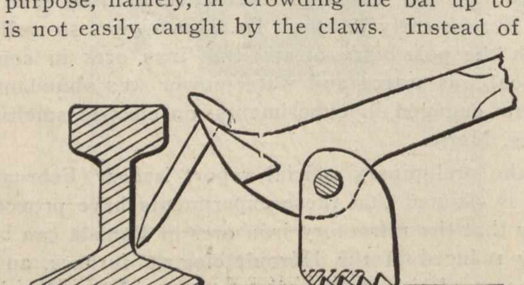
First Bite of Spike.

the spike out quickly, without bending. In getting the spike started the foot block is not used, but the moment the spike is loosened the bar is thrown up and the block falls into place, as shown in Fig. 2. By bearing down on the bar, with the block now acting as a fulcrum, the spike can be lifted out of the tie at one stroke, and without bending. In-



Second Bite.

as much as the fulcrum is attached to the claw bar, the necessity of reaching for a separate fulcrum, and placing the same in position with one's fingers, is done away with; hence both time and trouble is saved by the use of this excellent combination of claw bar and fulcrum. The total weight is 30 pounds. The foot block also serves another useful purpose, namely, in crowding the bar up to a spike which is not easily caught by the claws. Instead of thrust-



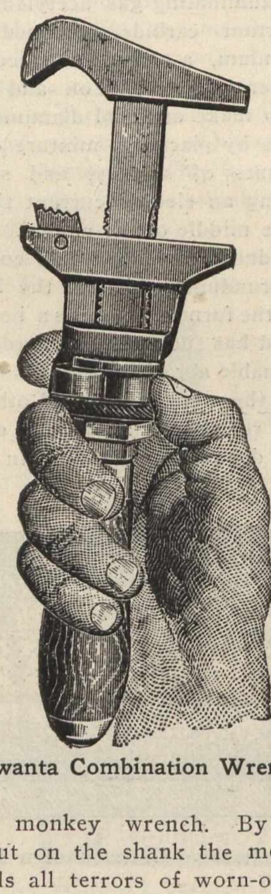
Out Without Bending.

ing the claw bar against the spike, as is customary with the ordinary tool, the claws are placed against the spike, the bar is raised up almost straight, allowing the foot-piece to take a bite into the timber. The bar is then moved back and forth a few short strokes until the claws are worked under the head of the spike. The foot-piece is then pulled back and the spike started and pulled, as previously described. This method of work prevents dulling the edges of the claws, which necessarily occurs with ordinary claw bars when punching the bar at the spike to get hold of it.

The sales agents in Canada are: W. H. C. Mussen & Co., Montreal.

## UWANTA MONKEY WRENCH.

The origin of the so-called "monkey" wrench is obscure, but it certainly dates back as far as the time of James Watt; for one was found in his historic workshop at Handsworth on his demise in 1819. Many are the forms of adjustable wrenches used in the metal trades to-day; but it is claimed that the improved appliance illustrated, and known as the Uwanta combination wrench, for both pipe work and nuts, is in advance of anything yet attained in the way of mechanical advantage and rapidity of action. They are so designed that instant and positive adjustment—for any sized nut up to the capacity of the wrench—can be made, and it is possible to get a much firmer grip than can be obtained



Uwanta Combination Wrench.

by the ordinary monkey wrench. By applying another wrench to the nut on the shank the mechanic can get a grip which dispels all terrors of worn-off corners on nuts and screws. The head, bar and shank are made of one solid steel forging, and all parts finished, finely polished and interchangeable. The Uwanta wrench is also furnished with jaws of the standard wrench pattern for nuts only. The eight-inch opens 1¾ inches; the fifteen-inch opens 2⅞ inches.

These new tools, manufactured by the Uwanta Wrench Company, Meadville, Pa, U.S.A., are made of the best material, and are guaranteed to withstand all reasonable usage.

## A SIMPLE METHOD OF SQUARING.

With a mark, nail or stake as a starting point draw two lines as nearly right-angle as the eye will determine. From the starting point, measure and mark 3 ft. one way and 4 ft. the other. When the distance across from one mark to the other is exactly 5 ft. a perfect angle will be obtained. Any multiples of 3-4-5, such as 6-8-10, 9-12-15, may be used also.

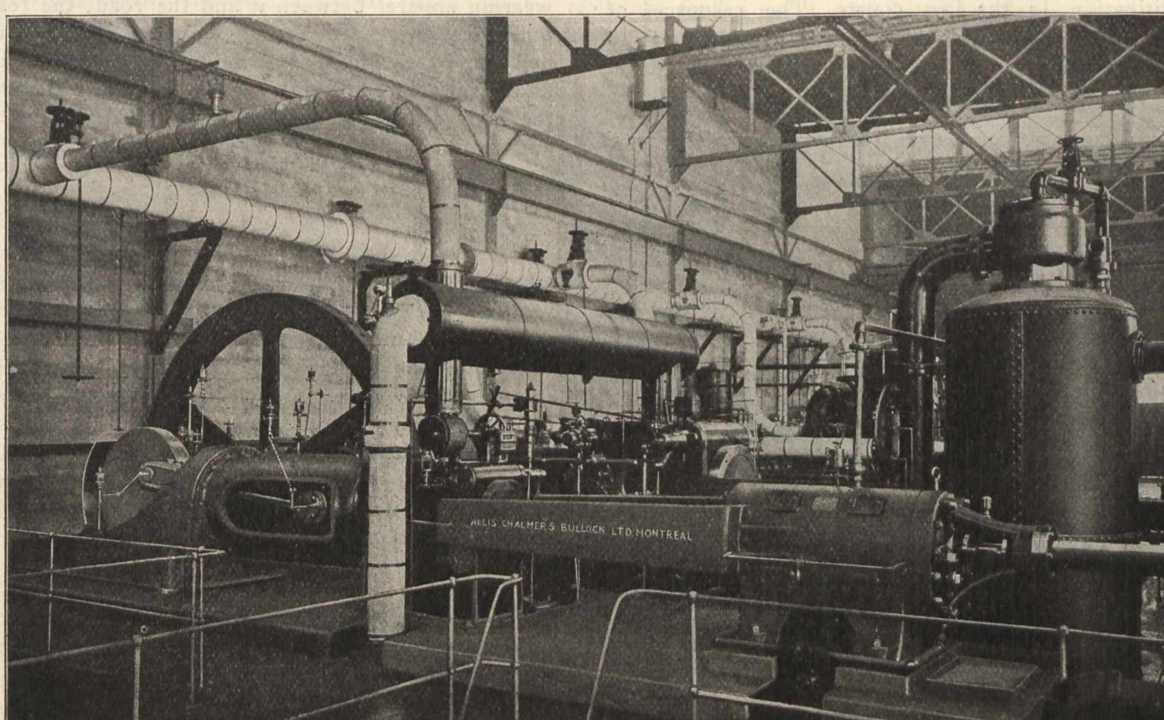
## POINTER.

Put a piece of resin the size of a walnut, into your babbit; stir thoroughly, then skim. It makes poor babbit run better, and improves it. Babbit heated just hot enough to light a pine stick, will run in places with the resin in, where without it, it would not. It is also claimed that resin will prevent blowing when pouring in damp boxes.

# AIR COMPRESSOR INSTALLATION

We illustrate herewith the large air compressor in the power house of the Canada Car Company Limited, Montreal. It is a Corliss cross-compound steam and compound air type, and was built by Allis-Chalmers-Bullock, Limited, Montreal.

The compressor is designed to stand a steam pressure of 190 pounds at the throttle of the high pressure cylinder. The steam valve gear is of the standard Corliss release type. The air cylinders and heads are thoroughly water-jacketed. The air inlet waves are of the Sergeant patent piston inlet type, and the discharge valves of the improved poppet pattern. A vertical receiver intercooler, 48 in. in diameter by 13½ ft. high, containing tinned brass tubes through which the cooling water circulates, stands between the cylinders. It is shown at the right in the illustration. The receiver is situated in the basement beneath. The steam cylinders are 16 inches and 32 inches in diameter, and the air cylinders




**Air Compressor Installation, Canada Car Company, Limited, Montreal.**

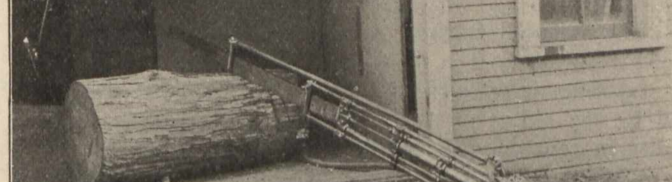
The governor is of the improved fly-ball type, regulating the valve gear of the steam cylinder, and capable of speed adjustment by means of a lever and adjustable weight for at least five revolutions above and below normal speed. The governor is furnished with an air regulator attachment, operated by pressure from the air receiver, and so controlling the steam cut-offs independently of the action of the governor balls, so that the speed compressor will vary automatically in proportion to the amount of air required. The 18¼ and 30¼ inches in diameter; stroke, 30 inches. The view shown was taken from the high pressure side of the compressor. When operating at 85 r.p.m. the compressor has a piston displacement of 2,125 cubic feet of free air per minute, and is designed for a final working air pressure of 100 pounds per square inch. An idea of the size of the compressor may be gathered from the flywheel at the left, which is 12 feet in diameter, and weighs 15,000 pounds. The total weight is approximately 115,000 pounds.

---

## PORTABLE PNEUMATIC SAW.

In view of the fact that lumbering in Canada is receiving much attention at the present time, the air-propelled saw which we are enabled to illustrate through the kindness of the White Engineering Company, Marion, Ohio, is quite opportune.

This machine is of light, easily-handled construction, weighing only about 60 pounds. To operate the saw it requires a 6 h.p. engine and a compressor capable of supplying from 50 to 60 feet of free air per minute, running at 150 r.p.m., and maintaining a pressure of from 50 to 75 pounds. During tests that have been made the saw was driven through hardwood at the rate of 8 to 12 inches per minute. In the six-foot saw illustrated the machine is shown resting on a log lying horizontally, but it can be laid flat on the ground, and then will cut down standing timber, practically level with the earth. This is an economic feature of great merit, especially as lumber is getting more valuable every year. Any device that will cut standing timber with a minimum stump should attract the attention of every one interested in the lumber business. The machine is very simple in construction, and will do the work of ten men, requiring only two men to run it: one to watch the saw, the other to attend engine and compressor. An entire outfit would weigh not more than 1,500 to 2,000 pounds; hence



**Portable Pneumatic Saw.**

can be moved over the timber lands with ease. The manufacturers claim that the machine can be operated by anyone, and that it is "fool-proof."

# JENKINS AUTOMATIC SAFETY FENDER

## FOR STREET RAILWAY CARS.

*(Endorsed by the Ontario Government.)*

The swift-running electric car has become such an essential factor in our modern civilization, and the ever-increasing demands on the street railway service has necessitated such dangerous intersections of lines that speed in congested districts can only be made at a constant risk to life and limb. Accidents are of frequent occurrence, followed every time by public outcry for protection, and often by costly litigation in the law courts. The resources of traction engineers have been strained to the uttermost in the effort to invent devices for saving the lives of those who fall on the tracks in front of street cars. But hitherto

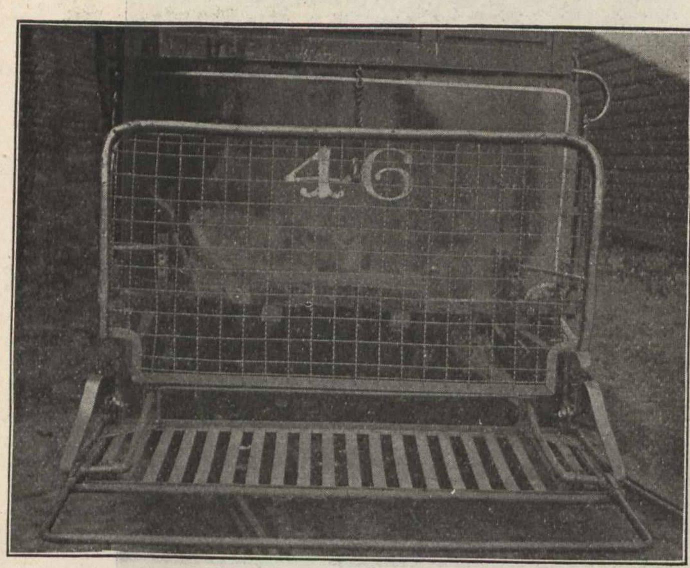


**Fig. 1.—The Jenkins Automatic Fender attached to Car No. 46 of the Hamilton Street Railway.**

these praiseworthy efforts seem to have been in vain. The Patent Office archives are full of the futile claims of eager inventors. Some in theory seemed to be perfect, but when tried *practically* were a miserable failure. Unknown to the general public, street railway companies have spent small fortunes in trying device after device, all of which have been consigned to the scrap heap. At the last, however, it seems that Mr. B. B. Jenkins, of Toronto, is able to cry, "Eureka!" for after devising three preliminary safety appliances he has invented and patented an automatic fender which has been subjected to the severest practical tests, and has come out of the ordeal with complete success. Indeed, so enthusiastic were the Government engineers at the result of the trials that, on their recommendation, the Jenkins automatic fender is now being placed upon the market, with the unqualified official endorsement of the Ontario Government.

Through the courtesy of Mr. Jenkins we are enabled to set forth in detail the advantages of this timely life-saving invention.

### Ideal Conditions.

The essential features of a successful street car fender are:—

(1) That it shall be automatically dropped to the road-bed by the object on the road before the object actually comes in contact with the fender.

(2) That it shall be rigidly held, not only in its normal position, so that it cannot rise above a certain level, but in any position between the normal height and the road-bed, so that it cannot by any possibility mount and pass over the object struck.

(3) That it shall maintain a definite normal level above the road-bed, instead of moving up and down with the body of the car, sometimes being down to the road, at other times between ten and twenty inches above same—though examples of such movements are to be seen in almost every single-truck car, and special attention should be paid to this point, for, as will be obvious, if the fender is even twelve inches above the road a full-grown adult, if prone on the ground, would pass under without being touched by the fender.

(4) That the fender, when dropped, shall go under the object struck, without pinching any part of the body or wearing apparel between it and the road; the result of such pinching, which produces great friction between the body and the road, almost invariably causes the latter to roll under the fender to the wheels, inflicting death, or drags the body along the road, tearing the flesh from the bones, and maiming the person so that death would almost be preferable.

**And generally—**

A fender that, under any circumstances or conditions—whether the car be going at a high or low rate of speed, whether the road-bed be rough or smooth, wet or dry, whether the motorman be looking or not, whether he has time to act or not, whether he be cool-headed or flustered, whether he is engaged with the controller, brake, sander and gong, whether the person struck be a big, strong man or a little, delicate child—will work promptly and efficiently, and absolutely without any attention or assistance on the part of the motorman. **It is claimed that the Jenkins fender absolutely fills the above requirements.**

### Three Essentials.

Three leading features of the Jenkins fender that are absolutely indispensable to success, and which cannot be found in any other fender in use to-day, are:—

(1) It is automatic—positively automatic.
(2) It gets under the object struck, and is held there.
(3) It is non-oscillating.

### Construction.

The cradle or the horizontal portion of the fender upon which the bodies are picked up is a strong steel frame, covered with light steel bands, and is held in place by two steel gravity supports. On each side of the cradle is a

**Fig. 2.—Folded up for Barn Storage.**

strong flat steel spring, with a heavy downward strain. Connected with the above support a safety guard extends out about sixteen inches in front of and on a level with the front of the cradle as a feeler, and when the car approaches an object on the track, the above mentioned guard is the first to come in contact with it, and is pushed back freely towards the fender, releasing the two steel supports, when the springs at once force the fender to the road before it reaches the object struck.

The above mentioned springs force the cradle to the ground, hold it there, and while the pressure is sufficient to prevent anything getting beneath, the fender is not so locked as to break when it comes in contact with rough or uneven ground.

Some idea of the rapidity with which the fender acts may be gained from the fact that when a car is travelling at the rate of ten miles an hour it travels fourteen feet eight inches in a second; hence the fender must move downward from its normal position to the road-bed in about one-fifteenth of a second from the time the guard or feeler touches the object until the fender reaches it, if it is to get clear underneath; and, as this fender has, in the tests made by the Ontario Government engineer, dropped from ten inches above the road-bed instead of five inches—its normal level and the engineer's requirements—in time to pick up objects when the car was travelling at about fifteen miles an hour, it will be seen that the cradle drops with at least three times the rapidity that is necessary in ordinary use.

In addition to the fender being automatic, it can be operated by the hand, foot or knee.

It is readily interchanged from one end of car to the other.

The cushion, or that part of the fender which stands up in front of the dash-board, is made of woven steel wire, with about a three-inch mesh, which, if the opportunity presents itself, a person may grip. The steel frame is covered with a rubber cushion, as is also the front bar of the cradle.

The fender can be raised or lowered to meet the requirements of different road-beds, or of snow storms, etc.

It can be folded up on front of the car to run into car barn or other purpose.

**Non-oscillating.**

On single-truck cars the fender is attached to the truck by means of flat steel arms, with a spring near the front, connecting them with the body of the car to relieve a portion of the weight of the fender, and with a guide to keep the fender always in place in front of the car. This prevents the fender following the motion of body of the car up and down, and keeps it always at a uniform distance from the track, even when travelling over the roughest road—preventing the fender striking the ground or over-running any object on the road.

The flat bar from the truck to the fender, with a net-work drape over it, serves as an excellent wheel-guard, so that there can be no possibility of a body rolling in from the side of the fender—a thing that has often occurred heretofore.

**Tests.**

One of the fenders was fitted to, and operated on, car No. 46 of the Hamilton Street Railway for some five months, during which time the Government Engineer, R. P. Fairbairn, and the Government Mechanical Superintendent, M. J. Quinn, paid repeated visits to Hamilton for the purpose of applying such tests as their wide and extensive experience with street car fenders suggested. For instance, one of the tests to which this fender was subjected was, with the fender set four and one-half inches from the road, to pick up a bag six inches thick, loosely packed with sawdust, shavings, etc. (to represent a child prone on the track), while the car was travelling at full speed, and this was done repeatedly with the bag in centre of the track, at the corner, one-third over the rail, two-thirds over the rail, lying sideways, lying at various angles to the approaching car, etc., and in every case, with the fender working automatically, the bag was picked up clear of the road.

A variety of other tests were made, such as picking up huge bags, loaded and packed, slack and tight, with cinders, lying in various positions, among others, in an oblique position, with the top slanting away from the approaching car, and propped in that position with a stick—the intention being to compel the fender to mount and pass over the bag, if such a thing were possible—and also with the bag lying with a loose mouth towards the car.

During one of the tests Mr. Jenkins insisted that a bag which had been cut to pieces while testing other makes of fenders, and still containing a shovelful or two of cinders, should be placed in front of his fender; and, while the unanimous opninion of the onlookers, and even the Government officials, was that it would be unreasonable to expect any fender to pick up so small and dilapidated an object, yet the Jenkins fender picked the remains of the bag up just as well as it did full bags. An impact blow of 5¾ lbs. is sufficient to trip the guard, liberate the springs and drop the fender.

Out of a total of between forty and fifty such severe tests, the fender never once failed to respond, and to do its work thoroughly.

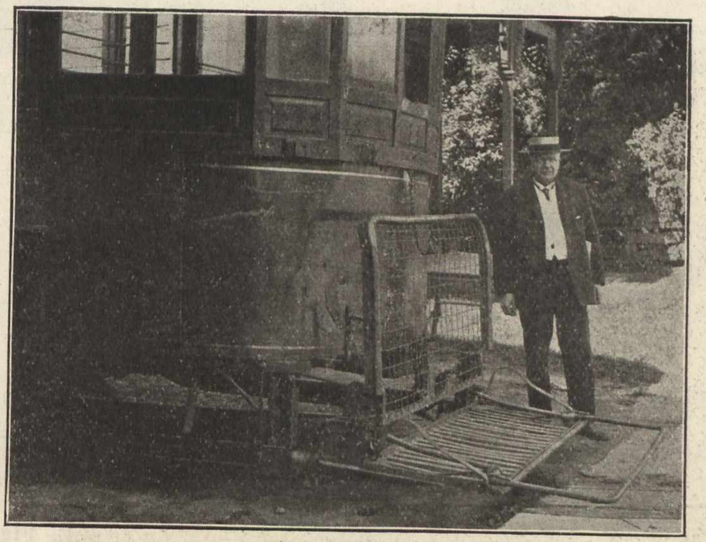


Fig. 3.—Ready for Use.

It is to the credit of the Toronto Street Railway Company and their enterprising general manager, Mr. R. J. Fleming, that they are alive to the advantages of the unique life-saving invention described above, and are constructing in their workshops 150 of the Jenkins automatic fenders for immediate application to street cars in the city of Toronto.

Every municipal corporation in the Dominion ought to seriously investigate the claims of this simply constructed and mechanically effective life-saving appliance, which has stood the severest and most exacting tests, is endorsed by the Ontario Government, and has been adopted by the Toronto Street Railway Company.

## NEW OFFICES OF H. W. PETRIE.

It is not so many years ago since large employers of labor began to pay unusual regard to the conditions under which their employees worked. Following this awakening it was found that first one large establishment and another instituted changes in their plants. The gospel of light and cheerful surroundings became a very part of industrial enterprise. If it is important that mechanics be cheerfully surrounded, it is none the less true of the office staff.

In this connection it is a pleasure to call attention to the new offices of H. W. Petrie at 131 West Front Street, this city.

These new offices are cheerful and light and sweet in the extreme, and it must be a great pleasure to work amid such cheerful surroundings. A balcony has been erected at a proper height around a section of the old Cyclorama building. The offices are finished in light wood, while there is an abundance of windows, ensuring the best of light.

We understand that it is Mr. Petrie's intention to devote the premises west of the main building to second-hand machinery, while new machinery will be kept in Machinery Hall, which has become a centre of attraction to all who are interested in machinery.

# PIPE FOUNDING IN CANADA

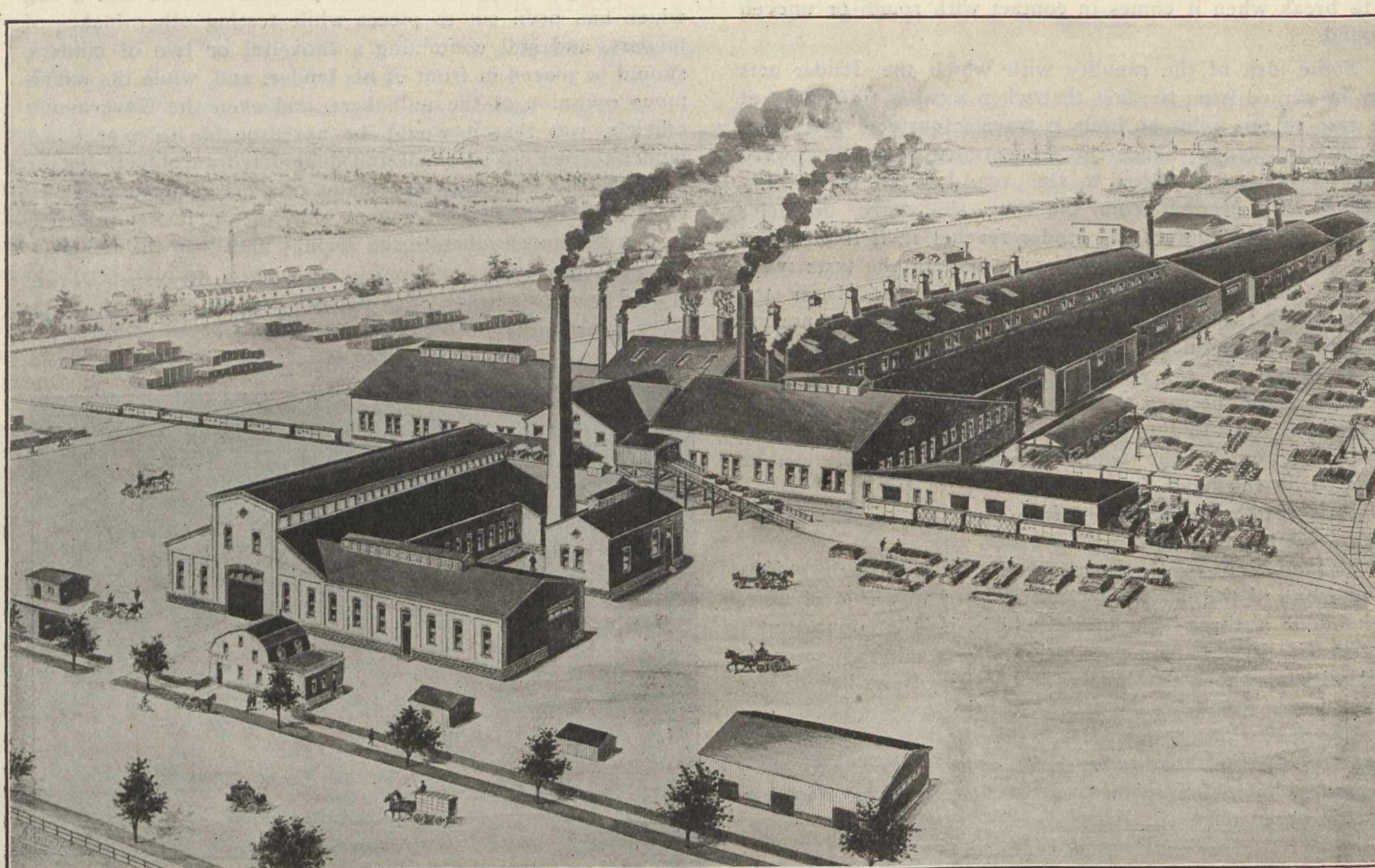


**Fig. 1.**

**Works of the Montreal Pipe Foundry Company, Limited, at Three Rivers, Province of Quebec.**

Inasmuch as Canada is one of the most progressive countries in the world to-day, a brief survey of her resources for supplying pipes to convey water and gas from central works to the homes of her people in the rising towns and cities should be of unusual interest; and we deem ourselves fortunate in being able to set before our readers this month a description of the most modern pipe founding plant in the Dominion. At the present time five pipe foundries supply the wants of the country; located respectively at Hamilton and Toronto, in Ontario; Londonderry in Nova Scotia; and Three Rivers, in the Province of Quebec. The total output of pipes in 1905 is estimated at about 21,500 tons, valued at, say $750,000. This figure, however, does not represent the pipes used in Canada; for although the high tairff of $8 practically shuts out the American manufacturers; the preference tariff of $5.33 a ton against Great Britain lets in the Scotch and English makers, who have succeeded in filling orders for seaport municipalities in Canada, at prices which it is claimed would be ruinous to Canadian manufacturers.*

Tempting though a discussion of the tariff question is, we cannot dwell on this phase of the pipe founding industry now, and only refer to it in order to account for the fact, that though the need of pipes in the country is daily increasing, the existing plants generally are not by any means working up to their maximum capacity.

On the occasion of our recent visit to Three Rivers, however, we found the Montreal Pipe Foundry Company's plant at this place working at "high pressure"; indeed, the very imperfection of the photographic illustrations showing the interior operations is due to the clouds of dust and smoke pervading the atmosphere of the shops in spite of the excellent system of ventilation.

*[Three reasons are assigned for this ability to undersell; (1) pipe foundry pig-iron in the British Isles is $2.50 a ton cheaper than in Canada; (2) coke is $3 a ton more at Three Rivers than in England or Scotland, on account of the long railroad haul from the Connelsville country; (3) Canadian labor is paid from $1.25 to $1.50 per ton higher than English or Scotch. Editor.]

As shown in the panoramic view, Fig. 1, these works are situated on the western bank, and near the mouth of the St. Maurice River, where it delivers into the St. Lawrence, divided in midstream by islands, which form three short, converging rivers. The freight facilities by both land and water are all that could be desired.

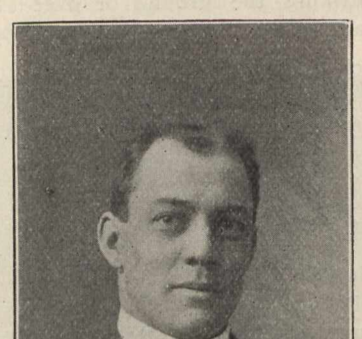


Fig. 2.
**G. R. Duncan, M. Sc.,**
Engineer and Superintendent,
Three Rivers.

The works proper, located on land, embracing ——acres, are equipped with the most modern machinery, and have a daily capacity of 35 tons, or 10,000 tons annually. The number of men employed is less than in most pipe foundries, due to the unique labor-saving appliances which confront one at every turn as we pass through the various departments. The general plan is almost in the form of a latin cross; the top consisting of offices, stores, forge, machine shop, and power house; the arms of jobbing foundry, cupola house, and general repair shop; while the trunk forms, main foundry, core ovens, pipe cleaning, testing and dipping shops; all planned so that raw materials go in at one end, and finished pipes come out at the other.

**Machine Shop.**

On our way to the pipe foundry, we first passed through the machine shop, 200 x 70 ft., which is well lighted and fitted with modern tools, suited to their special line of business. Two side galleries run the whole length of the building, on which the pattern-making is done. In the space between these galleries is an 8-ton electric hand-power travelling crane. The shop is operated entirely by electric power, delivered from water falls on the Batiscam River, 17 miles from Three Rivers—the oldest long distance transmission line in Canada. The power is delivered per three-phase system, 3 wires, 60 cycles, at 12,000 volts, reduced to 550 and is entirely satisfactory. From this department—busy on the finishing of flasks, tumbling barrels, special pipes, etc., we enter the

**Fig. 3.**

**Core Making.**

While electricity plays an important part in the general operations, flask tipping, sand mixing, pipe cleaning, etc., is all done by compressed air, hence, we found in the powerhouse an Ingersoll air compressor installation, driven by a 65 horse-power A. C. motor, and nearby a reserve 150 horse-power, 16 x 32-in. Wheelock Corliss engine, capable of driving the whole plant if necessary. The steam is generated in a 150 horse-power Robb-Mumford boiler. After a glance at the forge annex: well equipped for general smith and forge work; we leave behind all these necessary adjuncts to the foundry, and find ourselves among the piles of pig-iron, shown in the foreground of Fig. 1.

**Pipe Foundry Iron Supplies.**

Three brands of pig-iron are used in this foundry, viz., "Londonderry," No.'s 1 and 4; "Port Clarence," No. 1; and "Sommerlee." The first named are made at the Drummond furnaces in Nova Scotia, and have the following analyses:—

No. 1—Si. 3.76; S. .017; P. .907; Mn. 1.1.
No. 4—Si. 2.75; S. .075; P. 1.08; Mn. 1.1.

The Port Clarence iron is made in Durham, England, from high phosphorus ores, taken out of the Cleveland Hills of Yorkshire, while "Sommerlee" is made in Scotland, and is high in silicon; hence used as a softener—changes white into grey iron. Since phosphorus is a preventative of oxidation, high phosphorus iron is peculiarly suitable in the manufacture of cast-iron water pipes; and the owners of the Three Rivers pipe foundry are fortunate in being also the proprietors of both mines and blast furnaces from whence they get most of their pig-iron.

In this foundry the metal mixtures are prepared with the exactitude of a science; the selections are made in accordance with rigid chemical and mechanical tests. Every car load arriving is accompanied by guaranteed chemical analysis, and each brand when unloaded is piled separately, and carefully marked. Each day the superintendent gives the cupola charger instructions as to which piles are to be used; hence, each day's mixture is carefully determined by the analysis of the iron, and the proper proportions of each grade used.

**Physical Test of Metals.**

W. P. Keep's well-known system of mechanical tests is used.

(1) **Shrinkage and Chill.**—Two bars cast daily, ½-in. square x 10-in. long. On the day of our visit (March 3rd, 1906) the result was as follows:—Shrinkage 0.140 in. in 10-in.; chill ⅛-in.

(2) **Traverse Fracture Test.**—Three bars cast daily, 1-in. square x 12 in. long; same day as above, the result was (a) 3,200 pounds; (b) 2,700 pounds; (c) 3,220 pounds; ¼in. deflection (approx). Bar marked (b) had slight defect at point of fracture.

Our visit was a complete surprise, so that we had an opportunity of witnessing every-day practice; and we must say, that after critically inspecting the systematic provision made for the selection of metals, we wonder not at the reputation this company is gaining, as regards the quality and suitability of the materials used in the manufacture of their gas and water pipes.

The flux for the cupola consists of excellent local (Radnor) limestone, and the fuel of best 72-hour Connellsville coke, imported from Pennsylvania, U. S. A. These supplies, together with the pig-iron, are elevated to the charging platform in steel skips, by means of an incline and wire rope drive. A series of 5 turn-tables at the entrance end of the 30 x 50 ft. charging house, transfer the respective materials (which are carefully weighed) on 30-in. tracks to the cupola mouth. Two cupolas, 80 and 56 in. diameter respectively, furnish metal to the foundries. The blast is delivered through 2 x 12 in. vertical tuyeres by means of a Sturtevant fan blower, electrically driven. By way of a narrow doorway in the cupola house we enter the main pipe foundry, which is 170 ft. long x 40 ft. span. The first impression was disappointing to one familiar practically with the great pipe foundries of Britain and the United States. This negative impression, however, was soon turned into surprise, for in

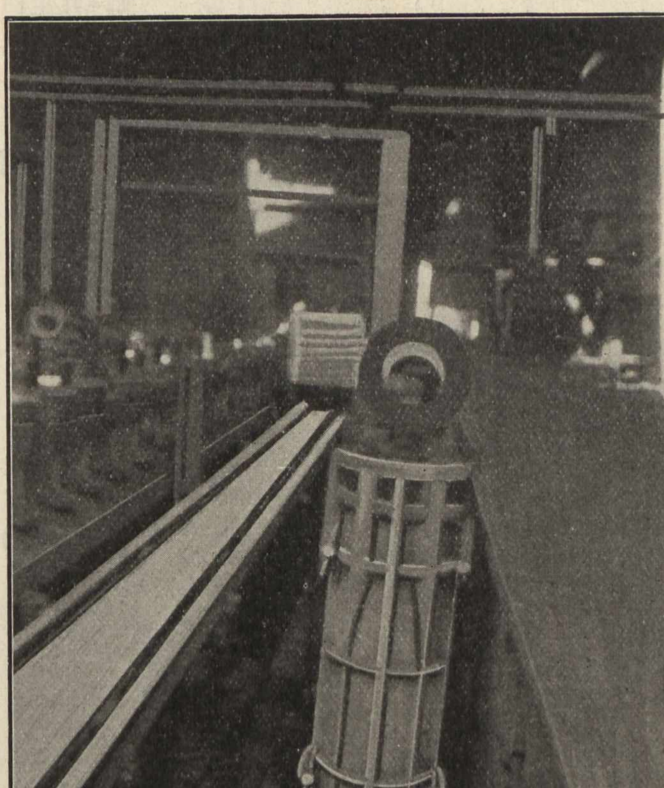


**Fig. 4.—Pits and Tracks.**

this comparatively narrow building, we beheld pipes made with a mechanical precision, quickness of movement, and in such quantities as would be simply impossible in other foundries we had seen twice the size; and all due to the unique system of mechanical appliances with which the plant is equipped.

On the left of the cupolas are a series of core ovens projecting outside the wall of the main building and heated by means of coke-fired grates of approved construction, located below ground at the rear.

Seeing that coke is an expensive fuel, drying heat generated in water seal gas producers would doubtless be more economical, and when extensions are made, steel roller doors should be found more convenient. On the floor in front of the ovens core-making, as shown in Fig. 3, was in active progress.

Hay rope binding for solid shell core barrels is an old and effective device; but a mixture of loam, sawdust, and hydrated starch—as used at the "Addyston" foundries in the U. S. A., and at Cochrane's foundries, Middlesborough, England—is an equally effective, cleaner, and much more economical core material for the making of pipes in vertical moulds. From the able superintendent we gleaned that important improvements are contemplated in this section, so that in a little while, the core-making department will be as "up-to-date" as any part of the plant. From near the 5-ton mixing ladle in front of the cupolas, we turned our attention to the busy work going on down the middle bay, where two electric cranes (supplied by W. H. C. Mussen & Company, Montreal), 10 and 5 ton capacity respectively, were hoisting cores, swinging flasks, etc., over the 100-ft. longitudinal pits, in which pipes were being moulded and cast with remarkable rapidity, by aid of mechanical appliances and machinery, the like of which we had never seen in our travels before.

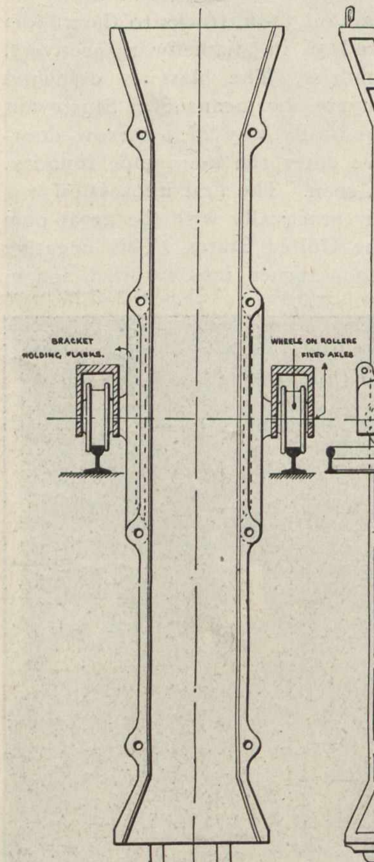



Fig. 5.

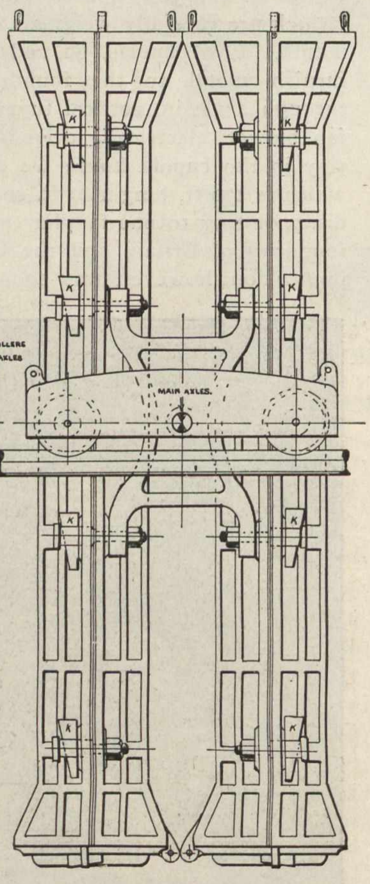



Fig. 6.

#### Mode of Manufacture.

As illustrated in Fig. 4, the pipe-moulding area consists of two 50-ft. narrow pits, provided with rail tracks upon which the pipe flasks—connected in pairs in one, and in fours on the other—are moved along on four-wheeled carriages, having swinging axles as per Figs. 5 and 6.

The cast iron flasks are made in hinged halves, bolted together, and secured by means of the keys "K" (Fig. 7). The cone or riser pattern "C" (Fig. 7) is then set in the door at bottom, closed, and also fastened by tightly driven taper cotters. The body pattern "B" is lowered by crane into position, and the mould rammed up as far as the bell pattern. The moulding sand used in this operation is imported in barges from Burleigh, Vermont, U. S. A., and the ramming is done by hand with light hollow pipe-rammers.

The bell pattern "A" is slipped over the top pin of "B" and the ramming of mould completed. Thereupon "A" is removed by hand, guided by the top pin, while the pitman below opens the bottom door, allowing "C" to slip out, also guided by the centre pin, which prevents distortion or rupture of the mould. The body pattern "B" is lifted out by crane, bell and riser mould slicked, and a pail of wet black-wash—made of special facing mixture imported from Scotland—swirled down the mould, the surplus wash dropping into a tank. The pitman then adjusts the temporary setting ring (Fig. 8), and the moulds are pushed into the oven at the lower end of pits to be dried over night. In the morning the entire series of moulds are drawn out of the ovens and the core is lowered in, and set as shown in Fig. 8. The top chill ring is then put on, a covering of moulding sand is carefully packed, and cover plate set in place and tightly keyed on. When all the cores are thus in place, Fig. 10, the mould carriages are all spaced, and the flasks, by means of the crane, are turned over: the spigot end being now at the top and the bell at the bottom. The temporary setting rings are now removed, the spigot or "bead" end of the core being carefully centred by clamps as per Fig. 9; gauges being used to ensure the core being concentric with the mould. The hinged door on top is now tilted and the moulds are poured full (Fig. 12), the riser being 5 or 6 inches high, after which the runner gate, together with a portion of the riser, is broken off while in a semi-molten condition.

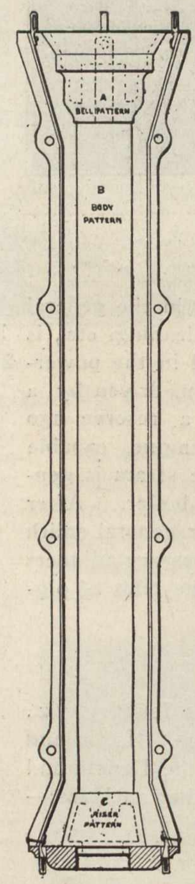



Fig. 7.

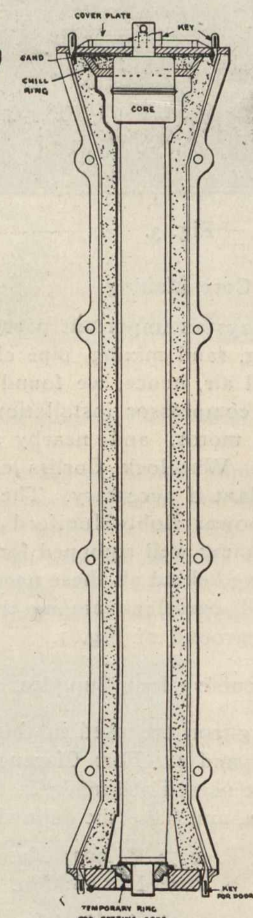



Fig. 8.

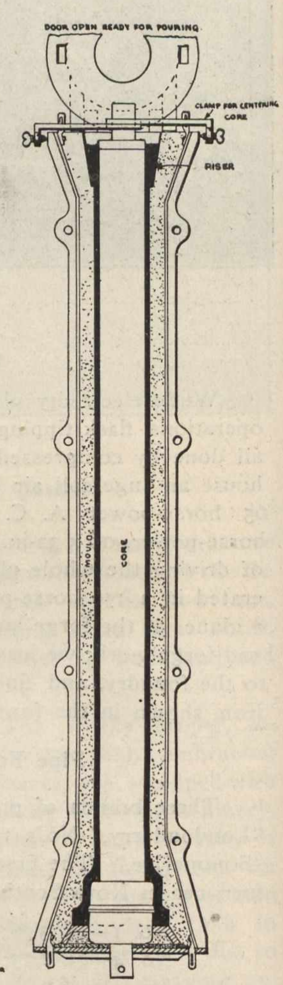



Fig. 9.

Soon after the metal in the moulds is set the flasks are turned upside down again, so that the bell is upwards, and the cover plates and chill rings removed, and the core barrel hoisted out by the crane (Fig. 13). Then the flask keys "K" are slackened, a drawbar lowered by crane through the pipe, and a triangular "hook" attached to same by the pitman. Straightway the pipe is pulled up out of the flask, and the mould sand falls down into the pit conveyor underneath. The bottom end of the uplifted hot pipe is lowered on to a skid, wihch enables it by gravity to drop gradually down on to the rail gauntry, along which it rolls on to the cleaning department. The burnt sand deposited at bottom of pits is carried through a central culvert in side wall, and elevated at night in buckets on endless chain to mixing department,

Fig. 10.

where the requisite new sand, coal dust, etc., is added; then the renewed sand is delivered next morning to steel trucks, 6 ft. 0 in. x 24 in., shown on left foreground of Fig. 14, and used in the ramming of new moulds.

**Pipe Cleaning.**

The method adopted in this foundry for the cleaning of pipes is certainly novel. As illustrated in Fig. 14, the lower

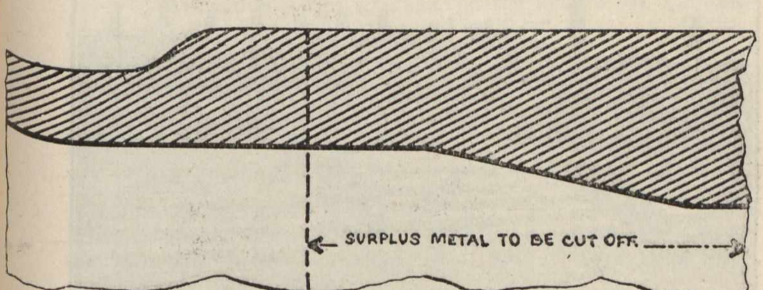



Fig. 11.

**Full size section of bead from 6-in. pipe, showing surplus metal cast on, to be subsequently cut off in the lathe, in order to ensure a solid, clean end of pipe.**

half of an endless chain running at high speed on sprockets located at each end of the pipe is passed through the interior, and by its errosive action removes the adhering mould sand therefrom, and very effectively it does the work. The sand having been removed the pipe is rolled on to a small 4-wheel truck, having a central vertical screw, capped with an adjustable saddle, by means of which the pipe can be lifted and connected to lathe headstocks in quick time. In half a minute the surplus metal on bead is cut off, and the spigot end presents a clean, sound and finished appearance. Pneumatic chippers are employed to remove all lumps and rough places on the outside. Following this operation a blast of air from the compressed air line is sent through and over the whole pipe, thoroughly removing all sand and metal dust from the skin. The pipes are now rolled into an oven and evenly heated to a temperature of about 450 degrees F., then picked up by a 5-ton air hoist and dipped into a tank containing an antiseptic tar solution and well coated. From thence, rolled on the continuous rail gauntry to the hydrostatic testing press, the moveable headstock on which, is shifted by means of a powerful set of compound gears, having high mechanical advantage; and each pipe when adjusted is subjected to a hydrostatic pressure of 300 pounds per square inch. They are then rolled out of the testing press on to the scales, and there carefully weighed and recorded.

From the secondary operation of hoisting the newly cast pipes out of the flasks and depositing them on the cleaning gauntry to the final operation of weighing, the process is entirely continuous; and in this respect the Three Rivers plant is one of the best examples we have seen of a foundry laid out systematically, and logically with a view to economy in production.

After weighing, the pipes are carried to their respective piles in the stockyard (Fig 15), ready for shipment in accordance with contract.

Fig. 12.

**Special Pipe Foundry.**

Allied with every straight pipe foundry is a department for the manufacture of irregular pipes; such as tees, crosses, elbows, bends, collars, etc., similar to those assembled in the left fore-ground of Fig. 16.

The jobbing foundry in these works is an ell shaped building, 70 x 50 ft., extending from the right of the Cupola house, and forming one arm of the cross. This department is the least modern of the whole plant as regards equipment; for here we found jib crane, wooden flasks, etc., on the one hand, with an utter absence of labor-saving moulding machines on the other. The coke-fired core oven and its truck are up-to-date, however; and in the moulding of specials, we noticed several examples of resourceful, economical moulding. In the making of elbows for instance, we noticed that the drag half of cores consists of **dry sand,** while the cope half is made of **green sand,** with the exception of the curved part forming junction of angle, which is made of **dry sand.** All the irregular pipes after cleaning are heated and painted with a tar mixture of similar composition to that of the famous antiseptic solution of Dr. Angus Smith. It appears that a common practice with many municipalities

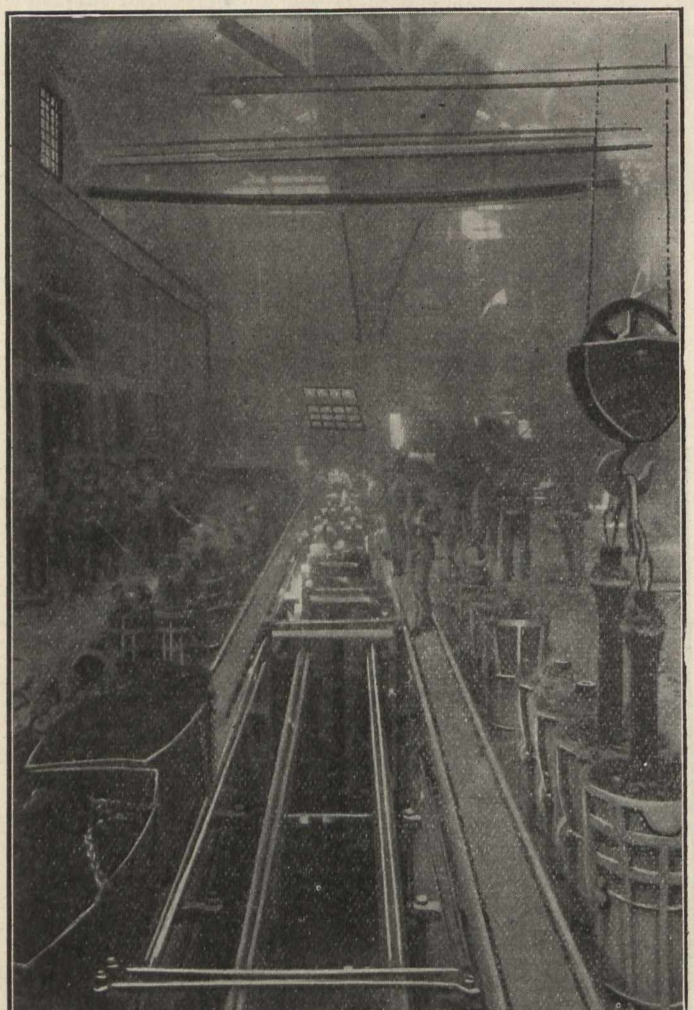


Fig. 13.

is, to place contracts for straight pipes with one firm, and orders for the special pipes with another, hence the meagre attention hitherto paid to the outlay and equipment of the jobbing foundry in standard Canadian pipe works. But it seems a change is coming over the scene in this respect, and as a consequence it is not surprising to gather that a larger and more commodious jobbing foundry may be seen in the near future at Three Rivers, which will, no doubt, be designed in accordance with the latest ideas, and embody the best labor-saving appliance known in modern foundry practice.

Emerging from the jobbing foundry we found ourselves at the point near the offices from whence we started, having made a complete circular inspection of the plant, which, according to Tariff Commission evidence, represents an investment of $135,000.

**Logical Deductions.**

Looking back in perspective, the following features having unusual merit, stand out prominently:—(1) The care with which the materials used in the manufacture of the pipes are selected and handled; (2) the altogether admirable method of making moulds with bell at top and bead at bottom; but by reversal, pouring the moulds with bell downwards and bead upwards; for, the casting of bell downwards ensures—due to head pressure of metal—close-grained iron at the shoulder of socket, where there is danger of porosity due to irregular sectioning and, hence, unequal shrinkage; while the casting of an elongated bead—say 6in. long—which is subsequently cut off in the lathe, guarantees a sound, solid, spigot end; and (3) the evident marks of system and scientific method which pervades the operations on the plant generally.

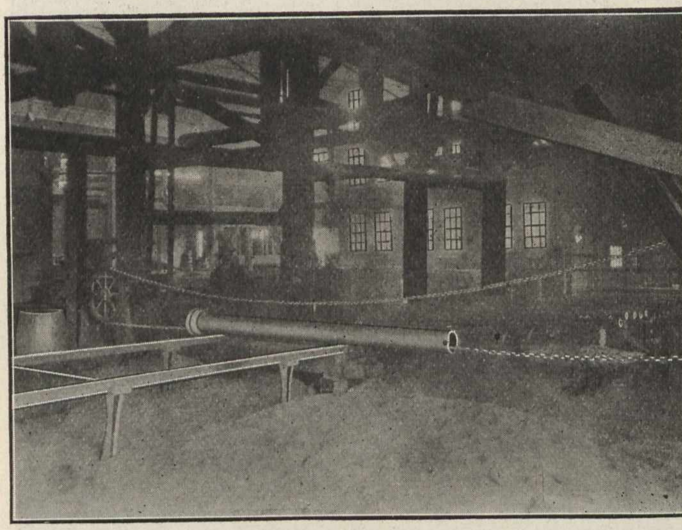


Fig. 14.

In concluding this meagre description, and summing up our impressions, we can only say, based upon wide practical experience in pipe founding, and taking into account the limited extent of the present operations, that as regards layout, mechanical appliances, systematic working, and economic management, the Three Rivers plant of the Montreal Pipe Foundry Co., Limited, is one of which the owners are justly entitled to be proud.

**Personnel of Company.**

In addition to the Three Rivers Works, the company has a pipe foundry at Londonderry, N. S., and the combined

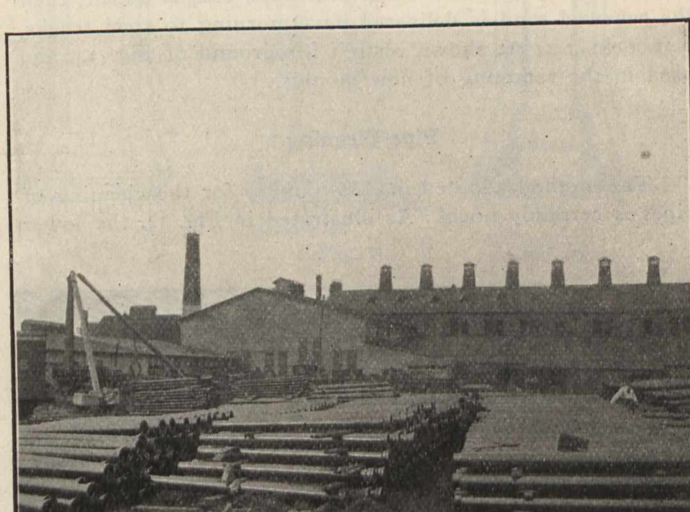


Fig. 15.

daily capacity of the two plants is 70 tons of straight pipes and 15 tons of irregular castings. C. L. Jobb is general superintendent, with headquarters at Londonderry and occasional visits to Three Rivers. The daily works management at the latter place, however, is in the hands of G. R. Duncan, M. Sc., a graduate of McGill University, and one of the ablest of our younger Canadian engineers, who is ably supported by N. A. Garvin, foreman of the pipe foundry department. J. P. Edwards is manager of the Londonderry works, which we hope some day to describe in our columns.

The officers of the Montreal Pipe Foundry Co., Limited, are: T. J. Drummond, president and managing director; C.

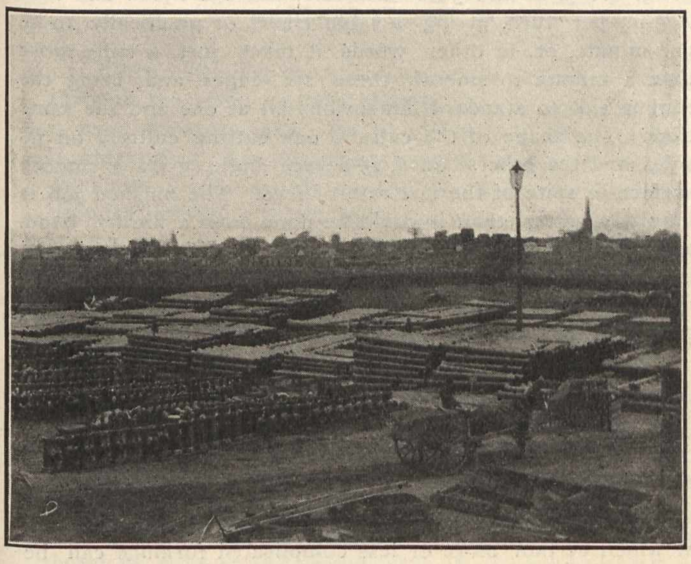


Fig. 16.

Ed. Gudewill, vice-president; James T. McCall, secretary-treasurer. Headquarters of the company are at Canada Life Building, St. James St., Montreal.

## THE PRESERVATION OF IRON AND STEEL.

By B. H. THWAITE, C. E.

II.

Having dealt with the importance of preserving steel from corrosion, and having pointed out the advantage of Portland cement and cement concrete as efficient preservatives, I must, however, confess that, unfortunately some details of steel construction do not lend themselves readily to the application of cement or cement concrete, and that for this reason, it is also necessary to consider what other preservative methods are available, that at least afford some moderate protection, if regularly applied. Thus the question of protection by paint and by solutions also requires attention.

### Paint an Unreliable Preservative.

The ordinary rust-preventing precautions adopted in the United States by steel-frame construction experts is probably well represented by the following extracts from two specifications.*

In the first relating to the "Kuhne Building," New York, it is required that:—

"The foundation grillage beams are to be painted with two coats of graphitic paint and the space between the beams and around them for a distance of 14 inches is to be filled up with concrete."

In the second, referring to the new "Times Building," New York, it is provided that:—

"All parts of the structural iron and steel-work must be painted with two coats of red lead, all finished members must receive one complete coat of paint before they are taken from the shop or exposed to the weather. Covered surfaces (surfaces in contact and surfaces enclosed) of all parts of riveted members, should receive one coat of paint before they are assembled. All accessible surfaces must have one coat of paint after erection."

"The first coat must not be applied over loose scale or over initial corrosion. If the scale has not fallen off, or if rust has formed, it must be removed, if necessary, with wire brushes. Painting must always be done on dry surfaces and preferably on warm ones. Mud, grease, and dirt of every kind, must be thoroughly removed before painting. Bolts remaining in the structure must be dipped in paint before being put in place."

"All paint must be mixed in small quantities immediately before application, and paint mixed and not immediately applied cannot afterwards be mixed with fresh material. The first coat must be mixed in the proportion of one gallon of boiled linseed oil to 33 pounds of red lead. The second coat must be mixed the same way, with lampblack ground in all, added in sufficient quantity to color a light brown."

* From copies of specifications kindly put at the disposal of the author by Mr. Croydon Purdy, of New York, U. S. A.

Whether the foregoing paint coverings will be adequately effective, time alone will tell. The writer, is, however, of the opinion that no ordinary paint depending upon the oxidation of its driers for hardening, is even moderately impervious to either air or water.

The fact that the oxidation of the drier is supported only from the air outside the painted surfaces, obviously means that air must penetrate the latter during the hardening process for so long as any drier remains. Consequently, owing to the pores produced by the flow of air and by the volatile gases given off by the drier during evaporation, the paint cannot be impervious to air and moisture. Of course, the greater the number of coats, the less porous the paint will be, because the lines of the air pores will be broken, but when once air and moisture have secured a passage the effect of the local oxidation of the metal will be to lift the covering of the paint at the **locale** of air entrance, cracking the paint and allowing further air and moisture to pass to the metal, with the ultimate effect of lifting the paint from off a considerable part of the surface requiring protection.

Lately a special paint claimed to contain a considerable proportion of india-rubber has been put on the market, which, by reason of its claimed elasticity, should be less liable to crack than even the best of ordinary paints. This so-called "Vulcanite" paint certainly merits attention amongst the best of the moderately impervious paint coverings.

Outside the Portland cement and cement concrete method of preservation, which should be applied whenever practicable, there is, however, no painting, or other method in general use for steel-frame structures that can be said to afford really adequate protection against the culminating effects of oxidation or rusting.

### Tar and Pitch Solutions as Possible Preservatives.

The writer, however, submits a proposal that he believes will provide considerable protection for steel structures against corrosion in any ordinary everyday environment. It is based on Dr. Angus Smith's process of treating cast-iron water pipes, which, if properly applied gives most satisfactory results.

The ingredients used in the Angus Smith process,* consist of coal tar and pitch oil. These materials, mixed in the proportions of one part dead coal tar and three parts pitch oil, are heated in a tank of suitable capacity and design, until a temperature of between 350 to 450 degrees F. is attained. If the temperature is allowed to fall below 350 degrees F. the preservative coating will be no better than mere tar, and if the temperature of the mixture exceeds 450 degrees F. the pitch coating will be overheated and liable to scale off after application.

Having been heated to the proper temperature the mixture is ready for the reception of the structural steel or iron members, which are then to be immersed in it, until they attain throughout their mass the same temperature as the mixture. The metal can then be gently lifted out of the preservative fluid by the aid of lifting tackle provided in conjunction with the tank, and which the author has designed to be portable so as to permit the process to be applied on the field of erection. The naptha and other volatile oils

* Based upon the formulæ specified by the late Dr. Angus Smith, and which he asked the writer to make public early in the eighties of last century.

evaporating will then leave a firm hard coating like pure pitch, which will tenaciously adhere to the steel surface, and being elastic, will expand and contract with the metal.

In the opinion of the writer, a hydro-carbonaceous coating of this kind is next to cement, by far the best preservative yet put forward. It has been found to be an excellent preservative for water pipes, and if it is satisfactory for surfaces over which water is constantly flowing it should be much more so for static applications exposed to atmospheric influences only.

Any parts of the coating disturbed by riveting or other causes can be made more or less perfectly good by applying the hot fluid to the surfaces preliminarily heated by gas jets, by heated iron plates, or in any other suitable manner. Rivet heads can be treated before they are allowed to cool so that the erection disturbance of the Angus Smith coating can be effectively made good. As the hardening of the pitch surface does not depend on oxidizable driers there should be no pores through which the air can penetrate to the metallic surface.

Of course, when it is desired to ornament the metallic surfaces, ordinary paint of any color can be applied to the pitched surfaces. For foundation steel elements, the application of the Angus Smith composition can, and should be supplemented where practicable with a covering of Portland cement. These two effective preservatives should last for centuries, unless disturbed by violence.

### Conclusion.

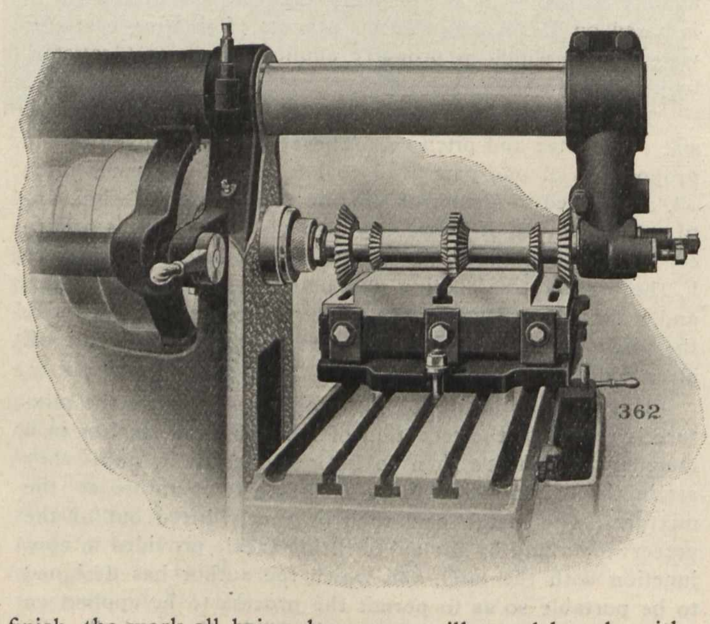
The author trusts that this discussion of the means available for the preservation of iron and steel employed in construction may be of some assistance to those who desire to adopt adequate methods of fighting against corrosion, and that it may also serve in some measure to allay the uneasiness recently expressed as to the permanence of future structures depending wholly or in part upon the continued strength of iron and steel members, if such members be suitably protected.—**[From "Concrete and Constructional Engineering, London.]**

## MACHINE SHOP NOTES FROM THE STATES.

By CHARLES S. GINGRICH, M. E.

XXV.

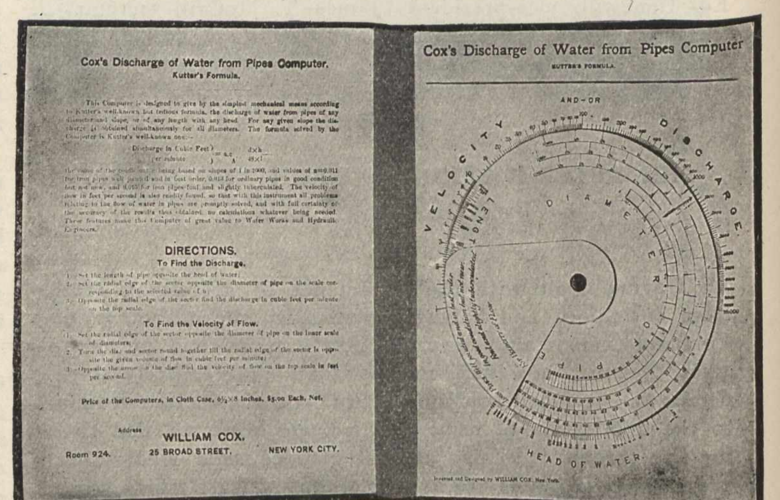
In the October issue of our paper we gave a short description of some rather remarkable results that were being obtained in machining flat cast iron pieces 14-in. long, 1¾-in. thick, 10¼-in. wide over all, to a very close degree of




finish, the work all being done on a miller and largely with the use of gang cutters. This, of course, brings all the corners of the piece to a very sharp edge, and the illustration herewith shows a method adopted for reducing those edges. The tools consist of a gang of angular cutters of the proper diameter and properly spaced on an arbor carried on a No. 2 Plain "Cincinnati" Miller. These finish six corners at one time. The interlocked side mill also finishes the tongue slot in the piece exactly to size. The cutters composing this gang, are 3, 4, and 5-in. diameter, run 132 r.p.m. and feed .075-in. per turn, giving a table travel of practically 10-in. per minute, or, in other words, it takes just a trifle more than a minute to smooth these six edges and bring the tongue slot to standard dimensions all at one and the same time. The shape of the cutters, one cutting entirely on its sides and the others on a 45-degree angle, gives a smooth surface in spite of the fast rate of feed. The finished job is infinitely better than it could be done with a file by hand, and at only a small fraction of the cost. This is of interest in that it suggests another class of work on which the modern miller can be profitably used, adding another important item to machine-shop economy.

## MECHANICAL COMPUTERS.

These computers are simple mechanical devices by means of which certain more or less complicated formulæ can be almost instantly solved, each computer solving merely the one special formula for which it was designed. They con-




**Discharge of Water from Pipes.**

sist in their simplest form of a foundation plate in the centre of which a disc revolves. Upon these, logarithmic scales, corresponding to the several factors of the formula, are arranged and combined in such manner that by turning the disc round and bringing the values of two known factors opposite each other, the value of the fourth factor is at once seen opposite the third one. When there are 5 or 6 factors in the formula, an extra piece of sectoral shape with similar scales upon it, revolves between the disc and the plate, about the common centre.

One very important feature, which adds much to the value of these computers, and which has been so thoroughly appreciated, is that in problems of which many solutions are possible, all the values of the different factors producing the **same result** are at once read off, the only thing that remains to be done being the selection of the most suitable combination of values.

With these computers hours of tedious calculation may be avoided, errors eliminated, and the solution of a problem obtained with a far greater appreciation of the effects produced by a slight modification of any one of the factors than is possible by working out arithmetically any number of suppositional cases by means of the formula.

The standard size adopted for these computers, most of which are made by hand, is 12 x 12 inches for formulæ of 3 and 4 factors, and 12 x 14 inches for formulæ of 5 and more factors. In all cases the very best bristol board is employed, and every care exercised to make them reliable scientific instruments.

## ELECTROCHEMICAL CALCULATIONS.

By Joseph W. Richards, A.C., Ph.D.

Professor of Metallurgy in Lehigh University, Past-President of the American Electrochemical Society, Author of, "Metallurgical Calculations," etc.

Electrochemical processes produce chemical changes through the agency of the electric current, and the current is used primarily either for its electrolytic effect or for its thermal effect. The first thing needful, in order to make any calculations connecting electric energy with thermal or chemical effect, is to set forth the values of electric energy as expressed in thermal or mechanical units, in order to get a common energy basis on which to make comparisons, and to postulate the facts concerning the electrolytic effect of the electric current.

### Energetics of the Electric Current.

One watt-second of electric energy may be postulated as equivalent to one joùle of mechanical work, or 0.2385 gramcalories. This is the energy basis on which electric and chemical phenomena meet on common ground, for the only energy measure of chemical reaction which has as yet been quantitatively investigated is the thermal one. We, therefore, express the energy of a chemical reaction in the terms in which that energy has been measured, and then have the theoretical basis of calculating the amount of electrical current which can theoretically furnish that amount of thermal energy.

### Principles of Thermo-Chemistry.

The measuring of the amount of heat liberated or absorbed in chemical combination or decomposition or reaction is the province of thermo-chemistry. Many enthusiastic scientists have accumulated large numbers of these experimental data, from which, however, very few generalizations have been, up to the present, deduced. There are critical discussions of thermo-chemical data for inorganic compounds in Ostwald's "Allgemeine Chemie;" one can find the most compete collection of thermo-chemical figures yet published, both for inorganic and organic compounds, in Berthelot's "Thermochemie;" in English, Muir's "Elements of Thermal Chemistry" is the only collection of tables on this subject which aims at completeness, and the work is at present nearly two decades old. More or less incomplete or fragmentary tables can be found in works on chemistry or treatises on heat. In giving the data, chemists always give the heat change for molecular weights of the substances concerned; for instance:

$$(H^2 O) = 69{,}000 \text{ Calories}$$

means that when two parts of hydrogen unite with 16 parts of oxygen to form 18 parts of water, 69,000 heat units are evolved. If the weight of the substances be called kilograms, the heat units are kilogram-calories; if called grams, they are gramcalories; if called ounces or pounds, they are ounce- or pound-calories (1°C). The Germans write the above $(H^2 O) = 690$ K, in which K stands for 100 ordinary heat units; while the French write it $(H^2 O) = 69.0$ Cal., in which the weights of the substances are supposed to be taken in **grams**, and the heat evolved expressed in **kilogram** calories. In our opinion, the English style first given is logically and practically superior to the other two, and is the best to follow.

It must be borne in mind that almost without exception the thermo-chemical data given in the tables are those which have been determined starting with the constituents at laboratory temperature and ending with the products at the same, or very nearly the same, temperature. The heat quantities, therefore, apply strictly only to electrochemical processes taking place at ordinary temperature, or very near thereto, and with the constituents or products in the same physical state as was used in the calorimetric determination. If the electro-chemical process is taking place at any different temperature, let us call it t°C., and the ordinary temperature 15°C., the heat of the chemical change at t°, from constituents at t° to products at t°, or **vice versa**, can be calculated from the rather simple rule that—

**The heat of combination at t° equals the heat of combination at 15° (tabulated heat), plus the heat necessary to raise the constituents from their ordinary state at 15° to their ordinary state at t°, and minus the heat which would be necessary to raise the products from their ordinary state at 15° to their ordinary state at t°.**

The above calculation requires a knowledge of the specific heats and latent heats of change of state of the constituents and of the products of the reaction, between 15° and t°, but when these are known, the heat of the reaction at t°, the quantities very often needed in electro-chemical calculations, can be evaluated. These specific heats and latent heats are best obtained from such standard works as Landoldt and Bornstein's "Physikalische-chemische Tabellen," or works of similar scope in English.

### Faraday's Laws.

There is another and an entirely different quantitative relation between the amount of electric current used and the quantity of electrochemical action produced, which applies to direct current producing electrolysis. In this case, while the energy relations hold, yet they are conditioned by the fact that every coulomb of electricity passing produces a definite amount of chemical change, equivalent to the setting free of a certain weight of hydrogen, for instance, and the energy required must adjust itself to the bringing about of this amount of chemical change. I am referring, of course, to Faraday's discoveries, which may be briefly summed up in the two statements that:

1. The amount of chemical change produced electrolytically by the current is proportional only to the amount of electricity passing, as measured in coulombs, and is independent of the strength or temperature of the electrolyte, or the size or distance apart of the electrodes.
2. The amount of different elements dissolved or set free by the passage of a given amount of electricity proportional to their chemical equivalents.

When it was determined experimentally that 0.00001035 grams of hydrogen is set free by one coulomb, or that 96,540 coulombs set free one chemical equivalent, one gram, of hydrogen, the whole scale of relations for all elements whose chemical equivalents were known, became known. The **"Faraday"**—96,540 coulombs—sets free, or tends to set free, in passing from an anode to a cathode, a chemical equivalent weight in grams of any element. No law of nature has been subjected to more rigorous tests than this law of Faraday, and it appears so far as a law without an exception.

### Evolution of Gas Electrolytically.

A Faraday of current, 96,540 coulombs (representing 26.82 ampere hours) sets free one gram equivalent of metal or acid element or radical. If the element or acid radical is gaseous, there is a simple relation between the current flow and the volume of gas evolved, based on the observation that a gram equivalent of a monatomic gaseous element has a volume under standard conditions of temperature and pressure of 22.22 litres, of a diatomic gaseous element of 11.11 litres, etc. Thus, 96,540 coulombs set free a gram equivalent weight of hydrogen, chlorine, sodium, zinc, etc. The formulæ for these in the gaseous state are Na, Zn, $H^2$, $Cl^2$; the molecules of these gases, representing 22.22 litres, contains, therefore:

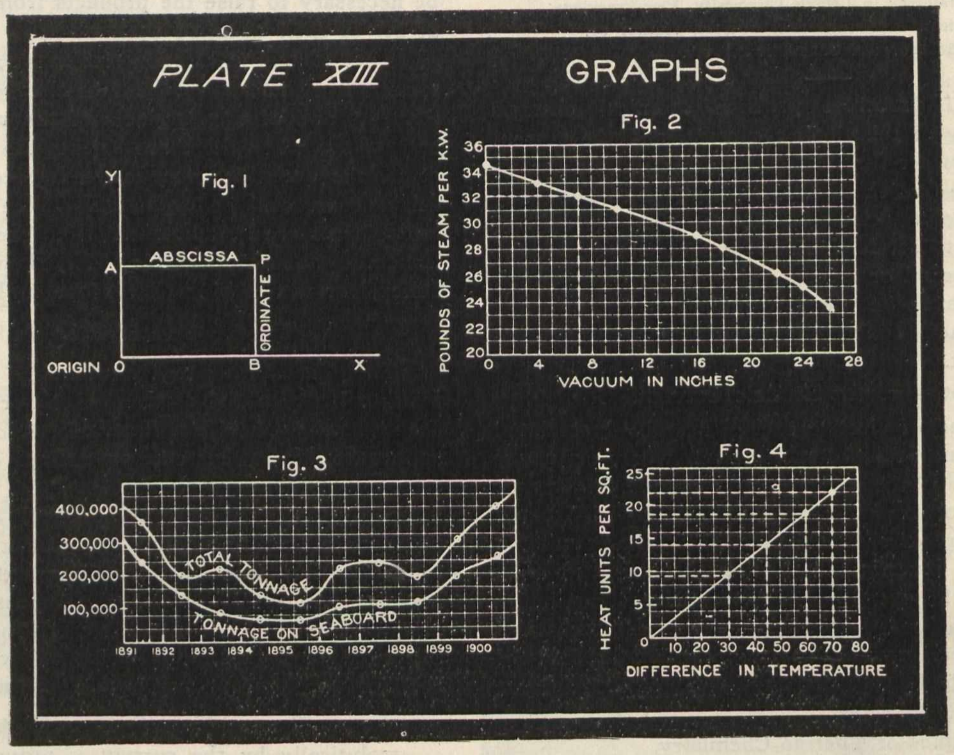
| | | | | |
|---|---|---|---|---|
| Na | molecule | —1 | gram-equivalents. | |
| Zn | " | —2 | " | " |
| $H^2$ | " | —2 | " | " |
| $Cl^2$ | " | —2 | " | " |
| $O^2$ | " | —4 | " | " |

Therefore, 1 Faraday (26.82 ampere hours) sets free 1 gram molecule of sodium vapor (22.22 litres), and ½ a gram molecule (11.11 litres) of vapor of zinc, hydrogen gas or chlorine gas, assumed at normal temperature and pressure. For any other temperature, t, or pressure, p, in m.m. of mercury, the volume would be:

$$\text{Standard volume} \times \frac{273 + t}{273} \times \frac{760}{p}$$

(*Continued.*)

# EXTRACTS FROM AN ENGINEER'S NOTE BOOK




## GRAPHIC DELINEATION OF DATA.

In reading a technical book or magazine, we often see curved lines drawn on paper ruled off in small squares. To the uninitiated these lines mean little or nothing; but to those who can understand them, they show far more than can be explained in many pages.

To interpret the meaning of these graphical representations, one must first of all know how they are constructed, and then, by careful study and practice, learn to read them correctly and formulate the laws they express. It is indeed surprising to see how plainly such a curve shows facts, and how much can be represented by a single line referred to fixed base-lines.

### Principles of Construction.

Before discussing the shapes of plotted curves, let us consider the method of construction.

The usual bases are two straight lines at right angles to each other. These lines are often called "rectangular axes." In Fig. 1 on the blackboard, **OX** and **OY** are the axes, and **O** (the intersection) is the "origin." If the perpendicular distances **AP** and **BP** are known, the point **P** is fixed—that is, its position relative to the axes is known. The distance **AP** is called the **abscissa**, and **BP** is called the **ordinate**, of the point **P**. The distances are also called the **co-ordinate** of **P**.

If we have a table showing these distances for a series of points, each point may be plotted. A simple case is a table of variables, such as is given below. In using such a table, one column may be taken for the abscissas, and the other for the ordinates. Thus a series of points represent graphically the data given in the table.

The following table was compiled from the results of a test of a steam turbine driving a generator. It shows the effects of increasing the vacuum:—

| Vacuum, Inches of Mercury. | Pounds of Steam per K.W. per Hour. |
|---|---|
| 0 | 34.5 |
| 4 | 33.0 |
| 7 | 32.1 |
| 10 | 31.0 |
| 16 | 29.0 |
| 18 | 28.0 |
| 22 | 26.1 |
| 24 | 25.0 |
| 26 | 23.6 |

The plotted results are given in Fig. 2. The readings of vacuum are taken as abscissas, and the pounds of steam as ordinates. Thus we commence with no vacuum (atmospheric pressure), and 34.5 pounds. For a vacuum of 7 inches the ordinate is 32.1. Other points are located in the same way.

The curve shows that, as a more perfect vacuum is maintained, the steam consumption decreases.

### Another Example.

The following table appears in a recent government report. It gives the total tonnage of vessels built during the years 1891-1900 inclusive; it also gives the tonnage of vessels built on the seaboard:—

| Year. | On Seaboard | Total Tonnage. |
|---|---|---|
| 1891 | 237,462 | 369,302 |
| 1892 | 138,863 | 199,633 |
| 1893 | 102,830 | 211,639 |
| 1894 | 80,099 | 131,195 |
| 1895 | 67,127 | 111,602 |
| 1896 | 102,544 | 227,097 |
| 1897 | 103,504 | 232,233 |
| 1898 | 112,879 | 180,458 |
| 1899 | 196,120 | 300,038 |
| 1900 | 249,006 | 393,790 |

Unless studied very carefully, this table does not mean much. Contrast it with Fig. 3 on the blackboard. These curves are plotted in the same way as was the curve shown in Fig 2. The dates are taken as abscissas, and the tonnage as ordinates.

It may be noticed that the point for the year 1891 is not taken at the origin, but at a distance corresponding to a half-year beyond. The reason for this is that the data in the table are for the whole year, and to get a point for plotting, the ordinate is placed at the middle of the space indicating the year.

It is well to note that the plotting of this curve differs in one respect from Fig. 2. In Fig. 2, all points are accurate, while in Fig. 3 it is impossible to take into account hundreds, tens, and units, unless the values are plotted on a very large scale. The form of the curve is sufficiently accurate, and expresses the principles.

Fig. 3 shows that there was a marked decrease in shipbuilding in 1894 and 1895. During 1896 and 1897 the totals were higher, but there was but little increase on the seaboard. Doubtless the general decrease was due to the hard times of 1893 and 1894. Probably an economist would tell us that the increase in 1896-1897 on the lakes was due to the development of the iron ore trade on the Upper Lakes, which caused the building of more ships to carry the ore. The increase in 1899 and 1900 may have been due to the Boer War, which decreased shipbuilding in England, and increased it in other countries.

### Curves and Aids in Calculation.

In engineering work, there are many cases in which constants to be used in formulæ are plotted in curves rather than expressed in tables. Take Fig. 4 as an example. In this graph, the number of heat units lost from a 12-inch wall is shown to vary as the difference in temperature varies. Thus, in calculating the size of radiators, we first estimate the probable difference between the temperature of the room and that of the outside air. Let us suppose this to be 60 degrees. Then by following the ordinate for 60 degrees we find that a square foot of a 12-inch brick wall will radiate 19 heat units per hour.—[**Technical World.**]

# The Canadian Engineer.

ESTABLISHED 1893.

With which is Incorporated

THE CANADIAN MACHINE SHOP

ISSUED MONTHLY IN THE INTERESTS OF THE

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

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

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

BIGGAR-SAMUEL, LIMITED Publishers.

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

EDGAR A. WILLS, Sec.-Treas.

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

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

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

TORONTO, CANADA, MAY, 1906.

## CONTENTS OF THIS ISSUE.



## ANNOUNCEMENTS, ETC.

All communications having any reference to data for the editorial columns should be addressed direct to "Editor, The Canadian Engineer, 62 Church Street, Toronto."

Our June issue will contain a third article of special scientific and commercial interest by Charles H. Mitchell, C.E., on "European Hydro-Electric Development," descriptive of two of the most notable installations in Europe—at Milan, Italy.

In a pleasant letter from Venice, dated April 12, 1906, he says: "The next will probably be on the Tivoli plant at Rome, combined with a short description of another near Naples, which operates under a thousand feet head. By the way, talking of Naples, Mrs. M., her mother and I were up to the top of Vesuvius two days before the recent eruption commenced in earnest, and we saw sights we can never forget. It was a grand, wonderful and awful spectacle."

In June also will, in all probability, appear an article entitled "Impressions of Canada," from the pen of Nanabhai Dayabhai Daru, B.Sc., B.A., A.R.S.M., barrister-at-law, of Bombay, India, Attaché of the Indian Government to the Geological Survey of Canada. Mr. Daru is an accomplished Indian gentleman, and his first views of the Dominion should make interesting reading.

## ON A CERTAIN CONDESCENSION IN "THE TIMES."

Lowell once wrote a famous essay entitled, "On a certain condescension in foreigners." The "foreigners" were the British, and the immediate cause of this biting appellation when referring to the inhabitants of the "Old Country," was, the patronizing and supercilious manner in which everything typically American was referred to in the English press. For diplomatic reasons, this attitude has of late years, completely changed. The "can-any-good-thing-come-out-of-Nazareth" tone, has given place—especially in matters industrial—to fulsome eulogy on the one hand, and servile imitation on the other. "Imitation is the sincerest form of flattery." Only yesterday, a communication came to hand, emanating from Askam, in Furness, England, in which was the spirit of rejoicing, because they were just about to start up their "*American*" furnace.

The patrician characteristic of liking to patronize and belittle something, is, we suppose, a hard trait to get rid of. Of this, we have a forcible illustration in the recent attitude of "The Times," with regard to Canada's triumph in electric smelting. We freely recognize, that in dealing with matters of public policy, "The Times" is the greatest conservative force in the British Empire; when, however, it comes to matters of science, and especially metallurgical science—which has received its greatest *practical* development on this side the Atlantic—we decline to bow the knee at Printing House Square. That the motherland as represented by "The Times," is deeply interested in the Canadian Government experiments on electric smelting at Sault Ste. Marie, is manifest; for in its issues for March 14th, 21st, and April 4th, 18th, respectively, appeared elaborate references thereto. We certainly can not complain that Canada's unique enterprise in metallurgy is being treated with indifference. What we do complain of is, the strained effort to minimize and belittle the results achieved; mainly on the grounds that the man who superintended the experiments is not an "admirable Crichton;" does not know everything in metals; has not puddled iron, worked in front of an open-hearth furnace; supplied ferro-alloys to a Bessemer converter; or tapped a blast furnace. Here is what is said on March 21st:—

> The value of Dr. Haanel's assurances of the commercial prospects of the Heroult steel process could be more definitely estimated if we knew what, if any, commercial experience Dr. Haanel himself possesses of the manufacture of steel on a commercial basis. It is understood, however, that Dr. Haanel is a Superintendent of Mines to the Canadian Government, a position which does not argue any presumable acquaintance with the conditions of up-to-date steel manufacture.

In the other articles, we read of Canadian "glorification;" that "the premises are rather slender for the bold assumptions;" that "the experiments so far have been conducted on too small a scale." And all this negative criticism was made before "The Times" was in possession of Dr. Haanel's now celebrated address before the Canadian Club at Toronto. When the address containing preliminary details reached London, the world-wide readers of the "Thunderer," were favored with this ungracious comment and fallacious inference:—

It appears, in addition, that an examination of the step toward further progress recommended by Dr. Haanel, does not seem to present financial attractions to the capitalist, of a very high order. It is as follows:—"A unit of 1,500 horse-power is perhaps the largest that, under present circumstances should be constructed. Such a unit would have an output of 18 tons per day, and corresponds in size to about the larger Swedish charcoal blast furnace."

The influence of authority in matters of opinion always counts; but in this case it is not a question of the opinion of this man or that man; but a matter of logical induction from facts demonstrated. Dr. Paul L. Heroult, one of the greatest electro-metallurgists living, and the largest user of hydro-electric power in the world to-day—conducted the experiments; hence, they may be taken as scientific. But it was on the initiative of Dr. Haanel that the experiments were instituted; and being an expert physicist, trained in scientific method and the investigation of natural phenomena, his presence as recorder of production and electrical measurements, is a guarantee of the deadly accuracy and reliability of the trials. All that he has done so far, is to publish in a *preliminary* report the facts, and claims success in the electric smelting of refractory iron ores, by comparing the cost of producing pig-iron with conventional blast furnace methods.

A serious error vitiates all the negative criticism of "The Times." The experiments at Sault Ste. Marie, were not intended to demonstrate the manufacture of *steel*; but to prove that the refractory iron ores of Canada can be smelted economically into *pig-iron*—suitable for subsequent conversion into steel. In this, Dr. Haanel has completely triumphed; as "The Times" will see when the *official* report is published. We certainly prefer the Doctor's logic to that of the writer in "The Times,"—if the inference contained in the last quotation may be taken as a sample. It is not necessary to confine operations on an electric smelting plant to one 18-ton furnace, any more than a steel plant is limited to one 20-ton open-hearth furnace. The capitalist of a "very high order," can install 18-ton electric furnaces side by side *ad infinitum.*

The sneer at "*quasi*-laboratory experiments," might have given place to eulogy, had "The Times" known, that all ore smelting experiments made in Europe or elsewhere, hitherto, were conducted either in the laboratory, or in furnaces designed for steel making. Dr. Haanel's experiments are the first ever made in a furnace specially designed and equipped for the smelting of refractory ores, on a scale analogous to the blast furnace.

One word more. In "The Times," of August 2nd, 1905, we read a signed article on "Electric Steel," by F. W. Harbord, and as it was special, presume that this metallurgical expert is their ideal of an authority on electric smelting and its possibilities. That article concludes thus:—

When the irregularity in supply **due to the change of seasons,** and the generally inaccessible position and remoteness from sources of supply, and from the markets for the sale of the finished product, are taken into consideration, the much talked of **cheap production of electric energy from water-power,** will often be found to be more apparent than real.

This is the stuff "The Times" accepted and published, in spite of the fact, that at Niagara Falls, the world's supply of aluminium, calcium carbide, etc., has been made summer and winter, for years past, in electric furnaces, receiving their heat energy from hydro-electric power developed at the Falls.

## EDITORIAL NOTES.

**Engineers and Longevity.** It has been generally believed, that the professions of the church and the law are most conducive to longevity; the career, however, of Charles H. Haswell, the remarkable man whose portrait and biography appears on page 191, would seem to indicate that the palm rests with the profession of engineering. True it is that one swallow does not make a summer, but even a cursory comparative glance over the professional world at the present time, would seem to bear out the induction. This view was forcibly impressed upon us as we listened with unfeigned pleasure to the choicely expressed wisdom of that Nestor among mining engineers, Dr. James Douglas, at the Quebec meeting of the Canadian Mining Institute. His plea for the cultivation of the imagination in our embryo engineers; and statement that the engineer without it will always be found driving a one-horse shay, might have been amplified by the fact, that wherever we find an engineer on the borderland of three score years and ten, in whom imagination has been a minus quantity, senility is the dominant trait: eyes they have but see not; ears they have but hear not; the mental processes are slow; though living, yet practically dead. Striking examples to the contrary are the two veteran engineers whose names we have mentioned in order to point a moral. May they live much longer, and continue to diffuse wisdom and light.

❧ ❧ ❧

**Steam Turbine Scare.** A well-known Engineer, trained in the "Watt" school of steam engineering, but guiltless of any knowledge of Machiavelli and the ways of the world, brought in the sad news recently, that the steam turbine was a failure. Like many others, he had read in the papers an inspired news item, emanating from a deeply interested source in the United States:—

### TURBINE ENGINES TOO SWIFT.

**Slender Blades are Broken by Hundreds Owing to Vibration.**—Washington, April 10.—"I saw broken blades taken out of the turbines by the shoveful," said a naval engineer, in speaking of the performance on some of the ocean liners of the new motors with which it is proposed to equip the new United States battleships. "The engineers knew at the time that the slender blades were being torn off as the turbines spun around at the rate of a thousand revolutions per minute, but no repairs were possible while the ship was under way, and it was only when the castings were removed in port that the extent of the damage was ascertained."

"Experiments have been going on, which so far have shown that the cause of the breakage is the vibration that is set up in the slender blades by the high steam pressure and excessive speed of rotation."

In our January number, (p. 23), we had occasion to refer to the campaign of gross and wilful misrepresentation which a German syndicate had been pursuing against the Parsons' Turbine, and which had actually brought to a standstill the popular movement in American naval circles in favor of adopting the turbine as motive power in the White Squadrons. Now that Great Britain is equipping her battleships with turbines; and the Kaizer has endorsed them after personally witnessing trials, the swing of the pendulum is once more moving towards turbine adoption in the United States navy, it does not need second sight to perceive the meaning of spurious statements like the one contained in the quotation we have just nailed down. In an early issue, we purpose setting forth in our columns some valuable data on the Westinghouse-Parsons' Steam Turbine; data gathered from reliable sources, and which should satisfy any unbiased mind that the turbine engine is here to stay. This does not imply that the reciprocating engine is doomed; for at the present time, the best evidence goes to show that a combination of high pressure steam engines, and low pressure condensing steam turbines, give higher economy* than either alone.

**Elimination of Dust on City Roads.**

One of the main reasons for prohibiting the establishment of large iron-works within our city limits,—Toronto for example,—was to conserve the cleanliness of our streets and comfort of our homes. The terrible clouds of dust, however, which fill the air with the passing of every swift running street-car or automobile, has, this Springtime, become an almost intolerable nuisance, and is getting the Queen City a bad name. Citizens of Pittsburgh (the smoky city), will tell you that it will be a sad day for their city when you can see no black descending smoke there; since it is an unerring sign of industrial prosperity, and the creation of wealth; hence, the people grin and bear it. The gray dust sent swirling up from our streets has no such redeeming feature; and laden with disease germs, it is a positive danger to the health of the community. Watering the streets is wrong in principle; they should be so made and kept that they do not need watering. It is manifest that the city authorities are doing their best to give us good roads. But even on the best roads the dust nuisance is found. Is there a remedy? Yes, in "Akonia." The evidence is overwhelming, that this road dressing is practically perfect as a preventive of dust. Its chief advantages are:—

1.—"Akonia" is cheaper in most cases, than ordinary watering at the rate of 250 applications a year.

2.—It is not only a dust-preventer, but it also acts as a road-preserver and improver by rendering the surface hard and smooth and thereby diminishing the disintegration of the macadam, the result being further a considerable saving in the cost of scavenging.

3.—It is absolutely odourless and free from emanations of any kind, uninjurious to health, without hurtful effect upon tyres, metal, clothes, horses' hoofs, etc., and it makes the road neither slippery nor cloggy.

4.—It does away with the mud which invariably follows ordinary watering, and it also renders the road less muddy in wet weather.

5.—It requires no special appliances beyond an ordinary water-cart, and can be kept for any length of time without losing its properties.

The claims of this alleged remedy for the dust nuisance, are worthy of serious investigation by municipal engineers and city authorities everywhere.

## Book Reviews

**The Business of Contracting.**—By Ernest McCullough. Chicago. Ill., 1906: Technical Book Agency. Size 7½ x 5¼, pp. 45. (Price 50c.)

This unpretentious little booklet fills a long-felt want. Although contracting is, and always has been, an important factor in civil and mechanical engineering, it has received little attention in technical education; and we never remember hearing any complaint about this "masterly inactivity" from practical engineers. The tacit understanding seems to have been, that the contractor is born, not made. A change is coming over the scene. McCullough's book is a "sign of the times." The colossal scale upon which engineering enterprises are now carried out, has demanded, not only high powers of generalization, but has involved such bewildering amount of detail, that only by sub-division of labor, and the keeping of systematic records can the great works be successfully executed. Rule of thumb methods in tendering and in the execution of contracts is a thing of the past. The getting out of quantities, determination of costs, preparation of tenders, and carrying out of contracts is now done with the exactitude of a science. A knowledge of the ways of the cunning contractor has been a weak point hitherto in the education of engineers. The days of the searchlight are here, however, and the secrets of the wise contractor are set forth in this excellent pamphlet with a clearness of statement and fullness of knowledge altogether satisfactory, and shows that the man who wrote it is not only familiar with modern office system, but has himself been down in the trenches, climbed steel structures, and knows the best practical methods of field work. Starting with a diagram showing how to lay out a contractor's stock yard, the writer in a series of seven chapters deals with the whole business of contracting in the following logical order:—I. Duties of staff, manager, and superintendent; II. the foreman; III. bidding on work; IV., hints on bidding; V., working methods; VI., the office on the work; VII., field and office methods. The foregoing syllabus indicates the scope of the work. We have to congratulate the author on having done a good thing for engineering in preparing and publishing this invaluable primer on the business of contracting.

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

During the past year the attention of engineers has, by numbers of articles in engineering journals, been drawn to the subject of producer-gas and gas-producers, as well as the revolution their use is likely to bring about. But there has been a need for some complete and reliable data upon the subject, however, which is now supplied in the volume before us. In this treatise the fundamental physical and chemical laws, and definitions involved in the study of gases, is followed by thermal and physical calculations and descriptions of the commercial gases, and the manufacture, history, and use of producer gas. There are over thirty different makes of pressure and suction gas-producers described and illustrated, with the special features and adaptability of each clearly shown. The various methods of purifying the gas for use in gas engines are also fully described. A chapter of special interest is one dealing with the installation of a gas-producer power plant, its economies and advantages; also giving particulars of its operation, and describing the causes of various troubles. The author's prophecy as to the complete revolution which the gas-producer will effect in the future may be rather optimistic; time alone will tell. That gas-producer power plants more than hold their own as rivals of small steam plants, in the point of economy, has already fully been demonstrated. This book will undoubtedly be greatly appreciated by those seeking information on this economic method of power production.—M. R. S.

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

The author deals with his subject in an unconventional but very practical manner. Commencing with the principles of the forces of nature, he first eliminates those which are impracticable for present utilization, and then deals with the economic aspect of the various methods of transmitting power in order to perform useful work. In connection with electric transmission, continuous current work and alternating current systems are dealt with respectively, setting forth the advantages and disadvantages of each, commercially and practically, as proved by experience with plants installed in Europe and America. The complete organization of both steam and hydraulic power plants is also dealt with, from the choosing of a site to the minutest details, particular attention being called to the different forms of apparatus which have proved the greatest commercial success under the varied conditions of power transmission. Attention is drawn to the difficulties which have been experienced in different power stations, in order that they may be avoided. The various methods of distribution, according to the work to be done at different points is fully dealt with, and much valuable information as to what has proved most successful in actual practice is given. The chapters on lines and line construction deal with many of the difficulties that have appeared in connection with the transmission of high

* See Henry G. Stott's paper read before American Institute of Electrical Engineers.

voltage currents and the methods by which they have been overcome, together with many other practical points. A paragraph from this chapter shows the practical aspect from which every problem is discussed.

"It will be seen that, quite aside from engineering details, divers really commercial factors must enter into any final decision regarding the voltage to be used; and these commercial factors are the final arbiters as to the working voltage, and even more completely as to the proportion of energy which it is desirable to lose in the line. **Power transmission systems are installed to earn money, not to establish engineering thesis.**"

A chapter on the commercial problem, Will it pay? gives the cost of production and supply of actual plants, and the conditions to be determined beforehand in each case to answer the question with any degree of accuracy. To those men who have to do with power transmission, wishing to know what will make it a commercial success or failure this book is invaluable; and we are pleased to be able to call attention to it.—M. R. S.

**Gasoline Engine Ignition.**—By E. J. Williams. Cincinnati: Gas Engine Publishing Co. Size 5¼ x 7¼, pp. 91, illustrated. (Price $1 nett.)

The field for the gasoline engine is widening each year, especially in connection with the automobile and small motor-boats, where the purchaser in many cases operates the engine himself, often knowing very little of the construction of the machine. Ignition—one of the major difficulties that has to be contended with, has been completely overcome by the author, and the simple, non-technical manner in which he has dealt with the subject in this book, taking for granted that the reader is a novice, commends the work to the amateur as well as the professional engineer. As an example of the lucid style in which the book is written we give herewith an extract from the first chapter:—

"A wire, when charged with an electrical current, contains a property adverse to the natural state of the wire when not electrified. When a wire has an electrical current passing through it, magnetic lines of force surround it to a distance consistent to the strength of the current. If the wire is wound in a circular form, in layers, forming a coil, the magnetic lines of force are increased in strength, and if wound around a bar of soft iron an additional increase is gained.

"If a bar of soft iron is wound with several turns of insulated (covered) copper wire, and a current of electricity passed through the wire, either from a dynamo or battery, the bar becomes saturated with a property called magnetism, and is capable of attracting particles of steel as long as the electricity flows through the wire, and ceases immediately, when the wires are disengaged and the current flow is stopped. When the bar of iron is magnetized, one end will attract steel while the other end will repel it."

"Induction or jump spark coils and any electrically operated mechanism, such as dynamos, magnetos, etc., are based on the principles of phenomena of electro magnetism as above stated." P. W. B.

## BOOKS RECEIVED.

**Modern Steam Road Wagons.**—Dealing exclusively with heavy steam motor wagons, giving an impartial analytical account of past and present practice. By William Norris. London and New York: Longmans, Green & Co. Size 9 x 6, pp. 172, 79 illustrations. (Price 7s. 6d. nett.)

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

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

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

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

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

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

To be reviewed in our May number.

[Note.—Several of the above books will be reviewed in subsequent issues.]

## NEW PUBLICATIONS RECEIVED.

**American Mining Congress.**—Proceedings of the seventh annual session of the Congress. Part II., containing the papers of 1904. Published at the office of the secretary, Denver, Colorado, U. S. A. Page 6 x 9, pp. 232.

**The Canadian Mining Institute.**—Journal of 1905, containing the papers and proceedings of the institute, together with half-tone portraits of the officers. Published at the secretary's office, Montreal. Size 5¾ x 8½, pp. 367.

**The Mining Society of Nova Scotia, Halifax, N. S.**—Being the transactions of the society during the year 1904-5, including a list of officers and members. Size 5¾ x 8¾, pp. 174.

**American Society of Mechanical Engineers.**—The twenty-seventh year book of the society, containing alphabetical and geographical lists of the entire membership; also half-tone portraits of the officers. Copies may be obtained by addressing the society at 12 West 31st Street, New York, U. S. A. Size 6 x 9, pp. 203.

**Hydro-Electric Power Commission of the Province of Ontario.**—We have just received the first report of the Commission, which deals with the present demand for power within economical transmission distance of Niagara Falls, and the cost of generating, transmitting, and distributing electric energy within this area. Size 6¾ x 10, pp. 51.

## CATALOGUES AND CIRCULARS.

**Smooth-On Iron Cements.**—The Smooth-On Manufacturing Co., Jersey City, N.J. The catalogue just received from this company sets forth lucidly the many uses to which Smooth-On products may be put: for repairing blemishes, blow-holes, or defects in iron or steel castings; for repairing breaks in castings and making connections in steam and hydraulic work, etc. 4½ x 6¾, pp. 92.

**Buyers' Reference.**—This reference contains the names of electrical jobbers, dealers, contractors, consulting engineers, fixture companies, and repair shops. The Buyers' Reference Co., Inc., 123 Liberty Street, New York, N.Y. 8¼ x 9¼, pp. 138.

**Agricultural Machinery.**—George White & Sons Company, Limited, London, Ont. The 1906 catalogue fully describes the White traction engine, illustrating the many styles manufactured; also threshers, weighers and baggers, together with many other agricultural implements. 10x 6¾, pp. 48.

**Machinery Stock List.**—H. W. Petrie, Toronto and Montreal. A list of new and second-hand engines, boilers, steam appliances, and other power equipment kept in stock is issued by Mr. Petrie each month. A copy may be obtained upon request. 3½ x 6, pp. 32.

**Non-Fluid Oils.**—New York and New Jersey Lubricant Co., New York, N.Y. Non-Fluid oils are exactly what their name indicates; they are non-fluid oil just as truly as snow and ice are non-fluid water. The advantages to be derived from their use are fully described in a 12-page booklet. 3½ x 6.

**Air Brakes.**—The Westinghouse Air Brake Co., Wilmerding, Pa., being the reproduction of an illustrated paper read before the New England Street Railway Association, entitled "Air Brakes for Electric Cars." 6x 9, pp. 32.

**Gauges.**—The Schaeffer & Budenburg Manufacturing Co., New York, N.Y. Gauges of every description, for almost every purpose, are manufactured by this company—steam, automobile, test gauges, etc. 9¼ x 12, pp. 52.

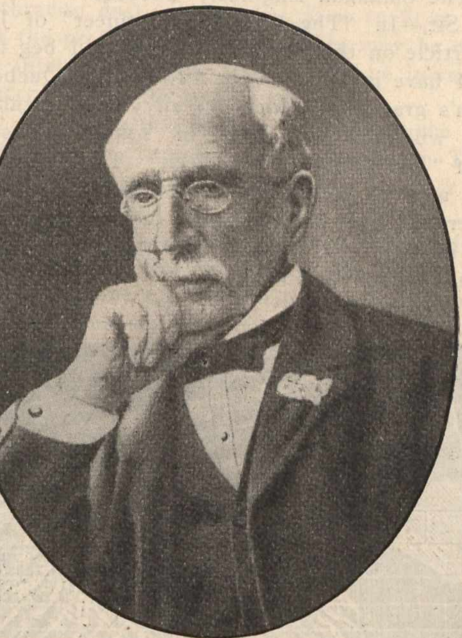
**Electric Fans.**—Canadian Westinghouse Co., Limited, Hamilton, Ont. Ceiling and floor column fans, for alternating and direct current, are elaborately described and illustrated in an artistic booklet of 12 pages. 3½ x 6.

**Hoisting Machinery.**—Marsh & Henthorne, Belleville, Ont. W. H. C. Mussen & Co., Montreal, sales agents. A pamphlet is to hand this month giving an outline of what is contained in their 1906 catalogue of contractors' supplies. 3½ x 5¾, pp. 4.

## CHARLES HAYNES HASWELL.

In New York city there is an engineer 96 years old, and yet in active everyday practice: the man whose portrait appears below.

There are very few engineers of distinction on the American continent to-day who have not been indebted to Haswell's Engineer's and Mechanic's Pocket Book, which is now in its 69th edition. What Molesworth has been to the British, Haswell has been to the American engineer—"guide, philospher and friend." The following biographical data with regard to the editor of "Haswell," will, we doubt not, be a pleasurable surprise to not a few of our readers.



**Charles Haynes Haswell,**
A Practising Engineer at Ninety-six Years of Age.

Charles Haynes Haswell, who was born in New York, May 22, 1809, was given a classical education; but his inclination lay in the direction of a technical career, and in 1828 he entered the employ of James P. Allaire, then the largest manufacturer of steam engines and boilers in the United States. While with this firm he decided to build a private steam launch for his own use. As a result of this determination the "Sweetheart," the first practical steam yacht, was launched in 1832. The success of this little craft attracted the attention of the United States Navy Commissioners, and Mr. Haswell was requested to take charge of the first attempt to build for the United States Navy a steamship-of-war. He immediately started to work preparing plans for a steam plant for the frigate Fulton, then under construction in the Brooklyn navy-yard.

His zeal and energy, however, nearly resulted disastrously to his career as an engineer. No sooner had he visited the frigate and examined her hull as she lay upon the ways than he hurried to Washington and recommended to the Secretary of the Navy that she be cut in two in the centre and lengthened twenty feet, in order to allow for sufficient room to build the type of engine and boiler which he believed should be supplied to send her through the sea at a fair rate of speed. This recommendation was deemed of such serious presumption and unwarranted interference by the older men who had prepared the plans for the frigate, that they made immediate demands for his dismissal from the service, and nearly succeeded. Fortunately for the navy, that was not done, though he was warned that another offence of the kind would result in immediate dismissal. Nevertheless the "Fulton," in 1852, was lengthened thirty feet!

His second ship, the "Missouri," was burned at Gibraltar by the bursting of a demijohn of spirits of turpentine in consequence of the ignoring of a requisition from Mr. Haswell that a metallic vessel be provided in the engine-room for holding turpentine. His aggressiveness continued to disturb the authorities in Washington, however, and the final act which led to his dismissal from the service is best told in his own words:

"Prior to the departure of the 'Missouri,'" he says, "a charlatan had the effrontery to submit to the Secretary of the Navy a design to replace the smokestacks then in use with two horizontal pipes leading into the wheel-house, in order to conceal the smoke of the fires from the enemy by drawing it from the furnaces by the suction of the water-wheels.

"Inconceivable as it may appear, the project was indorsed by the Secretary of the Navy, and the contrivance ordered on the next ship. I fought the proposition and was suspended from the service. When the thing was finished the Secretary of the Navy invited the members of the Cabinet and the President to witness its trial. The result, of course, was a complete failure, and later I was told that if I would make a written apology for my action I would be reinstated and could proceed with the ship. I refused, of course, and as a result was declared to be insubordinate and was detached from the service."

Mr. Haswell was first Chief Engineer and Engineer-in-Chief, U. S. N., 1836 to 1851. In 1851 Mr. Haswell was superseded as Engineer in Chief by the appointment of an intimate acquaintance of President Fillmore, the excuse given that Mr. Haswell's politics were objectionable. Shortly afterwards, however, he was restored to his former grade and rank. This experience and further unsatisfactory relations with the heads of the Navy Department, who had ordered him on sea service although he was suffering from the effects of malarial fever, induced him to leave the service, and he resumed the practice of civil and marine engineering in New York.

After leaving the United States Navy, Mr. Haswell performed services for the Russian Government, for which he received, in addition to his regular compensation, a splendid diamond ring from Emperor Nicholas.

In pursuance of his profession, he designed and superintended the construction of warships, revenue cutters, yachts, and other steamers; the foundations of buildings and bridges; designed the bulkhead of Hart's Island, New York, and one in the Harlem River; was a trustee of the New York and Brooklyn Bridge during its construction, and has been associated with many national and civic undertakings of magnitude.

From 1855 to 1858 Mr. Haswell was a member of the Board of Councilmen of New York City, and during the latter year was its president. Later he entered the civic service of the city, and during the many years in which he has served the municipality he has been Chief Engineer of the Dock Department, Superintending Engineer to the Department of Charities and Correction, the Board of Health, and Consulting Engineer to the Board of Public Improvements.

In 1898 he was appointed by the Board of Public Improvements of New York to design and direct the extension of Riker's Island, Long Island Sound. In 1902 he was appointed Consulting Engineer to the Board of Estimates and Apportionment of the City of New York, which office he still holds. Although more than ninety-six years of age, he never misses a day at his office, and is particular about giving the city all the time it requires in return for the salary he receives.

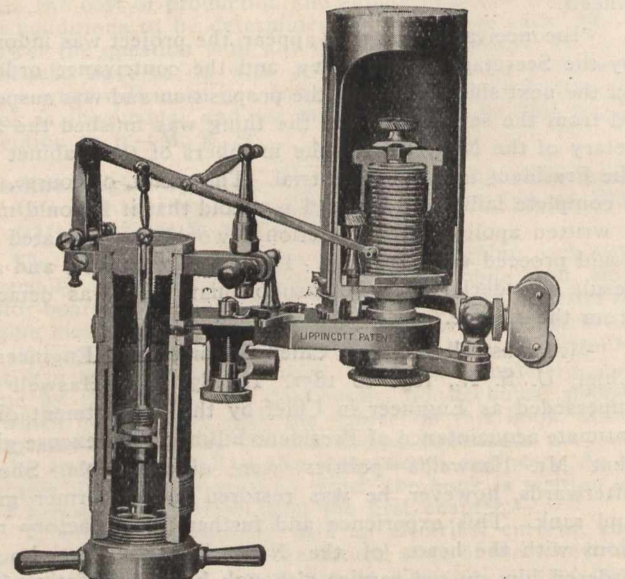
## SPEED OF GRINDSTONES.

Grindstones used for grinding machinists' tools are usually run so as to have a peripheral speed of about 900 feet per minute, and those used for grinding carpenters' tools about 600 feet per minute. With regard to safety, it may be stated in general that with any size of grindstone having a compact and strong grain, a peripheral velocity of 2,800 feet per minute should not be excelled.

## DESCRIPTION OF INDICATOR.

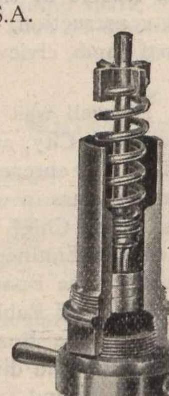
Years ago the operating engineer did not consider it within his province to own or use the indicator, as this work was always performed by a so-called expert, who would charge almost as much as the cost of the outfit for indicating one engine, and in those days an indicator outfit cost considerably over one hundred dollars.

One of the first to recognize the importance of placing this instrument within the reach of all engineers was Mr. Lippincott, who designed an instrument which was simple




and practical, and which proved thoroughly satisfactory for ordinary work. This venture was successful from the start, and not only placed his instruments within the reach of any operating engineer, but served to reduce the price of the older makes.

After making these instruments for a while improvements were added so that as time passed the Lippincott indicator took its place among the standard instruments of the world, and we now take occasion to illustrate the latest instrument of this pattern, known as the high-pressure, which is made by the Lippincott Steam Specialty & Supply Co., Newark, N. J., U. S.A.



EXTRA INTERCHANGEABLE HIGH PRESSURE CYLINDER AND PISTON

In general design these instruments follow out the lines which experience has proven to be good, so we will only call attention to a few of the special features. One of the most serious objections to indicators is the friction in the piston, and in the Lippincott instrument a novelty has been introduced. The piston-rod is extended, forming a tail bearing, and the piston head is carried loosely between two flanges so that it can centralize itself in the cylinder under all conditions, thereby practically eliminating all friction.

The cylinder is removable, and may be replaced with another one of smaller area for very high pressures. There is a jacket space around the cylinder, which is supplied with live steam through small ports drilled beneath the piston. The cylinders have a bearing at the top as well as at the bottom, contributing to perfect alignment.

Instead of discharging the exhaust steam through a row of holes in a fixed direction, Mr. Lippincott provides a "swivel elbow," so that the exhaust steam may be turned in any direction to satisfy the convenience of the operator.

The springs may be changed in a moment, and with the two cylinders but one-half the usual number of springs is required. The instrument has a detent motion for stopping the drum to replace cards, and the drum spring may be adjusted to any tension for any speed.

The instrument is made in both the inside and outside spring pattern, and is provided with a very convenient and accurate reducing wheel and planimeter.

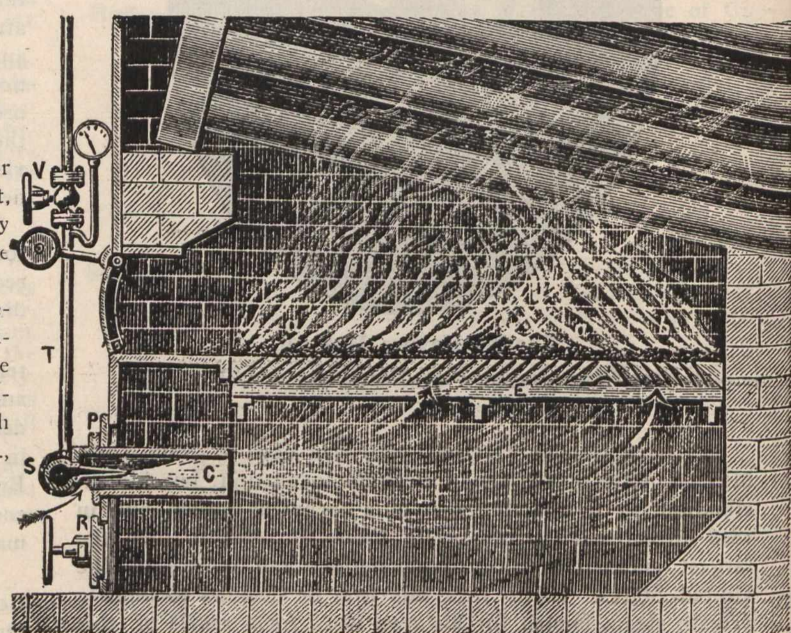
Catalogue of these instruments may be had by addressing the above company at their Newark office.

## CORRESPONDENCE.

Montreal, Jan. 13th, 1906.

Editor, "The Canadian Engineer," Toronto:

Dear Sir,—In "The Canadian Engineer" of January, I read an article on the Meldrum furnace. I beg to inform you that I have installed in the Province of Quebec several of Poillon's grates, of which I mail you a circular. Perhaps you will find the grate of some interest for the readers of "The Canadian Engineer." The Poillon grate is blown by a jet of steam like the Meldrum's, but its grates are not vertical; they have the form of Venetian blind grates, and their inclination is forward near the door, and backward in the other end of the furnace.




Poillon's Venetian Blind Grates.

The advantages of this grate are:—

(1) Blowing air under a grate, the bars of which are vertical, may allow some vertical jets of very hot flame to burn the sheets of the boiler at the spot they reach. The inclination of the bars prevent these vertical flames, so that there is no possibility of deteriorating the boiler.

(2) The inclination backward and forward of the grates causes the current of gases to mix thoroughly together, ensuring a complete combustion with the minimum of air; giving an economy of 15 to 25 per cent. in weight of coal. The absence of any trace of carbon monoxide in the smoke of a Poillon furnace, has been proved, indicating a very thorough combustion with the minimum quantity of air. The smoke contains 19 per cent. of carbonic acid, very near the theoretical 20 per cent. that is obtained by a complete combustion, without excess of air. With ordinary grates 5 to 8 per cent. only of carbonic acid are to be found, indicating a large excess of air. The loss occurring by an excess of air may be closely calculated.

The theoretical quantity of air necessary for burning 1 pound of coal is about 136 cubic feet. If we suppose that a double quantity of air, say 272 cubic feet, be needed for an ordinary grate, the quantity of B. T. U. drawn out and lost by this air at the temperature of 570 degrees would be:—

$272 \times 0.08 \times 0.237 \times 570 = 2941$ B. T. U. About 1184 B. T. U. are needed to produce with water at 32° F. = 1 pound of steam at 90 pounds of pressure. Then 2941 B. T.U. are thus corresponding to a loss in the production of steam amounting to $\frac{2941}{1184} = 2.4$ pounds per pound of coal. Thus if an ordinary furnace necessitating that amount of air can vaporize 6 pounds of water per pound of coal, the furnace that needs but 136 cubic feet of air per pound of coal would vaporize 8.4 pounds, say an increase in vaporizing power of $\frac{214}{6} = 40$ per cent.

(3) As the draught of the furnace is increased, a cheaper fuel may be used, thus reducing by 25 to 60 per cent. the price of fuel. Several Poillon grates installed in Canada are burning anthracite dust, costing but $1.00 to $1.25 per ton.

(4) As the pressure under the grates may be regulated at will, the intensity of vaporization may be increased or decreased according to the needs.

(5) By increasing the draft of the furnace the capacity of the boiler may be increased by 50 per cent. The consumption of steam for the blower is from 3 to 4 per cent. of the production of steam.

(6) The natural draft of the chimney is freed from the resistance of the passage of air through the grates.

(7) As the dampers are regulated so that there is no vacuum into the flues; cold air cannot enter the flues.

(8) The clinkers cannot stick to the grates.

(9) The injected steam cools the grates.

(10) By burning anthracite there is no smoke at all. By reducing to ⅛ of an inch the intervals between the grates, even anthracite dust may be utilized on these grates. But even with bituminous coal, the strong mixing of gases by the inclination of the bars causes a more complete combustion of gases, so that, at the instant of the opening of the doors, and charging, a great quantity fresh coal, some black smoke may escape for a very few seconds, but as soon as the doors are closed, grey smoke is allowed to enter the flues.

Yours truly,

(Signed) J. DE CLERCEY.

[Owing to some inadvertence, the MS. of this communication was mislaid; but although belated, so important are the data contained therein, in view of the almost universal agitation against smoke emission, that we have incorporated same among the other good things in this issue. 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, W. A. Sweet; vice-president, Joseph Ironside, Hamilton; secretary, D. Outhwaite, Toronto; treasurer, A. M. Dixon, Toronto.

**Toronto Branch American Institute of Electrical Engineers.**—Chairman and secretary, R. T. McKeen; 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 Company, secretary and treasurer, Montreal; A. Chase, Sawyer & Massey Co., secretary and treasurer, Hamilton.

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

## ENGINEER'S CLUB OF TORONTO.

During the month of April the subjects dealt with at the regular meetings were as follows:—

April 5th.—**"The City Plan of Improvements."** General discussion on the scheme proposed by the Guild of Civic Art for the beautifying and transit improvement of Toronto city.

April 12th.—**"The Blast Furnace: Its Theory and Practice,"** by S. Groves, Editor "The Canadian Engineer." The lecture was illustrated by specimens of the iron ores of commerce: magnetite, haematite, and carbonate; also limestone, coke, etc., as well as by large colored diagrams of a mine, calcining kiln, regenerative stove, and interior of a modern blast furnace. The following is a syllabus of the discourse:—

Ores of commerce, calcination, reduction and dissociation of ores in the Furnace by means of coke fuel and limestone flux. Utilization of waste gases. Regeneration of heat through Cowper Stoves. Blowing engines. Slag conveyors. Dust catchers. Casting appliances.

An interesting discussion followed.

April 19th.—**"Turbine Pumps,"** by W. C. Brown, Montreal. Consisting of the evolution and construction of the turbine pump, together with illustrations of its utility and various applications in industry.

April 26th.—**"Electric Smelting of Iron Ores,"** being a paper prepared by J. W. Evans, of Cobalt—descriptive of laboratory experiments with refractory ores in Hastings County—and presented by Professor J. R. Mickle of the School of Practical Science, Toronto. The paper was severely criticized by S. Groves, who praised the technical data set forth, but denounced as utterly fallacious the deductions drawn therefrom. The conversation was continued by Messrs. Johnson, Black, Tate, and others, proving to be one of the liveliest and most interesting discussions of the session.

—The remarkable strides recently made in the design and construction of large gas engine units, both in this country and abroad, have clearly indicated that the possibilities for the application of that form of prime mover are practically limitless.

German builders were among the first to appreciate this fact, and, as a result, have perfected the best types so far produced. American builders, however, have not been slow to see the advantages offered by large units, and the Allis-Chalmers Company, of Milwaukee, for one, has been placing before the purchasing public, for some months past, its gas engines of the Nurnberg type, in capacities ranging from 300 to 5,000 horse-power and for all power purposes.

An 1,800 B.H.P. Allis-Chalmers Unit was recently ordered for the Crystal City, Mo., plant of the Pittsburg Plate Glass Company. It is of the well-known four cycle, double acting type, direct coupled to a 1,000 K.W. Allis-Chalmers generator.

The Illinois Steel Company, Chicago, at present using a large number of Allis-Chambers steam units of various kinds, has very recently ordered two large gas engine generating units, twin tandem type 1,000 K.W. each. These machines will be installed in the company's present power plant for lighting and power purposes.

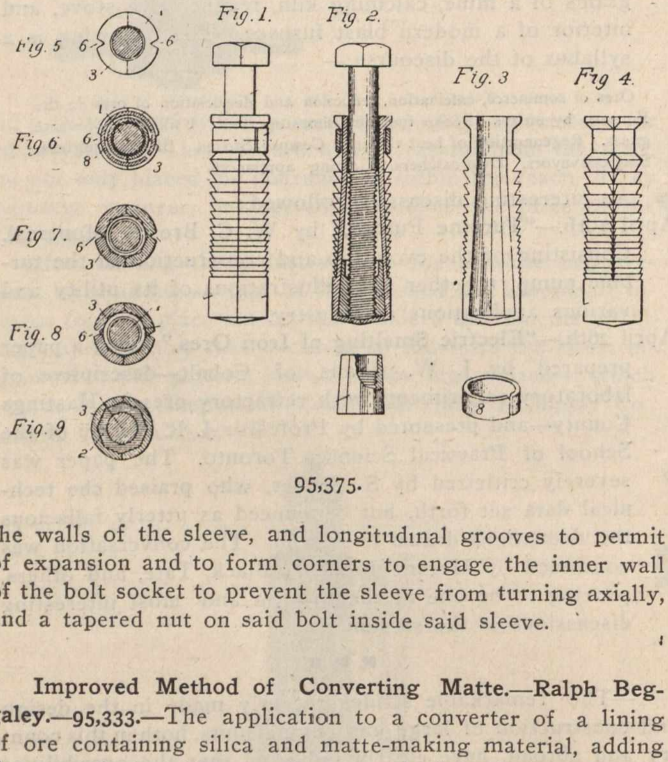
# INTERNATIONAL PATENT RECORD

Dominion Houses of Parliament.

## CANADA.

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

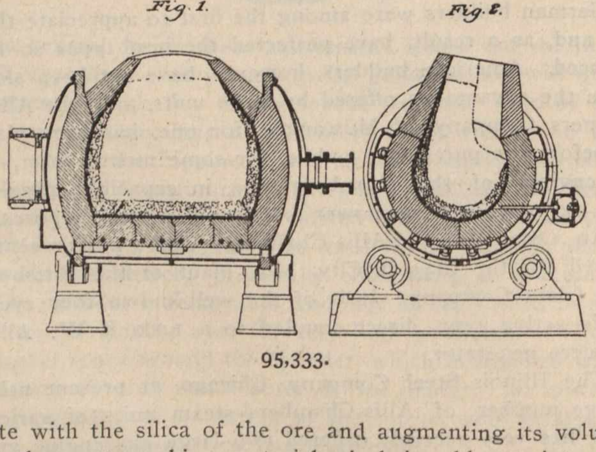
**Expansion Bolt.—Isaac Church.—95,375.**—Being a substantially cylindrical sleeve, having a tapered bore, enlarged at its inner end and external circumferential corrugations, varying in depth according to the transverse thickness of




95,375.

the walls of the sleeve, and longitudinal grooves to permit of expansion and to form corners to engage the inner wall of the bolt socket to prevent the sleeve from turning axially, and a tapered nut on said bolt inside said sleeve.

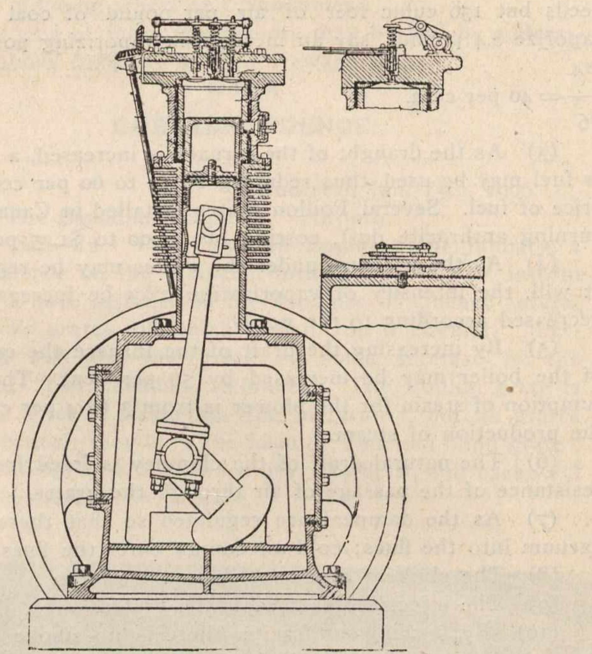
**Improved Method of Converting Matte.—Ralph Beggaley.—95,333.**—The application to a converter of a lining of ore containing silica and matte-making material, adding thereto a body of low-grade matte, fluxing the iron of said




95,333.

matte with the silica of the ore and augmenting its volume with the matte-making material, air being blown into the converter and consuming the entire body of the lining in the converting operation.

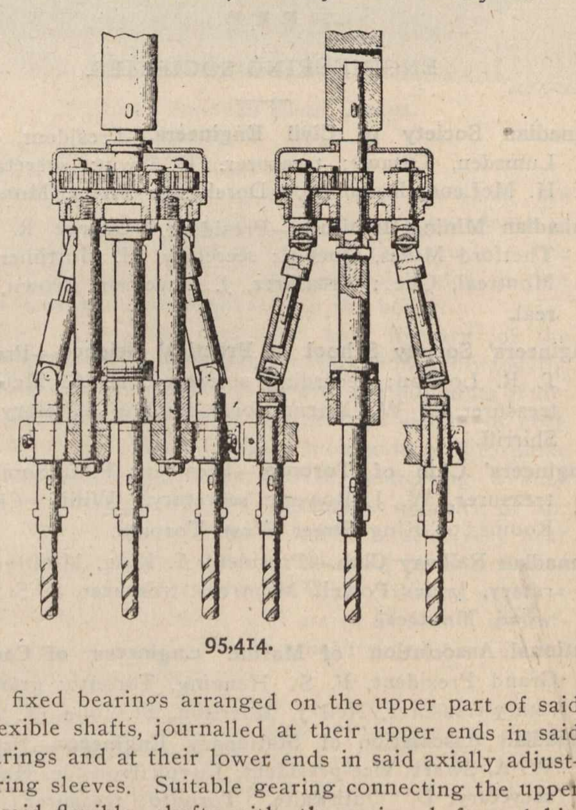
**Internal Combustion Engine.—Howard A. Johnston.—95,556.**—An internal combustion engine having a cylinder and a combustion chamber forming an extension of said cylinder, a piston operating in said cylinder having an expansion portion adapted to enter the combustion chamber,



95,556.

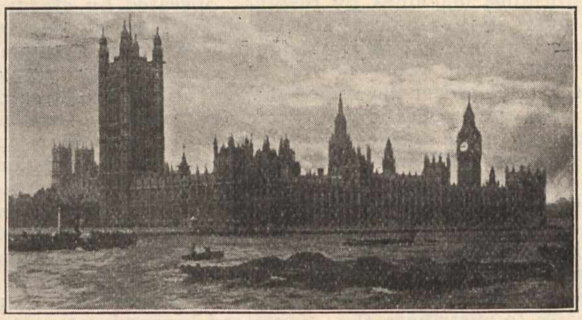
and having a fuel spreader on the end thereof, the combustion chamber of said cylinder being adapted to be maintained at a temperature above the ignition point of the fuel, means for injecting fuel into said combustion chamber substantially at the end of the compression stroke, and suitable air inlet and outlet valves opening into the combustion chamber.

**Multiple Bit Tool.—J. H. B. Bryan.—95,414.**—Consisting essentially of a main shaft, having a bit-holder arranged at the lower end thereof and a revoluble frame, the said revoluble frame having laterally adjustable brackets mounted on the lower part thereof, and bearing sleeves arranged parallel with the main shaft, and adjustable axially on said



95,414.

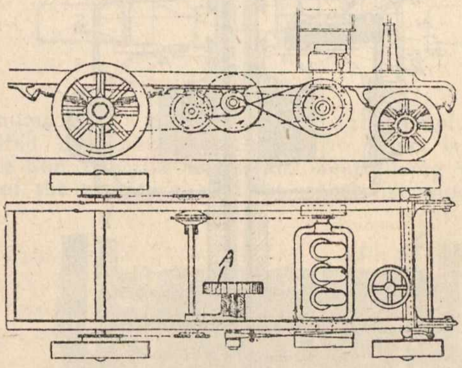
brackets, fixed bearings arranged on the upper part of said frame, flexible shafts, journalled at their upper ends in said fixed bearings and at their lower ends in said axially adjustable bearing sleeves. Suitable gearing connecting the upper ends of said flexible shafts with the main shaft and bit-holders arranged on the lower of said flexible shafts.



British Houses of Parliament.

## GREAT BRITAIN.

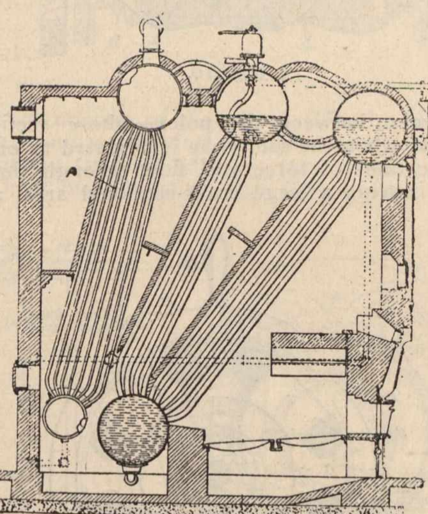
**Mechanically-propelled Road Vehicles.—Lanchester.—7,949.**—A high-velocity flywheel A is connected by means of fast and loose pulleys, and by a crosswise mounted belt with the shaft of the motor, in order to store energy and




7,949.

then assist the motor when obstacles are to be overcome, the crosswise arrangement of the belt being selected in order to avoid difficulties arising from gyrostatic action.

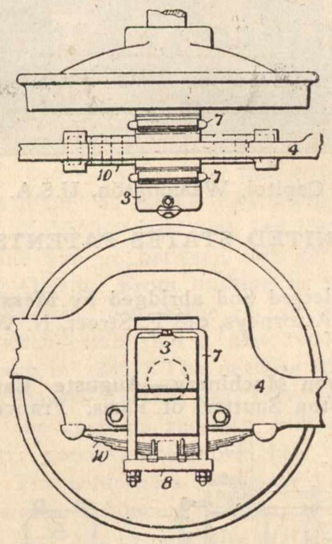
**Combined Boilers and Superheaters.—Sneddon.—22,440.**—The superheater A consists of an upper drum divided into three parts, and a lower drum divided into two parts, both being connected by banks of tubes having a rear baffle,



22,440.

causing the gases to circulate upwardly among the superheating tubes before passing to the outlet flue, and the whole superheater is arranged in the last pass of the furnace gases.

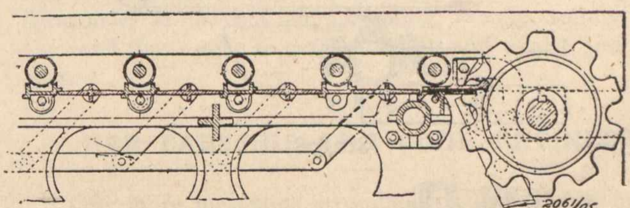
**Railway and Tramway Trucks.—E. Peckham, New York.—11,461.**—The present invention relates to an improved means for suspending the truck or under carriage of railway and tramway vehicles from the axle journal-boxes, and is especially applicable to electric or other power-driven vehicles. In accordance with this invention it is proposed to suspend the truck or under carriage from the axle journal-boxes in such a manner that the axles may move in a lateral direction to relieve the wheel flanges and rail from the bad effect of side thrust. The improved means of suspension of the truck from the axle journal-boxes consists in forming on the top of each of the journal-boxes 3 a single groove or two horizontal parallel grooves a suitable distance apart. These grooves are provided to furnish a recess or recesses for a suspension-link 7, or links sufficiently strong to support safely the weight of a loaded vehicle. The links 7 straddle the journal-box, and at the lower end carry a stirrup 8, on which rests the semi-elliptical spring 10. This spring lies beneath the truck side member 4, lengthwise therewith, and is shackled or otherwise suitably secured at each end to the lower end of the side member. The grooves are preferably made broad enough to permit lateral movement of the links therein, and also to allow this lateral




11,461.

movement. The grooves, when two links are employed, are far enough apart so that the truck side member may lie between the links, and not interfere with the movement of the said links. It will be readily understood that when side thrust occurs the improved link suspension will permit lateral movement of the axle through the journal-box links being allowed a lateral movement in the elongated grooves. To lessen friction of the links in the grooves an anti-friction roller may be employed, and to assist in centreing the truck the grooves may have inclined sides.

**Chain Grate Stokers.—Babcock and Wilcox, Ltd., McLaren, Kolle, and Parker.—2,061.**—In this chain grate stoker a series of trough-like castings supported by the side frame immediately under the rollers carrying the grate-bar links



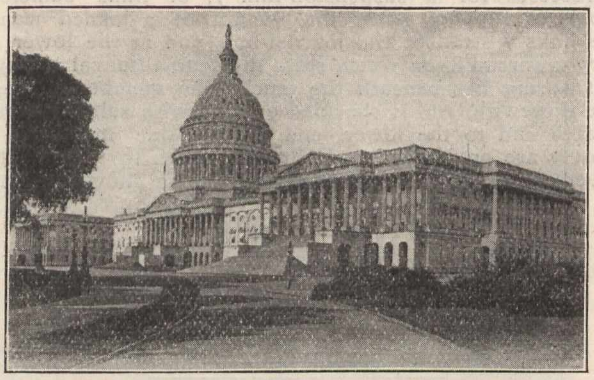

2,061.

with intervening air seals formed by butterfly dampers, to whose supporting axes are attached levers connected to a long rod extending to the stoker front, and by means of which the dampers are operated.

* * *

## A 1,500 K.W. ALLIS-CHALMERS TURBO-GENERATOR FOR MEMPHIS.

Following the lead of progressive central stations in all parts of the country toward the use of the steam turbine as the prime mover best adapted for electric lighting and power purposes, the Memphis Consolidated Gas and Electric Company, of Memphis, Tenn., has recently purchased a 1,500 K. W. Allis-Chalmers turbo generator unit, with condensing and auxiliary apparatus, for installation at Memphis. The new unit is of the horizontal parallel flow type, designed to operate at a speed of 1,800 r.p.m. and generate a current at 60 cycles, 3 phase of 2,500 volts; the jet condenser and auxiliary pump to be furnished and also built by the Allis-Chalmers Company. This unit will run in parallel with other units of similar type or with a reciprocating engine unit built for parallel operation, properly dividing the load so as to prevent surging.

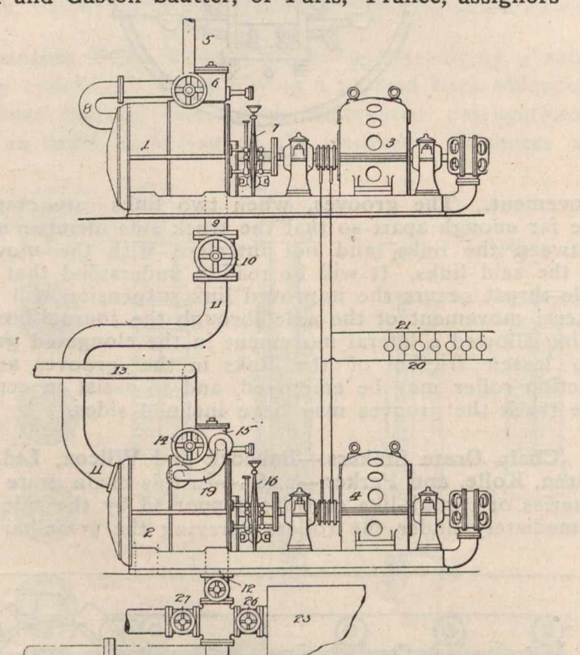


Capitol, Washington, U.S.A.

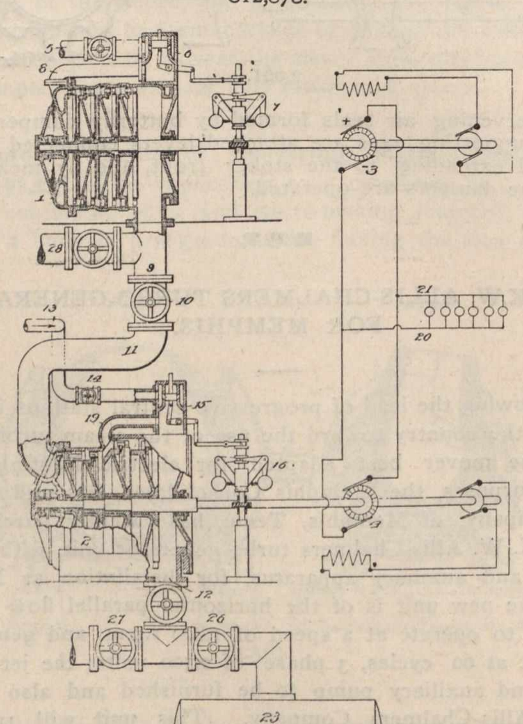
## UNITED STATES PATENTS.

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

**Turbine-Driven Machinery.—Auguste Camille Edmond Rateau and Gaston Sautter, of Paris, France, assignors to**



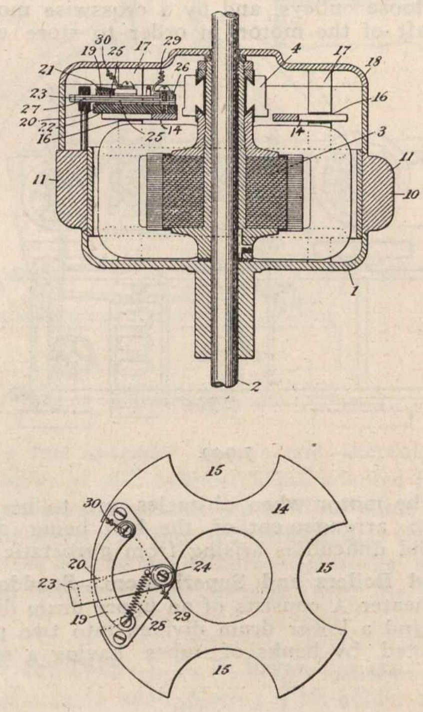
812,878.



812,878.

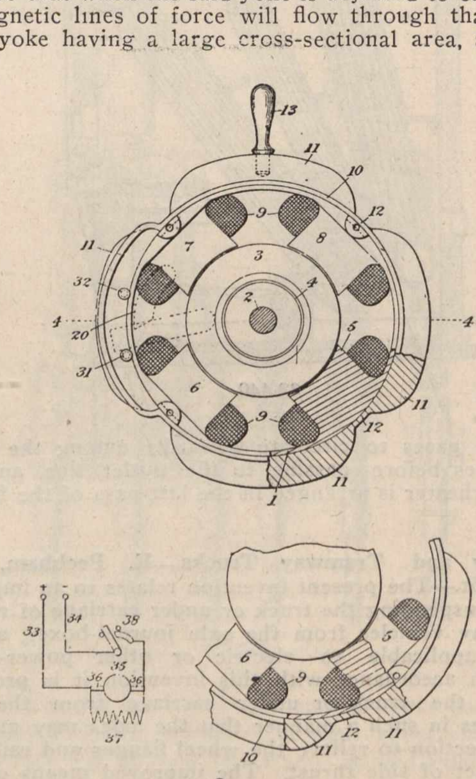
**Rateau Turbine Co., of Chicago, Ill.—812,878.**—This invention relates to the driving of electric generators or other power-transforming machines by turbines operated by steam, gas, or similar motive power; and its object is to provide an improved construction and arrangement whereby a single turbine unit of very great power and speed may be employed, and the total power developed thereby utilized most efficiently, as for the generation of electric currents. It consists of two or more turbines and means for conveying motive fluid through said turbines in sequence to operate the same as a unit of motive power, of a corresponding number of power-absorbing machines driven each by a corresponding one of said turbines, a regulator mechanism responsive to slight changes in speed of one of said turbines and arranged to control the admission of motive fluid to said series of turbines, and means for causing said driven machines to react mutually to distribute the total load in proportion to the power developed by the respective turbines.

**Motor Control.—Chas. A. Eck, Newark, N.J.—813,410.**—To provide a simple and efficient means whereby a motor can be controlled; that is, whereby the speed and power can be regulated. The invention comprises essentially an



813,410.

adjustable yoke between the poles whose sectional area varies, so that when the said yoke is adjusted to one position the magnetic lines of force will flow through that portion of the yoke having a large cross-sectional area, and when



813,410.

adjusted to another position the magnetic lines of force will flow through that portion of the yoke whose cross-sectional area is smaller.

**Alternating Current Motor.—Benjamin G. Lamme, Pittsburgh, Pa.—811 231.**—This invention relates particularly to such motors as have their armature-windings connected to

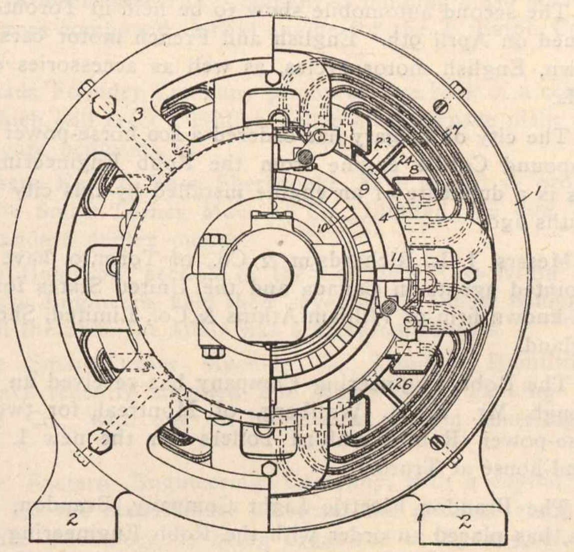



Fig. 1.

commutators in a manner similar to that employed in motors operated by direct currents. The object is to provide a simple and effective means for neutralizing the self-induction of the armature without otherwise modifying or dis-

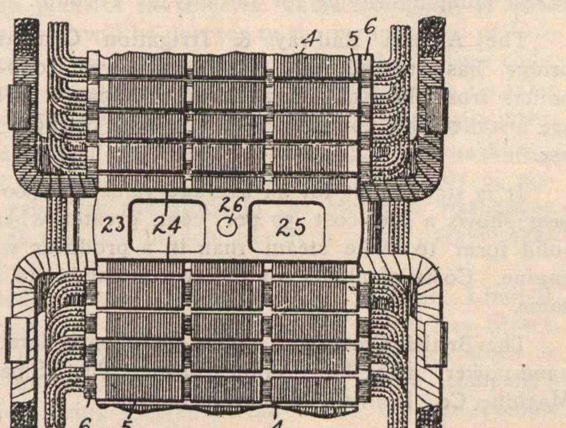



Fig. 2.

turbing the magnet of the motor. The invention consists of an electric motor, having armature and field magnet windings that are supplied with currents of different phases, and having field magnet pole-pieces that are provided with slots

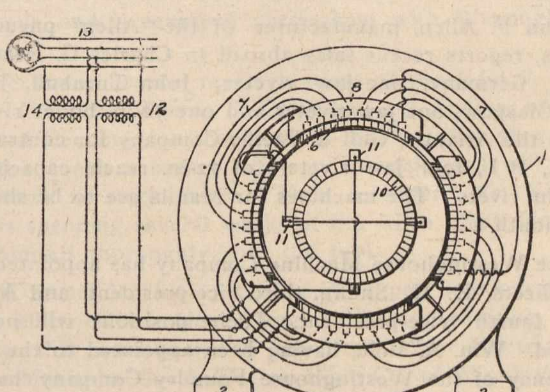



Fig. 3.

parallel to the armature-axis, neutralizing-conductors located in said slots, and low-resistance plates that bridge the spaces between the tips of adjacent pole pieces and are insulated therefrom.

—One of the luxuries of the engineer in charge of construction work is a complete photographic outfit. On large, important work it becomes almost a necessity, for the reports to directors can then be largely made up of photographic records; the entire establishment may, in fact, be benefited to the extent that constant and close watch is kept upon the progress of, and manner of doing the work.

## VANCOUVER, B.C.

Our special commissioner, at present making a tour of British Columbia in the interests of this journal, writes in very glowing terms from Vancouver concerning the present position and future prospects of that city. He says evidences of rapid but sound growth are seen on every hand. Twenty years ago the population was 900; now it is 50,000. Twenty years ago the city council met in a tent; now it is housed in a palatial city hall, flanked by a massive court house, and a General Hospital, which alone cost $225,000. Up to 1886 the silence of the ages had never been invaded by the whistle of the locomotive engine; in 1906 four transcontinental railways find Vancouver a profitable destination. Twenty years ago the great Pacific ocean was a "trackless main" as far as Vancouver shipping was concerned, but to-day no less than ten "floating palaces" perpetually come and go between this gate of the West and the opening Orient. From **nothing** in 1886 to one hundred millions dollars in 1906 is the record of "bank clearings"; and every week establishes a new record now. Buildings were unknown in 1886. The permits for the present year will total $3,500,000. In **that** year there was "nothing doing," but in **this** the customs receipts will exceed $200,000,000. Land registry receipts are more than doubling themselves every year. The wilderness of twenty years ago is now the cultivated, wealth-producing garden, and the waste ground of a decade back has become the real estate of a flourishing city, with rapidly increasing value. Here fortunes have been made already, and many more will still be made, for nature and man in joint endeavor are laboring hard "to crown the years with plenty." The earth brings forth abundantly fruits, vegetables, flowers. The waters teem with fish. The forests yield the grandest timber in the world in limitless supply. The hills and the valleys are alike the storehouses of many precious metals. The climate is mild, genial and salubrious. It is a place of many charms, and every prospect pleases.

The Vancouver Tourist Association has been formed for the purpose of "spreading the light," and another new society has just been organized whose mission is to secure a population of 100,000 by 1910. The society's banner bears the words, "Move her, move her. Who? Vancouver"; and Vancouver **is** moving—unmistakably, rapidly, solidly, along the road that ought to lead to health and wealth and happiness.

## HER LADYSHIP THE CIVIL ENGINEER.

One more masculine stronghold is invaded. A member of the American Society of Civil Engineers, chosen from the alumnæ of Cornell, comes pretty near to being "something new under the sun." The Cleveland "Leader" thus narrates the story:

Another triumph has been won for American womanhood. Miss Nora Stanton Blatch has been elected to membership in the American Society of Civil Engineers, the first woman so distinguished. She is a granddaughter of the famous Elizabeth Cady Stanton, and the first woman to win the degree of civil engineer in Cornell University.

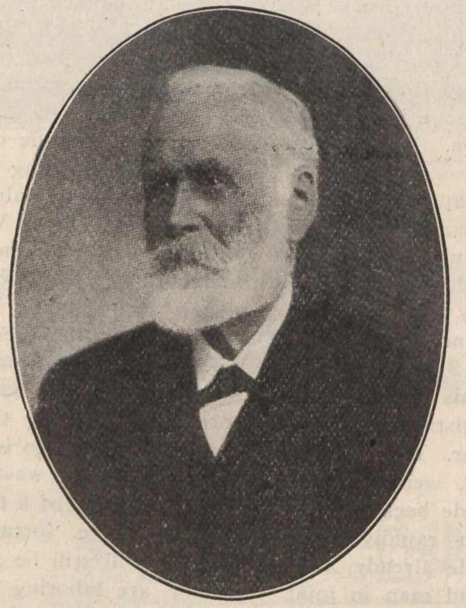
Miss Blatch has been still further honored. A Chinese student at Cornell, who had watched her work closely, turns out to be an agent of his Government sent to this country to organize thirty-six corps of engineers for the great industrial undertakings contemplated by China. He has offered her a fine position in one of these corps. His response to her enquiry as to the difficulties a woman might encounter in the interior of China is interesting in two ways. It indicates the advance of thought in the New East and has a bearing on the status of the modern professional woman.

"I know of no difficulties," he said. "You have chosen a man's career; you studied like a man, and your scholarship is superior to that of most men. Why hesitate to do a man's work? I suppose you do not fear anything? Act like a man. As for me, I shall consider myself greatly honored to take the first woman engineer to China." Miss Blatch has the offer under consideration.

Whatever be her field of work, there is little doubt that this young woman engineer will take a worthy place in her chosen profession. She may become eminent in it. The fact that she has already won high honors in one of the most difficult lines of human endeavor will be gratifying to all American women, regardless of their opinions as to woman's most suitable work in the world.

## OBITUARY.

With the death of John Bertram Canada has lost one of its pioneers in the iron and steel industry, a loss that is deeply regretted by all those who knew him in business and public life. Mr. Bertram was the head of the firm of Bertram & Sons, Dundas, Ont., and was one of the best-known manufacturers in Canada.



John Bertram, late of Dundas, Ontario.

He was born in Eddlestone, Peebleshire, Scotland, on September 13, 1829. His ancestors were pioneers in the mill-wrighting industry in the south of Scotland. As a boy he attended a parochial school in his native place, subsequently taking a course at Galashiels, where he learned his trade as a machinist with his uncle, Thomas Aimers. He came to Canada in 1852, after his marriage settling in Dundas. For nearly eight years he worked at the old Gartshore foundry, and in 1865 he formed a partnership with Robert McKechnie, the firm name being McKechnie & Bertram, for the manufacture of iron and wood-working machinery. From a small start the firm grew into the present Canada Tool Works. In the second year of the partnership the works were destroyed by fire, but they were rebuilt. In 1886 Mr. McKechnie retired, and Mr. Bertram took into partnership his sons, Henry and Alexander, thus forming the firm of Bertram & Sons, who have built up a wide reputation as manufacturers of all kinds of machine tools of the very highest grade.

# INDUSTRIAL NOTES.

The Hamilton Cataract Power Co. have placed an order for a horizontal duplex power pump with The Smart-Turner Machine Co., Limited, Hamilton, Ont.

The town of Strathcona, Alberta, has ordered a 200 horse-power Robb-Mumford boiler from the Robb Engineering Company.

The Canada Foundry Co., Toronto, is being supplied with mechanical draft equipment by the B. F. Sturtevant Co., Boston, Mass.

The Amherst Foundry Co., Amherst, N. S., have placed an order for a 2½-ton single beam travelling crane, with the Smart-Turner Machine Co., Limited, Hamilton, Ont.

The Belleville rolling mills, which have lain idle for many years, have been sold to J. Wardrope of Ottawa, who is said to be acting for a syndicate. It is said machinery will be installed and the plant operated. There is $30,000 of the city's money in the bank, waiting to be earned as a bonus by whoever operates the mills.

The Great Lakes Dredging Co. have recently ordered an independent jet condenser from The Smart-Turner Machine Co., Limited, Hamilton, Ont.

The second automobile show to be held in Toronto was opened on April 9th. English and French motor cars were shown, English motor cycles, as well as accessories of all kinds.

The city of Calgary has ordered a 400 horse-power cross compound Corliss engine from the Robb Engineering Co. This is a duplicate of an engine installed by this city a few months ago.

Messrs. J. L. Richardson & Co., of Toronto, have been appointed agents in Canada and the United States for the well-known firm of William Atkins & Co., Limited, Sheffield, England.

The Robb Engineering Company has received an order through Mr. E. A. Wallberg, of Montreal, for two 200 horse-power Robb-Mumford boilers for the new I. C. R. round-house at Truro.

The Brandon Electric Light Company, Brandon, Manitoba, has placed an order with the Robb Engineering Company for two 375 horse-power compound Corliss engines for direct connection to 250 kilowatt generators.

The Allis-Chalmers-Bullock, Limited, of Montreal, have appointed T. J. Lynch district manager at Toronto. Mr. Lynch superintended the construction of the fifteen million gallon pumping engine for the city of Toronto.

The Alberta Railway & Irrigation Company, Lethbridge, has ordered two 175 horse-power Robb-Mumford boilers from the Robb Engineering Company. When these are installed this company will have nine of these boilers in use.

It is stated that for an average value of 6,300 B. T. U. peat shows a fuel cost 50 per cent. greater when used in solid form to make steam than in a producer with a gas engine. Costs of plants for the two methods are about the same.

The British Columbia Copper Co. have ordered a 10-ton hand-power travelling crane from The Smart-Turner Machine Co., Limited, Hamilton, Ont.

The tower erected this past winter on the northern side of the departmental block to the west of the Ottawa Parliament buildings fell just lately, and now lies a heap of stone and cement. Fortunately signs of the coming collapse were noticed in time for everybody working in or near the tower to escape, and consequently no one was injured.

John F. Allen, manufacturer of the "Allen" pneumatic riveters, reports recent sales abroad to Charles G. Eckstein, Berlin, Germany, one jaw riveter; John Turnbull, Jr., & Sons, Glasgow, one jaw riveter and one 72-in. boiler riveter, also to the Atlantic, Gulf & Pacific Company for contract in Manila, P. I., four jaw riveters of 72-in. reach, capacity ⅝ and 1-in. rivets. The machines for Manila are to be shipped next month.

The Westinghouse Machine Company has appointed two new officers, E. H. Sniffin, third vice-president, and Arthur West, fourth vice-president. Their positions will not be changed. Wm. A. Bole, having been appointed to the vice-presidency of the Westinghouse Foundry Company, has resigned his position as manager of works of the Westinghouse Machine Company, in order that he may better serve the interests of the Foundry Co. Henry L. Barton has been appointed works manager of the Machine Co.

The Consolidated Water Company, of Utica, N.Y., has closed a contract with the Ambursen Hydraulic Construction Company, of Boston, Mass., for a concrete-steel dam across Black Creek, near Poland, N.Y. The present height of the dam is to be 30 feet, and the length about 330 feet. A special feature is the novel design which enables the dam to be raised in the future to a height of 40 feet without increasing the cost of the original construction above that proportionately due to its height. Work commences immediately.

The Smart-Turner Machine Co., Limited, Hamilton, Ont., have recently supplied the Huntsville & Lake of Bays Navigation Co. with one of their standard duplex pumps.

The Robb Engineering Company is building a 450 horse-power cross compound Corliss engine for the T. Eaton Co., Toronto.

Canada Foundry Company promoters are back of a company which will erect a million dollar blast furnace plant in the Niagara peninsula.

Messrs. Kerr & Foss, Sherbrooke, have placed an order with The Smart-Turner Machine Co., Limited, for one of their standard duplex pumps.

The Hamilton section of the Canadian Association of Stationary Engineers, held their seventeenth annual banquet on April the 12th, the affair was a complete success.

The Smart-Turner Machine Co., Limited, Hamilton, Ont., have recently supplied The Magnetawan Tanning & Electric Co., with one of their side suction centrifugal pumps.

The Eastern Engineering Company, with a capital of $30,000, for the manufacture of steam and gasoline engines and other machinery, is being organized at Sydney, N. S. Considerable capital has already been subscribed.

The Gates Company, Midland, Mich., are asking for catalogues from manufacturers of, and dealers in mining and ore milling machinery, conveyors, elevators, dumping cars, pipe fittings, and general power transmission machinery.

The new plant of the Electric Cable Company, Bridgeport, Connecticut, will be devoted to the manufacture of Voltax, of magnet wire, rail bonds, and field and armature coils. The company reports an increase of 50 per cent. in its sales during February and March, over the two preceding months.

We are advised by H. W. Petrie, general machinery dealer, that he has had to ship two more carloads of machinery to replenish the stock of the Montreal warehouse. The trade at the new branch has been much larger than anticipated.

The Dodge Manufacturing Co., of Toronto, Limited, have removed their city offices from 116 to 138 Bay Street. This office is purely a local convenience, where stock is carried for quick distribution in the city, the company's general offices being located at the works, Pelham Avenue, Toronto Junction.

The Canadian Westinghouse Company, Limited, are furnishing the T. Eaton Company, Limited, of Toronto, one 300 kw., direct-current, 550 volt engine type generator, to be used as part of their present large power plant, which is considered one of the most up-to-date direct-current plants in Canada, and is equipped throughout with Westinghouse apparatus.

The Paris, France, representatives of the John F. Allen riveter (Fenwick, Freres & Company) are finding such an increased demand for that tool in Europe that they have decided to open a branch office in Brussels, and will carry these tools in stock there. Their manager, Mr. Vincent Riga, is spending several weeks at the Allen plant, familiarizing himself thoroughly with the tool.

The Stuart Machinery Co., of Winnipeg have purchased all the electrical machinery, engines boilers, shafting, belting, etc., that were in use by the North-West Electric Co., and the Manitoba Gas & Electric Light Co., of Winnipeg, before they were taken over by the Winnipeg Electric Street Railway Co., and they are advertising the electrical machinery for sale at bargain prices on page 62 of this issue.

The Westinghouse Machine Company has begun a third suit against the Allis-Chalmers Company in which infringement of another Westinghouse-Parsons steam turbine patent is alleged. The bill was filed in the Circuit Court for the district of New Jersey, and the Westinghouse Company charges the Allis-Chalmers Company with infringement of patent No. 788,830 owned by the Westinghouse Machine Company. This patent covers the construction of the rotating element of the turbine as used by the Westinghouse Machine Company and the Allis-Chalmers Company. The suit was filed on Wednesday, April 11th.

The Toronto Board of Trade building has been purchased by a syndicate of New York and Toronto capitalists from the New York Life Co. for $200,000.

The next convention of the Canadian Forestry Association will be held in Vancouver in September, at which time the forests of the Province are to be better seen.

Mr. H. C. Minnett, of Gravenhurst, has placed an order with The Smart-Turner Machine Co., Limited, of Hamilton, Ont., for one of their centre, outside packed duplex plunger pumps.

A new firm has recently been organized under the name of the Electrical Machinery Co., of Toronto. Office and works, 115 Simcoe Street. They will manufacture electrical machinery of all kinds, giving special attention to motors and dynamos. Those interested are A. J. Phillips, F. Mussen J. H. Harris, Toronto.

The Lake Superior Corporation has purchased from the Canadian Government the Heroult experimental plant for electrical smelting of nickel ore. The consideration paid was nominal, being something under $5,000. The Government expended about $15,000 in fitting up this plant at the Sault, the Lake Superior Corporation giving the use of one of its buildings for the purpose.

The Cling-Surface Company, of Buffalo, N.Y., manufacturers of Cling-Surface "for belts and ropes," have just moved into a fine new plant which they have erected in Buffalo at No. 1032-1048 Niagara Street. This new plant is of the most modern fire-proof construction—brick, concrete, hollow tile and wire glass, for wall, floor and ceiling. Increased domestic and foreign business has necessitated the change, and the present new plant trebles their capacity.

John F. Wallace, former chief engineer of the Panama Canal, whose affiliation with the Westinghouse interests was announced some months ago, has been chosen to head a new electric securities corporation soon to be organized. The new corporation will take over all the stock of Westinghouse, Church, Kerr & Company, and, besides conducting a general engineering and construction business through that concern, will operate as a holding company for the securities of electrical enterprises.

The Hon. Mr. Cochrane made the announcement before the Ontario Legislature recently that coal had been discovered in New Ontario. He declined to give any information as to its whereabouts, but it was understood that extensive beds are in the neighborhood of the Albany River. The full significance of the discovery can only be realized when it is taken in conjunction with the vast deposits of iron ore throughout the northern part of the Province. The one element lacking to start New Ontario on a career of manufacturing greatness was a good hard coal.

The output of the Canada Corundum Company, Craigmont, Ont., now averages about 300 tons per month, a greater output than that of any other like plant in the world. About 200 men are employed steadily all the year round. Already this year large orders have been received from England and the Foreign Office in Germany, together with one from East Russia. Owing to the mill being unavoidably shut down for two months the output in 1905 was only 3,125,638 pounds, but it is expected that during 1906 the production will be in the neighborhood of 8,000,000 pounds.

The Canadian Westinghouse Company, Limited, has been awarded a contract by the Montreal Street Railway Company for a large amount of apparatus. This was necessitated by the rapidly growing traffic of the company. The order included twenty quadruple equipments of 101-B railway motors, complete with controllers and details; also 1,000 kw. 600 volt, direct-current engine type generator for installation in their main power house, and three 500 kw. three-bearing, motor-generator sets, consisting of type C motors and 550 volt direct-current generators. These latter are similar in capacity to those now installed in their various sub-stations, which feed directly into the trolley circuits.

The Smart-Turner Machine Co., Limited, Hamilton, Ont., have recently supplied Messrs. Geo. Roberts & Sons with one of their standard duplex boiler feed pumps.

The E. Long Manufacturing Co., of Orillia, have ordered a standard duplex pump from The Smart-Turner Machine Co., Limited, Hamilton, Ont.

Fire caused about $10,000 damage to the machine shops of the John Gillies Estate Company, Limited, recently.

The Marconi Wireless Telegraph Company has ordered from the Robb Engineering Company two 150 horse-power Robb-Mumford boilers for their station at Glace Bay, C. B.

The Canada Coating Mills, Georgetown, has placed an order with The Smart-Turner Machine Co., Limited, Hamilton, for four of their centrifugal pumps.

A 42-in. sand blow-off for 7-foot Penstock, designed by Ross & Molgate, engineers, Montreal, and built by The Jenckes Machine Co., Limited, of Sherbrooke, Que., was recently shipped to the West India Electric Co., Kingston, Jamaica.

The Smart-Turner Machine Co., Limited, Hamilton, Ont., have received an order for a side suction centrifugal pump from The John Whitfield Co., Toronto, Ont.

The Canadian Chrome Co., of Thetford Mines, are installing an additional 10 stamps in their stamp mill, which will bring it up to 20-stamp capacity. Since commencing operations about a year ago, this company has met with excellent success in marketing their product, which is of an especially fine grade of chrome iron concentrates, hence the present increase of plant. The additional equipment was furnished complete by The Jenckes Machine Co., Limited, of Sherbrooke, Que., who were also contractors for the first 10 stamps.

Works for the manufacture of tubes and wire nails are projected at Port Arthur, Canada. The town will furnish a site of 100 acres, which it has yet to purchase; it will take £20,000 of the company's bonds at par; it will have three representatives on the board of directors; and it will appoint the company's treasurer. On their part the promoters contract to erect boiler, tube, and pipe mills costing £150,000, to begin work on the mills three months after the agreement is ratified by the ratepayers; to make the works of 1,000 tons monthly capacity; and to employ 250 men from the beginning. The plant is to be operated by electricity, requiring from 1,500 to 2,000 horse-power.

Work on the new municipal electric lighting plant for Drummondville is about to commence. The Standard Construction Co., of Montreal, have the contract. The contract for the hydraulic machinery has been sublet to The Jenckes Machine Co., Limited, of Sherbrooke, Que., and the contract for the generator has been sublet to the Canadian General Electric Co., Toronto. The water wheel plant will be composed of one 55-in. special Crocker turbine vertically set in steel case and complete with gearing, bridgetrees, shafting, etc. Under 11 feet head the turbine will develop 240 horse-power at 90 revolutions a minute. The generator will be of 150 K.W. capacity.

Port Arthur, Ont., is to become a prominent manufacturing centre of the North-West, says a dispatch from that city. With the establishment of the blast furnaces at that place by the Atikokan Iron Co., attention has been drawn to Port Arthur, and recently several representatives of industries have been in Port Arthur negotiating with the authorities. The Seaman-Kent Company, manufacturers of mantles, etc., will locate a factory there, and the employment to fifty hands is assured. Last year the company shipped from their present factory at Meaford over 100 cars of material into the North-West. A concern is now negotiating for the manufacture of cement at Port Arthur. The great market of the West is attracting the cement makers.

The Jenckes Machine Co., Limited, of Sherbrooke, Que., are building the turbines and Allis-Chalmers-Bullock, Limited, of Montreal, the generator for Parry Sound's addition to its lighting plant. The turbine plant is made up of a pair of special 38-in. Crocker turbines, set in steel case, with quarter turn elbow and developing 750 horse-power at 200 revolutions under 25 feet head. They will be direct connected to a 425 K.W. 3-phase alternating current Bullock generator.

## MARINE NEWS.

Navigation for the Toronto Ferry Company opened on April 3rd, when the "Island Queen" made her first trip across the bay this season.

The Dominion Government quarantine steamer, "Alice," being built by the Canadian Shipbuilding Company, was launched on April 7th, at the shipyard in Toronto.

The Niagara Navigation Company will commence the season on May 1st this year, 15 days earlier than in previous years. From June 12th, six steamers will be in service.

The opening of navigation in Owen Sound commenced on April 9th, when the "Caribou" sailed for the Collingwood drydock for repairs. The "Glenella," a big grain freighter, also left port on that day for Fort William.

Sturtevant marine generating sets, built by the B. F. Sturtevant Company, Boston, Mass., are to be installed on the Toronto Ferry Company's new boat, "Bluebell," built by the Polson Iron Works, Limited, Toronto.

A Toronto man has invented a preparation for removing barnacles from ships. The preparation is a sort of paint or wash, which is applied to the keels of the vessels while they are in dry dock, and it prevents barnacles from clinging to the keel or hull..

The "Empress of Britain," the Canadian Pacific Railway Co.'s new steamship, concluded her trial trip around Ireland, from Glasgow to Liverpool on April 22nd. She encountered a heavy sea, but made a splendid performance. She will sail on her maiden trans-Atlantic voyage May 5th.

The Canadian Shipbuilding Company are rushing to completion their Bridgeburg yards, so that they can commence the building of two large steamers, for which they have orders, one for the Chicago and St. Lawrence Navigation Co., and the other for the Canadian Pacific Railway Co.

It is understood that the Turbine Steamship Company of Hamilton, which ran the steamship "Turbinia" on the route between Toronto and Hamilton last year, has been reorganized. The T. Eaton Company, of this city, has bought up enough of the stock to elect John C. Eaton president; John Vaughan, of the Eaton Company, secretary-treasurer, and Harry Magee, of the same company, on the board of directors.

"Blue-Bell," the Toronto Ferry Company's new boat, building at the shipyards of Polson Iron Works, Limited, Toronto, was successfully launched on April 16th. The "Bluebell" when completed, will have cost $65,000, and will carry 1,200 passengers. She is 150 feet long and 45 feet wide. She will be equipped with a 90-horse-power low pressure duplex engine, with low shafts, the first of the kind built in Canada. The steam-steering gear was built in Glasgow and cost $8,000. Both ends of the boat can be controlled from either end.

The Dominion Government has under consideration the construction of a second ship canal at the Soo. Towards this the Provincial Government is being asked to grant 55 acres of land, part at the eastern and part at the western entrance of the proposed new canal. The rest of the land necessary would, no doubt, be expropriated. The new canal will be 1,400 feet long, or 500 feet longer than the existing canal, 80 feet wide, which is 20 feet wider than the present one, and considerably deeper. The increased width, depth and size will be necessary in order to accommodate the large freighters now being built, some of them having a 65-foot beam. The cost, it is estimated, will be about $10,000,000. The canal would parallel the present one.

## RAILWAY NOTES.

The Winnipeg Street Railway Company will sue the city to recover compensation for the damages inflicted to its cars during the recent strike riots.

Messrs. McKenzie and Mann, the railway constructors, are said to be building steel mills at Port Arthur and Fort William, in Ontario, which will be the largest in Canada.

The promoters of the Hamilton, Guelph, and Galt Electric Railway say that they are now prepared to finance the scheme, and intend applying to the city council for right of way.

The Canadian Northern are adding 33 locomotives to the motive power on their western lines this spring. Twenty-five of these are for hauling freight, six for passenger trains, and two for yard work.

The Delaware and Hudson River R. R. will shortly commence to build a section of their road through the southern part of Quebec. When completed this line of railway will form an air line between New York and Quebec.

The James Bay Railway Company have got the area bounded by Vine, Trinity and Front Streets, and Eastern Avenue, for railway yards, except St. Lawrence Park, which is owned by the city of Toronto, and which is also desired.

A contract has been awarded by the Canadian Pacific Railway to the Ross-Harris Co. for the construction of the section between Parry Sound and Byng Inlet of the new Toronto-Georgian Bay line. It will involve a million and a half dollars.

The work on the Quebec bridge is to be resumed at once, and will be pushed vigorously throughout the summer. A large amount of iron work for the structure is now ready at the works of the Phœnix Bridge Company at Phœnix, Pa., and will be forwarded as rapidly as possible.

It is stated that plans have been filed with the Government at Ottawa by the Canadian Pacific Railway for a line from Ingersoll to St. Mary's, and it is expected work will be rushed along as quickly as possible. Unless the present plans are changed, St. Mary's will be a junction point for the said railway.

By June 1st J. D. McArthur expects to have 10,000 men at work on his various contracts in Western Canada and Western Ontario. In addition to the 275 miles of the Grand Trunk Pacific Railway, for which he has received the contract, he has contracts for grading 370 miles of road in Manitoba, Saskatchewan and Alberta for the Canadian Pacific Railway Company.

Work on the C.N.R. line to Hudson Bay was started on April 23rd, when a gang of 200 men with an extensive outfit left for a point twenty miles west of Erwood, and from there they will immediately start grading north. The contract has been let to James Cowan, who is bound to complete the line to the Pas Mission, a distance of 95 miles from the main line, within the year.

## MINING MATTERS.

A large quantity of mica has been found in Matchedash township.

An advance in mining methods is forecast in a move made recently for the formation of a company for the purchase and operation in the Temiskaming district of two diamond drills.

The Ontario Government has decided upon the appointment of a Provincial assayer, who will be an official of the Mining Bureau. The appointment will not be made until the mining bill is passed.

A report is being circulated to the effect that the Dominion Coal Company will, in the course of some little time, have a rival in the Cape Breton coal fields, the plan being to effect a consolidation of the smaller properties under one great centralized management, to include all the mines and areas of Cape Breton available and not at present held by the Dominion Coal Company.

A large mining dredge for the Yukon is being constructed in the yards of the Pacific Coast Lumber Company, of Vancouver, to be shipped to the north in knock-down condition. It will be assembled at White Horse, and floated down the Yukon to Dawson. The huge machine, which will cost about $200,000 when completed, is being constructed for the Forty-Mile Company by the Allis-Chalmers Company, of Milwaukee.

The Brockville Mining Co. is developing the mica mine near Elgin, Ont., and has opened works in Brockville for finishing the product. About twelve people are employed, and the outlook is that the industry will become an extensive one.

## LIGHT, HEAT, POWER, ETC.

North Toronto, Ont., council will install an electric power and light plant.

The British Columbia Electric Railway Co. will spend $20,000 on an electric power line to Ladner, B. C.

The town council of Macleod, Alta., are considering the advisability of acquiring the electric light and telephone plant there.

The Canadian General Electric Company have been awarded the contract for supplying series alternating arc lamps for the British Columbia Electric Railway Company, Vancouver. The contract calls for four hundred 480 watts, 7.5 ampere lamps of the latest type, and the supplying of these, as well as five new transformers for the lighting circuits, will cost over $20,000.

The second report of the Hydro-electric Power Commission of Ontario covering the Trent district has been made public. It shows that there are five water powers on the Lower Trent River that are worth developing for transmitting power to the towns along Lake Ontario, but on the Upper Trent and on the Moira River and its tributaries there are numerous water-powers which are now developed and which are capable of supplying the immediate local demand.

## PERSONAL

A. H. A. Robinson has been appointed permanent mine inspector in the Temiskaming district. He is a mining expert and has lately been engaged in New Brunswick.

Cecil B. Smith of the hydro-electric power commission has been asked by the city of Winnipeg to be consulting engineer in the building of their municipal power development. He has declined.

The St. Jerome Power and Lighting Company, St. Jerome, Que., have retained the services of R. S. Kelsch, consulting engineer, of Montreal, in connection with their new power development.

L. A. Osborne, formerly third vice-president of the company, has been elected second vice-president of the Westinghouse Electric & Manufacturing Co., succeeding Frank H. Taylor, resigned. Mr. Taylor will retain his seat on the board.

Geo. S. Hanes, formerly of Toronto, has been appointed city engineer of Windsor. He has in hand the laying of about 8,000 square yards of asphalt block payment; 12,000 square yards of cedar blocks, and about 8,000 square yards of macadam.

C. H. Bowden, for two years chief draughtsman of the public works at Montreal, has been appointed designing engineer of the department of railways and canals. He will design the new buildings at Moncton. Mr. Bowden is a native of the eastern townships and is a graduate of McGill.

## MUNICIPAL WORKS, ETC.

New Liskeard, New Ontario, will install a waterworks system. H. Hartman, clerk.

Carman, Man., will expend $58,000 in installing waterworks and purchasing light plant.

Peterborough, Ont., council will ask tenders for construction of eight miles of granolithic sidewalks.

Winnipeg will spend a million and a half in local improvements. One hundred and fifteen thousand will be expended in extending the granolithic walks, $372,610 on sewers, $432,873 on water-works extensions, and $300 000 on asphalting.

## TELEGRAPH & TELEPHONE

The Bell Telephone Company are installing a local system at Shoal Lake, Man., and Mr. T. W. Miller has been appointed local agent.

The Bell Telephone Co. are commencing work that will result in 200 miles of cable lines being placed in Calgary this year. Some 150 miles of metallic circuit lines will also be built out of the city before the season closes.

The Bell Telephone Company of Canada has recently completed two additional copper metallic circuits between Toronto and Hamilton, with a view to rendering more prompt service to subscribers between these very busy stations.

Quebec is to have a new telephone service, the Bellechasse Telephone Company having decided to extend its lines into the city from the south shore, connecting Quebec with many of the parishes in the counties of Lotbiniere, Dorchester, Levis, Bellechasse, Montmagny, L'Islet, Kamouraska, Temiscouata, Rimouski, Matane and Bonaventure.

The British Columbia Telephone Company have awarded the contract for the construction of a new fireproof central exchange on Seymour Street, Vancouver, to Messrs. Baynes & Horie. The building will be a three-storey structure of brick and stone, having a frontage of 45 feet. It will be made as fireproof as possible. The estimated cost is $45,000.

F. H. Thomson, of Boston, Mass., has recently been appointed assistant general manager of the New Brunswick Telephone Company, with headquarters at Fredericton. He will have general supervision over the company's lines, and will attend to the development of new business. Mr. Thomson has been twelve years in the employment of the New England Telephone Company.

Sir Charles Euan-Smith told the shareholders in the Marconi Wireless Telegraphy Company, who met at River Plate House, in London, England, that the company was making steady progress. The net profit was £4,000 in excess of that for the year which ended in September, 1904. Although they had been unable to complete the installations from which they expected their principal profit, they were deriving enough from other parts of the business to pay substantial dividends. In view of the large expenses for development, however, it was thought inadvisable to make any distribution at present.

## NEW INCORPORATIONS.

**Ontario.**—The Hamilton Anchor Company, Hamilton, $40,000. H. L. Frost, H. N. Kittson, H. C. Beckett, C. S. Scott, D. R. C. Martin, Hamilton.

The Low Bank Telephone Co., Lowbanks, $20,000. Alvin Barrick, L. Eyers, J. E. Furry, B. F. Barrick, L. Furry, E. Eyers, A. Mann, Moulton, Ont.

London Machine Tool Co., Hamilton, Ont, $200,000. W. Yeates, E. G. Yeates, R. Yeates, P. M. Yeates, London; G. F. Webb, W. Southam, Hamilton, Ont.

The Norwalk Mining Co., Sault Ste. Marie, $300,000. W. E. Gill, J. M. Harr, S. Moore, C. D. Smith, Norwalk, Ohio; T. T. Morgan, Sandusky, Ohio.

The falls Power Co., Welland, $10,000. G. C. Brown, D. Ross, B. J. McCormick, J. E. Cohoe, H. A. Rose, Welland, Ont.

The Silver Development Co., Toronto, $1,000,000. E. J. H. Pauley, W. W. Rice, B. B. Pauley, F. A. Fenton, Toronto; E. R. Clarkson, Hamilton.

The British and French Motor Car Co., Toronto, $50,000. J. C. Palmer, E. E. Palmer, H. N. Baird, A. T. Malone, A. Mearns, Toronto.

Galt Malleable Iron Co., Galt, $100,000. M. N. Todd, P. Hay, J. H. Fryer, H. McCulloch, Galt; S. J. Cherry, Preston; W. M. Davis, Berlin.

Montreal-Cobalt Mining Co., Toronto, $500,000. H. B. Wills, Z. Gallagher, J. C. Colling, W. D. Scott, Toronto; W. Vandusen, Toronto Junction; J. S. Humberstone, York Tonwship.

The Shakespeare Development Co., Sault Ste. Marie, J. Miller, H. W. Evenden, W. H. Hearst, J. McKay, J. L. Darling, Sault Ste. Marie, Ont.

The Sterling Silver-Cobalt Mining Co., Toronto, $600,000. J. G. Beam, J. Robertson, T. E. McCraken, J. P. Esten, W. D. Earngey, Toronto.

The Chatham Motor Car Co., Chatham, $50,000. R. J. M. Gardiner, R. L. Bracken, H. Fisher, W. W. Logan, T. K. Holmes, W. J. Taylor, Chatham; T. Dillon, Detroit, Mich.

The Florence Mining Co., Toronto, $100,000. J. Hobson, J. A. Meldrum, H. S. Pritchard, F. Watt, J. Lewis, Toronto.

The Silver City Mining Co., Toronto, $350,000. A. B. Harlan, H. S. Pritchard, F. Watt, P. J. Montague, J. Lewis, Toronto.

Wonder Land Silver Mining Co., Windsor, $250,000. F. Schoonmaker, E. Peabody, W. Stone, H. Irish, E. Sellers, Detroit, Mich.

Peterson Lake Silver Cobalt Mining Co., Toronto; $3,000,000; B. E. Bull, J. Montgomery, J. G. Shaw, J. G. Strong, W. R. Williams, Toronto.

Star Silver Cobalt Mining Co., Toronto; $2,000,000; J. Meen, W. R. Williams, J. A. Shaw, J. Montgomery, B. E. Bull, Toronto.

Coppers, Limited, Montreal; $2,000,000; R. P. Inglis, G. Boulter, W. H. C. Mussen, F. H. Markey, Montreal; J. Playfair, Midland, Ont.; W. Inglis, Toronto.

Silverhorn Mining Co., Toronto, $50,000. A. Bicknell, J. W. Bain, G. B. Strathy, L. C. Todd, J. E. Riley, Toronto.

The Silver Bell Mining Co., North Bay, $250,000. J. W. Richardson, T. C. Begg, E. Brandon, A. C. Rorabeck, G. B. McConachie, North Bay.

Cobalt Townsite Mining Co., North Bay, $100,000. J. Mackay, Renfrew; R. Simpson, C. A. Foster, Haileybury; A. J. Young, North Bay; A. Santerre, Cobalt; G. Taylor, New Liskeard.

Cobalt Silver Queen, Cobalt, $1,500,000. F. R. Latchford, Ottawa; F. I. Culver, North Bay; R. W. Gordon, Pembroke; P. J. Montague, F. Pottage, Toronto.

Temiscaming Sterling Mining Co., Milberta, $40,000. J. Henderson, J. M. Barnard, H. A. Palmer, J. W. Jarvis, T. J. Newton, S. A. Hogg, F. D. Ramsay, R. Moffatt, Kerns, Ont.

The Green Silver Mines, Toronto, $30.000. S. L. McKay, Kingsville; C. L. Hanson, A. E. J. Blackman, E. A. Francis, J. W. McDonald, M. A. McKessock, Toronto.

**Dominion.**—Jones Underfeed Stoker Co., Toronto, $150,000. C. E. A. Goldman, J. M. Miller, T. A. Silverthorn, B. A. C. Craig, D. A. Brebner, T. G. McConkey, A. W. Holmested, Toronto.

Northwestern Brass Co., Montreal, $200,000. J. T. Ostell, P. Davidson, A. Wainwright, F. H. Hewitt, T. Davidson, Montreal.

The Montreal and Great Lakes Steamship Co., Ottawa, $90,000. R. Bickerdike, H. Munderloh, C. A. Jaques, A. Lefevre, M. Jacques, Montreal; J. H. Hall, Ottawa; S. Samuel, G. Somerville, Toronto.

The Yucatan Power Co., Montreal, $1,000,000. J. S. Lovell, W. Bain, R. Gowans, E. W. McNeill, W. F. Ralph, H. Chambers, C. H. Black, S. G. Cromwell, G. H. Cassels, Toronto.

The International Gold Dredging Co., Ottawa, $1,000,000. G. W. Cooke, Amherst, N. S.; J. H. Doody, St. John, N.B.; N. Curry, D. W. Robb, Amherst; W. Dennis, Halifax; J. Jack, St. John.

Canadian Yukon Mining Company, Toronto, $100,000. E. N. Armour, E. Bayley, W. Kelly, C. W. Mitchell, J. C. Mitchell, Toronto.

The International Gold Dredging Co., Ottawa, $1,000,000. W. H. Roughsedge, R. V. Sinclair, C. M. Farley, A. Macfarlane, R. A. Hickey, Ottawa.